die Reihe

1 Electronic Music

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die Reihe

A periodical devoted to developments
in contemporary music

Edited by Herbert Eimert
and Karlheinz Stockhausen

Electronic Music

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RECORDS OF ELECTRONIC MUSIC

The Deutsche Gramophon Gesellschaft in co-operation with Universal Edition has recently released three long-playing records of electronic music produced at the Cologne Studio. These records will be available very shortly in the U.S.A. and Canada, as well as in Great Britain, and the publishers will be glad to give full details on application.

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To be published shortly:

Number 2 Anton Webern

In preparation:

Number 3 Musical Craftsmanship

Number 4 Young Composers

For full details of these numbers see page 62

TRANSLATOR'S PREFACE

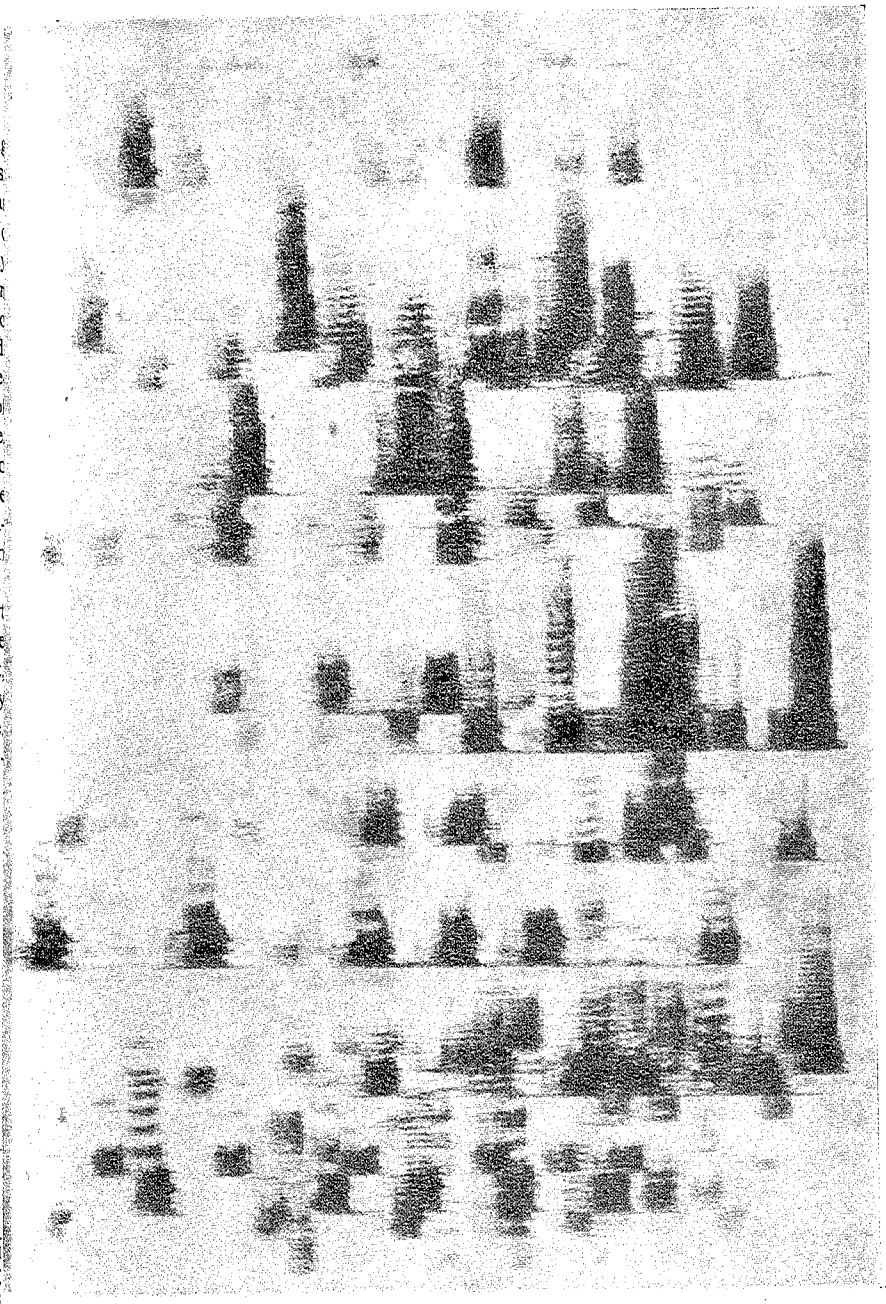
Die Reihe I, originally published in German in 1955, will introduce English speaking readers for the first time to some of the problems of 'Electronic Music'. These problems the writers of the various articles claim, are none other than the general problem relating to the composition of music in our time, for, as Dr Eimert writes, 'the electronic means fully correspond to the compositional situation'. These problems are adequately and variously described in these articles by Herbert Eimert (who has specially rewritten his article for the English edition), H. H. Stuckenschmidt and Ernst Krenek, who attempt to relate the very phenomenon of electronic music to its cultural background. Other articles by Karel Goeyvaerts, Paul Gredinger and Henri Pousseur not only 're-write' aspects of traditional history of music from a new angle but explain something of their authors' personal attitudes to the world of sound. Articles by Giselher Klebe, Gottfried Michael Koenig and Karlheinz Stockhausen introduce readers to the studio and describe actual 'work in progress'. Pierre Bouzel, taking a wider view of the whole of contemporary music, attempts the idea of a comparative synthesis between instrumental and electronic composition. Finally, Prof. Meyer-Eppler of the University of Bonn discusses problems of acoustics which throw further light on electronic music.

No apology need be made for discrepancies of viewpoint and definition on the part of the various individual contributors. There cannot at this point be any definitive terminology in the English language, as no actual work on electronic music has, as yet, been done in an English speaking country. Where possible the technical terminology corresponds to previous articles, broadcasts and books written in the English language. Elsewhere the reader is referred to the Standard Acoustical Terminology. The translator begs indulgence for any confusion caused.

LONDON, *December, 1957.*

Explanation of illustration on facing page:

Spectrogram taken according to the Visible-Speech-Process of the Institute for Phonetics and Communication-Theory Linguistics at the University of Bonn. The spectral combinations of sounds may be seen in their durational occurrence (vertical-frequencies, horizontal-durations). As opposed to traditional symbolic notation, this direct notation of sound allows the composer a precise control over the completed processes. Further information may be obtained by comparing this notation with the corresponding acoustical diagram in the score. (One sec. = 13·5 cm;. 1 kH = 1·4 cm.).



'Glockenspiel'; a spectrogram (for details see facing page).

HERBERT EIMERT,

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WHAT IS ELECTRONIC MUSIC?

HERBERT EIMERT

In the history of the 'Music of our Time', electronic music might be regarded as a final chapter or even as a postlude. It seems apart from the main stream of development, is the centre of violent controversy and it is ambiguous, as is anything which suddenly obtrudes itself uninvited on an already problematic situation. At the same time it is already of sufficient import to have come to the attention of academic study and pedagogical activity. To the ordinary music lover who listens to contemporary music, Stravinsky, Bartok and Hindemith are still the key figures; behind them stand Schoenberg, Berg and Webern surrounded by an international troop of twelve-note imitators; electronic music is seen as an enigmatic, extreme development. One thing only is clear · whether it be approved or condemned, it cannot be ignored any longer.

But let us see the situation another way with electronic music as the focal point of a progressive development, connected with the most recent instrumental school of pointillism. Next comes the only recently discovered music of Anton Webern, a point of departure for the present day composers, then Schoenberg's twelve-note music and finally the so-called 'modern classics'. In this arrangement we have at least a certain inevitability of human progress; what was seen as a postlude now seems like our prelude.

Despite the fact that electronic music is the outcome of decades of technical development, it is only in most recent times that is has reached a stage at which it may be considered as part of the legitimate musical sphere. The manner of its birth must in many respects be distinguished from all other beginnings which we have understood to be natural developments. Here there has been no extension of traditional procedure. By the radical nature of its technical apparatus, electronic music is compelled to deal with sound phenomena unknown to musicians of earlier times. The disruption by the electronic means, of the sound world as we have known it leads to new musical possibilities, the ultimate consequences of which can hardly yet be appreciated.

On the other hand there is an essential relationship between electronic music and the traditional world of sound, not only in the fact that musical elements are defined by pitch, duration and intensity, but also because of the connection between it and the most contemporary development of musical thought. Electronic music is, and remains, part of our music and is a great deal more than mere 'technology'. But the fact that it cannot be expected either to take over or to imitate the functions of traditional music is clearly shown by the unequivocal difference of its material from that of traditional music. We prefer to see its possibilities as the potentialities of sound itself. No position such as this could be reached by a mere transference of the traditional into the electro-acoustical. Here we touch on a most widespread misconception: namely, the idea that one can make music 'traditionally' with electronic means. Of course one 'can'; but electronic concert instruments will always remain a synthetic substitute. The fact that practically no music which can be taken seriously, artistically, has been written for electronic concert instruments is due precisely to the fact that its use as either soloist or

ensemble instrument does not transcend the old means of performance. New ways o generating sound stipulate new compositional ideas; these may only be derived fron sound itself which in its turn must be derived from the general 'material'.

Electronic music is based on the composition of electrically generated sounds mad audible by a generator, *i.e.* recorded on tape without recourse to any instrument o microphone. Electronic music exists only on tape (or on record) and can only b realised in sound by means of a loudspeaker system. That electronic music cannot b performed on instruments is due to the fact that the number of individual soun elements is so great that any attempt to find means of instrumental realisation is doome to failure.

There has been much bewailing on the part of 'dilettantes' of the element of spon taneous music-making which is said to be lost in electronic music; these gentleme conveniently forget that much of what is great and greatest in the literature of musi from Bach to Schoenberg will always remain outside the reach of their spontaneou music-making. To say that the artist makes music on a platform is just about as tru as saying that an Olympic champion wins a gold medal, without mentioning the lon preparations, the gymnastic exercises that lead to fitness. In fact 'spontaneous music making' represents something practised a thousand times, co-ordinated through re peated rehearsal, something which stipulates a well-lubricated, hyper-regular mechan ism, an almost unique mechanical production in which its studied precision is neare to a protracted electronic synchronisation than to 'spontaneous music-making'. It i not irrelevant to point out here that it is in no way the aim of electronic music to replace instrumental music. On the contrary, a deep kinship may be observed betwee instrumental music of recent date and electronic music, and the theoretical experiment in the elementary properties of sound phenomena which have been part of the be ginnings of electronic music have not been without their influence in the instrumenta sphere.

The invention of the valve in 1906 marks the beginning of the development of the phenomenon of electronic music, though naturally the invention had nothing to do with music. It is a coincidence, yet in a higher sense perhaps no coincidence, that at this very time Busoni and Schoenberg were first interesting themselves in the idea of an 'uninterrupted continuity' of musical material, thus touching the limits of instrumental technique. Busoni discussed the fissure of sound material, as it was known in his time, and Schoenberg invented the *Klangfarbenmelodie*. Busoni at that time referred to Cahill's electric organ which, for the first time, enabled a composer 'to attempt to fly'. Schoenberg did not pursue the idea of *Klangfarbenmelodie* in his later work but Webern was able to link it to his idea of a series of proportions which subjected harmony and melody to a common denominator of intervallic proportion. Webern was not able to extend the serial principle to all musical dimensions but did, at least, achieve sound structures generated according to the permutational principle of the series – in this he comes near to electronic music, which takes up his great idea and without imitating it, transfers it to the total organisation of the electronic sphere.

Developments in the building of electronic concert instruments began after 1920. The builders always attempted to imitate traditional sound, with the exception of Jorg Mager, who stated, referring to Busoni's idea, that it ought to be possible to 'make available to artists of the future all frequencies, melodically as well as harmonically, as

well as the partial tones which determine the timbre'. But the decisive means of maintaining and operating sound only became available some twenty years later with the discovery of the means of recording sound on tape.

Electrically generated sound could only be utilised as a genuine compositional element when this technique had been invented. In the ordinary way the tape recorder provides the means of playing back tapes. But the new tape technique which is no longer satisfied with a mere playback is of the greatest significance here. The normal studio technique of broadcasting is transformed into a compositional means. Tape recorder and loud-speaker are no longer 'passive' transmitters; they become active factors in the preparation of the tape. This is the essential secret of electro-musical technique. One might say that today we have perfected a 'keyboard' of this elaborate and differentiated sphere of radio transmission; now we lack only the virtuosi to master it.

The composer's equipment consists of a sound generator, a loudspeaker, tape recorder and filter; all this apparatus is to be found in any well equipped radio station. No especially expensive equipment is required, as has been generally suggested, and in fact there is no reason why electronic music should not be produced in any normally equipped radio station. The composer determines each note by its pitch, duration and intensity. Only he no longer has only 70–80 pitch levels at his disposal (this is the average number utilized in instrumental music; Bach's Wohltemperiertes Klavier utilises 50–55 different pitches), only 6 or 7 intensities from *pp* to *ff* and only minims, crochets, quavers, dotted and syncopated values. He now has at his disposal the entire range of frequencies from 50–15,000 c.p.s., 40 or more precisely calculated dynamic levels and an infinite number of durational values, measured in centimetres on tape. None of this material can be adequately notated by traditional means. The following example is given to illustrate this new world of microstructures which we have entered. Every musician is familiar with the note a′ at 440 c.p.s. The next whole tone above is b′ (492 c.p.s.). Within this major 2nd from *a′* to *b′*, we are able to generate 52 different pitch levels of which, when ordered in a scale, at least each fourth level is heard as a different pitch interval.

The multiplicity of forms of electronic elements far exceeds the possibilities of graphic notation. It is thus necessary to notate differentiations, which are unknown to traditional music, in a way which corresponds to acoustical phenomena. This cannot be effected by an extension of traditional notation; it is better to present the sound procedures of electronic music graphically in the form of an 'acoustical' diagram. Thus 'scores'[1] of electronic compositions resemble precise acoustical diagrams with their co-ordinates, frequency (cycles per second), intensity level (measured in decibels) and time (cm.p.s.). The composer is required to have a certain amount of acoustical knowledge. In this respect it is to be observed that acoustical conceptions do not always correspond to those of musical theory. Electronic sound is classified as: the tone, the note, the note mixture, noise, sound complexes and impulses.

1. The *tone:* is unknown to traditional music; is without overtones, is pure or sinusoidal; all sound phenomena may be reduced to it. No tonal system in the traditional sense may be constructed of sinus tones; they have no traditional place of a system, no tonal 'character'. Thus the sinusoidal tone system can only

[1] See the score of Stockhausen's Studie II, published by Universal Edition. UE 12466.

be a theoretical system of reference; the composer may build structures out of this system by means of serial organisation.

2. The *note:* is what every musician knows as a tone. It is built up from a series of harmonic overtones (partials, sinus frequencies). Thus, the 'tone' of an instrument is not the tone but the *note* which is immutable in its components, which determine its timbre. These partial components may only be varied by electronic means.

3. In the *note mixture*, the frequencies of the partials are not ordered harmonically; *i.e.* they cannot be expressed in terms of simple numerical proportions. Note mixtures are always sinus tone mixtures and are not the same as 'chords'; they have a higher degree of internal fusion of components and can be regarded as units more similar in category to the single note than to the instrumental chord. Note mixtures only exist in instrumental music where an attack is followed by a long reverberation (bells, pipes, plates, rods, drums). In electronic music, note mixtures may be realised without difficulty in any dynamic form (crescendo, diminuendo and unvaried).

4. *Noise:* defined by specific sound character and approximate 'pitch level'. Only 'blank noise' which fills an acoustic region may be determined in position. Filtered parts of 'blank noise' are called 'coloured noise' or 'noise colour'.

5. The *chord* (*note complex*) is identical acoustically and traditionally. It must be observed that the note and the chord are clearly differentiated in instrumental music; in electronic music the note mixture intervenes between the two with its particular levels of fusion of its constituent parts. Note and tone mixtures are electronically 'composed' not according to an harmonic or natural system but according to a composer's predetermined ordering.

6. *Impulse* or *pulsation:* also known as *Beats* or *Clicks*[1] (regular or statistic); at high dynamic levels corresponds to 'detonation'.

Uncontrollable sounds belong to the acoustical but not to the musical domain. They can fairly easily be produced by electronic experimentation or trick recording, and vague and 'atmospheric' effects can be obtained by cutting and assembling tapes. To demonstrate this, it takes two or three hours to construct a minute of good atmosphere music, often three or four weeks for a minute of real music. In connection with incidental music for film or radio, it is worth mentioning that no composer who intends himself to be taken seriously would have ever let himself in for electronic music if its entire resources consisted of vague experiments with noise and if all that could be produced were tapes of atmospheric sound. Whoever is attracted by the idea of the machine which 'makes things easier' and simplifies composition (in fact it makes composition considerably more difficult) is only comparable to the mediocre pianist who 'pedals' his way through the difficult passages of his concerto and hopes to get by by faking.

The stereophonic distribution of sound transmitters is a further element of the form of electronic music. The various loudspeaker systems around the hall are the 'concerting instruments' – a conception similar to the distribution of orchestral and choral

[1] c.f. page 47.

forces in church or concert hall. This special dimension is incorporated into the very plan of the composition. Multi-channel transmission can only be effected with multiple track tape recorders. At present radio transmission is only single channel. (Single- as well as multi-channel versions of electronic pieces exist depending on the purpose for which they are intended.) This spatial projection into the concert hall is seen as an entirely new dimension of the composition.

The basis for the production of electronic music were worked out in the Studio for Electronic Music of the Westdeutscher Rundfunk, Cologne, under the direction of the author of this article. The first studies were broadcast in an evening programme of Cologne Radio in 1951 and were performed at the International 'Ferienkurse für Neue Musik' in Darmstadt. In 1953 there was a public demonstration in connection with the music festival in the Concert Hall of the Cologne Radio. The first real electronic compositions were performed in a concert in the Cologne Radio on the 19th October, 1954; there were seven pieces, in all twenty-eight minutes of music, the second half of the concert being devoted to them. The composers were H. Eimert, K. Goeyvaerts, P. Gredinger, H. Pousseur and Kh. Stockhausen. Of importance for the further development of the medium was a concert in the Cologne Radio at the end of May, 1956, in which the 'Fünf Stücke' by H. Eimert, 'Klangfiguren II' by G. M. Koenig, the 'Oratorio for Pentecost' by E. Krenek and the 'Gesang der Jünglinge' by Kh. Stockhausen were given their first performances. The last mentioned works have in the meantime been issued as three long-playing records by the Deutsche Gramophon Gesellschaft. Since this time several small pieces have been composed by F. Evangelisti, G. Ligeti, G. M. Koenig and B. Nilsson.

Thus was the birth of electronic music. It seems to lack completely that surfeit of abundant vitality which so often characterises new movements. None would have taken the slightest notice if, after the First World War, the younger generation had begun by producing only a few isolated studies. But there are other beginnings. They come noiselessly and stay unheeded, like a biological transformation which ends in life or death; or like those in which the creative spirit is distilled into the essence of a new material object. The beginnings of electronic music may be seen as falling in this latter category. The composer concerns himself with a material to which the traditional, well-proven ways of his art do not apply. To begin to compose electronically means to select one single element from the limitless range of possibilities of the electronically emancipated material and to realise it in a compositional manner. It compares with the beginnings of polyphony in the music of the Middle Ages; what is practised is theory. So it is that, despite the apparent modesty of the preliminaries of electronic music, the full brunt of an experiment is borne in that a single creative selection and successful realisation can bring us face to face with the absolute nature of music. For this reason there can be no rules for electronic music in the sense of a traditional theoretical investigation of music; that which normally belongs within the scope of theory here remains bound up with the material object. Theory presents musical 'possibility' – this is valid here also, but with quite a different connotation, in that it is no longer permissible to fill out lifeless formal schemes.

These tiny beginnings and the limitless perspectives of electronic music cast a dim light on critics who would maintain that whereas there were 'possibilities' in electronic

music, at its present stage it had 'nothing to do with music'. Whether this viewpoint be the result of misunderstanding or whether expressing the sentiments of yesterday's avantgarde, it is clearly a waste of time to argue against it. Would one not be forced to the absurd conclusion that composers were occupied with the composition of something that was not music? We are not justified in attacking the authority of the composer from this point of view.

It is certain that no means of musical control could have been established over electronic material had it not been for the revolutionary thought of Anton Webern. Nevertheless, the compositional equipment of electronic music must be more than an extension of twelve-note technique. There are no gradual transitions from the twelve notes to the micro-structures. The barrier to these latter seems to have been broken at a single blow; we no longer see or hear chaos but rather the note, a sounding structure, consisting of its own analysable components. It is the most fundamental music-forming element. It is essential to have experienced and to know that the nature and perception of a note cannot be realised by simple physical devices of measurement, even if the physical and psychophysical qualities are only differentiated by the most infinitesimal fraction – the ways part here – one leading to nature, the other to music.

One of the most characteristic and prevalent misunderstandings of progressively-minded teachers and critics lies in the idea that music today has a dual existence: on the one hand a skeleton, on the other the living flesh and blood. There are, as it were, two separate aspects; one concerned with dry scaffolding, the other with expression and animation. We must point out to these critics that the scaffolding is inherent in the form of the note itself; the elements of construction are derived directly from it. Traditional twelve-note technique cannot suffice for this. In this is contained the fear that notes be lost from their rightful path and the hope that this loss be remedied by excited gesticulation. When the fundamental assumptions of the composer are naked and primitive he becomes involved in tragic-daemonic 'experiences', until we have the abrupt images and naked sensations of Expressionism. From a narrow viewpoint there exist those who are unable to visualise music as anything but 'psychographical': it would be of interest to conduct similar tests on Machaut, Josquin and Palestrina. Once and for all with electronic music we leave this 'psychographical' domain.

Alone among the twelve-tone composers, Anton Webern conceived the row non-subjectively, so that to a certain extent it functioned externally. Seen from Schoenberg's viewpoint this would be like cutting the threads of life in music: a silence, a dumbness, an end. In truth, this end is our beginning. If these procedures are made absolute it is not difficult to discern its negative, deadly side, as Adorno has done. It does not seem out of place here to question the possible objectivity of music. Clearly there can be no private self-portrayal identifying itself with Art within the broadly 'objective' historical context of music and of masters of non-subjective music; there can be none of that 'pathetic-bourgeois' pose which associates and presents Art as arrant, tragic-daemonic play-acting.

We know little of how emotion became involved in the practice of music making and even less of its intensity, which was observed for the first time in the 'musica reservata', around 1550. These questions cannot be separated into separate pigeon holes. We must ask: has not music always been made by men? Even Pythagoras' music of the spheres was the work of human fantasy. Is electronic volume control anything else but the old

dynamic? Though the directness of tape music has eliminated spontaneous performance, interpretation has remained in a new guise, for composing surely means performing music without the associations of time. What is then the human element upon which our humanists are always harping? One might wager that most of them are thinking only of the vibrato of Tschaikowsky's violin cantilena on the G string.

From the viewpoint of heightened *espressivo*, pre-expressive music appears to be subjectively under-developed. It has other traits in common with electronic music; most significant its distinctly material character. The material itself is made to 'speak' – not because it has found voice but because it has been arranged by human device, even if with theological help, at least without pathos and subjectivity in the modern sense.

Evidence of this may be found in the theoretical tracts of the time. They testify to the way in which the material played an active role, as if a secret rationality was contained within it. The validity of this impression is enhanced by the way in which the material itself is hesitatingly, almost blindly tested, leading finally to a logical, conscious procedure directed by intellectual principle. It is not without significance that so many post-Schoenbergian composers have studied the music of the 14th and 15th centuries. Here too Webern set the example. All this only goes to show how false is the argument so often raised against the contemporary composer that the fact that he must actually and, it is said, vainly grapple with the very material organisation of music, separates him from the legitimate concerns of traditional music. It is argued that this is a unique situation which may be compared with nothing. Our illuminating reference to historical precedent does not imply that we in any way seek justification in mediaeval theory for electronic music, which is characterised by a meeting of acoustical and compositional developments which are particular to our epoch. A further sign of its integrity is shown by its awareness of Expressionism. It has learned from the work of Debussy, who created form patterns which in the electronic sphere are called 'statistic structures' and which can exist only as a result of the quantitative multiplication and division of sounds in density and augmentation.

Objectivity stipulates objects, but the material of Art is objective in a sense which is different from that of Nature. If the barrier between these two is removed a fatal misunderstanding results. It has been assumed that the fundamental conception of music must be separated from the considerations of Art, and be approached physico-scientifically. According to this conception the definition of a note by its pitch, duration and dynamic intensity may be taken both acoustically and musically. Acoustics concerns itself with the nature of sound; physiological aspects of hearing are concerned with the relationship of volume and intensity, with registering variations in these and with the relationship of duration to the period of 'growth' (Einschwingdauer) in the ear or the perception of pitch levels. From the musical point of view the note exists for the listener as a unit and only as such is it recognised and analysed in its triple unity and entity. Nothing more about it can be learned by physical or physiological means. The 'musical' discovery of the conditions of a note's existence – first made by Messiaen, who worked on this basis, if not serially at least strictly modally, is certainly the right way towards electronic music. Here a definition of a note considers timbre as resulting from the proportional strength of partials in a fixed frequency.

It would never have occurred to a musician of the 19th century to define a note by its pitch, duration and intensity. At that time the note was understood through its

relationship to other notes, and through its relationships to tensions within the structure of a chord. The 19th century did not ask '*what was*' a note, but only '*how did it function*'? In twelve-note music it is still required to function, though it no longer can, and thus its function is no longer measured by any principle inherent in the music, but by an analogy of effect.

Webern was the first composer to move on from the single level conception of the twelve-note technique; namely that of a technique of organising pitch levels. In his work, for the first time, we see the beginnings of a three-dimensional row technique – of what in short, we know as *serial technique*. Webern restricted his music to interval and single note, and composed structures which are not in the traditional sense developed in a continuum, but which proceed by autonomous 'leaps', leaps which in the pre-electronic stage could achieve everything but that final step from the bounds of instrumentally tempered sound. Only in electronic music has the real sense of these developments been realised.

The relationship of note to row is only known as a principle of fixed constellation in twelve-note music. In electronic-serial music, on the other hand, everything, to the last element of the single note, is subjected to serial permutation, resulting in a completely new way of composing sound – the poetics of sound, as the mediaeval theorist would have called it. Examination of material inevitably leads one to serially ordered composition; no choice exists but the ordering of sinus-tones within a note, and this cannot be done without the determination of the triple unit of the note. A note may be said to 'exist' where elements of time, pitch and intensity meet; this fundamental process repeats itself at every level of the serial network which organises the other partials related to it. The fact that tone, duration and movement are almost tautologies, testifies to the pre-eminence of the time process. The note is subjected to time for its pitch levels and intensity – this we may call the 'tonality' of electronic music.

In traditional twelve-note music the row is already omnipresent yet discursively imperceptible and only determinable with reference to basic shape. This omnipresence remains incomplete; it applies only in one dimension and is only thrown into relief by the simulation of emotion. The procedures of electronic music cannot be understood from this point of view and from here stem the complaints and criticisms of lack of musical 'connection' and the insensitive or malevolent misunderstandings that proportioning of time and pitch be nothing but a 'calculating game' in which the composer fiddles about with formal problems and builds up a numerical framework which he later transforms into notes. What can one say seriously about such marble games? It remains of significance, however, that the electronic material as a musical material completely answers to the conditions of a compositional situation. It is not that music can be composed by electronic means 'too'; in the contemporary phase of music only one way can be seen of determining the compositional situation, that is: 'after Webern', the situation resulting from the discovery of 'the *single* note'.

Critics who have found this position inadequate have found plenty of points of criticism to raise. Two of the most important are, firstly, that music is a 'language', and that exactly in this post-Webern development of musical pointillism and electronic music, it is no longer spoken; and secondly, that the sinus tone is not a fundamental element of musical perception.

The 'linguistic' theorists of music do not refer to what is generally meant by 'musical

language'. They mean something else which has been taken out of its narrow context in Schoenberg. They mean a kind of wordless recitation with the accentuation of speech within the corporeality of sound; they refer to the flow and gesture of talking, the sequence of speech inherent in construction, which alone secures connection and context. In answer it must be said that the ear's ability to perceive effective connections is in no way restricted to the unique level of speech elements. Thanks to its many simultaneous dimensions, music is a language of many meanings and for this exact reason it is not formulated speech or talking. If the elementary components of a note are related in a new way, according to new musical principles and not arbitrarily or mathematically, the ear must do as it always has done; it must adapt itself to the demands of the composer and the composed notes rather than depend on fossilised ideas, newly revived. That the problem of appropriation and communication is raised by electronic music in its early stages, no one will deny. It is not to be avoided. On first acquaintance even the ear trained in the perception of a dodecatonic structure is faced in electronic music with a foreign musical language. This book testifies to the fact that it can be learned and is already spoken by some.

The second argument, that the sinus tone is not a fundamental element of musical perception, is rather the product of wishful thinking than of knowledge, and does not stand up to any practical or theoretical examination. It is essential to realise the properties of the sinus tone, on the one hand as a unit of measurement, on the other as a musical phenomenon. It has long been realised that the idea that formulating sound in composition – which means sinus tone composition – is perpetually measurable, is false. Electronic music has its own incalculable relationships of elements in overlaps, volume control of frequency and intensity as well as in all non-stationary elements. If anybody is simple-minded enough to imagine a robot violinist performing Handel's Largo with stationary sinus tones, he will immediately be compelled to realise that technique will only provide the homunculus with an electric plush-vibrato soul. This electronic music is not 'another' music, but is serial music. And being so, the series must necessarily be called upon to determine the exactly measurable area between the stationary and the modulating note.

Thirty years ago, in scientific circles, it was fashionable to conduct psychological examinations of the phenomena of sound by studying sound procedures in slow motion. In this way a whole organism of forces, movements, kinetic and potential energies was discovered, though no one is able to hear music thus, as it were, in slow motion. Today the physical magnification of a sound is known, quite apart from any musical, expressionistic psychology, as exact scientific data. It cannot, however, be the function of electronic music to make the sinus tone like the living 'parasite', to feign similarity where disparity exists. Talk of 'humanised' electronic sound may be left to unimaginative instrument makers. This is particularly important when, later in this book, we come to deal with aleatoric modulation, which becomes the further removed from music the more it attempts to imitate it and which is only significant when subjected to compositional ordering. Similarly with dynamics: any performance of piano music, which is, to some extent, differentiated in its dynamics (*e.g.* a piece by Mozart, which is made up out of three or four notated dynamic levels) will, when recorded, register at least 30 or 40 different degrees of intensity on a control indicator. It would be pointless to imitate these electronically but of the greatest significance to organise them.

This leads us to an understanding of the compositional microstructure. It runs parallel to instrumental sound not in the manner of accrued imitation, but as an artificial procedure of order. Everything is designed not to escape from the nature of electronic sound, but to go further into it. No composer would set himself this task were he not certain that the idea of order running parallel with Nature was something he could believe.

Our first little pieces of electronic music from the Cologne Studio were composed in this spirit of faith. They are not experiments, inasmuch as experiments forswear music. Nor are they mere products of technology or of the technocratic spirit. There need be no song and dance, as is so fashionable nowadays, about the human cost incurred in the attaining of technical progress. There is no more to it than that a new way of thought has found a new, transformed musical material. Sufficient is it that young composers are fascinated and committed to the great discovery of 'the note' in Webern. No longer is Webern seen at the centre of classical twelve-note technique. Although he was not offered the possibility of thinking serially in terms of microtones, he nevertheless stands at the outermost limits of instrumental material, as if he had already cut off the properties of the past and was on the point of moving on.

The music of the younger generation after Webern has taken the logical consequence of his work. For the second time in our century after Schoenberg, the painfully 'impossible' has been realised. It may be that 'pointillist' instrumental music closes the gap, but only in coming to electronic music can we talk of a real musical control of Nature. Its dependance for reproduction on the loudspeaker, which has almost imperceptibly revolutionised our way of hearing, leads us to reflect whether perhaps it is not the symphony recorded on tape or disc that is the synthetic, and electronic music the genuine article. For in the latter, we may find, is the genuine musical order.

THE THIRD STAGE

Some Observations on the Aesthetics of Electronic Music

H. H. STUCKENSCHMIDT

Form is created of Necessity
(W. Kandinsky)

If it is of the nature of music to give substance and definition to nothingness and chaos, it is also its nature to be in a state of continuous self-renewal. Its only certainty is in the unheard. What has been already created is drained of its resources for re-engendering because of its very existence. There is, thus, a conflict within the creative process. On the one hand there is the fundamental desire to create out of chaos; on the other, a desire to repeat existing structures, allowing them to sound again and again, and to create through this repetition. This process may be compared to a crystal where the basic immutable shapes combine to make a whole. The musical form of the variation is, significantly, the result of a merger of these two forces, the engendering and the repetition of a structure.

The process of repetition must, obviously, be preceded by invention; otherwise there would be nothing to repeat. Thus, we may say, that the construction from nothing is the true and most important process in the creation of music from sound material.

The first results of compositions with electronic means have been available for a few years. It need hardly be stressed that we are not concerned with works for the Trautonium or Ondes Martenot concert instruments, but with music conceived purely for the electronic sound generator and which for its realisation does not require, indeed excludes, human interpreters. These experiments have been conducted principally in the Studio of West German Radio in Cologne, which is directed by Herbert Eimert and whose most promising composer is Karlheinz Stockhausen. Associated with the work and ideas of the Studio are, amongst others, Pierre Boulez (Paris), Luigi Nono (Venice), Henri Pousseur (Ypres) and Giselher Klebe (Berlin).

As spokesman for the group, Eimert has repeatedly drawn attention to the creative possibilities of electrically generated sound, but has disassociated himself from the 'fashionable and surrealistic' *Musique Concrète* produced at the *Club d'Essai* in Paris, and any incidental manipulations or distortions haphazardly put together for radio, film or theatre music. He is opposed to all metaphorical synaesthetic interpretation – that is, he is opposed to the idea of composition and interpretation by association and reference.

Aesthetic understanding of the new art is not facilitated by this attitude. It cannot be denied that this associative effect, which the initiator denies as being of any relevance, has been the principal reaction of the majority of listeners faced for the first time with electronic music. There appears to be a considerable discrepancy between postulation and reception, a discrepancy which must lie in the very nature of the new art form.

In a revealing lecture: 'The Image of Nature in Contemporary Physics' (printed in

'Arts in the Technical Age', R. Oldenburg, Munich, 1954) Werner Heisenberg has drawn attention to the radical changes in the fundamentals of our existence and their effects on all other aspects of life. In a world completely transformed by human hand, he asserts, we are continually presented with humanly conceived forms. In the natural sciences, the object of research is no longer Nature itself, but a Nature deprived of its absolute autonomy of behaviour and controlled by human intervention. The natural scientist sees an image of Nature which is in reality an image of human relationship to it. Heisenberg concludes his lecture with the refutation of the Cartesian conception (*extensio cogitatio*): Man as a conscious being develops within an area which certainly has other dimensions than the single one in which he has developed throughout the last centuries. One would do well to apply much of this view of the present situation to any attempt to determine the relationship of man to this 'completely transformed' music with its 'humanly evoked' forms.

The first reaction of the listener to electronic music is one of perplexity for he lacks a point of comparison between it and vocal and instrumental music. In a J. C. Bach allegro or in a movement from a Mozart symphony one is still able to appreciate vocal origins despite instrumental elaboration. In the most elaborate leaps, virtuoso passages and colour mixtures in a composition for the Trautonium the listener is reassured by the fact that it is executed by human hand. Indeed, music is also apprehended from an associative viewpoint in that the associated object may be of a nature akin to the agency by which the music is made to sound: the human voice, the wind, string or keyboard instrument. As a result the association is practically imperceptible and is assimilated into the image of the music itself. The listener is lead along familiar paths.

In that nothing pertaining to electronic music is analogous to any natural existent phenomenon of traditional music, associations have to be evoked from elsewhere. Instead of being integrated, they remain, an ever increasing conglomeration of mentally indigestible matter. Thus the listener's reaction, in broad outline, corresponds to his relationship to a humanly transfigured world. The ear recoils from assimilating, in any accustomed manner, this music, 'totally predetermined' by human hand. (The pertinent phrase is by Ernst Krenek). Thus the relevance of the synaesthetic metaphor grows. The sound mixture is heard in such a manner as to associate it with phenomena experienced by any perceptive listener; it is associated with reverberating projectiles from the mineral domain, with sounding metals, with the music of cylinders.

That which is actually heard is, in fact, something which seems extremely complicated, without recognisable order, yet something which is clearly organised, more strictly ordered than ever was music before. The aesthetics of electronic music stipulate elimination and selection of material. The new means of production are not to be misused; they are not to emulate that which can be effected equally well or better by traditional means. So, the natural is abolished. Vocal and instrumental forms are eliminated, tonality, functional harmony, simple polyphony and symmetrical rhythm are suspended.

All elements of the music are statistically calculated. The serial principal of twelve-note technique and the isorhythm of mediaeval music are combined with an ordering of timbre and dynamic. In this way the music may be predetermined, allowing for modifications arising out of variants in the proportions. The composer is able to anticipate the consequences of the forces he has set in motion in the same way as an

astronomer is able to anticipate the movements of stars and calculate constellations, eclipses and cosmic collisions.

Thus music enters its Third Stage. The first was restricted; the music was written to be performed principally by the human voice, and as is the voice, it was limited in its range of expression. It was conditioned by the limitations of the voice in the execution of fast or loud passages; its range of colour was determined by the technique of voice production, developing from strict, monodic incantation to the virtuosity of bel canto. The second was the instrumental stage. Here also the human agency was the key factor, and instrumental technique was largely conditioned by its vocal precedents; *e.g.* the violin vibrato, the singing legato of the piano. At the same time development of the potentialities of the instruments, virtuosity, differentiation of timbres, rhythmic complexity and the augmentation of the dynamic range, brought it further away from its vocal origins. The third, the electronic stage, retains human participation in the compositional process, but excludes it from the means of realisation. Such a dehumanized music is conceived by the intellect alone; the range of experience derived from traditional procedure is transferred to a radically new material.

The new music is, in some of its elements, foreshadowed in the late works of Anton von Webern, in the montages of timbre and note complexes in the works of Edgar Varèse and in the isorhythmic pedals of Olivier Messiaen. A music of such severity and purity may be seen against the background of an artistic climate which has turned away from Realism and has reaffirmed the significance of the intuitive, the symbolic. It is not without significance that a manifesto of young French composers is dedicated to the memory of Mallarmé. Two of the foremost exponents of the new style, Pierre Boulez in France, Giselher Klebe in Germany, have made reference to Paul Klee. The former has taken a maxim of Klee's as a personal aesthetic, the latter has written a composition for orchestra which borrows the title and general atmosphere from Klee's picture, 'Die Zwitschermaschine'.

It would not be difficult to demonstrate the manner in which frontiers have been overcome and contacts established between the different arts in the contemporary world: a further corroboration of Heisenberg's ideas. It will be seen how, from the concrete realities of his environment, man turns back to the image of himself. Thus, unexpectedly, the whole circle is completed. Music has developed further and further away from its human origins; now, at what we define as its Third Stage, the Electronic, we are astonished and not without pride, to have before us an art, totally controlled by the spirit of man, in a way not previously imaginable.

A GLANCE OVER THE SHOULDERS OF THE YOUNG

ERNST KRENEK

The question of the systematic formulation of musical material must clearly come up for re-examination in light of the new methods used by those composers who have composed with material derived from sinus tones. As we have understood it, the composers who, up to this time, have made the most significant contributions in this medium, have subjected their work methods to a discipline which, exceeding anything previously imagined, has stipulated the derivation of every dimension and detail of the composition from a pre-established row of proportions. The way to such a position has already been shown by the technique of composition with twelve notes, in that the basic tenet of that technique has been that all sequences of intervals in a given piece should be derived from a combinatorial ordering of the twelve notes and that to a certain extent harmonic elements should also be pre-established.

'To a certain extent' – in the course of the compositions, twelve-note composers found ways of utilising their pre-selected note row in an individual manner and showed that it was possible to be very free while retaining the essence of their conception and not in any way foreswearing or omitting that which they considered the justification for and purpose of the technique. As far as we are able to see it, the majority of the twelve-note composers have found that the justification and purpose of the technique lay in the fact that in this way it was effectively possible or at least easier to remain faithful to the basic stylistic conception of Classical Music, namely, the development and variation of clearly defined musical ideas, without being limited by functional, tonal harmony. This mode of thought enabled, and in fact facilitated, twelve-note composers of the 'middle generation' to neglect the inherent idea of twelve-note music, *i.e.* the total determination of the musical continuity, and emphasise the melodic-motivic functions of the row. Technical procedures – the sub-division of the row into smaller groups and their independent utilisation, the rotation of notes within groups, etc. – were means discovered to facilitate the realisation of this conception. I have discussed these elsewhere.[1]

It would possibly be going too far to say that these composers had finally learned to dispense with twelve-note technique altogether. When a twelve-note composition is found by some listeners – rather against their will – to have a certain 'direct appeal', they come to the conclusion that the composer has succeeded in spite of his application of this technique. The matter is not so simple. One may safely wager that if the composer had set out to write the piece with direct methods (and direct here means 'traditional') he would precisely have failed to obtain this 'direct' appeal. If for the sake of argument one grants these 'traditional' critics that twelve-note technique stands in the way of an immediate style such as that developed by Puccini, Strauss or Verdi, and if one further admits, as every right-seeing person does, that this effect can no longer be attained with the methods of Puccini and Strauss, one comes to the conclusion that the

[1] 'New Developments of the Twelve-Tone Technique', *The Music Review*, May, 1943: 'Is the Twelve-Note Technique on the Decline?' *Musical Quarterly*, October, 1953 and *passim*.

extraordinary directness of appeal of so many twelve-note compositions is due to the conflict (and the inherent competition) of two apparently contradictory principles: desire for spontaneous utterance and restriction imposed by technical procedure.

Once we have established this fact, we may admit that much of the technical justification and intentions of twelve-note composers up to this time, represents a rationalisation which does not stand up to definitive critical examination. It is certainly possible to follow the classical ideal of development and variation of ideas in an atonal idiom, free from the restrictions of twelve-note technique. It must, however, be remembered that this way only leads to valid results after the procedures of traditional twelve-note technique has been mastered. There was not much attempt at the development and execution of larger forms in the period of the so called 'Free atonality'. Historically this has been the endeavour of the middle generation of twelve-note composers.

It does not seem that the younger composers are particularly enthusiastic about this 'loophole in the rules' which allows so free an application, nor about the use to which it was turned. They do not want to limit serial pre-composition but rather to extend its scope. The formulation and development of individual musical ideas (*Gestalten*) is not part of their aesthetic programme. The desire for an all-embracing pre-formulation can be explained by the wish to subjugate material completely to the control of the human mind. Seen from an historical viewpoint, the development of music has been one in which man has gradually found, by the creation of his own methods of regulation, the means to put artificial manipulation in the place of natural sound control. A musician who blew into a reed pipe or sea shell could only produce very few notes and, consequently, was restricted in the extent to which he could create musical forms. As he improved his instruments technically, he was enabled to extend his range and produce other than the natural notes. Thus, he freed himself from the limitations imposed by nature. Clearly the purpose of this freedom is to create richer and more interesting artistic forms. The creation of these forms entails greater detail and precision in planning. If these plans lead to characteristic procedures which in their turn are related to extensive areas of expression, we reach that pre-formulation, which is our present subject.

The tempered system had already brought the pre-formation of material in the tonal system far from its natural conditions, though to a certain extent these survived in the system of natural harmonic overtones which provided a norm for intervallic consistency. Tonality as an artistic system was the realisation of these natural proportions in the principal dimensions of form (key relationship, modulation, the cadence). The organisation of detail in the musical procedure was left to the spontaneity of the creative genius and was considered as the achievement of a freedom wrestled from the confines of natural law. In those cases where the detail was subjected to constructive methods, precise contrapuntal working, density of motivic relationship and other similar procedures, it was regarded as a self-imposed limitation to spontaneity and was considered, according to taste, as the sign of remarkable mastery of the material or as useless pedantry.

Atonality dislodged the ultimate foothold[1] of natural pre-formation, when it suspended the norms of intervallic consonance and thus dispelled their hierarchic relation-

[1] In light of the electronic development one had better say penultimate, for atonality did still accept the natural structure of notes, as delivered through the medium of the then existing instruments.

ship. One may speculate whether it would not have been possible to proceed from here directly to the final step, namely, the elimination of the natural structure in the musical molecule, the single sound – to the musical atom – the sinus tone. If liberation from the natural conditions in tonality was an essential step to the achievement of atonality, then the progress towards the neutral sinus tone would indicate a more complete realisation of that liberty.

However this may be, the final step has in reality been the consequence, the carrying to a logical conclusion, of that train of thought which led to the establishment of the twelve-note technique as a means of pre-forming atonal material. It differs in its essentials from the tonal system, as a means of pre-organisation, in that it is not dependent on a basis of natural conditions. In addition, it concerns itself not only with the larger aspects of musical context, but extends its control to the individual detail. Further, every single case demands a freely composed, arbitrary 'medium' for the pre-formation (*i.e.* the composer selects a different twelve-note row in each case) and lastly, the principle of pre-formation is the row (in concrete form the row of intervals); *i.e.* an ordering of the sequence of musical elements which can be expressed numerically as a Series of Proportions.

It appears that the extension of the serial pre-formation of intervals into the domains of rhythm, dynamic and to a certain extent, sound aspects in music, has brought the younger composers to a complete liberation from the offerings of nature, which cannot be improved upon at our present level of knowledge of the material. (The next step might surely be the 'splitting of the atom', *i.e.* the sinus tone). It is not without relevance to observe that this overall freedom has been purchased at the cost of an acceptance of total pre-determination. What would have happened if this stage had been reached directly, without taking the long way round of the twelve-note technique? Would there have been complete chaos? It is curious that in listening to the few pieces in the new idiom and based on the new methods, which have been performed to date, even the listener current in the ways of twelve-note technique had the impression that chaos, whether intentional or otherwise, was the final result of these efforts. The cause of this naturally lies in the abandonment of the exposition and development of defined ideas in the Classical sense. At this point in its evolution it is impossible for the present writer to decide whether the abandonment really is essential and whether the musical content which is meant to compensate for this deficiency really comes up to the standard of what has previously been considered the minimum necessary for the awakening and retention of the listener's interest, in fact, to make the music worth one's while to hear. To the superficial observer it appears that the phenomena demonstrated so far in electronic music: levels of colour, texture, density, consistency and mass of sound material, are of a considerably lower intellectual level of musical consciousness than the aspirations which were associated with the demanding music of the past. Perhaps this only represents a beginning; history cites us many examples of the way in which creative energy has been expended on the achievement of progress of one dimension while temporarily impoverishing the other dimensions of the subject. An apocalyptic vision of a music developed to a state in which thinking out is more significant than performing or listening, can bring us no fear. The idea that we should have been chosen to witness the end of time is, after all, just as presumptious as the idea that ours is the best of all possible worlds.

FIRST PRACTICAL WORK

GISELHER KLEBE

I had my first opportunity to experiment with sound created by electronic means in February 1955 at the studio established for this purpose by the Cologne Radio. Although I had thought a great deal about electronic sound production and its potentialities before this time, it was the instinct in me to seek a union between the artistic and the technical that first attracted me to it. This musico-emotional reaction is similar to the stimulus to composition provided by imposing certain technical conditions, or to the amount of purely musical impulse needed to give substance to a conception that may seem to be intellectual but which is, in fact, still consciously perceptive in its original form.

It was fairly simple for me to grasp the technical procedures, thanks to a certain amount of preliminary work. These procedures in themselves proved to be a considerable inspiration and gave me much to think about, modifying my previous views. I soon grew dissatisfied with the purely acoustical experiments of my first days in the studio. I endeavoured to limit my experiments by certain preliminary conceptions of a musical nature and in this way was able to apply some manner of aesthetic judgement to the results of my experiments. These first attempts in formulating and hearing a musical situation brought with them many surprises and fresh ideas. I found, however, that though modifying details, I did not have to change radically any of my basic tenets, stylistic or technical. Rather, were they enriched, in that the change of medium from vocal or instrumental to electronic cast a new light on old problems. For example, I discovered considerable divergences and sometimes even contradictions in my notions of consonance and dissonance, and a completely new world of sound resulting from the disassociated and independent manipulation of the three parameters (pitch, duration, dynamics).

Of particular interest to me were experiments with rhythm. I had assumed that, by electronic means, one would be able to realise complex rhythms, which in their rapidity transcended the technical possibilities of traditional instruments. To my great surprise, I discovered that the limits beyond which the ear could not differentiate in any detail, roughly corresponded to the limits of the traditional instruments. Of course, electronic music enables one to realise precisely rhythmic structures which, by the traditional means, can only be approximated. This power alone would ensure a substantial enlargement of the scope of the composer, for it would enable him to differentiate the most detailed structures by the great number of different possibilities made available to him by the electronic means. But the most powerful impression made on me was the possibility of abandoning the so-called well-tempered system of twelve notes to the octave and creating systems which would enable the composer to realise structures in sound and form which would be entirely new and at the same time characteristic of their electronic means.

I am convinced that in these possibilities are contained the beginnings of a new and

significant development of Western musical culture and I believe that the creation of sound by electronic means will bring the greatest stimulus to the composer.

'AT THE ENDS OF FRUITFUL LAND...'

PIERRE BOULEZ

Unforeseen difficulties confront the composer who enters the realm of electronic music for the first time.

If he intends to pursue the consequences of an aesthetic that transcends the instrumental medium, he will find himself in an environment which will appear to him as the sole admissible possibility.

It is certainly possible to overcome the preliminary difficulties of studio work by continually striving to master the new mode of expression. But the electronic means themselves will initially cause the composer to be confused; he will be unable to reconcile them with his own traditional ideas of sound. What previously have been fixed limits are now suspended; they even become a sort of negative cliché: everything which was limited becomes unlimited; everything which was 'imponderable' can now be subjected to precise measurement. Furthermore, this very idea of precision, which has for long been sought after, has now become a myth; the more one seeks to limit possible sources of error, the more limitless they seem to become. We have long since passed the stage when we were enticed by the lure of further inventions, were enthralled by the composer's power which, we thought, would enable him to free himself from the ever more constricting bands of tradition.

Considering the logical developments which are bound to come about, we will have to approach the two domains, the electronic and the instrumental, in radically differing ways. The natural sound world consists of sounds defined in their essentials, by a more or less variable timbre, a wider or more limited range, a certain dynamic scale and certain durations, controlled or otherwise. A use of this sound world stipulates a concern with the possibilities it grants us, and at the same time limits the executant by a kind of 'inertia' – that is, if the executant is not already limited by his own bodily limitations. For this reason several sound generating agents are required, each of which furnishes us with a different range of possibilities. We have already reached a point of development at which these possibilities of potential sound can only be utilised in connection with a precise method by which we supposedly regulate them. No such limitations of possibilities suggest themselves in the electronic sphere. Here, from a world undifferentiated in its timbre, pitch, intensity and duration, we are required to create a composition which is coherent not only in its internal structure but also in the constitution of its actual sound material.

Rarely in the history of music has the musician found himself in a more radical position, faced with as unaccustomed a task as the creation of the very sound itself. He is not faced (which would be banal) with a projection of the traditional problems of orchestration and instrumentation, in which the choice of sound material is made according to its decorative or predominant effect, but with a choice of material determined only by its intrinsic structure. The composer is simultaneously the performer: the realisation becomes all important. In that he has a direct control over the quality

of the realisation, the musician takes on a function similar to that of the painter.

There are two diverging reactions to these electro-acoustical phenomena. We are amazed, at first glance, by the radical means of production, transformation, or deformation of sound; we are amazed, whether we hear or whether we ourselves create, by what, literally, is unheard of. With electro-acoustical procedures we can create with little trouble what has never been heard before. Unusual conditions, simple procedures such as acceleration, slow motion, montage juxtapositions, already put us into a 'modernistic' atmosphere even if we can too easily anticipate its commonplace nature. Nothing is simpler than the composition of canons at the unison; just take one track with several heads. Different speeds suffice to make a fugue and there is nothing easier than making a tape-loop and so obtaining an ostinato. Unfortunately, this mechanical efficiency is of little use to us. For after all, who really wants to make canons which only function at the unison? Who, today, cares to compose fugues in which the tempo is automatically regulated by the transposition of the subject? Who requires ineradicable ostinatos? Only a primitive mind will be impressed by the wonders of the machine, only one which is ignorant of music evolution. This kind of thought represents an enormous retrogression from the achievements of the past, and our 'sorcerer's apprentice' will hardly be able to take his place beside his precursors in the art. It must, however, be said that though these experiences remain meaningless on account of the mechanical mode of their application, they do nevertheless show the beginnings of a synthesis of all the possibilities of sound, one which is certainly demanded by contemporary musical thought.

It is indeed here that we see a more serious, or at least less naïve attitude taking an increasingly more important role in contemporary composition. These procedures cannot be considered as the unique means of creating on the one hand electro-acoustical, on the other, 'ordinary' music; only illiterates could take so ridiculous an antithesis seriously. It should rather be observed that on the one hand we have a remarkable coincidence between the evolution of music and consequences which it not only implies but demands, and on the other a new freedom necessitated by the need of realising the very complex thought of a new technique or means of expression, the further consequences of which we are only beginning to grasp.

Despite this felicitous point of contact, it cannot nevertheless be agreed that it results entirely from a mature development; reciprocal contact has burdened the musical mind with questions which have hardly been formulated, while the technician is faced with a number of unusual problems which he must solve in order to 'realise'. We have mentioned above a real disturbance of the limits imposed on the creative artist; one of the foremost problems of this transformation consists of the fact that for the first time the musician has to deal with the idea of continuity. It must be pointed out that this is a problem not only of pitch level but also of duration, dynamic and, the most problematical of all, of timbre. Never has it had to be so clearly realised that pitch, duration and dynamic are irreducibly bound together both in the organisation and the actual production of sound. A final obstacle linked with 'interpretation' is the continuity of projection of a work in space; contrary to what has previously been said, we are here faced with definite limitations; the attraction of an 'objective' work is speedily dissolved, for psychological reactions of an audience to which the music is fed by loud-speakers can hardly be avoided where that audience is deprived of the possibility of associating

a sound with a gesture. Thus the arrangement in space becomes a structural necessity and represents considerably more than an appropriate setting for a more or less spectacular exhibition – though the very idea of this stereophony is enveloped in such a mist of confusion, owing to its continual vulgarisation in the cinema and in all kinds of 'outdoor shows', that the best intentions are discouraged by the incidental experiences of similar appliances.

Is a concert-hall really necessary when the performing artist has been eliminated? Is it not insolubly bound to the idea of the instrument? Is it not then necessary to find new conditions for listening or are we to contemplate the reuniting of this 'artificial' music with a 'visual double'? We are touching here on the external influence of the performer on human communication; but further consequences of the elimination of the performer affect the internal conception of a work of art. Compared with the capacity of the performer the machine can, at once, do very little and very much; a calculable precision is opposed to an imprecision which cannot be absolutely notated. *Tempo* is in itself a key to the respective functions of the interpreter and the machine; one is tempted to say that extreme precision has only a limited efficacy by comparison with that imprecision which exceeds the limits of notation. Above all, we are interested in this small, ultimate margin of error rather than in a definitive realisation, which does not depend on individual fantasy, on the daily inspiration of a human being. We need only be disturbed at the passing of the performing artist, if some part of the 'musical miracle' goes with him.

Will the composer be able to transcend this liberty which he has himself sought for the sound material of his composition? Or will it in the end suffocate the potential poetics of his work? Will it never be possible again to imagine a synthesis in which the very contradications of the two sound worlds will interact to widen the scope of our structures? Are we to be spared the nostalgia and transformations of a new 'total' art?

In considering his electronic means, the composer has first to free himself from the conception of absolute interval. This can certainly be done. The tempered system of twelve equal semi-tones seems to lose its necessity at the very moment at which it passes from chromatic organisation to the Series. There have already been experiments with intervals of less than a semi-tone, of quarter-, third- and even sixth-tones. Unfortunately, the works written as a result of these experiments proved to be of no great interest; a hyper-chromatism was developed which did not really modify the basic system of arranging intervals otherwise than by an enlarged modality. More recent experiments have been of greater significance. Here there has been no more hyper-chromatism tempered or otherwise, and the characteristic intervals used for each work were specified from a particular range of sound. In principle this has nothing to do with the interval as a basic unity. In fact electronic research has demonstrated that the idea of an absolute interval is fictitious and that the ear's capacity for differentiation is determined either by a basic unit or by the extent of the registers in which these intervals are heard. So we see that ideas of continuity and non-continuity overlap considerably and can hardly be applied mechanically.

In fact, to select a fundamental unit other than the semi-tone, means to conceive a kind of temperament peculiar to a single composition; all intervals are to be heard as deriving from this fundamental tempering, thus affecting the listener's conditions of

perception. But owing to the fact that our ears are conditioned by the semi-tone, we have an incorrigible tendency to reduce everything back to our traditional chromatic temperament and to hear new intervals as 'out of tune'. Nevertheless, one cannot deny a certain harmonic atmosphere to this arbitrarily tempered sphere in which the structural consequences and characteristic gestures are developed from this kind of premise. This tempering may take place within the octave, so that the traditional definition of scale in the tempered twelve-note scale will remain unchanged; or, it is equally possible to construct in such a way that the interval with which the démarche of the scale commences again is other than the octave; in this case the different registers of a note will appear as essentially dissimilar. Comparison of a flat and a curved surface suggests the kind of difference between these two systems.

We mentioned above that the ability of the ear to discriminate depended to an equal degree upon the extent of the register in which the intervals were heard. By this we mean that a micro-interval will only be distinguished within a very narrow range. This has already been ascertained with durations. It is most easily demonstrated if we take two very long durations which differ only by a very short duration: we will be unable to discern which is the longer of the two. Similarly, let us take a relatively wide interval, such as a twelfth (octave plus fifth); it is certainly true that at first hearing the ear will have considerable difficulty in establishing a precise difference between this exact interval and the same interval altered by the addition of a sixth of a tone. But if we modify a single whole tone interval by a sixth of a tone, the difference is immediately perceptible. There is thus in the ear a certain capacity for adaption, as there is in the eye. In a narrow area, where micro-intervals are the unit of alteration, the ear momentarily acquires a sensibility which it is unable to retain when the range is broadened, or, otherwise, the ear establishes its own scale of appreciation in proportion to the intervals utilised. This fact is true for a normal pitch level of medium frequency; the capacity for differentiation diminishes towards high and low extremities. As for discerning harmony, here the situation is even more delicate, in that the ear's ability to discriminate must intervene in a simultaneity of sound phenomena rather than in a succession, as in the previous case where memory can play an important role. Study of the various musical cultures of the Near- and Far-East has always emphasised the non-harmonic character which differentiated these from Western polyphony, thus explaining the greater richness and complexity of intervals utilised. (This is true, especially of Indian music, in which the rhythmic complexity is the consequence of the same fact.)

We have thus to resign ourselves to the fact that we must find an idea more complex than that of a *continuity* which frees the composer from all limitations, and must realise that our famous continuity is conditioned by aural capacity – be it to a certain extent a dialectic, apparent or real, between the idea of temperament (regardless of the basic unit) and the idea of dimension of range used. Electronic music will have a higher aim if it dispenses with this unlimited area in which neither can anything be apprehended by the ear nor can transformations be registered (which is 'theoretical' and completely unmanageable), and replace it with a multi-dimensional range which is based on the aural capacity for adaption, a multiple dimension which, furthermore, may be suitably expressed by a real multiplicity of dimensions in a stereophonic space. This question must be discussed in greater detail. For the time being we will deal with the problem of a synthesis between electronic and illustrumental dimensions with sole

regard to pitch-levels; it seems unlikely that, if any such synthesis is to come about (we are not here concerned with the question of its necessity), it will do so without some reference to this idea of multi-dimensional space; a successive or simultaneous multi-dimension with either single or several basic units. In this way it would be possible to derive from one structure based on wide intervals, *i.e.* having a wide compass and a semi-tone as the unit, a corresponding structure based upon micro-intervals, in which the compass would be greatly reduced and where the unit would be either a very small interval or irregular intervals defined by a series. An example of this kind enables us to imagine the possibilities of various different modes of transitions from tempered to non-tempered, from micro- to macrocosm. Electronic music would be the sole means of exploiting these transformations to their fullest, and instruments, whether normal or with some kind of tablature, would represent certain fixed points in an evolution, the continuity of this evolution being represented by the electronic dimension. This idea must be seen above all as a project, as a working hypothesis; certainly, working experience, yet to be gained, will show us fallacies in such Utopian ideas, which nevertheless have to be described.

We have already mentioned above that with tape the composer can avail himself of any duration, whether or not it is playable by human interpreters, merely by cutting the tape length which corresponds to the duration. Nevertheless, three problems to which the composer must find an answer are posed by this seeming simplicity: they are the perceptibility of the duration, the definition of tempo, and the continuity of non-formulated time. Certainly the first problem is of slighter importance than the second. This poses the relevant question of the severed relationships of composer and interpreter; nothing is *indicated*, everything has to be *realised*. Can it not be said that, essentially, an interpretation is defined by tempo, as it is the tempo which determines the various phases within a composition; and can it not be said that the transitory *accelerandi* and *ritardandi* are here only fictitious, potential simulations, which defy precise control, even though any number of irrational values be utilised? For our third problem, that of a non-formulated time, it is appropriate to consider that at their limits arithmetic and logarithmic progressions become a real continuity. But where are these limits?

Let us return to the first objection which may be raised against this new concrete way of dissecting time: namely that there is a danger that the unit will not be perceived by the listener; that it exceeds the lowest limit of differentiability. We have already referred to irrational values; their use does not represent only a written out *rubato* but a point of contact between the variation of a unit value and the variations of the particular duration itself. This meeting point gives rise to fractions of irrational values within a group of irrational values at another level! . . . In short, to realise these instrumentally and at the same time to retain the sense of pulse of the unit value, the player must be able to realise three mental operations, the one deduced from the other, almost simultaneously: supposing the initial pulse to be established, we have the metre, the irrational value of the first level, the further irrational value or the fraction of it, which depends upon it. Strictly speaking, it is just within the realms of possibility for the interpreting artist to realise this kind of value if he has to perform these operations successively and if he has a sufficiently detailed knowledge of the score; the process of simultaneous

deduction is, however, for all practical purposes impossible. It is better to substitute an alteration of tempo and thus simplify passages which are otherwise inexecutable. We have only described these difficulties of rhythmic micro-structure to enable us to extend our examination to the electronic sphere. Is one to consider that the only function of working with tape is the facile solution of problems of transmission? What is the point of it, one might well ask, since man will be unable to perceive that which he is himself unable to perform, without recourse to a mechanical procedure external to himself. Reasonable as this argument appears it does, however, depend to some extent on a belief in some absolute law of intervals. Besides, it has not been established that the ear is incapable of perceiving subtleties which the hand cannot realise; even if a subtle differentiation is not exactly perceived, it is at least registered and that is almost enough. But electronic music is not to be reduced to the role of robot which fulfills inhuman tasks; it is certainly possible to realise otherwise unrealisable values on tape, but the very simplicity of procedure demonstrates the poverty of the idea. It is of more value to reconsider fundamentally the whole problem of musical time and its organisation. This can straightway be done by starting with the durational lengths themselves.

To do this we must refer to a series of unit values within the relationship of a single value and its double. Thus we are able, as it were, to make a registration of durations. An idea which until now has only been concerned with pitch levels will be extended to time. As we have shown with pitch levels, we can modify this so that we will be able to cover all eventualities which a composer might encounter. How electronic music fundamentally differs from instrumental music is demonstrated by the fact that it may be based on a series of unit values as opposed to a single pulsation or a particular unit. This constitutes a completely new conception of rhythm, one which refers to the past only in its use of normal and dotted units (the relationship of 2 to 3); precedents for this may be found in certain folk music cultures. We may define it as a registration of durations based on a changing unit duration. As has been seen with pitch levels here too we may observe that the ideas of continuity and non-continuity can hardly be separated.

Our second stage towards a conception of duration as length (measured on tape): a definition of *tempo*. Our usual simple proportions of abstract values do not appear to be a valid system for electronic music. We are disturbed here by a lack of tempo, in the traditional meaning of the idea. We must ask the exact meaning of tempo (though more has been written about it than about any other aspect of music, it is certainly the least clearly defined). In any case, there can be no question of a certain 'speed' of notes, as one would speak of the speed of the current in a river. Certain fast movements have a very low density in their rate of events, while some slow movements, on the contrary, have a much higher density. Nevertheless, they are clearly perceived as characteristically fast or slow movements. We have to take into account the harmonic rhythm, a greater or lesser ornamental character in the sounding phrases; we must reckon with the so-called agogic of development. In instrumental music certain conventions enable us to find answers to these questions without too much difficulty. The interpretation of durations is subjected to a whole series of modifications and, in fact, if there is one aspect of instrumental music which has not been adequately studied, it is the particular duration of a sound unit in absolute time. Emphasis has always been placed on the relativity of tempi, one to the other, or on the constancy of rhythm of procedure. A rhythmic pulsation of greater or lesser complexity, whether it be appreciated

physically or mentally, is established and all principle points are related to it. On tape, however, the absolute duration of a unit of sound is alone of significance, since no psychological consideration is possible and the duration must be appreciated regardless of a regular pulsation; strictly speaking, there is no tempo. In electronic music, the most general substitute for instrumental *tempo* is that of an augmented registration in the general scheme of the composition. The meaning of this registration of duration has been described above; we must be able to extend this phenomenon to a group of durations which would in their turn lead to other groups in which the tempo was not specified in advance. Combinations of these two variable registrations would create networks of variable *lengths* – as happens to an absolute duration of time when transposed to tape. The significance of the same length would vary according to which group it belonged. Thus, in a more general category of order such as that of tempo, electronic music will depend on a conception of non-continuity; at the same time instrumental music will increasingly depend on one of continuity with its variable tempo, within which transitional procedures such as *accelerando* and *rallentando* will take on a greater structural significance. A particular definition of a duration is common to each of these two worlds of sound; at the same time contrasting conceptions may be discovered which cause a fundamental differentiation between them and give to each its intrinsic physiognomy. To recapitulate, these two contradicting conceptions are: in the first case, an unchanging *tempo* within which durations may be subjected to almost unlimited degrees of variation; in the second, a *tempo* which is itself subject to the greatest degree of variation but within which there are limits to the degree to which values may be varied. We see the possibility of a synthesis in the simultaneous registration of time, which reveals itself directly in the unity of the duration and at a higher level in the tempo itself.

Perhaps the reproach will be made that we have been too concerned with the idea of a synthesis, too obsessed with the similarities and contradictions between the respective domains of instrumental and electronic music. Let it be remembered that it is hardly reasonable to suppose that one sound world can supplant the other; and further, that it is futile and inconsequential to conceive the relationship of one to the other as a simple '*progression*'.

Before we leave the subject of duration we must examine the principle of *unformulated time*, such as is given us by tape montage. Formidable obstacles could arise out of this procedure. We have examined how temporal organisation implies a network of durational *lengths;* we have not, however, mentioned the fine degree to which these networks may be potentially differentiated. At the present time, with careful cutting, the nearest millimetre is the limit to possible precision in measuring and cutting tape; this represents, at a speed of 76 cm.p.s., a duration of 1/760th sec. This precision certainly oversteps the limits within which the ear is capable of differentiating two durations differing by this amount, whatever be their actual duration. There are maximum limits for the aural appreciation of rhythmic structures which in effect forbid the use of continuity which is not in some way restricted. Fechner's law stipulates, with regard to pitch, that there is a logarithmic relationship between sensation and stimulation; in fact, as we have already observed, the same law is maintained by a classical rhythmic usage in the temporal dimension. The different values are established in logarithmic scales from simple to imperfect (1:2), from the demi-semi-quaver to the minim (a 32nd

note to a whole) or from simple to perfect (1:3), (dotted values in a ternary measure). We see that one arithmetical difference may be negligible or considerable, according to each case. If the amount of difference is a small fraction of the original value, the effect will be small; *e.g.* a minim plus a demi-demi-semi-quaver (1+1/64) is a proportion of 64:65. As has been described above, the ear is incapable of distinguishing two durations of similar length differing only by a very short interval, though two values of shorter duration differing by the same amount may be easily appreciated. Thus it is hardly possible to take only 'neighbour' durations (1/64, 1/32) into consideration. The ear does not appreciate so much absolute differences as general proportions. Logarithmic and arithmetic scales are to be utilised in some way analogous to the way in which micro-intervals are related to large intervals. An arithmetic scale will be best appreciated where the degrees of the scale are close to one another. A logarithmic scale may be utilised to cover a wider 'time-area'. Here we see that same *power of adaption* of the ear, of which we spoke with regard to pitch. A consideration of it clearly determines the rhythmic life of electronic composition; as we have looked forward to a multi-dimensional area of pitch, so we hope to work out an analogous multi-dimensional area of time. Once again the idea of a synthesis; only electronic music enables us to reach the *limits* of rhythmic transformation; the principles of writing being, however, statically applied to instrumental music.

It will not be necessary to deal at any length with the problem of dynamic intensities. In this dimension there have been no real modifications nor are there really any new problems. This is due to the fact that intensities have always been applied in a continuity in instrumental music through the use of *crescendo* and *diminuendo*. On the contrary, a precise application of a non-continuous scale of intensities is the only real innovation in this sphere resulting from the use of the medium. Nothing has proved of greater difficulty for the performer than to adapt himself to those needs of contemporary musical thought, which require him to separate emotional power from the idea of an intensity – in other words, to go from *nuance* to *dynamic* alone, *i.e.* the establishment of a certain number of levels of intensity which are to be strictly respected wherever they are indicated in the score. In practice it is almost impossible for an instrumentalist to grade the dynamics he uses; and the same *forte* is rarely executed in the same way; it is influenced by its context, the mode of its attack, by certain psychological factors, quite apart from the nature of the instrument itself. Thus, let it be clear, scales of intensities in an instrumental work are modified by the mode of attack and give rise to certain undefined areas within which the interpreter acts; the composer in the writing of his works is bound to concern himself with what one might call a psychological notation as much as with a real notation.

With the use of electronic instruments on the other hand, the maximum precision desirable can be attained in the registration of dynamic degrees. New problems are raised here. Strictly speaking, a dynamic scale is only valid for a limited and small area of sound; to obtain the identical acoustical effect throughout the entire range of sound it must be modified according to the curve of audibility. Thus the measurement of a sound level is not an absolute conception, but a relative value, in its turn modified by the nature of its timbre.

Suffice it here to observe the interferences between real and psychological intensities;

in opposite senses they are of importance both in electronic and instrumental music. If they are co-ordinated with other conditions of hearing we find that nothing is more relative than a dynamic scale and that no new problem is really presented. Despite all efforts to integrate it with the other components of sound, the intensity of dynamics must finally be regarded as a kind of superstructure, with a demonstrative function rather than a real factor of structural organisation, since it is always impeded by a degree of vagueness, unless it is made to participate in the elaboration of the timbre. This we will now examine.

Of all the separate dimensions which go to make a composition we have chosen to leave timbre to the end of this study. There are two reasons for this: first, that within the timbre itself are combined the three elements with which we have already dealt: pitch, duration and intensity; secondly, because in the timbre we have the greatest divergencies – one might say the essential antithesis between the traditional and the electronic sound processes. This is due not only to the fact that the composer is here compelled to choose his own material but also because he has to consider in a completely new way the problem of a continuous timbre, an idea which is the most disconcerting of all he has to face and one never before encountered in the history of music.

The manufacture of instruments has always tended to create families of characteristic timbres; these were differentiated according to the sounding body utilised, the way it was made to vibrate and the way in which the resulting sound was maintained. Actually the instrumental apparatus has undergone little variation in its basic forms for several millenia; we have the strings which are bowed, struck or plucked, wind instruments making use of various kinds of bevel reed or mouthpiece, the essentials of the percussion family which, whether of defined or undefined pitch, have been skin, wood and metal. These three families further sub-divided into three groups, give us the majority of all *natural* sounds. The use of the melody of timbre and, following this, the series of timbres in the orchestra has altered the whole approach to sound combinations in shifting the emphasis of what really may be called orchestration to the acoustical aspect of these combinations. As with intensity, orchestration no longer has only the decorative function which was attributed to it in the 19th Century. The way it is organised imbues it with a significance which it has never known before; it is no longer the 'dressing', it is the sound phenomenon of the entire manifestation. Nevertheless, a free use of orchestral timbre is still based on the clearly defined instrumental families even if the boundaries between them are frequently traversed. It is worth recording that these timbres result not only from the super-position of several overtones but as much from the transitory events, the attack, the appearance or disappearance of certain overtones, the proportion of their intensity.

Electronic music compels us to assemble each note as we require it. This is not a question of substituting copies of natural sounds; in this domain there are structures of a complexity which are practically impossible to reproduce synthetically. The idea of creating an ersatz natural sound world is very questionable; neither would it attain to the quality of the original, nor would those properties which one might expect to find in fact exist. Here exactly we have the rub of all those specialists in hybrid, sexless, electronic paraphernalia who never really concern themselves with the real condition of timbre in the *artificial* sphere.

There are various ways of achieving a real sound complex: one can either start from sinusoidal tones which are superposed in a manner sufficient for the creation of a single aggregate complex, or one may utilise the sum of the frequencies contained within an area limited by two frequencies. This *noise* is then filtered until it becomes a real sound. No need here to recapitulate the various discoveries which have been made with sound aggregates; we take the most general viewpoint as to experimental procedure: valuation only with reference to the effective resultant obtained in the composition of sounds. Our first question is: can one abstract the proportions of harmonic or natural sounds; are we to rely on arbitrary connections which are dependent solely on the composer's whim? Whether one or the other method is utilised the danger of obtaining either pseudo-natural sounds or aggregates of harmonics which do not resemble the homogeneity of a single sound is always present. For the time being a methodic empiricism still seems to be the best way of finding solutions which are aurally satisfactory: an empiricism derived from the interferences between a system based on non-harmonic acoustical relationships and a conjugation of harmonic relationships.

It is possible that from a result obtained in this way, one might have to elaborate further the created *sound object*. Just as in composition the development consists of the working out of single complexes extracted from a simpler, more general series of relationships so the working out of *sound objects* formed in the above mentioned way, consists in their subjection to a higher order, in which transformations are parallel to those which contributed to the original function of the object. In this way it is possible to free oneself from a dogmatic organisation, and to imagine a multi-dimensional development in which one transformation generates another. One would no longer be bound to a unilateral system which rather tends to impoverish by the limitations of its sound phenomena. Taken in this sense the sound object appears to enable the composer to attenuate the confusion with which a dimension of absolutely differentiated timbre confronts him. He will be able to corroborate it into the morphological procedure of composing in the rhetoric of the work. To sum up, if we wish to make any progress in the methods of working with sound objects, the idea of the series must be extended to include the primary interactions of temporal phenomena resulting either from the differences between manner of organisation arising from the objects themselves or from within a single family of objects deduced one from another. It must be remembered that this is only a hypothetical course of action which has been thought out on the basis of past experiences, successes and failures. Let it only be asked whether control will not restrict and obtrude if sound phenomena are not considered, or whether these new considerations are not flexible enough to make the unexpected a real participant.

To draw logical conclusions from our investigations of the concept of continuity which faces the composer in all dimensions, we will have to extend still further the idea of a *real spatial continuity* into which the sounding aggregates are to be projected. The instrument is a fixed source of sound, but stereophonic projection is easily adapted to a dynamic relief. It is the only means of avoiding the impression of a pseudo instrument, where the ear is turned to a single loudspeaker in a fixed direction. We discussed above, at the beginning of this study, the psychological reflexes required of an audience having to assimilate a music which is not linked to any visual action, which is not evoked by any gesture of an executant.

We are led to certain considerations on the aesthetic aims of electronic music. In the first flush of electro-acoustic experiment there were many grandiose, if naive, conceptions: freedom, precision, the unlimited possibilities which a truly modern civilisation gave the composer; this was to be music's own 20th century. The very freedom which he sought becomes chaotic and if it is not limited all work loses its point; the further we investigate the less tangible seems the very precision we seek, nor is the margin of error any smaller. The conceptions of continuity and non-continuity are imbued with such ambiguities that one is compelled to utilise their very internal contradictions in order to obtain some positive result.

We cannot believe in any 'progress' from instrumental to electronic music; there is only a change of field of action. What will attract us most? We can only repeat, by way of conclusion: to confront the two sound worlds with multi-dimensional structures: an activity which will doubtless lead us, if not drive us, to what, as Paul Klee called one of his pictures, lies 'at the ends of fruitful land . . .'

FORMAL ELEMENTS IN A NEW COMPOSITIONAL MATERIAL

HENRI POUSSEUR

We had arrived at a fairly precise idea of the new technique of composition and the results it was likely to achieve before the problem of actual composition with electronic means was attempted. We saw it as a means of bringing the smallest dimensions of sound processes within the scope of compositional form. It had nothing to do with anything pseudo-scientific. Rather was it the result of an unequivocal desire to direct our musical sensibility along new channels. We sought a means of expression that would take its place in the natural evolution of music and at the same time be rooted in our own deepest consciousness.

It cannot be denied that the character of music has been significantly altered in the last fifty years. Even in Debussy the exclusive attention of the listener is directed to the phenomena of sound itself in a way which radically breaks with the sentimental conception of the 19th century. In what is generally known as the 'Emancipation of the Dissonance' we see the real beginning of an evolution which leads directly to our own composition with electronically generated sound. Increasingly complex finely differentiated sound structures are brought within the scope of musical form. The powers of human invention are applied to elements which have previously been considered outside the realm of music: these are the non- or semi-formulated oscillations of what we know as note- and sound-mixtures, of rustles and noises. Even repeated figures, with variable pitch or dynamics, had only to a limited extent been considered independently, although they have always been a logical consequence of instrumental technique. Except in the case of dynamic alteration or in the 'expressive' use of vibrato and glissando, these elements have been left unnotated. Gradually the expressive elements within the material itself and their relationships have come to be recognised once more and examined for their own sakes. This led to a significant extension of musical possibilities.

The chord amalgams in Stravinsky's early works (from *The Rite of Spring* to the *Symphonies of Wind Instruments*) demonstrate the manner in which simultaneously sounding pitch-levels result in impenetrable opaque sound-complexes. In the context of other superimposed pitch-levels where durational values are short, the ear can register these sounds only in the most general terms. At most the outside frequencies or the predominant pitch-register can be absorbed: everything else merges into a collective phenomenon. We may ask ourselves whether such sound phenomena, which are explosive in effect, can not from a compositional point of view be regarded as inexact. Or is it not rather that the means with which we have attempted to measure them are utterly inadequate? Can one assume that a figure is imprecise because it cannot be easily circumscribed by straight lines? It must not be forgotten that even acousticians have given up the inflexible methods of harmonic analysis in studying the problems of psycho-physiological relationships. In their analysis of sound they are no longer satisfied to discount the most important of all the co-ordinated elements, time, as a pseudo-spatial dimension; consequently, they come much closer to an active perception

of it. According to the principles of aural perception they accept a certain degree of inexactitude in the pitch dimension. But it must be remembered that Stravinsky himself has not drawn the ultimate and only valid conclusions from these procedures. The manner in which he relates one sound to another and in which he organises them within a context to a fixed polarity, neutralises the explosive effect of the sound-complexes and reduces them to an elementary augmentation of percussive noise whose only function is accentual.

We see an entirely different state of things in the work of Schoenberg. Here tonal necessity leads to a world of sound in which the listener is expected to adapt his ear constantly to the reception of new phenomena and the simultaneous sounding of the most variegated formal elements and tensions. This is particularly the case in the pre-twelve-note compositions, the so-called atonal pieces, between the composition of the second string quartet and the pause in the composer's output which followed Op. 22: (*Five Orchestral Pieces, Erwartung, Pierrot Lunaire*). In his later work the new forces are too often cast into a rhythmic scheme and subjugated by the imposition of academic formal principles, so that sometimes only a caricature, intended or otherwise, remains.

With Webern, we come closer to the problems which are our special concern. We will demonstrate the clarity of his vision with a single example. The fifth of his Six Bagatelles for String Quartet is built up of the simultaneous sounding of minor seconds. Of all the intervals of our tempered system, the minor second produces the most complex structure of oscillation. Of all simultaneous soundings of two sinus components, the minor second may be regarded as the least rational interval. Although the conception of 'rationality' of an interval has been disputed, we nevertheless see sufficient musical considerations to justify its retention. Despite the apparent paradox, a further conception, that of a rationality of perception, serves effectively to define the idea. Given two individually sounding frequencies, such a conception would regard the resultant vibrations not as a combination tone, but as the indices of rationality in the interval. This indices would naturally be related to the inner structure of the resultant frequency; in a static event of this kind the particular frequency curve would be contained within two points, *i.e.* it would be circumscribed by a single rationality period. The greater the frequency of the rationality, the shorter and structurally simpler is the total period, and vice versa. In this way an arrangement of intervals might be undertaken, which would, of course, respect the limits of differentiation imposed by the ear. What is valid for the dyad remains true for combinations containing a greater number of frequencies. Account would have to be taken of fragmentary sections arising from some part of the total components and obtruding by a particular tendency to polarization or isolation. Anyone who has worked with strict twelve-note composition, will know what we are talking about and he will know how difficult it is to attain this purity.[1] This concept of rationality would only partially depend on the duration of a sound phenomenon or a stationary section of one. Naturally it would not become perceptible in a duration of value shorter than the minimum of rationality. The loudness level intensity must also be considered as a determinant of rationality.

In all that has been said we have referred only to stationary phenomena. Where the

[1] A further principle might be formulated: if the rationality frequency is above the lowest limit of audibility, the sound combination may be regarded as being rational; but if it is below ca. 20 c.p.s., it must be assessed as being 'irrationally perceived'. I have found justification for this hypothesis in practice.

time element effects a certain minimum rate of change in the quantities, frequencies and superpositions of them, the possibility of discerning parts of a collective phenomenon is further reduced. Webern was well aware of this fact. He writes a minor second and, a certain duration of time having elapsed, introduces a third note, which is related at the minor second, to one or other of the original notes. One of these two original notes then disappears; the picture is transformed. At another place, one note of the dyad of the minor second grows louder, the other softer; or the introduction of a third note is effected by a pizzicato. In this way the composer is enabled to realise varied structures which embrace the innermost properties of his material. In fact, they cannot be considered as entirely unrelated to what, until now, has been known as noise. But, today, 'noise' is formulated creatively and so gives rise to entirely new, unknown, aspects of conscious hearing.

Further experiments have taken place since the end of the last war before actual work with electronic means was begun. Though they were frequently disappointing, they have nevertheless taught us something if only what not to do. Outstanding among these, for the thoroughness of their musical thought, are the two *Concrète* studies by Pierre Boulez. They are based on a richly characterised material, but in the actual composition this is reduced to its barest necessities. They hold the attention of the listener by a process of perpetual self-renewal. Despite the efficiency of the realisation, one cannot but observe the extreme contradiction of the means. It was hardly two years later, at the Studio in Cologne, that Karlheinz Stockhausen undertook the realisation of the first composition specifically based on the electronic means. Other compositions followed and today we may consider that a first stage has been completed. The time for a re-assessment of our eventual aims is clearly needed.

It is not my purpose here to give a chronological description of the various experiments which have been carried out at the Cologne Studio. Nor will I examine formal considerations here, except in so far as they are relevant to the specific questions of a formulation of the material. It is important, however, to examine the various solutions that have been offered and, consequently, the attitudes they imply, to the questions described above.

In his most recent work, Paul Gredinger has devoted his entire attention to one important question: how, unobtrusively or continuously, to alter the timbre which is peculiar to a given pitch level. Notes produced by combinations of partial frequencies seem capable of reaching dynamic levels which, especially in the extreme bass, cannot be achieved with sinus tones and mixtures. This is clearly of importance. Notes of this kind have, however, a peculiarly instrumental character which is clearly derived from the structure of their formant series, *i.e.* they are based on a condition which prescribes a single timbre for a fixed pitch level. Although this kind of sound is not really part of the language of electronic music, it is nevertheless worth examining, in that it reveals to us certain synthetic qualities of our hearing capacities. Much controversy has been raised over the question of timbre. One thing, however, is certain: as long as partials are heard as individual frequencies they can have no effect on the timbre. Timbres of frequencies are completely swallowed up by the principal frequency and are subordinated to it. They effect the inner structure, the detailed form of the, in its turn subordinated, periodicity, which is determined by the acoustically verified pitch levels. They may be taken as statistic phenomena, a kind of source of probabilities; their density is determined by secondary oscillations, by the smaller or greater degree of complexity in their internal proportions and by the degree of inequality between them. This attitude nearly coincides with aural experience. It would be seen to what extent the sound and the invention of the timbre are affected by those supposedly subjective qualities, which have been so richly described. Will not the characteristic quality of the sound depend on the nature of its secondary accompanying partials? Is not the whole basically unaltered and regular in character, even if the smallest units within it are varied? We hear a fixed, linear pitch level; this exactly contradicts our intuitive idea, for we imagine a much higher and more general degree of transformation. We see the search for ways of breaking this regularity, even to the microscopic details which go to make up the frequency of the sound phenomenon as the principal task of our generation, starting as it does from the apex of Webern's work.

The basic material used in *Studie I* by Karlheinz Stockhausen, *Study in note mixtures* by H. Eimert, and in my own *Seismograms*, is, in its essence, totally opposed to the work of Gredinger. Sinus notes were utilized in fixed constellations, but not according to the ordering of the harmonic series. We argued that as a harmonic timbre was the resultant of harmonic partials, it followed that a non-harmonic quantity would result from the setting together of non-harmonic sinus notes. We anticipated that these would be well suited to our ideas of form. Many factors were found to contradict this idea: the small number of partials (which gave rise to fairly high rationality indices), the fact that generally they began and finished sounding simultaneously in time, and the constancy of the relationship which existed between their relative dynamics. This became evident in my *Seismograms*, where the individual note mixtures had no enveloping curves proper to themselves and remained static in regard to their overall dynamic strength. Where the loudest of the constituent partials did not simply swallow up the rest and in cases where, despite its brevity, the process remained aurally perceptible, one tended to hear 'chords' in which the components were related in a fairly complex manner but still remained as isolated, fixed pitches. At the same they had a soft transparent timbre which characterises sinus note production. Even the method itself was doubtful in the fact that it was at the opposite pole: 'a harmonic synthesis', which amounted to little more than harmonic analysis.

We tried to overcome these difficulties in the first part of the *Seismograms* by building up note mixtures from various areas. Each area would consist of a determined number of sinus notes at selected pitches, chosen in such a way that the components were more or less dissolved into one another. Each area was furnished with its own separate enveloping curve. Sometimes this could be opposed to a curve, proper to other areas. In this way, living, 'gyrating' sound procedures were created. It was only a partial solution. Further difficulties were raised in the co-ordination of preselected quantities with a durational ordering. Though they were theoretically correct, they did not have the anticipated effect. We were not satisfied with the actual curves of intensity. Like all enveloping curves drawn at Cologne up to the present time, they had to be executed freehand. Thus they could clearly only be approximations of the original plan. Their regularity depends on a steady control of the hand and there are certain limits to accuracy. This does not matter for certain overall *crescendo* and *decrescendo* curves which are only intended as such. Complex curves, however, are closely related to their durations of execution, thus affecting the resultant rhythm. Because of this, I limited

myself in the second part of my work to the utilisation only of static note mixtures and thus obtained a dynamic movement only by the juxta- and superposition of the various grades of the mixtures. Where a danger of continual alteration existed in this procedure, I selected durations which were shorter than the so-called 'actual density' (*Gegenwartsdichte*). At present this still raises difficulties due either to the time taken up by these delicate montages, to shortcomings in the technique of tape cutting or to the impossibility of coming closer to the problem of phase lengths in oscillations.

The automatic determination of continuous alteration procedures of amplitude or frequency might lead to better results. It would be fairly simple to produce controls with a photo-electric transformation implement. A sufficiently sharply focused result could surely be obtained by photographing differentiated degrees of light on a film-strip. Experiments of this kind would only be valid for structures which in some way are derived from fixed oscillating frequencies.

Stockhausen demonstrates further possibilities in his *Studie II* which represents the most advanced stage of development so far attained. Apart from Gredinger's *Formanten*, it is the only piece in which sinus notes are utilized so as not to be perceived individually. They are dissolved into oscillating complexes. The process is carried out here in a manner quite different from that of the *Formanten*. In *Studie II* the note mixtures are arranged by the equal distribution and equal loudness level of their components in such a way that they resemble a 'coloured noise', like that derived from the filtering of blank noise from the tape. In that they are still far from a really static predominance of contextually possible frequencies, they sound like 'filtered' noise, but more like a complex network than a flat sound. The density of this network is determined by the constant interval which divides the component frequencies . . . Really remarkable results are obtained at places where several of the five note-mixtures are superimposed and differentiated rhythmically and dynamically. In parts, this study fully exemplifies the aesthetic ideas discussed above. In our further work we will have to build on the basis of what has already been done. At this point we may conceive of musical structures which no longer abstain from all the variegated riches of the sounding world, but which replace 'natural sound' with the decisiveness of the consciously devised. One can imagine more or less gradual transformations from relatively light note mixtures to denser noise structures; structures which combine elements of pure noise and sinus note mixtures and which unite principal frequencies in which the various levels undergo a continuous alteration with regard to loudness, frequency, tape breadth and timbre. Most important of all is further work on the actual realisation of electronic music! Our final problem – it is almost paradoxical – deals with the co-ordination of technical means and ideas. Much that in principle is possible is not in practice at our disposal. There is a special need for the development of two technical processes: a precise controlling apparatus for the gradual transformation by automatic means, referred to above (this process would, by utilizing the variable tape recorder speeds or the buzzer, be able to control the loudness level as well as the frequency of all forms); secondly, a way of transposing frequencies and durations of previously formed note structures independently of each other. This would considerably simplify the composer's work in certain situations.

So we enter our second stage. Now may deeds replace our words.

THE SOUND MATERIAL OF ELECTRONIC MUSIC

KAREL GOEYVAERTS

On closer acquaintance with electronic music, one is astonished by the apparently artificial nature of its sound material. Indeed, in that it utilises pure vibrations it appears to stem from the basic components of sound production; and even the combining of these vibrations appears so artificial that spontaneous music-making as such seems unlikely to survive. For many musicians this will surely be felt as a loss – indeed the question arises whether music has not thus been deprived of an essential condition of its existence.

A sound phenomenon is relevant musically in as much as it conforms to the requirements of a spiritually conceived form, to which it has given rise. The relationship is hardly conscious and almost impossible to define, but it remains immutable, to the extent that it is to be considered a constant factor of historical evolution. Clearly, it does not follow that the choice of a sound material is determined purely by particular considerations of an intellectual order. It is to a far greater extent determined by intuition, and we find no exception to this rule in the case of electronic music. In short: every form of music demands its own material. While it is true that the composer's intuition is largely guided by his conscious judgement, nevertheless, the ultimate choice of a material is intuitive, whether it concerns a simple material based upon a single dimension of sound, or one compounded of many.

The sound material that went to make the polyphony of 14th Century music was formed of many elements of divergent sound character, the choice of which was left to the interpreter. The variegated nature of the sound elements was particularly suited to the fundamentally horizontal conception of compositional technique, in which a cantus firmus or a free melodic line successively gave rise to further counterpoints, duplum, triplum etc. In a technique of this kind the sound character of a tone is no more to be clearly defined than its intensity. Worthy of mention in this context is a remarkable reversion to this manner of thinking in Hindemith's vocal and instrumental music, Op. 45. In the 15th and 16th Centuries, the sound complex tended to become more and more homogeneous. This is clearly connected with the fact that the instrumental groups, the viols, flutes and oboes were completed at this time. At the root of this development lies the concept of blocs of related parts bound together by procedures of complementary rhythm. At the same time imitation and interweaving of melodic parts took on a greater importance in that they gave rise to harmonic sequence. The fact that the composer of the period was to a greater extent concerned with problems of homogeneity of sound character in no way altered his fundamental attitude towards the nature of sound: at this time versions of the same piece for alternative groups of instruments (voice, violin, organ or lute) were customary.

The concentration of intellectual forces which gave birth to Opera, the forces which to a great extent characterised the life and artistic achievements of the Baroque period, discovered an increasing strength within the substance of notes themselves, which at

once lead them to a thorough re-investigation of the very elements of sound material. The period saw the rise of individualism in the composer; he sought his purpose within himself, and attempted to realise it with the means at his disposal. The tension of this situation led to the creation of a type of music in which genuine structure was replaced by one from without, dramatic or literary, and in which all elements were valid in as much as they contributed to the realisation of dramatic intensity. In this light, the note was examined purely with regard to its evocative powers. It is clear that the orchestra of Monteverdi, and later of the Roman School, was assembled at random, the instruments being selected in each particular case at the composer's will.

While musical language became more and more inseparable from the kinetic structure which characterises Baroque style, an organic sound apparatus was developed from the continuo in which the evocative property of a single sound was retained only as a decorative element. At this period man saw himself in relation to absolute limits, having as the source of his activity, the totality of himself. This resulted in regular rhythms with unchanging dynamics. This trend was interrupted for the first time by the rationalist spirit of the 18th Century. Thereafter musical language had its own dynamic range, an augmenting and decreasing intensity within the structure of complementary phrases. The sonata form, rooted in the thematic process, was derived from this. This hierarchy of sound was replaced by patterns in which instruments or instrumental groups were superposed to obtain perfect blending of timbre. Thus, musicians were enabled to reproduce the whole gamut of musical dynamism.

The influence of a new transcendentalism marks the end of this period of musical upheaval, causing the nervous and restless spirit of one unable to reach his goal. The classical orchestra remains the foundation of a rapidly expanding organism. New instruments are added, particularly those suited to a heightened mode of expression. This leads to an increased exploitation of the psychological effects of sound. Such an expansion, increasingly complex in its technical apparatus, long outlived the Romantic era, as a nihilistic tendency derived of excessive transcendentalism, which was unable to evolve in a positive way. In the meantime, the individual has stepped back; a realisation of the transcendental has been revealed to him, and he has given up his active position in the face of the Absolute. At this time artistic creation has, in a remarkable way, been freed from the need for personal expression, in that it is conditioned by an almost completely objective system of proportion and balance. Music becomes a constellation of notes, intuitively conceived but consciously ordered.

Can one then wonder that the elements of vocal and instrumental music, which gave rise to their own intrinsic structure, appear to us as being unsuited to a world of totally organised sound? The greater the complexity within the isolated tone, the less it is suited for the realising of a precise sound structure, and the more must its particular constitution be taken into account. Suffice it to compare analytically a simple bowed with a simple struck note, to perceive the variety within their components. We have seen how, in earlier times, a current sound material would prove inadequate. In the same way, today, we seek to replace traditional instruments by a simplified means of sound production. Electronic sound provides the required elements, in the purity, regularity and variable intensity of its vibrations made audible by loudspeaker amplification. In a manner particular to themselves, these elements demand a musical organisation in which all dimensions are subjected to the most precise control.

It would be incorrect to evaluate electronically generated sound as anything more than the undefined, unorganised elements which we see in the traditional instrumental world. As I have tried to show, the nature of these instruments was perfectly suited to earlier musical forms. Today, we are doing nothing new. There is in fact nothing particularly revolutionary in our relationship to our means, as is shown by the nature of experimental works in which the material uncovers relationships which could hardly be predetermined. Today, once more, we are concerned with the creation of a new apparatus which will be suited to the realisation of a new way of musical construction. Such a process is constantly bound up with the necessity of experimentation similar to that which Haydn must have undertaken with the orchestra of Count Esterhazy, which for the first time led to an arrangement of the orchestra which not only was retained throughout the Classical period, but which served as the basis of the orchestra until our own times.

Long before the first experiments with sinus tone composition, it had occurred to me, in the search for a greater purification of sound material, to utilize absolute unaltered electronic sounds to realise a structure in duration which excluded all other at that time unmastered dimensions of sound. My second experiment further developed these ideas. Here I restricted myself to proportions of frequencies and dynamic intensities, without altering the durations. Being at that time unable to exercise any control over the notes or note complexes (this being impossible before the first sinus tone experiments), I created a series of simple proportions limited at either end by zero. It was impossible to proceed further in the dehumanisation of music.

The position has changed; ideas thought out in terms of an infinite material, tend to eschew extremes. Equally, certain aspects of music which I had thought to be able to eliminate, have again become active considerations. All this bears evidence to the degree in which electronic music is bound to tradition. So we reach the point of departure for my latest, as yet uncompleted, compositions of the phenomena of combined perception of a group of sinus tones ordered in certain proportions. Variations of tone quality result from small alterations of frequency.

No longer is the truth of logical ordering of any importance. The only valid musical truth: the acoustical perception. This sums up my present position towards electronic music. In the beginning, I sought after a greater musical purity; today, I am confronted by an *other* sound material. I do not consider its basic qualities except in so far as they are suited to the requirements of the composer. If electronic music influences the composer's imagination, his integrity is in no way challenged and the perception of so profound a truth can only be a great joy for him.

SERIAL TECHNIQUE

PAUL GREDINGER

I begin at the point at which historical study must end, with Webern and the contemporary twelve-note composers. In our times, every new aspect, idea and potentiality is freely developed and at the same time most precisely measured. I cannot attempt to give a general picture of the period nor to show it as a whole. Only by giving some description of my own ideas and experience and the experience of those with whom I am in principle agreed, can I present a single valid viewpoint. I can demonstrate the origins of a musical development and trace its growth, and can bear witness to the extraordinary conclusions reached at the various stages of its zig-zag path. Where others may pass by, unobserving, let us pause and see more. Let us endeavour to see the position of our often very specialised idea within the infinite organism of time. We will see the coordinates, the small in the great and the great in the small; more precisely, see the general in the particular, as that is our special interest.

With envy do visual artists, architects and engineers look at the ordered world of sound. The fixed relationships, an octave regularly divided, are lacking in the measurement of visual proportions. To remedy this deficiency, Le Corbusier in 1948 proposed the 'Modulor'. He described it as 'A Harmonious Measure to the Human Scale Universally Applicable to Architecture and Mechanics'. I quote from his introduction to the description of the way in which he thought out his method, a method similar in purpose to our own, which attempts to discover a formal principle in the existence of a *standard;* this not so much for the purpose of providing a statistical mean, as an attempt to find a balanced and measured proportion of absolute beauty. Le Corbusier writes:

> 'Sound is a continuous phenomenon, an uninterrupted transition from low to high. The voice can produce and modulate it; certain instruments can do the same, the fiddle for example, but others are incapable of it because they are based on an order of artificial intervals invented by man: the piano, the flute, etc.
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> For thousands of years men used sound to sing, or play, or dance. That was the first music, transmitted by the voice, no more. But one day – someone first thought of making music permanently transmissible in another way than from mouth to ear: that is, to write it down. No method or tool was available for this. Sound had to be registered at certain determined points, its perfect continuity being destroyed in the process. It was necessary to represent sound by elements which could be grasped, breaking up a continuous whole in accordance with a certain convention and making from it a series of progressions. These progressions would then constitute the rungs of a scale – an artificial scale – of sound. How could one divide into sections the continuous phenomenon of sound? . . . Pythagoras solved the problem by taking two points of support capable of giving both certainty and diversity: on the one hand, the human ear, the hearing of human beings (as opposed to the hearing of wolves, lions or dogs); on the other, numbers, that is to say mathematics in all its forms: Mathematica, herself the daughter of the Universe.
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> Thus the first musical script was created, capable of encompassing sound compositions and transmitting them through time and space: the Doric and Ionic modes, which later became the source of Gregorian music, and so also of the practice of the Christian cult for all nations and languages. Apart from a somewhat unsuccessful attempt during the Renaissance, this practice was continued until the 19th century. Then the Bach family, and especially Johann Sebastian himself, created a new system of musical notation: the 'tempered scale', a new and more perfect tool, which gave a tremendous fresh impulse to musical composition. This tool has been in use for three centuries, and it has proved itself able to express the subtlest of things . . . It may well be – I take it upon myself to predict it – that the apotheosis of the machine age will demand a subtler tool, capable of setting down arrangements of sounds hitherto neglected or unheard, not sensed or not liked . . . '[1]

I have quoted this section not so much for the detail of the argument, but for its general substance, its significance in light of the importance attached to it by Le Corbusier in his research in proportion. I would like to emphasise the importance of the Modulor. It is, as Le Corbusier originally intended to call it, a proportioning grid. I quote the remarks of the great architect, on the nature of music, with reverence. He continues: 'Nothing that is built, constructed, divided into lengths, widths or volumes, has yet enjoyed the advantage of a measure equivalent to that possessed by music, a working tool in the service of musical thought. Has this absence of a tool made the spirit of man any the poorer? It does not seem so, for the Parthenon and the Indian temples, the cathedrals, and all the refinements of recent human achievement, the incredible triumphs of the last hundred years, are there to mark man's progress along the path of time'.

So, we may ask whether man would not have been the poorer without the tonal system, without the *Wohltemperierte Clavier*? As the reality of the Indian temple answered the first question, so the reality of the music of the last centuries is adequate answer to our own. The composer requires an appropriate scale to reproduce his work, whereas the visual produces his own. Today, electronically, the composer himself can produce.

We cannot discuss these many new, literally unheard and unimagined possibilities. From its origins music has always been dependent on a standard which changed as it changed. The standard has moved within certain fixed limits, limits imposed by its physical nature. Today, it is in no way our purpose to exceed the natural limits imposed by the ear. Rather is it to the point to attempt an examination of what lies between these limits and to attempt to unravel the tangles of technical misunderstandings. When the time for comprehension comes, the paths of art and technology meet; then, a contact is established, the spark is ignited, the light burns and a new discovery is made. I do not claim the discovery of a new world; at best I can claim a fresh point of view in relation

[1] All the quotations from THE MODULOR by Le Corbusier are made by kind permission of the publishers and are taken from the translation by Peter de Francia and Anna Bostock, published by Faber and Faber Ltd., London and Harvard University Press.

to music. It is our task to describe a fundamental attitude; a principle, we may call it the *Series*.

A development in art covers a certain span of time, engages and serves the eyes, ears, hearts and minds of a certain number of people. It is our good fortune to be of these people. A description of our experiences is a description of the development of the *Series*. It is a gradual development. We do not search, for in Art experience must find itself. Our efforts are neither revolutionary nor reactionary, nor do they guarantee a certain predictable result. 'The piano teacher is unaware of the fact that he is handling logarithms' (Henri Martin). Today, we are aware of it and our knowledge of acoustics helps us to develop ways of comprehending the as yet uncalculated. Our aim is an art, in which proportion is everything; *a Serial Art*. We have not come to this decision theoretically, but are convinced that it derives from a network of co-ordinated experiences common to all of us.

My greatest musical experience was my meeting with the music of Webern. Today it may seem snobbish or even naïve to say so. But it must be remembered that a few years ago Webern was so little performed that one might well have come upon his music by chance, without any previous knowledge of it. Later when, in all good faith, I spoke of so remarkable a discovery, there were already many who were able to testify to its importance. In fact, I only got to know my Webern in recent years, and it is only recently that I have been able to study, analyse and discuss his music. In Webern's work we realise for the first time the necessity of a system of proportion, in fact, for what I have called a *standard*. Webern's music is not serial, but it is on the way to being so in its limitation of itself to a single system of proportion in a composition. Webern is a twelve-note composer, but that is only of secondary importance. For him the important thing was the relationship of intervals. Fundamentally there is no great difference in the manner of composition between those of his works written before 1912 and his later twelve-note compositions.

I came to the electronic studio in Cologne with a knowledge of Webern's music, and when I had my first opportunity to work with magnetic tape, it suddenly occurred to me that the measurement of time and intensity could be taken for granted; it was the natural solution to a physical problem, a solution which is obvious at the right time and in the right place.

Stockhausen seemed the best acquainted with the inherent problems of serial instrumental music. Though it is possible to compose and hear precise interval relationships between pitches, durations and intensities, one fundamental element remains unaffected. The timbre, a fundamental property of music, is neither integrally composed nor heard in the atonal structure of a serial composition. Here the composer has little choice. In their physical nature and artistic functions, the instruments are so different that they cannot be related on the basis of any common denominator. And no Serial conception can exist without a common denominator.

A certain number and selection of overtones at certain intensities result in certain timbres. The ear is effectively equipped for the perception of the relative pitches and intensities of these partials but is not trained to do so. There is a simple reason why, until today, so little attention has been paid to timbre as an independent phenomenon. The outward (heard) harmony of tonal music and the interior harmony of its partials were identical; they both derived from the same principle: tonality.

Only today when serial structure has been extended to all dimensions, do we realise the disparity of the instrumental means and see its fundamental unsuitability for our ideas.

A disparity of means must always be eliminated. Thus the traditional instruments must be eliminated, and in our electronic music we do so. We work only with the smallest basic element in sound, the sinus tone. As I speak of 'our' electronic music, my mind goes back to the first times in Cologne, when Stockhausen was working on the first serial electronic piece. At this time he discovered the principles which today we call our own and which really are our own. Today, there are already several compositions by various composers and by continued experiment and discovery on our parts, our basic views are now generally accepted as valid.

The use of the sinus tone is a synthetic process derived from the sinus tone itself. It leads to a new tone spectrum, which may be included in our general structure, and so to all new spectra which may be derived from this structure. Physics tell us that all natural acoustical phenomena, from the most dissonant noise (*geräusch*) to the most euphonious instrumental note, are composed of combinations of overtone partials. Non-natural phenomena are produced in the same way. There has been much misguided propaganda for electronic music which has promised new previously unheard aspects of sound. Naïve people have been transported to the world of flying saucers. Unfortunately, we will be unable to fulfill such expectations. On the contrary, we should like to stress the self-evidence of much of the sound world into which we have been initiated. The impact of the obvious is always greater than that of the improbable and fantastic. Reality precludes thoughts of creating a music consisting only of the most radical innovations in sound effects. Let someone attempt this! Our experiences with electronic music prove that there is no barrier between it and the world of traditional music. There is only one world of music, and the young composers are aware of it. Is it a paradox that it is exactly this realisation that attracts us the more to electronic music?

We have demonstrated the artistic justification for electronic music, and have attempted to show it from a new angle, which originated in instrumental music. It is derived from the compositions of Webern, based on an idea of proportion derived from Schoenberg's twelve-note technique and its aim is serial continuity. Interest, if not scepticism, may be aroused by the names of our tools: machine, studio, generator, decibels, tape speed, modulator, frequency, etc. These names only testify to the actuality, to the severity and multiplicity, the involuntary necessity of a proportional system. A further paradox: we conform to general principles and procedures so that we may the more freely select the conditions of our work. Conditions of work here refer to the transformation of every quality into a quantity; the establishment of a proportion between these elements; the introduction of a dimensional ordering; the strictest regularity in the alternation of parameters, etc. The idea, the general principles of procedure to be derived from these conditions give us an idea of proportion, of texture. It is formulated as a musical form or structure; a form, a textural continuity. Its most obvious manifestation is the *Series*.

We cannot yet claim to have defined the nature of the *Series*. Its inner constitution is regulated and we may conceive the idea of a serial continuity of texture as a third

aspect of the serial process. I distinguish between texture and structure. Both represent complements, the one aesthetic, conceptual; the other a dynamic, empirical quality; the idea and its realisation.

Our ears have been the best tools for the examination of acoustical phenomena. Our observations have been realistic, our logic has been a musical logic. The desire for formulation, for the creation of form, for form itself, has come from the material. This well-worn argument has all too frequently been used in defending or attacking a new development in art. Nevertheless, we must admit that the basic materials are the only limits of our work. In this respect we learnt much from the first electronic composition. We were faced with totally new experiences in the creating of a conceived texture in space and time. We discovered that the basic inner truth of a compositional idea is no guarantee of beauty in the external structure. Truth and Beauty stood opposed. This situation belied Schoenberg's conception of the force of truth alone, and caused us no little concern. The idea of musical texture was further complicated. It was demonstrated that a texture derived only from functional proportion was not necessarily aesthetically beautiful. The incompatibility in the reactions of ear and mind and the realisation of the disparity of truth and beauty often forced us back to a revision of some of our calculations. We learned to assess a musical composition actively rather than passively. A fourth principle of the serial process is demonstrated: a serial conception of *Gestalt* must be a generating principle together with the idea of textural continuity, the one being measured by the other. Beauty is measured by Truth.

I have attempted to describe our most important experiences, to make some theoretical synthesis and have given the general principle the name by which it has come to be known: *the Series.*

The *Series* or *Row* was originally a term which referred to the twelve-note row and was extended to rhythm and dynamics. At the same time (here the writer refers in particular to France and the French term, *la Série*) the Series is used to notate what in new sound experiment is a freely selected number of sound complexes. Certainly experiment of this kind can lead to good aesthetic results, but it also endangers the dignity of an art in that it can ultimately become an infinite, limitless bluffing. For us the Series means a principle, a generating law of proportion, of duration, the essential principle of our music. A specific approach to all musical problems is conceived. Our series is a system of regulating a conception of order; is the method by which simple quantities (smaller or greater sections of the static area ranging from the sinus note to blank noise) are systematically deduced and extended; is the fundamental principle of relationship which generates the structure of a work. The serial principle creates forms in which the whole as well as the parts depend on a single characteristic of the Series. It took a great deal of preparatory work to reach this conclusion; we have indicated certain ideas which act as stepping stones to an understanding of it. The work itself is the study of the principles of measurement, of proportion, the principles of the Series. Unfortunately not everything can be determined in this way. Each only gives a sequence of momentary pictures or cross sections. We are still far from the integration and a more profound understanding of them.

We do wait for *the* discovery, *the* final choice of *the* absolute fool-proof system of black and white. Our aim is to create serial music, not a branch of arithmetic. Nevertheless, the basis of our work remains within the domain of physics and the numbers

inherent in music have their significance. 'The numbers play together' (Klee). But beware he who becomes the servant of these numbers. In the infinite possibilities of composing with fundamental notes or noises, our first object is to give quantitative definition to these elements and to consider them in the light of their later realisation and derivation and to relate them with reference to their inherent properties. We discover laws for the arrangement of quantities and, by quantitive regulation (in the strictest technical sense), attempt to create an autogeneous quality. For this, system and principle must be matched by a complete freedom of action within the overall necessities of the order. Thus we enter the domain of mathematics, and figures. Where I say order, I mean proportion; specifically: cycles per second, decibels, which are only abstract notations, nomenclatures for specific arrangements. Within this arrangement the principle of proportion generates relationships, as it were, families of related and organised qualities: a selection from the infinite possible number of values, derived not by the statistics of probability but in the anticipation of finite forms. These selected values must still be expressed as numbers, and only the music derived from them imparts importance to them. It is preferable to hear rather than to think the proportions we choose. C.p.s. represents pitch levels; decibels, loudness levels; tape length, durations. The actual means of electronic music enable us to practise the hearing and recognition of these quantities. We believe that actual contact with sound is augmented rather than diminished by the change from traditional to electronic music. The first stages of creation are inherent in the proportioning of the material and must mean a breathing of life into the dead numbers, an 'awakening' of proportions into live forms. They become music when they sound – previously I said that they were part of mathematics. Once more I repeat that the ultimate aim is the creation of quality out of quantity.

Let us return once more to the three separate quantitative conditions which determine an acoustical phenomenon: the pitch level, the intensity, and the duration of its partials. I do not wish to go over the ABC of electronic music again, but I must draw attention to fundamental divergences of opinion on this question. I purposely avoid defining them as three dimensions, as it seems questionable to me whether time can be considered as a third dimension. New conceptions have it that time may possibly be considered as the only general dimension, and refer to it as the only conceivable reality. The question is of the greatest importance to us; if time is the matrix, our idea of proportion will be considerably altered. We will be enabled to control an ideal *texture in time*, control pitch levels and their spatial realisation through dynamic intensity. The time structure is created. What the basic series, the ideal texture is for the foundations of the compositional process, the manner of the permutational transformations of the texture is for the technical structure, the evolution of the piece.

I wish thus to demonstrate that it is the regular permutation of structural elements that differentiates our conception of form from that of rhythm and tempo in the 19th century. Our idea of structure, a genuine structure in time, is formed of the continually varying movement of events in time, their acceleration, their slowing down. In this way we are enabled to compare our conception with that of *space-time* in the Renaissance, which derived its symmetrical forms from similar criteria of space distribution. The impression of space in Electronic music, on the other hand, is caused by the differentiation of intensities. About fifty values of the logarithmic scale of intensities can be discerned by the ear. From this scale we derived a measure of distance from the

source of the sound to the ear receiving it, and so can characterise movement of notes or tone mixtures as 'towards' or 'away from' the point of aural perception. One movement succeeds another; nothing is perceived as stationary; the measure is only partially apparent in that one acoustical phenomenon overlaps another. 'The rule will still make itself felt in the form of a subjective experience.' The movement of frequencies, the actual pitch levels, are the *objective reality* which determine the character.

While the somewhat schematic definition of pitch and intensity as subjectively intellectual and objectively real, to a great extent approaches the truth of the matter, we are unable to define time and duration as being either the one, the other, a mixture of the two or even within or without the scope of either. I would call it rather, *organic*, a word on the one hand too limiting, on the other too general, to ensure certain comprehension. Making a virtue of necessity, I am led to realise its unique nature, in that it is impossible to find any comparison or effective definition for the idea of duration. The *form-in-time* is expressed within the duration of a piece by the movement of pitch and intensity *standards*, and so may justly be conceived as an organism; at the same time it is the *resultant* of the systematic application of a single proportional principle, a singular aggregate, a structure. The result is *Serial* music. In truth everything in it: 'to the smallest detail, is regulated by proportion, and all designs, and consequently all experiences of it are unified. Procedures of this type seem to bring one closer to the ways of Nature, in that they, as it were, blossom outwards. All elements, all acceptable patterns, are harmonised and unified within the three proportions.'

So we return to our quotation from Le Corbusier at the beginning. It is no accident that every quotation we have chosen can be taken as referring to music. Of all the graphic arts, architecture is the one which has most in common with music. 'Architecture is not a synchronizing phenomenon, but a gradual unfolding. It consists of a sequence of tableaux, associated in time and space.'

Like music, it is a means of conceiving in time.

With his Modulor, Le Corbusier has produced a measure based on human proportion, a series of harmonic quantities based on the Golden Mean. This measure has had the greatest influence on his practical work, though it is only partially connected with serial principles. Nevertheless its part in the work is sufficiently important to enable us to conceive of an architecture based on serially permutated proportions. Unfortunately this must remain a theoretical idea. In practice the architect is concerned not with the demands of a permutational series but with the conditions of life, which differ from those of art. It would not be of any practical advantage if a door were permutated so as to be situated in the ceiling of a room. To this extent architecture can never be serial in all its elements; the limitations in what cannot be claimed as a pure art, have been obvious for some time. Serialism has a certain place in the plastic arts, though I can cite no examples of it. There are, however, indications that it may come about. It is not surprising that there are as yet no examples, when one remembers that music has only been concerned with the serial idea for a short time and that even here there are as yet very few examples. Similar is the situation in the world of painting. Here the serial idea is the youngest and has hardly yet taken route. We see great possibilities for it, when we remember that in the new music we utilise colour as an aid to the understanding of our quantities and proportions. Let us stand and watch. As we wait, the work goes on.

ACTUALIA

KARLHEINZ STOCKHAUSEN

Over the course of two years the elementary conditions necessary for composition with electronic means have been worked out. We have created prototypes in sound; we have grasped the essence of what is to be learned from these prototypes. Now we can give some account of the new composition on which we are engaged.[1]

Up to this time our basic material has consisted solely of sinus tones.

In the new composition, sung language is combined with electronic sound. Sung speech phones[2] are, in part of their structure, more differentiated than any sound utilised in composition up to this time. The combination of the given phones and the composed electronic sounds should be quite natural.

Only by 'objectivising' the sung speech phones, *i.e.* subjecting them to an artificial process and thus bringing them within the sphere of electronic sound, can this be achieved. We are in no way concerned with simple antithesis or contrast, which would be crude.

The phones are introduced into the continuous range of timbres which exists from sinus tones to 'blank noise'.

Every phone is characterised by a fixed number of acoustical properties. Together they constitute its form.

A certain number of phones go to make up the text we have selected for our composition. Some of them are closely related in the structure of their timbres, others have only certain characteristics in common; yet others have hardly any or no elements in common. The degrees of relationship in sound between all the phones in the text are quite incidental and arbitrary in their proximity to each other. This, of course, is obvious. Language has its own phonetic laws.

Where the text does not supply degrees of relationship which are necessary for the composition, they are supplied by electronically generated sound. Or, alternatively, the phones are organically included in the rows of electronic timbres.

Thus we may consider every sung phone as one permutational resultant of the elements contained within it.

This is valid for the overall structure. The combination of phones into words and of words into sentences provides the sense of the text.

Similarly to the electronic sounds, all sung phones in this composition are submitted to procedures of musical structuring.

Where the phones of a word are permutated, at least one of the rows utilised includes the phones in their original order as they appear in the text. The purely musical sense of phone permutation is in a more or less surprising manner transformed into word-or phrase-sense: (telbju, lebtuj, jubelt, blujet, etc.).

The gap between musical sense and word sense is continually variable in the same

[1] The composition referred to throughout this article is Stockhausen's *Gesang der Jünglinge.–Trans.*

[2] Phone = an elementary sound of spoken language; a single vowel or consonant sound (O.E.D.).

way as is the relationship between sound and phones; certain permutations allow the sense of the words to come through, even though certain phones be interchanged and so not in their 'most meaningful' positions. There are various levels of normal comprehensibility.

Whatever we may compose the transformation remains immanent.

This simple idea makes necessary adequate methods for the selection and composition of material.

All individual phones or permutations of phones which are required, among them the words of the original text, are executed by a boy's voice. Similarly to the electronic sounds, they are recorded on tape for later use. Where possible the pitch level, duration and dynamic intensity desired for the singing of the phones or sequences of them are executed by the boy at the recording. Otherwise, the sung sounds are transposed to their final pitch levels, durations and dynamics during the montage. The timbre is, as far as possible, determined during the recording.

The basic elements of the electronic sounds must be differentiated in a way similar to the elements of the various speech phones – and *vice versa*. Only if this is so can we consider real permutation and only then can a continuum of timbre be perceived.

The vowel is thus a single element in the series of spectra of harmonic formants; the simple voiceless consonant a single element in the series of 'noises'. The various groups of mixtures and combinations occur between these two series.

Each timbre, like the phone family, must be available to composition in forms of regular 'periodic' elementary structures. All perceptible properties of 'periodic' and 'statistic' structures must be accessible to the composer's complete control and must be sufficiently variable according to his ideas.

For our composition the choice of eleven basic elements ensures a sufficient number of sound relationships between all utilized electronic sounds and phones.

These eleven forms are considered as non-identical in their basis and are used like the sinus tones which had previously been our only element. A basic element is one which cannot be reduced to further varied spectral components, either by direct hearing or by means of any methods of practical acoustical analysis, and which may be utilized at any pitch level, duration and dynamic.

In fact, out of the sound world of the entire utilized sound continuum, each of these eleven elements defines an area which, essentially, is of its own nature. Overlapping areas merely substantiate our idea of the timbre continuum. Each element determines its own appropriate functional application and its own limited sphere of functional activity. It is possible with some difficulty to produce a 'coloured noise' from sinus tones. This, however, is not a functional procedure.

The eleven elements are 1. Sinus tones; 2. Sinus tones in which the frequency modulates 'periodically' or 3. 'Statistically'; 4. Sinus tones in which the amplitude modulates 'periodically' or, 5. 'Statistically'; 6. 'Periodic' or, 7. 'Statistic' combinations of both sinus tone modulations; 8. Coloured noise with constant density or, 9. With 'statistically' varied density; 10. 'Periodic' or, 11. 'Statistic' sequences of filtered 'beats' (*Knacke* – clicks).[1]

These basic elements are controllable in all three parameters and may be freely varied within the limitations of our compositional methods.

[1] *Translator's Note:* 'clicks' and 'beats' (cf. page 4) may be regarded as identical.

The ranges of modulation and filtered band widths are limited by the intervals of resolution of pitch levels and duration sequences.

So, all elements are heard as 'simple' tones of similar colour. They are differentiated only in the detail of their micro-time-structure.

The various ranges or line- and band-spectra of sounds, tone mixtures and noises as well as the limits of timbre permutation, as they are conceived for this work, are only defined by the simultaneous composition of these elements.

The selection and composition of material is one indivisible conception. Six scales were selected for the pitch level system. As in earlier works they represent the 'interval' relationships between elements, whether they be harmonic or melodic ratios, or those between sound and phones, sound groups or pitch 'regions'.

Harmonic, sub-harmonic and chromatic pitch scales and the combination of all three are used.

Thus we may understand why sung sequences of phones, in which the basic pitch levels have been varied according to their contexts, cannot be definitively registered by the singer on tape.

The system of pitch levels which is used requires mixture-scales which combine harmonic, sub-harmonic and chromatic pitch intervals and in which the steps of the scale must be clearly differentiated. These intervals cannot be sung precisely. The singer sings an approximation of the required pitch which is rectified only in the course of the actual montage work.

In *Studie II*, tempered pitch scales were used to delineate the area between tone mixtures and noises. The closeness of steps varied the degree of 'brightness', but not of course of 'colour', which results from the nature of the elements and the proportion of partials and intensities. This may be seen in the illustration of one page of the score of *Studie II*.

In the present composition the three scales of pitch-level and the three types of their combinations ensure, with regard not only to the spectral composition but also to harmony and melody, an adequate variety of line- and band-spectra. The interval ratio of harmonic, sub-harmonic, chromatic and combined interval scales are largely varied by the series of scales.

Additionally, the partial-tone structures of the sung phones are organically arranged within this interval continuum.

To ensure sufficient variability of the regions using elements simultaneously or in groups, up to six of these 'regions', each an octave in span, are utilized.

Differentiation of the intended permutation of timbres is obtained from the complexity resulting from the simultaneous combination of the six formant regions within one sound process, from the varying of the elements or groups of elements, in all their components, according to the series and of coordinating a special intervallic scale of partials or of medium frequency width ratios in each formant octave.

The methods by which we differentiate and select elements lead us to the following conclusions: our point of departure is always the structure of duration; all other functions of sound are derived from it. To illustrate this we will describe elements numbers 10 and 11: filtered periodic and statistic sequences of beats.

A sequence of 'clicks' at a periodic rate is determined by the number of clicks per second. The clicks are produced by a special generator. If a sequence at 20 Hertz in width is filtered at any pitch level – let us take for example 980/1,000 Hertz at a constant rate of for example every 1/10 second – we get a clear note of medium pitch between 980 and 1,000 Hertz with regular beats ten times a second.

If the rate of beat is gradually increased to exceed the 'time-constant' (*Einschwingzeit*) of the filter in use (this depends on the frequency) and the limits beyond which the ear can no longer differentiate, what started as a rhythmically repeated note becomes continuous. If, on the other hand, the rate of beat is reduced towards zero, the regular structure of the tones becomes increasingly more apparent. Single, isolated beats are better heard; the note is resolved into a sequence of individual tones of identical pitch and duration. In the present work, 20 beats per second is taken as the fastest speed.

These limits are selected for a good reason: if the beats become any faster, the frequency of beat is heard as a second pitch level rising up out of the bottom besides the filtered pitch. The element would then no longer be a 'simple' tone and, therefore, no longer an 'element' according to our basic premise.

The relationship between pitch and time structure, which has always been of particular interest to us, is here emphasised.

Similarly, we see a continuous transition between what may be called durational intervals which are characterised as rhythmic intervals, and durational intervals characterised as pitch levels. On the average, the transition from one to the other occurs at ca. 20 beats (or oscillations) per second and is continuous.

A spectrum is composed of rhythmically periodic tones of varying pitch levels, determined on the basis of the filtering mentioned above. Differentiated variants of it are effected by the various polyphonic microstructures of the chosen regularly pulsating elements. A further factor of the permutation is the variation of dynamic intensity.

In addition to these periodic tone forms we have the second, the 'statistic' type. Contrary to 'statistic' amplitude and frequency modulations, in which we are at present unable to determine technically the rate of phase of modulated or modulating frequency, we can here come nearer to the determining of the statistic interval rate in 'statistic' clicks. Individual clicks are isolated and ordered one next to the other according to the quantities assigned to them by the statistic permutation of rows. Every interval is exactly calculated. When the sequence of beats is filtered as previously, we obtain non-periodic, seemingly haphazard beats at the selected pitch levels. We may perceive the differentiations in these 'statistic' rhythmic element-structures only when further variants and average speed (obtained by the alteration of the smallest interval of the series of durations) are permutated. The spectra resulting from the combinations of these elements are once more characteristic.

If, as in the previous example, these 'statistic' sequences of intervallic beats pass the threshold for the differentiation of pitch levels (by the average speed of the clicks' exceeding 20 per second) we hear a noise outside the filtered pitch level. The noise becomes proportionally lighter as the average speed of the clicks is increased. But the determination of its pitch levels must be approximate and is only possible in the form of a 'statistical' average.

Thus we define 'noises' in general as resulting from 'statistic' polyphonic time structures of sounding elements:

Tones: resulting from periodic polyphonic time structures.
Elements: 'simple tones' as periodic linear time structures.
Sounds: is taken as a collective term; electronic sounds, instrumental sounds, speech sound (phones), sounds in general.

'Tones' and 'noises' are *spectra.* They may be harmonic, non-harmonic, sub-harmonic, chromatic, combined, statistic, etc.

Each of these basic elements is structured in the way shown above.

Six different types of scale are used for the intensities as for the pitch levels.

At this time it might be better to discuss in some detail the problem of loudness levels without demonstrating the way in which the conclusions have been utilised in the composition in progress.

By loudness levels we mean the perception of quanta of sound energy. If the quanta are increased we say it is louder and *vice versa.*

We do not regard loudness level as an independent dimension: intervals of duration between sound perceptions can surely not be effected if they are not 'loud'. We perceive time in the intervals between the registering of sound quanta.

We have found out empirically the relationships between durations and intensities. If two tones of equal duration have different loudness levels, the 'louder' is perceived as 'longer', the 'softer' as 'shorter'. Every musician knows this intuitively, when he quite unconsciously allows a shorter duration for louder than for softer notes, in order to obtain the effect of regularity. Is the reason for this that the louder ones are retained by the memory longer? Or do the air columns vibrate for a longer period when the intensity is increased? The musician is not concerned with 'why': he measures with a perception, not with a ruler – as long as he plays and listens. If the quanta he perceives are not borne out by the watch or the rule, then the technical measurements are wrong; this only proves that an abstract idea of quantities has been formed, and watches and metronomes have been set according to it.

In electronic music, however, we no longer 'play' the music according to our perception. Technical ways of measurement stand between us and our musical material. We have to give a decibel or cm. p.s. measurement in order to determine the loudness and length of a required note. We must indicate the number of oscillations per second, in order to dermine how 'high' the note is to sound.

Thus a conscious realisation is forced upon us of what previously has been practised as being obvious. Our invention has to be expressed in terms of technical quantities and there are good motives for this being so.

As we have said above, two notes of equal duration (according to the stop-watch) are only perceived as being of 'equal length' when they are of 'equal loudness'. Our experiments with elements 10 and 11 have done much to clarify this. If we gradually reduce the amplitude of tones pulsating periodically at say, 10 Hertz (filtered clicks, not, of course, sinus tones of 10 Hertz) we perceive it as becoming increasingly more 'continuous': the individually perceived quanta are gradually mingled one with another and they, as it were, dissolve into each other; finally, its character is so vague that it can no longer be differentiated at all and the feeling of duration of the individual beat is levelled out and disappears. The same happens with amplitude-modulated tones. On the other hand, if we make the pulsating notes louder, our time perception becomes more distinct.

It is simpler to differentiate the single element: each separate one seems 'shorter'; the durational intervals may be exactly perceived.

This has always been apparent in musical practice, but until now there has been no need for an explanation of it. If a piece of music is played at a fixed tempo and if sequences of equal values are to be executed softly and loudly, the soft one becomes less clear and its shape is lost. The perception of time disappears in the individual interval and only a vague 'fluctuating' movement remains.

This is, of course, obvious; let the reader imagine a piece of shadowy character where the feeling for articulated detail is lost; 'time is forgotten'; and it is to be played forte; misterioso in fortissimo . . .

We do not maintain that pitch levels or intensities are illusory and that everything is time. That would be a levelling out of qualities of perception which have been developed and formulated from the sea of quantities. We are, however, concerned with compositional consequences resulting from a realisation of certain relationships: the realisation that rhythm may be projected into a perception of pitch or timbre, that the perception of time is dependent on intensities, that technically measured durations do not correspond to perceptions of them where various intensities are juxtaposed, that a timbre does not remain the same if its intensity or the frequency of a partial is altered, that . . . that . . .

We aim not at an equating but at a further differentiation.

Some human beings have the remarkable faculty of being able to co-ordinate time quanta with perceptional qualities and being able to say, 'that is an a^1' without having to think or make a calculation in time: 440 periodic vibrations per second equals pitch a^1. Nor need anybody think, when the pitch is altered, that the procedure must be altered in time, that 660 vibrations instead of 440 per second must be generated in order to make an e^2.

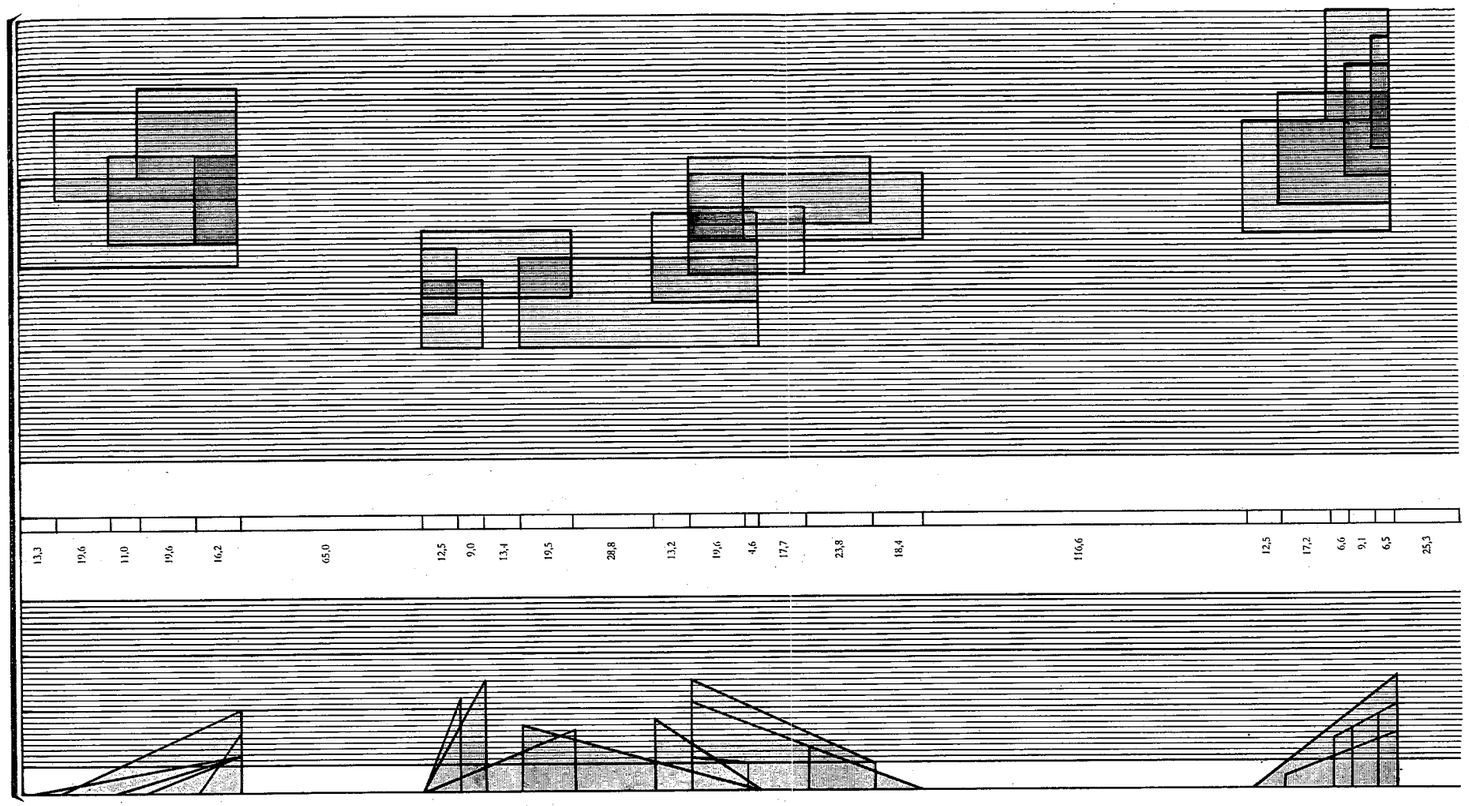
Is it not equally surprising when somebody says: 'That car is going at 50 m.p.h., that other one at 70'? Is not the same faculty called for here of associating individual variations of time with general conceptions of speed, tone, colour and in the film, frame?

Some of this cannot be found in books. More than ever before we have to listen, every day of our lives. We draw conclusions by making tests on ourselves. Whether they are valid for others only our music can show.

A further principle, the most important of all, is revealed to us when we consider the way in which all properties of sound procedure are to be extracted from the structure in time.

Explanation of illustration on facing page:

The frequencies are drawn along the top of the score. The line spacing corresponds to the interval $\sqrt[25]{5}$ from 100 to 17,200 c.p.s. As each note mixture contains five frequencies with constant intervals, only the highest and lowest intervals are indicated by horizontal lines joined at the beginning and end by vertical lines, the enclosed space being shaded. (Only three appear on this page.) The three remaining frequencies between the highest and lowest are ascertained by dividing the enclosed space into 4 equal intervals following the vertical lines. In the lower system, envelopes varying between a constant step height from —30 dB to 0 dB are notated. Each tone mixture has its corresponding envelope. The duration is indicated in cm. at 76·2 cm. per second on lengths of tape. If the relationships of partials are closer, the tone mixtures are perceived as darker and *vice versa*. This cannot be seen on the notation as this would involve shading wider regions lighter and narrower regions darker. But a further variation of the density by overlapping of tone mixtures can be seen in the notation of the various degrees of shading.



KARLHEINZ STOCKHAUSEN, Studie II: a page from the score published by Universal Edition (for details see facing page).

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The elements which we have chosen do not amount to more than neutral material; they are differentiated only because of the different ways in which they have been selected. It is, however, possible for the composer to make structures as he wishes or imagines them, from these elements, which may be related to the overall structure, the plan of the whole work.

Thus one comprehensive idea of working suffices to provide the elementary microstructure as well as the macrostructure of a composition. The meaninglessness of the elements themselves is dispelled and they gather a specific musical importance. A sound which results from a certain mode of structure has therefore no relevance outside the particular composition for which it has been intended. For this reason the same 'prepared' element, the same sound or the same 'object' can never be utilised in different compositions, and all sounds which have been created according to the structural pattern of one composition are destroyed when the composition is completed.

A prototype is created and, in the actual assembling of the composition, is copied wherever the original sound or a further variant of it is required. When the work is completed these prototypes become useless and are destroyed.

We are of the opinion that the basic conception of our work can become the central idea of electronic composition. Against doubt and hostility we will hold fast to the idea 'that the structure of a work and its material are one and the same thing'.

The polyphonic idea of structure in our present work demands a corresponding spatial projection.

Sextuple stereophonic sound is used. There are six loudspeakers or groups of loudspeakers (according to the dimensions of the auditorium). They are placed around and above the listeners; in this way the listeners are, as it were, enclosed within the sound polyphony of the composition.

The original purpose of electronic music was for radio transmission. In this we have anticipated the technique of stereophonic radio sound. For the time being a version has been arranged for transmission on single channel radio.

Up to now all electronic compositions have been composed for transmission over a single loudspeaker. For this reason concert performance in large auditoria has been quite necessarily unsatisfactory whereas transmission has been adequate.

In our present work we have to show whether this, the first stereophonically conceived work in total structure, will lead to a new, active art form of musical composition and listening.

By regulating the positions of the sources of sound it will be possible for the first time to appreciate aesthetically the universal realisation of our integral serial technique.

STUDIO TECHNIQUE

GOTTFRIED MICHAEL KOENIG

Electronic music comes into existence at the intersecting point of two tendencies: a technical and a musical. Even 50 years ago experiments were made to produce music by electrical means and later electronic concert instruments were invented. Of course, as long as the limits of traditional instruments presented no prohibitive resistance to the intentions of composition, it was impossible that the experiments in electronic sound production should have any influence on musical development.

Were it not in the nature of technique, taken independently of artistic considerations, to produce quantitatively, it would not concern itself with the exploration of possibilities for their own sake. Art, on the other hand, is qualitatively designed, aiming not at universal application, simplification or efficiency but at the most precise, most unique expression. The more differentiated this expression becomes, and the more it departs from traditional formal categories, the more it falls back on the language of the material itself. From this, music obtains a control principle which reflects our compositional situation, a principle of systems and statistics. The analyzed single event is understood as part of a group which is generated according to the same principle, in order to project this group structure into the totality of a finite form. Simultaneously, music discovers the developments of electro-acoustics, and technique, meanwhile improved, once again crosses the path of music whose structural propositions are scarcely any longer to be realised by traditional instruments. The sound material that compositional tendencies now have makes possible differentiation to the limits of audibility.

The progressive separation of partial events, the isolation of the single tone, the colour, and the rhythmic value, would reduce it to a unit of pitch, duration, and loudness, were not other composed relationships of this data available. If proportion is the structural principle it is limited by the musical instrument: the continuous traversing of the area between the extremes should be possible. Also it is necessary to compose the colour, and to continuously alter it. This is possible with electrical measuring instruments. A colour can be created from its elements, the overtones; dynamic values can be varied according to the requirements of the composer by means of volume control and level-indicator. Durations correspond to lengths of tape; the tape is cut with scissors. Because these manipulations follow a score and the measurements are so combined that they integrate the structural idea, obligatory for the complete piece, they lose their technical character, which is irrelevant compared with the formal intention.

Although the basic equipment of a studio, namely two tape-recorders, a control-panel, and a tone-generator already present the composer with a great number of possibilities, every score calls for a particular work plan for its realisation. The statistical nature of serial composition requires a rationalisation of production. The manifold quality of the music requires a corresponding complexity of electrical and recording technique. Since the diverse musical demands require corresponding technical

procedures, these procedures are not yet universal enough to be valid for the most extreme demands imaginable.

Rationalisation is not only the technical consequence of the artistic construction, but a matter of technical quality. The more the sound is subjected, once produced, to further processing, the worse its quality becomes. Accumulating a sound from several sinus tones already demands repeated copying; further processing makes it difficult to keep the copying noise within tolerable bounds. One solution for this problem can be provided by a thought-out plan of realisation, which translates the musical structure into a technical one. In doing so the necessity for simplification should not be enforced at the expense of the score. Appropriately the composer makes thorough inquiries in the studio in advance as to the working of the different instruments. Since he is used to taking into consideration the technical possibilities of the orchestral instruments, he will be able to organise an electronic score according to the given technical facilities. Technical quality could also be achieved by further improvement of the studio. If there are a sufficient number of frequency generators to hand it becomes possible to produce the component parts of a sound simultaneously, *i.e.* without copying. Apart from these, research should be made into mechanical or photo-electric automation, which could be controlled by some adequate notation. Then the composer could constantly give his ideas a supervisory hearing without wasting work or time. Directly, without any electromagnetic processing and storage, the final composition would be converted into sound that is technically immaculate.

A critical attitude to the working methods develops studio technique, quite apart from the musical demand. This results in either improved or entirely new methods. Some of these are used for processes for which they were not conceived. The continuous tape loop, for example, originally designed for controlling or repeating shorter events, was later used for the production of sounds. Now it is used for accumulating whole sections of the score. The fact that the drive motors of the tape recorders run at a regular speed can be utilized in a rational manner. The irregularities of this speed, which can produce noticeable inaccuracies, can be automatically adjusted. In principle any unanticipated deviation can be used consciously as a new means.

Many of these means, which were either thought up, tried out, or suddenly perceived, remain unexploited until they collide with a compositional idea. The realisation of electronic music is entirely conditioned by this dual musico-technical character. To consider both the realisation of a given score and the artistic application of technical structural methods pushes ahead both music and working methods. Thus the need to accumulate a sound from partial tones led to the invention of the tape loop, which then gave the idea of constructing complete structures with its aid. This loop moreover makes it possible to provide each partial tone with its own dynamic curve within a sound, the length of which is already fixed. In this way the electronic sound achieves a flexibility which the instrumental sound could never achieve. The buzzer (a difference-tone generator) is used to produce either single frequencies or glissandi, but is also used to control the drive motor of a transposing machine. An especially practical sychronisation device is to apparently shorten the tape loop in a constant ratio. If this ratio is made variable, entirely new conditions are created for the composition of music, particularly for shaping the precise state (growth, decay or steady state) of the tone, which modifies the colour; the only other procedure for modifying the colour is an electrical one: by

means of the cutting angle of the tape. There exist procedures whose application is limited to certain musical demands, just as it is imaginable to develop a piece of music exclusively within a single working method. Music and technique are so inter-related that only by a united effort can the artistic idea transcend the technical restrictions.

STATISTIC AND PSYCHOLOGIC PROBLEMS OF SOUND

WERNER MEYER-EPPLER

1. *Aleatoric Modulation*

A process is said to be aleatoric (from Lat. *alea*=dice) if its course is determined in general but depends on chance in detail. Calculation of these procedures can be effected by statistical means. Musically, everything which is not 'written in the notes' is within the aleatoric sphere. In traditional music, the significance of statistical questions has been limited to the scientific investigation of the particular instrumental result attained by an individual performer by the almost imperceptible variations of relevant musical parameters, such as pitch, intensity, timbre and the duration of sound elements (16)[1]. It has been correctly pointed out that up to the present all technical endeavours to include these variations as a constructional element in the building of instruments, have gone astray. As an irrefutable example we may cite the case of the cinema organ.

At first appearance the critics seem to have all arguments on their side, but a closer examination persuades us that a general human inadequacy cannot be blamed on to a technical process. Fault is to be found not with the technical process but with the builder of the organ, who could think of nothing more enterprising than mechanical regular vibrato of amplitude or coupling of two pipes to produce beats. With the addition of one more pipe, he would have been able to replace the sweet penetrating sound of the cinema organ by a genuine 'choric effect'.[2]

Certainly the resultant oscillatory modulation which is valid in all three dimensions (pitch, intensity and timbre) is still far from corresponding to the aleatoric modulation resulting from the playing of a string instrument. Some of its characteristics do, however, approach strict aleatoric modulation. This approximation may be considerably extended by appropriate choice of frequency range and amplitude of oscillation in the three pipes. It would nevertheless be misleading to attribute the ugly effect of the regular vibrato to the technical 'perfection' of an instrument, thus attributing the bad taste of the instrument builder to the nature of the technique. The contrary is true: from a technical viewpoint instruments which correspond to an alleged public taste are primitive and it will be seen that real perfection will eventually lead to instruments which at the same time fulfil artistic requirements. The manufacturer is not to be excused on the grounds that a greater degree of creative effort is demanded in order to find better solutions.

Certainly it is in no way a simple task to effect a strict aleatoric modulation on a mechanical basis with mechanical instruments. But it is impossible to discover why the builders of electronic musical instruments insist on retaining the unbearable vibrato of the cinema organ. It would require no additional technical expenditure to replace the

[1] These numbers refer to the Bibliography at the end of the article.

[2] The choric effect (swell on the great organ) may be described in terms of physics as a combined frequency and amplitude modulation of internally independent spectral regions leading to an increased fusion of sounds.

sinusoidal modulation by an aleatoric oscillation. Completely adequate for this would be a noise signal limited by filtering to its aesthetically most effective region around 6 c.p.s. Apart from several patents registered in the Patent Office (*e.g.* 7) I have nowhere found any evidence of this kind of modulation. The composer, however, who wishes to work with electronic means is not bound to look for an instrument manufacturer who is prepared to build an aleatoric amplitude or frequency modulator into his generators. In a studio he can produce these modulations for himself, and is thus enabled to experiment on the dependence of sound effect on the average frequency, the band width and the r.m.s. amplitude of the modulating aleatoric oscillation.

One requires a sound generator operating within a frequency region of up to c.100 c.p.s. (heterodyne generator) (1), together with a band-pass filter whose pass range does not exceed 10 c.p.s. In this way an aleatoric oscillation is obtained where the average instantaneous frequency lies at the centre of the transmission range of the filter, and where the amplitude oscillates aleatorically with an average instantaneous frequency equal to half the band width of the filter. With a band-pass filter with a free transmission range of from 5 to 15 c.p.s., the average instantaneous frequency of the aleatoric oscillation is at 10 c.p.s., the average oscillatory frequency at 5 c.p.s.

The aleatoric oscillation enables us to modulate a periodic carrier oscillation, *e.g.* a sinusoidal oscillation. If A (t) is the filtered aleatoric oscillation and $\sin 2\pi\nu t$ is the sinusoidal oscillation, (ν is the instantaneous frequency of the oscillation in this formula), the following modulation forms may be distinguished:

(i) Modulation of amplitude: $A(t).\sin 2\pi\nu t$;
(ii) Frequency or phase modulation: $\sin(2\pi\nu t - A(t).)$

These two types of modulation may also appear simultaneously.

For the realisation of the modulation we require in (i) a modulator, in (ii) a controllable delay-line in so far as the oscillation generator's frequency cannot be directly affected through a reactance tube (*i.e.* a tube operating electrically as a capacity or self-induction). For example, a stepwise controllable delay-line is to be found in the vibrato arrangement of the Hammond organ. Oscillator controls with reactance tubes are described by Flanagan (4) and Weber (14). They contain a pentode as a controllable frequency selecting element.

A timbre modulation may be obtained by means of a controllable filter, *e.g.* of the RC- or RL-type. E. E. Schneider (10) describes this type of filter and the way in which it works. If a transposing filter is utilised the pass band is controlled in the simplest way by a phase-shift generator (6).

The composer who disposes of the possibilities of aleatoric modulation will be surprised to discover that this kind of modulation leads him directly into a world of phenomena, previously described as 'noises'. By broadening the frequency range of the modulating oscillation and increasing the r.m.s. amplitude the resultant sound becomes more similar to a noise, *i.e.* a sound whose exact pitch cannot be determined.

These few observations clarify the fact that aleatoric sound procedures need not necessarily produce aleatoric (*i.e.* non-predictable) sensations. For this it is essential that the frequency range of the applied aleatoric modulation be selected in such a way

that the oscillation of amplitude and frequency may not be perceived as dynamic or pitch alterations. Gliding up and down of the tone when the frequency is modulated stops for modulating frequencies of above 7 c.p.s. according to examinations made by Stevens and Davis (11). It does not, however, follow from this that a pitch movement is to be observed in all cases of frequency modulation below this level. For this purpose, as G. W. Stewart has shown with reference to the uncertainty relation of the conjugated variables duration and frequency, a frequency swing is required (*i.e.* a variation upwards and downwards of the carrier frequency) of a size as great as that of the modulation frequency. For a frequency modulation with pitch-level oscillation of 3 c.p.s. to become audible, a carrier frequency of *e.g.* 440 c.p.s. (a′) must oscillate at a rate of at least three times per sec. between 437 and 443 c.p.s. If for aleatoric modulation of amplitude and frequency a frequency range (defined by the middle of a narrow noise frequency band) of below 7 c.p.s. and for frequency modulation the corresponding frequency swing stipulated by Stewart (half the width of the noise frequency band) is selected, the unsystematic course of the modulating function becomes perceptible, *i.e.* the dynamic or pitch structure of the music becomes to a greater or lesser extent aleatoric. A procedure of this kind can attract the composer, and cases are known where aleatoric characteristics have been introduced (by mathematical, not by technical means) into the structure of the composition (J. Cage).

2. *Analysis of Compositions by Methods of Information Theory*

Apart from the application of statistical methods by composers as described above, other statistical methods are utilised in analysing musical compositions. Here it is a matter of examining musical creations with the mathematical means provided by statistical information theory. One assumes as a premise that music, just as language, is made up of defined or at least definable single elements which can be nominated and described, *i.e.* it does not form a structureless continuum. It is hardly necessary to recall that the sum of these elements does not result in the music, no more than component syllables form a poem. Nevertheless, it seems that by concentrating only on the 'semantic' aspects of music and by the elimination of all the emotional-aesthetic qualities, interesting aspects of musical structure may be discovered which cannot be found out by any other means (13). In this way special criteria of form are added to older ones, which are designed for the examination of latent work methods of the compositional process.

Formal criteria of various orders may be determined. The first order contains all observations concerning the statistical distribution of the sound elements themselves without reference to any mutual relations.[1] The second order ('Markoff chains') and all higher orders take into account, in examination, the frequency of transfer from one element to another or between further distant elements, and their contextual relationships; considerable mathematical problems arise from these examinations. As a characteristic which serves as a form criterion of the first or higher orders, information entropy may be derived from an observation of the rate of appearance of elements or

[1] We consider, for example, in statistical terminology the 'mean' or 'average' pitch level (respectively value, intensity, spectral density, speed, etc.) of the composition and the absolute or relative distribution of the appropriate characteristics around this average value. The adoption of an averaging interval, *i.e.* the time region over which averaging is extended, is essential for the comparison of values; for a piece of music is not strictly stationary in the statistic sense and so not liable to come under the application of the ergodic hypothesis.

groups of elements.[1] Up to the present, mathematical results exist only for literary works (5) but there is no reason why the same procedures should not be applied to musical compositions.

3. *Structural Characteristics of Valency Regions*

Though a specific statistical structure may be ascertained in a musical composition from an examination of the score, it is by no means certain that this structure, conceived at an intellectual level, is automatically transferred into sound. There are no relationships between acoustical stimuli which may be derived from the score and the corresponding sensations of sound which would permit us to consider these sensations as some kind of 'mapping' of stimuli within the physiologico-psychological range. To clarify the details of these fairly complicated relationships we are compelled to adopt a special notation for that property of an acoustical stimulus which determines the similarity or disparity of a sensation. With reference to the terminology customarily used in physiological optics, we will call this quality the valency of the stimulus (9).

These valencies may be represented in a multi-dimensional space. The components of the valencies, *e.g.* frequencies, time- and place-co-ordinates act as 'co-ordinates' of this space. In an abstract valency space of this type every sensation indicates a place of sensation. In opposition to what one might conjecture these places of sensation are not distributed arbitrarily close together but are separated from each other by different limina.[2] The resulting cellular structure is the metric field of the valencies.

Strictly speaking it is not constant but depends on the velocity of alteration of the stimuli. Sounds, for example, carry their metric field over a large area with them. They are only differentiable when they follow each other in close sequence. This phenomenon is known as conversion. Where the stimuli are presented in an isolated form the valency locations can only be roughly differentiated. The network is narrowed, as the number of stimuli per time unit is increased but at the same time it shrinks together.

All alterations of stimuli are rendered ineffective by the cellular structure of the valency-region if they are smaller than the difference limina at the appropriate velocity of alteration of the stimuli. It is not possible to effect an arbitrarily narrow scale either for pitch level or for intensity. Thus, for example, at a volume of 80 phons (forte), at a moderately fast rate of succession, we are unable to distinguish more than about 200 pitch levels in the whole sound area. We obtain similar limitations in examining the temporal sequence of compositional elements. Within a time interval of some milli-

[1] If p_i is the frequency of occurrence of the element 'i' in the work to be analyzed, the first-order information-entropy is defined as:—

$$H_1 = -\sum_i p_i \log_2 p_i$$

which may be applied to the total inventory of different elements. In the second order, the frequencies p_i are replaced by the joint frequencies p(i,j) which indicate the occurrence of the pair of elements 'ij'. Thus the second-order information-entropy is

$$H_2 = -\sum_i \sum_j p\,(i,j) \log_2 p\,(i,j)$$

[2] The idea of a metric field may be illustrated by an example from phonetics. Vowels are, as is well known, characterised by two formant regions each of a width of 300 c.p.s. Tests enable one to establish how many c.p.s. are equal to shift the middles of the formant regions to effect a noticeable alteration of vowel colour. M. Joos found that frequency alterations of approximately a semi-tone are necessary (8). The metrical field of vowel timbres then resembles honeycombs with diameters of approximately one whole tone.

seconds the sequence of notes may be interchanged without affecting the perception of the sound. The acoustical stimuli in this case associated to the notes are called 'conditionally equal'; the indifferentiable sensations are called 'metameric'.

Metamerism is a phenomenon which may be generally observed in the world of auditory perception.

> Filtered noise offers us a simple example of metamerism. Although this noise presents a quite different oscillographic picture at different times (as all aleatoric procedures should) the sound perception is unaffected by these alterations in the oscillation image.

Finally, it is to be emphasised that sound elements which are juxtaposed in time can have the effect that identical physical vibration procedures give rise to totally different sensations. The phenomenon has been particularly observed in the case of synthetic explosive sounds such as 'p', 't', 'k' which may be perceived in a totally different manner, depending on the vowels which are juxtaposed to them (3). To explain this one cannot attribute it to masking which has already been known for a long time because the influencing is effected by the following vowel (regressive dissimilation) as well as by the proceeding. At this point it may be mentioned that practically all statements about timbre have been effected by means of phonetic methods applied to spoken sounds. Contrary to instrumental timbres, vowel timbres have the particular advantage that they may be recognised by untrained hearers thus making it possible to describe precisely even small alterations.

4. *Pitch Loudness Level*

The newcomer to physio-psychological acoustics will be stupefied when the results of experiments show him that a note does not remain a note, and a sound not a sound of unalterable perceptible qualities, if alterations are effected in one of its valency dimensions, which at first glance would appear insignificant. Thus, for example, he cannot fully realise that a pure tone (physically – a sinusoidal sound signal) alters in pitch, if the amplitude is enlarged or diminished, where the frequency is constant. He will be equally amazed to learn that this phenomenon has nothing to do with the sound generating instrument and thus cannot result from a technical inadequacy, but is in fact a property of the human ear (the cochlea). Only after detailed study and experiments of one's own can one realise the fact known to acousticians, that the loudness level of a sinus tone of constant amplitude will alter by many orders of magnitude if the frequency is altered, and that the amount of alteration depends largely on the sound pressure amplitude chosen.

In returning to sounds, complex tones and noises, one will be discouraged by the multitude of occurring events (11). For example, it will be discovered that the loudness level of a complex tone cannot be calculated from the levels or at least the sound-pressure amplitudes of its components by any known mathematical means but that strange physico-psychological relationships intervene in the form of the Sone-curve. If the resultant loudness level is correctly determined, a new difficulty arises: it does not follow from the explanation of the loudness level whether certain components of the complex tone do at all contribute to the compound sound resultant; they sometimes are rendered imperceptible by masking.

5. *Triple Pitch Quality*

Research into electric methods of sound and noise generation has revealed a great number of perceptive phenomena which can only be discovered in traditional instrumental sound, where the ear has been prepared for it by electro-acoustic experiments. This is similar to the impression received from exotic languages; when one hears them for the first time one can hardly observe their phonetic characteristics. Only by concentrated study can one teach one's ear to distinguish the unaccustomed sounds and sound combinations.

One of the most significant discoveries for the composer in the sphere of sound perception is the triple pitch level quality. Every musician is aware of the fact that a note has a double quality, the one – its absolute pitch, running parallel to the frequency, the other – the chroma, a quality which recurs cyclically within each octave (only for frequencies of up to c. 4500 c.p.s.). It sounds obvious if we say that we hear a note a' if the fundamental of the frequency is 440 c.p.s. But what happens if we remove this fundamental by electrical means, leaving only the harmonics with frequencies of 880, 1320, 1760 c.p.s., etc.? Or if we take away the fundamental 440 c.p.s. and second harmonic 880 c.p.s.? We learn from experiments that the perceived pitch level remains the same: a'. One may take away many of the lower harmonics without altering this. If this 'mutilated' note is interrupted for only an interval of a second, the sensation is completely altered. Instead of the 'residual tone' on a' we now hear another pitch which lies approximately in the region of the strongest remaining harmonics and is called 'formant pitch'. With some practice one can hear the residual pitch and the formant pitch simultaneously, recognising their unmistakable varied qualities. Both pitch sensations are independent of one another and so, although it may sound paradoxical, a one-voice sequence of notes takes on the character of a two-voice line through the counter movements of residual and formant pitch. Sequences of notes may be generated in which even the experienced listener will not be able to tell whether the sequence rises or falls. The singular effect of certain carillons depends on this conflict between residual and formant tones.

Without going into the far-reaching consequences of a triple pitch quality of the theory of the mechanics of hearing, I merely wish at this point to emphasise that at this stage of our research the significance of the form of oscillation apart from the spectral structure of the musical sound signal becomes clear. If a stationary sound signal is supplied with a periodic envelope, under certain conditions the frequency of this envelope will become audible as a residual tone. This casts a new light on the problems of rhythmic formation, in that this may without effort be considered as the continuation of the pitch phenomenon in the lowest frequencies.

The timbre of notes with so called 'gliding formants' belongs to this order of problems. That a sound, whose spectrum lacks the even harmonics is known as 'a hollow sound' (*e.g.* the clarinet), quite independently of the actual pitch of the fundamental, ought to have to do with the form of oscillation rather than with the structure of the spectrum. Similarly with sounds which, for example, lack all harmonics divisible by 3 or 5. They also have properties which remain invariable although the frequency of the fundamental note is altered; we still lack a suitable notation for their sound characteristics. Examination of spectra of this type has been limited to the period in which one has been able to work with electric sound generators.

6. *The Psychological Effect of Infra Sound*

H. Burris-Meyer of the Stevens Institute of Technology in Hoboken has demonstrated that listeners may perceive rhythmically sound oscillations which lie below the lowest frequency threshold (*i.e.* below 16 c.p.s.). In a play 'The Emperor Jones' infra-acoustical sound beats were generated behind the stage by means of a super-dimensional 'electronic drum' which carried a significant intensity when the rhythm was tense. Despite the fact that the actor could hear nothing of this drum rhythm he soon began to synchronise his spoken part with the acoustically imperceptible drum beats. Thus sound, *i.e.* vibrations, may generate a physical effect even if they lie outside the perception area. It should not be necessary to demonstrate the consequences of this psychological discovery for electronic music.

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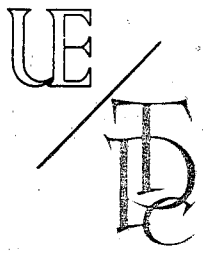

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in contemporary music

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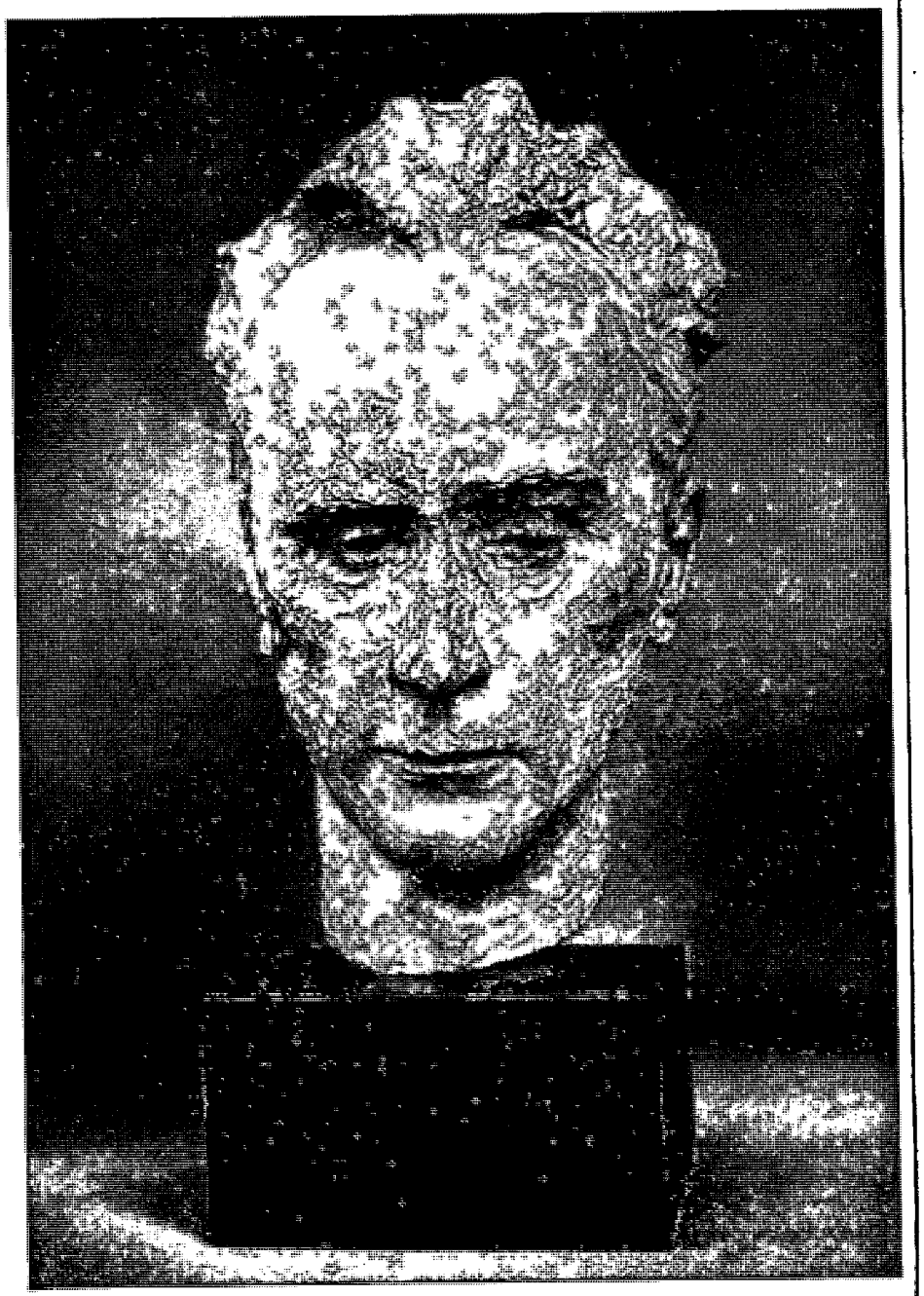


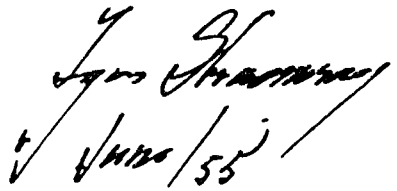
Bust by Josef Humplik

II

IGOR STRAVINSKY

The 15 of September 1945, the day of Anton Webern's death, should be a day of mourning for any receptive musician.

We must hail not only this great composer but also a real hero. Doomed to a total failure in a deaf world of ignorance and indifference he inexorably kept on cutting out his diamonds, his dazzling diamonds, the mines of which he had such a perfect knowledge.



The above foreword was specially written by Stravinsky for the original German edition of this work.

BIOGRAPHICAL TABLE

FRIEDRICH WILDGANS

1883	December 3; born in Vienna, second child of Dr. Karl von Webern, mining engineer (later departmental chief in the Ministry of Agriculture) and his wife Amalia, née Gehr.
1889–90	First years of primary education in Vienna.
1890	Father transferred to Graz as director. Primary education in Graz.
1893	Family move to Klagenfurt. Secondary education (*humanistisches Gymnasium*), first instruction in music (piano, cello, rudiments of theory) from the Carinthian musician Dr. Edwin Komauer.
1902	*Matura* (equivalent of University Entrance) in Klagenfurt, followed by first journey to Bayreuth (outstanding musical impressions of his youth). In September, to Vienna, where he begins to study musical history and musicology with Guido Adler.
Autumn 1902 to Autumn 1904	First systematic instruction in theory, at the musicological seminar of Vienna University (Harmony: Hermann Graedener, Counterpoint: Dr. Navratil)
1903	First surviving attempts at composition, dated during the summer (Songs, a Ballade with orchestra, 'Young Siegfried').
1904	Commencement of his studies with Arnold Schönberg in Vienna, after an unsuccessful attempt to take lessons with H. Pfitzner in Berlin.
1906	June: awarded D. Phil. (Vienna) for his dissertation on H. Isaac's *Choralis Constantinus*. Sept. 7; death of his mother at Preglhof (Carinthia).
1907	Composition of the *Five Songs*, Op. 3 (texts by Stefan George) begun, and of the Quintet for 2 violins, viola, cello and piano (without opus number), which receives its only performance in the autumn, under the aegis of Schönberg, at a private house in Vienna.
1908	A cappella chorus *Entflieht auf leichten Kähnen* Op. 2 (Stefan George), and *Passacaglia* for orchestra, Op.1.
1908–10	Activity as co-repetiteur and theatre conductor in Vienna. (1910 conductor in Teplitz.) Compositions: *Five Songs* Op. 4 (texts by Stefan George), *Five Movements* for string quartet, Op. 5, later (1910) *Six Pieces for Orchestra*, Op. 6, *Four Pieces* for violin and piano, Op. 7.
1911	Theatre conductor in Danzig. Feb. 22: marriage to Wilhelmine Mörtl. At the end of the year from Danzig to Berlin.
1912	In Berlin. Completion of the *Two Songs* Op. 8 (for medium voice and eight instruments, texts by Rilke), begun in 1911. Engagement in Stettin for the summer.

1913 Conductor in Stettin. *Six Bagatelles* for string quartet, Op. 9; *Five Pieces for Orchestra*, Op. 10, completed.

1914 Three short pieces for cello and piano, Op. 11.

1915 Joins the Austrian army for a year as a volunteer.

1916 Dec. 23; discharged from the army (as officer cadet) on account of bad eyesight.

1917 Completion of the *Four Songs* Op. 12, for soprano and piano, begun in 1915 (Texts: folk song, Bethge, Strindberg, Goethe).
In Vienna and Klagenfurt after his discharge from the Army.
Aug. 12: to Prague as theatre conductor (*Deutsches Landestheater*).

1918 May 31: end of his engagement in Prague. Early in June he moves into his first apartment in Mödling-bei-Wien (Neusiedlerstr. 58). Co-worker in a society for private performances of music, of which Schönberg was the head; later he became its concert organiser. The society was dissolved in 1922.
Completion of the *Four Songs*, Op. 13, for soprano and thirteen instruments; these had been begun as early as 1914. Their dates of origin are: 1917, 1914, 1917, 1918. (Texts: Karl Kraus, Bethge, Bethge, Trakl.)
General abolition of hereditary titles in Austria – but on the programmes of the Workers' Symphony Orchestra the conductor was still occasionally given as 'Anton von Webern'.

1919 August 10: death of Webern's father in Klagenfurt.

1920 End of August – early October; further period as conductor at the German theatre in Prague. First publisher's contracts with Universal Edition, Vienna (Passacaglia Op. 1, Chorus Op. 2, Songs Op. 3, Orchestral Pieces Op. 6).

1921 Completion of the *Six Songs to texts by Georg Trakl*, for high voice, clarinet, bass clarinet, violin, cello, Op. 14. (Work begun in 1917.)
September: conductor of the *Wiener Schubertbund* (until 1922), and choirmaster of the Mödling male voice choir (until May 1926). Invitation to Düsseldorf to conduct his *Passacaglia* at the festival.

1922 June; invitation to Berlin to conduct new Austrian works (Bittner, Schönberg, Webern).
Autumn: takes over the direction of the Vienna Workers' Symphony Concerts (founded in 1905 by Dr. J. Bach).
Completion of the *Five Sacred Songs* for soprano, flute, clarinet (bass clarinet), trumpet, harp and violin (viola), Op. 15 (begun in 1917; folk texts).

1923 Beginning of his activities as chorus-master of the Viennese Workers' Choral Union.

1924 May 1: awarded the Music Prize of the City of Vienna.
Composition of the *Five Canons* for soprano, clarinet and bass clarinet, Op. 16 (Latin liturgical texts), and the *Three Folk Texts* for soprano, violin, clarinet and bass clarinet, Op. 17 (sacred folk-texts). The first of Webern's works that makes use of a twelve-tone row (in the Schönbergian sense).

July: music festival in Donaueschingen (performance of Op. 9).

1925 *Three Songs* for soprano, E Flat clarinet and guitar, Op. 18 (texts: folk song, 'Youth's Magic Horn', Latin hymn); dedication to the Director of Universal Edition, Emil Hertzka, on his jubilee.

1926 April 19; memorable performance of Mahler's 8th Symphony under Webern, on the occasion of the 200th Viennese Workers' Symphony Concert. Webern conducts his Orchestral Pieces Op. 10 at the festival of the I.S.C.M. in Zürich. Elected honorary member of the Composers' Guild, New York.
Universal Edition grant Webern regular monthly payments as 'advance royalties' (until 1928).
Two Songs for mixed choir, celesta, guitar, violin, clarinet and bass clarinet, Op. 19 (texts by Goethe).

1927 Appointed as regular conductor for the Austrian Radio.
String Trio, Op. 20.

1928 *Symphony* for clarinet, bass clarinet, two horns, harp, and strings (without double-bass), Op. 21.
Early November; severe illness (stomach ulcer), which prevents Webern from working until the end of January 1929.

1929 November-December; first concert tour, via Münich, Frankfurt and Cologne, for B.B.C. concerts in London. Manifold activities during the 1929/30 season in Vienna (Radio, Workers' Symphony Concerts); private teaching.

1930 Appointed as reader and specialist adviser to the Austrian Radio on all questions to do with new music.
Quartet for violin, clarinet, tenor saxophone and piano, Op. 22.

1931 April 13: first complete programme of his own compositions, in the small hall of the Vienna Musikverein (with Kolisch, Steuermann and others).
Numerous radio and workers' symphony concerts in Vienna.

1932 May 1; second award of the Music Prize of the City of Vienna.
Second journey to London, where he conducts two B.B.C. concerts of works by Schubert, Johann Strauss, Wolf, Schönberg and Webern.
Summer: conducts two concerts at the I.S.C.M. festival in Barcelona.
August; rents a new apartment (the last) in Mödling – Im Auhölz 8.

1933–4 Third professional journey to London.
During these and the following years, active as a private teacher; apart from teaching composition, classes in private houses in Vienna. Teaching remained Webern's principal source of income until shortly before his death.
Three Songs for soprano and piano, Op. 23 (texts from *Viae Inviae* by Hildegard Jone); *Concerto for 9 Instruments* (flute, oboe, clarinet, horn, trumpet, trombone, violin, viola and piano), Op. 24.
End of his activities as conductor of the Workers' Symphony Orchestra and of the Workers' Choral Union.

1935 In Mödling. Very withdrawn life, as in the following years; active only as a private teacher, apart from a further journey to London for concerts.

Three Songs Op. 25 (texts: Hildegard Jone); *Das Augenlicht* for mixed choir and orchestra, Op. 26 (text: Hildegard Jone).

1936 *Piano Variations*, Op. 27.
Conducts a concert in Winterthur (for Werner Reinhart).

1937 —

1938 *String Quartet* Op. 28.

1939 *1st Cantata* for soprano solo, mixed choir and orchestra, Op. 29 (text: Hildegard Jone).

1940 *Orchestral Variations* Op. 30.
Throughout these years Webern lived in obscurity in Mödling, not taking part in any public event worthy of mention.

1941 Reader and editor for Universal Edition (free-lance).

1942 —

1943 *2nd Cantata* for soprano, baritone, mixed choir and orchestra, Op. 31 (text: Hildegard Jone).

1944 Sketches for a chamber concerto (presumably Op. 32) – never realised.

1945 About Easter in view of the military situation, Webern leaves his apartment in Mödling and takes his family to Western Austria in order to ensure their safety and his own.
September 15: death of Webern in Mittersill (Salzburg Province).

Opposite page

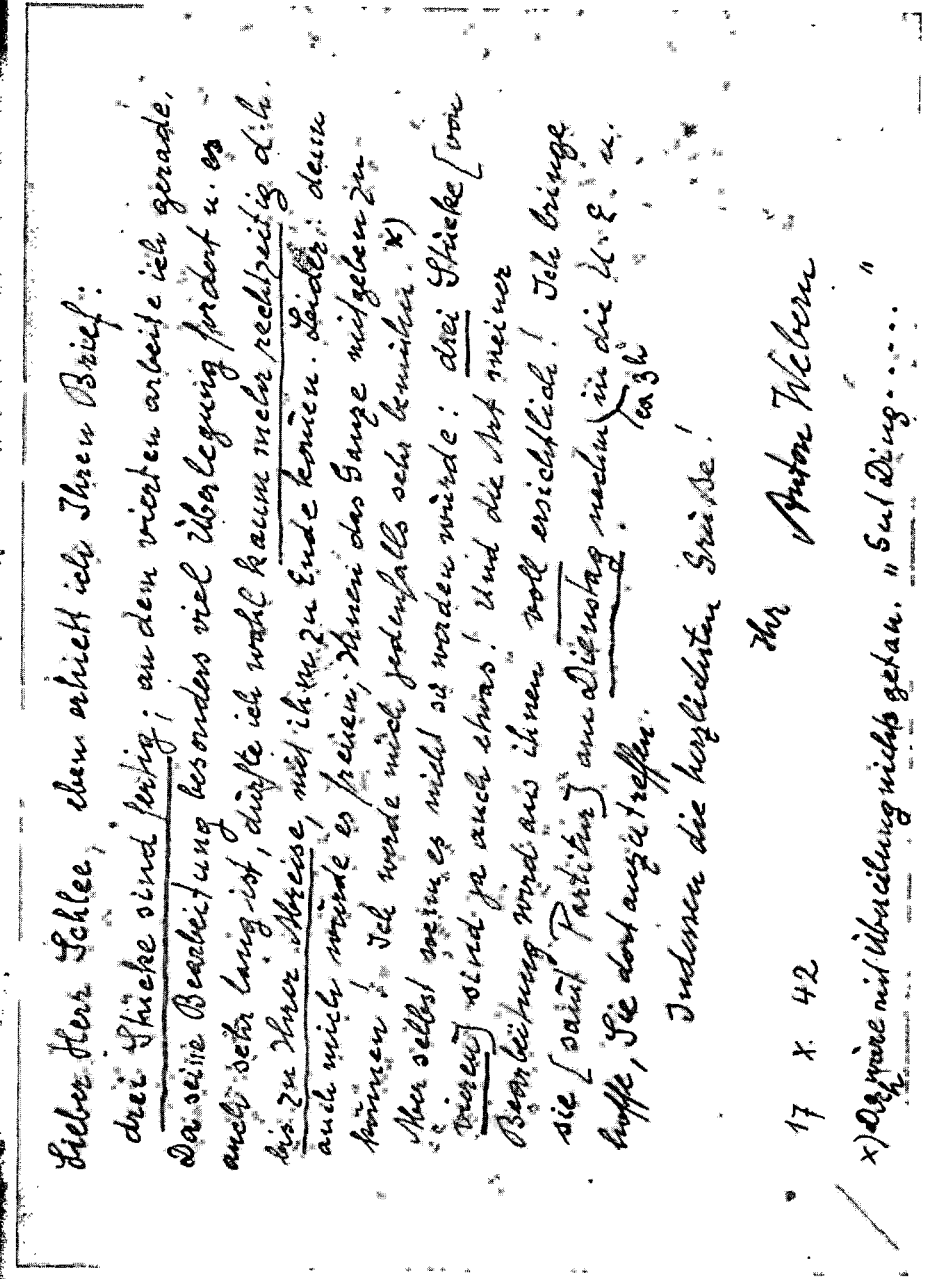
Text of postcard from Webern to Director Schlee of Universal Edition

Dear Mr. Schlee,
I have just received your letter. *Three pieces are ready;* I am working even now on the fourth. As I have to think very carefully indeed about its arrangement, and it is also very long, I shall hardly be able to get it finished *in time*, i.e. *before your departure.* A pity; for I too should be glad to be able to give you the whole thing! In any case I will make every effort.* But even if it should not be possible, *three* pieces (out of *four*) are something, too! And they will make the nature of my arrangement *wholly* clear. I will bring them to you (complete with score) on *Tuesday* afternoon, about 3.0., to the U.E., and hope I shall see you there.
Kindest regards in the meantime.

Your
Anton Webern.

17.X.42.

* But to hurry unduly would not be the best way. 'Rome was not built . . .'

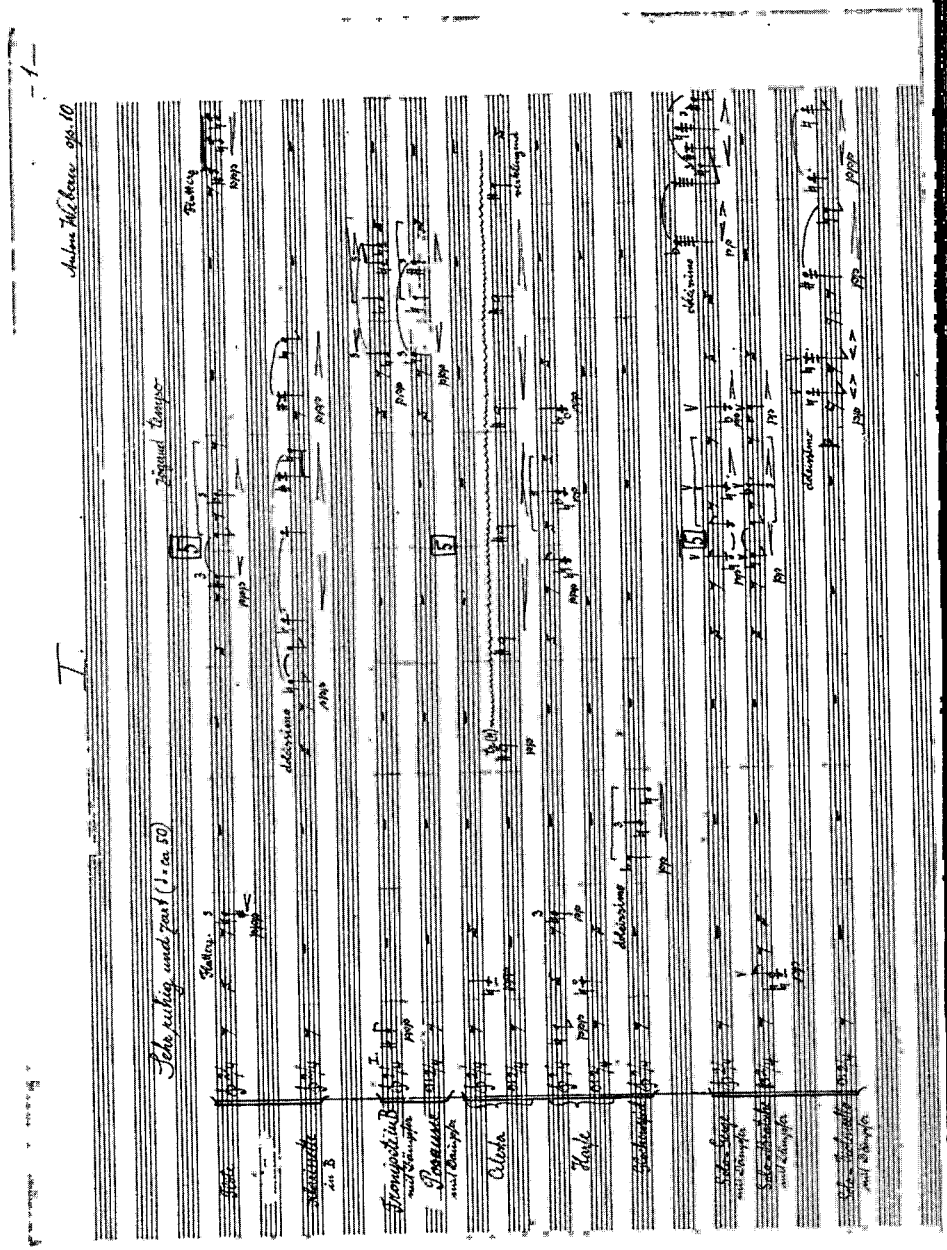


Liebe Herr Schlee, eben erhielt ich Ihren Brief:
drei Stücke sind fertig; an dem vierten arbeite ich gerade,
Da seine Bearbeitung besonders viel Überlegung fordert u. es
auch sehr lang ist, dürfte ich wohl kaum mehr rechtzeitig die
bis zu Ihrer Abreise, mir ihr zu Ende kommen. Sollte: deine
auch mich wundern es scheint, Ihnen das Ganze mitgeben zu
können. Ich werde mich jedenfalls sehr bemühen. x)
Aber selbst wenn es wirklich so werden würde: drei Stücke [von
vieren] sind ja auch etwas. Und die Art meiner
Bearbeitung wird aus ihnen voll ersichtlich! Ich bringe
die [ganze] Partitur mit dem Dienstag mit, wie die U.E. u.
Sie dort ausgemacht haben.
(ca 3h)
Indessen die herzlichsten Grüße!
Ihr
Anton Webern

17 X 42

x) Ich wäre mir Übersetzung nichts gesagt. „Sul Ding . . . . "

Postcard sent by Webern to Alfred Schlee, Director of Universal Edition.



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Without Opus Number

Quintet for 2 violins, viola, cello and piano (1907)

Arrangements:

J. S. BACH: Fuga (Ricercata) in 6 parts (No. 2 from the *Musical Offering*), for orchestra.

SCHUBERT: German Dances of October 1824, for orchestra.

SCHÖNBERG: Kammersymphonie, Op. 9, arranged for flute (or violin), clarinet in A (or viola), violin, violoncello and piano.

See also Op. 5.

Only for such reasons as this will the true artist produce the new, unusual element in a novel harmony; he must express something new, unheard-of, that moves him; a new sound is an involuntarily discovered symbol announcing the new man who expresses himself through it. Apart from myself, my pupils Dr. Anton von Webern and Alban Berg have written such sounds.

ARNOLD SCHÖNBERG
Harmonielehre

Beauty exists only from that moment at which non-productive people begin to find it lacking. Earlier than this it does not exist, since the artist has no need of it. For him, truthfulness is enough: for him, it is enough that he has expressed himself. To say what has to be said – according to the laws of one's nature.

ARNOLD SCHÖNBERG
Harmonielehre

The compulsion of form is admittedly severe. To this day, every master has broken formal bonds – in order to create his own. The anarchism prevailing in the realm of musical form since the disruption of tonality calls for all the severer formal measures. It may not prove altogether unfortunate that, in consequence, composing won't be 'so easy' any more.

ERWIN STEIN
New Formal Principles
Translation by Hans Keller,
(from 'Orpheus in New Guises')
Rockcliff, London, 1953.

A CANTATA

HILDEGARD JONE

For the close of his great cantata (*Cantata No. 1, Op. 29*) Anton von Webern set a verse of my poem 'The metamorphosis of the Graces' (*Verwandlung der Chariten*). Music may be set to words, too, for I composed the last verse of my poem after hearing the cantata.

We heard it for the first time on the 18th of August of this year of war (1940) at the flat of the composer Ludwig Zenk. He lived high up, right opposite the cathedral of St. Stephan, whose great tower dominated the view from the music room. The sight of that sacred rock awakened an impression of being in the mountains. It was here that our friend Webern presented his music to us, which with its illuminating grace gave us a deep insight and joy such as we are seldom granted in a lifetime.

The poem says what the word 'grace' means to me; above all, it means infinitely more to me than something not quite reconcilable with complete seriousness. For grace can itself be all that is purest and deepest in the seriousness of life, not only the breath of beauty in what is well and whole, but also the healing of the wound and the cheerful acceptance of the wound that cannot be healed. But the music, heard by us here in the neighbourhood of the bells, is no other than the sparkle of the grace of Grace, in the midst of the war. We cannot forget the war while listening to the music, but we are given something to take back into the dark with us and to give us light. In the music at 'Hearing the blessed strings of the sun-god' (*Tönen die seligen Saiten Apolls*).it is more than the Greek world of beauty; all the loveliness of lighter, purer and simpler life is heard, like the song of the shepherds watching in the still morning of the world. But now 'Who senses the Graces?' (*Wer nennt sie Chariten?*). Here a farewell sounds in the music, our farewell from the simplicity of joy. 'Echoes his song in the darkening evening, who thinks of Apollo?' (*Spielt er sein Lied durch den wachsenden Abend, wer denkt: Apollon?*) The music 'in the darkening evening' is inexpressibly melancholy. Night now falls in sound, it is late. Who indeed 'thinks of Apollo'? But now: 'Have not the weaker words long ago perished, slain by the Word's might?' (*Sind doch im Worte die Schwächeren Worte lange gestorben.*) What musical meaning is the 'Word' given here! All deities of melancholy are silenced in the Word, absorbed in its eternal meaning. Now follows a veritable miracle of musical treatment. 'Also the fainter image is melted as seal of the spectrum.' (*Und auch die blasseren Bilder zum Siegel des Spektrums geschmolzen.*) In the music of these last six words an amazing transformation takes place. Something perishes, something else is born. And now the apparition, 'Charis, the gift of the highest; the grace of her favour is sparkling' (*Charis, die Gabe des Höchsten: die Anmut der Gnade erglänzet*). This grace of Grace is truly perceived through our hearing. And now a feast of giving. The music to the words 'She comes in darkness' (*Schenkt sich im Dunkel*) so overwhelms the hearer with gifts that he is transfixed in joyful astonishment.

Webern wished to have no centre of gravity in this piece. The harmonic structure leaves everything in a state of suspense. 'She comes in darkness'; in darkness made deeper by the music; this gift must indeed come from above and be shining bright to be

sensed as a gift at all. 'In darkness, the ripening heart's gift' can only do good with a love full of grace. Yes, love is the 'dew of perfection' (*der Tau der Vollendung*). And we all feel it, we who need it so much in the middle of the war.

When the sound of this 'perfection' of unearthly gentleness has died away – and I assume all the friends gathered there felt much the same – a cheerful and lively conversation starts up, while we see our beloved cathedral before us. We find how fruitless and aimless all tedious discussions of things are, that today – in fact always – there is so much saying and disagreeing, denying and contradicting, as from time immemorial; that it is only in good deeds, in doing good, that a little light is given to reveal to us that our work should be the gift of uniting. For whatever really buds, grows, blooms and bears fruit will hang over walls and fences and burst open the frontiers. Let us begin today to rejoice in friendship as far as love may reach. Grace is courage to try to put the world in order through love. On this we shake hands.

We must give thanks to this true music for that happy hour.

(All quotations from the text of Webern's 1st Cantata are taken from the translation, by Eric Smith, printed in the vocal score.)

FOREWORD TO ANTON WEBERN'S 'SIX BAGATELLES FOR STRING QUARTET OP. 6'

ARNOLD SCHÖNBERG

Though the brevity of these pieces is a persuasive advocate for them, on the other hand that very brevity itself requires an advocate.

Consider what moderation is required to express oneself so briefly. You can stretch every glance out into a poem, every sigh into a novel. But to express a novel in a single gesture, a joy in a breath – such concentration can only be present in proportion to the absence of self-pity.

These pieces will only be understood by those who share the faith that music can say things which can only be expressed by music.

These pieces can face criticism as little as this – or any – belief.

If faith can move mountains, disbelief can deny their existence. And faith is impotent against such impotence.

Does the musician know how to play these pieces, does the listener know how to receive them? Can faithful musicians and listeners fail to surrender themselves to one another?

But what shall we do with the heathen? Fire and sword can keep them down; only believers need to be restrained.

May this silence sound for them.

Mödling, June 1924.

HOMAGE TO ARNOLD SCHÖNBERG

ANTON WEBERN

Schönberg as a Teacher

Faith in salvation through technique alone must be suppressed, and a struggle towards veracity encouraged.
(*Arnold Schönberg*, '*Problems in Teaching Art*'.)

All malicious, envious opposition and calumny raised by backward minds against Arnold Schönberg as a teacher meet the most brilliant confutation in Schönberg's own essay 'Problems in Teaching Art'.[1]

Never have truer, more penetrating words been said on these matters.

And what Schönberg writes here could and can be experienced by every one of his pupils. There is an impression about that Schönberg teaches his own style and forces his pupils to adopt it. But this is utterly untrue. Schönberg teaches no style at all; he neither advocates the use of old means of artistic expression, *nor of new*. He says in this essay: 'What is the use of teaching the mastery of every-day cases? The pupil would learn to turn to something which he should never use if he wants to be an artist. But the most important thing cannot be given him; the courage and strength to adopt a position from which his view will make everything he comes across a special case'.

Nevertheless, this 'most important thing' is just what Schönberg does give his pupils.

Schönberg demands above all from his pupils that they write, in their exercises for his lessons, not a certain quantity of school-book notes, but music undertaken through a need for expression. In other words, real creation; even in the most elementary stage of musical composition. All Schönberg's subsequent explanations will then have their organic basis in the pupil's work; he will bring in no precept from outside.

Thus Schönberg actually teaches creation.

He follows the traces of the pupil's personality with the greatest energy, and tries to deepen it, to help it to break through, in short to give the pupil 'the courage and strength to adopt a position from which his view will make everything he comes across a special case'. This education teaches one the greatest veracity in regard to oneself. Apart from the purely musical, it touches all the other fields of human life.

For truly, it is more than rules for art that you learn under Schönberg. Whoever has an open heart is here shown the path of good.

But how are we to explain why each of his pupils now working independently nevertheless composes in a manner that brings his own style very close to the music of Schönberg? This is undoubtedly the main cause of the misunderstanding about Schönberg's teaching, which we mention above. No explanation can be given. This question touches the secret of all artistic creation. Who is going to explain that?

There is certainly no question of a merely superficial adoption of these artistic means.

What is the answer, then?

A necessity rules here: we do not know its origins, but we must believe in it.

[1] *Probleme des Kunstunterrichtes*, printed in Musikalisches Taschenbuch, 2nd Year, 1911, published by Stern & Steiner.

Schönberg's Music

The artist never does what others find beautiful,
but only what he finds necessary.
(Arnold Schonberg, Harmonielehre)

Arnold Schönberg is self-taught.

Yet the phenomenal extent of his ability is proved by his works.

Even his opponents have recognised his virtuosic abilities. His works have bee spoken of as theoretical speculations; he has been called a 'theorist'; he has even bee reproached with his astonishing contrapuntal skill.

But theory brings us no nearer to his works. For this there is but one requirement; a open heart. Go and hear Schönberg's music without inhibitions or prejudices of an kind. Forget about theory and philosophy. In Schönberg's works there is nothing bu music – music as with Beethoven and Mahler. The experiences of his heart becom music. Schönberg's relation to art has its roots entirely in the need for expression. H emotion glows with scorching heat; it creates completely new values of expression an so also requires new means of expression. For content and form cannot be divided.

From the anthology 'Arnold Schönberg', Münich, 1912, publ. R. Piper. By permission of the publishers.

On Schönberg's 50th Birthday

It is now twenty years since I became a pupil of Arnold Schönberg. But however har I try, I can grasp no difference between then and now. Friend and pupil: one has ev been the other. And this beginning . . . 'Ye that rejoice; no beginning and no end!' (*Di Jakobsleiter.*)

From the special Schönberg Edition of *Anbruch*, August-September, 1924

On Schönberg's 60th Birthday

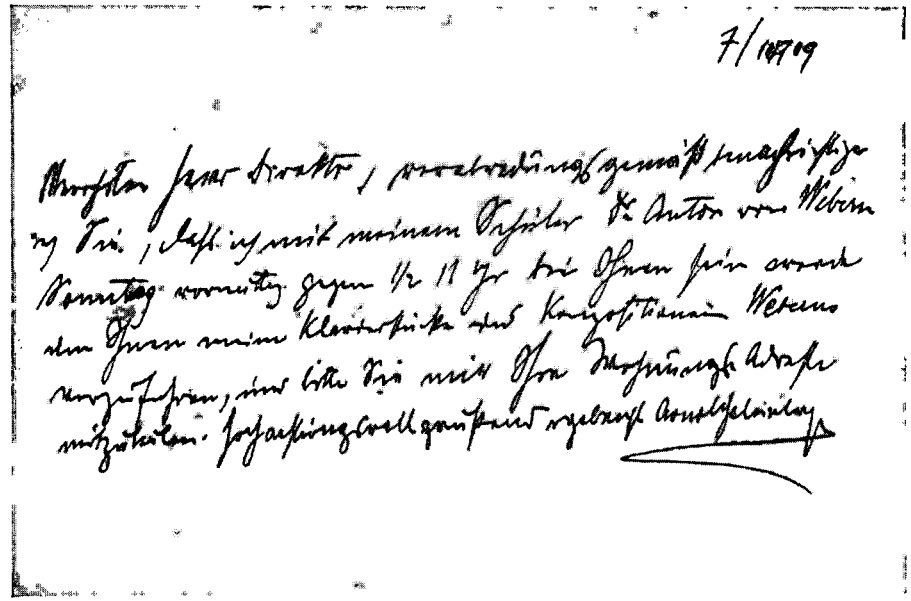
Dear Schönberg,

There are still treasures of your composition which are hidden in publications now ou of print and thus difficult or impossible to get hold of, so let me think on your 60 birthday how I can recover something of this treasure. For as Goethe wrote in his la letter, 'A confusing doctrine of confused action rules the world'.[1] How much then needs your word.

Ever yours
Anton Webern.

From the 'Schönberg-Festschrift' published by Universal Edition, 1934.

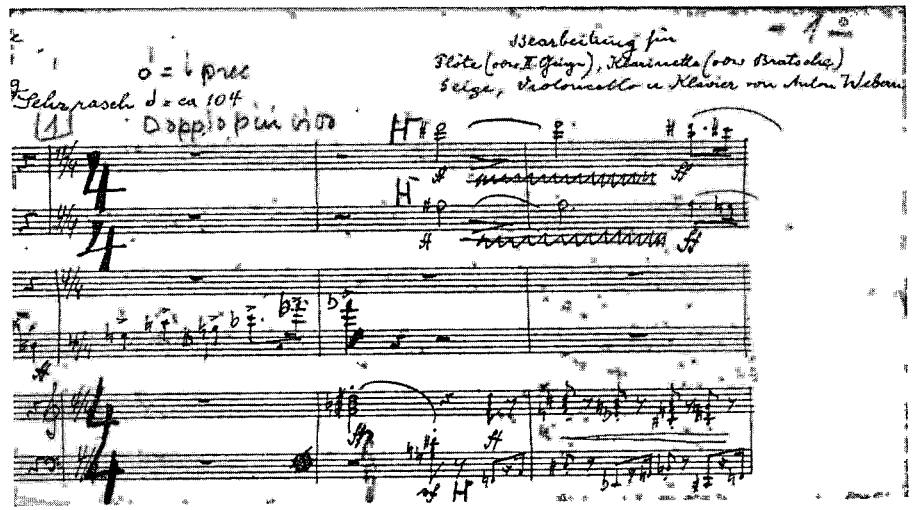
1 'Verwirrende Lehre zu verwirrtem Handel waltet über die Welt'



Schönberg recommends Webern to the Director of Universal Edition

7.10.1909

As arranged, I am letting you know that I will be calling on you on Sunday morning about 11.30, with my pupil Dr. Anton von Webern, to play you my piano pieces and compositions by Webern. Please let me have your private address.



From Webern's arrangement of Schönberg's *Kammersymphonie*

ANTON WEBERN AS A CONDUCTOR

(From the *Musikblätter des Anbruch*, 1927, Vol. 4)

Alban Berg's *Chamber Concerto* for piano, violin and 13 wind instruments received its first performance in Vienna during the course of the Beethoven centenary celebrations. The conductor was Anton Webern, the soloists Eduard Steuermann and Rudolf Kolisch, the wind players from the Vienna Philharmonic Orchestra, and the organisers the Society for New Music. The performance of this essentially happy work was an absolute model, and we mean this literally. Anton Webern had achieved in thirteen rehearsals a shape and clarity, an impetus and sense of rightness, such as are only seldom heard even in the performance of older works. Through his devoted efforts this complicated work was brought so close to the excellent orchestral musicians that they played with love and understanding.

(*Anbruch*, 1929, Vol. 1)

The programmes of the Workers' Symphony Concerts lead the way as always. The two concerts in honour of the Republic will remain unforgettable; Mahler's *Resurrection* Symphony and Schönberg's chorus *Peace on Earth* were performed. The latter is a work of magnificent construction and richness of sound, which has been ignored for too long. It is Webern's achievement to have taught the Vienna Workers' Chorus to sing such a difficult work so ideally. Since Webern fell ill just before the concert, Erwin Stein conducted. The success of the performance was of a splendour rare in Vienna's concerts.

Paul A. Pisk

(Extract from a letter to the *Tagebuch*, Vienna, 2-7-55)

Permit me, as a former member of the Workers' Choir, to add something to the article on Schönberg and the ensuing discussion. I was a member of the choir for more than a quarter of a century; we became acquainted with Hanns Eisler after the first World War, and in 1926 with the music of Arnold Schönberg and his chorus *Peace on Earth*. This work, which was rehearsed by Anton Webern, a conductor of genius, remained an unforgettable experience for all who took part. For with his real mastery and loving sympathy Anton Webern managed to bring even us workers close to the music of a Schönberg.

The most important thing for us members of the Workers' Chorus was that this music first taught us really to hear; and that was Anton Webern's great service. Certainly a long and steep path! I do not know where a choral conductor is to be found today who regards it as his duty to progress with art. Perhaps he became a critic, which is of course much easier than to teach and inspire people to take part in art.

What would be far more important than deciding 'For or against Schönberg' is a little more attention for the progressive composers alive today.

Hans Csap, Wien V.

'THE SAME STONE WHICH THE BUILDERS REFUSED IS BECOME THE HEADSTONE OF THE CORNER'

ERNST KRENEK

It would have been in the thirties that Berthold Viertel paid a visit to Vienna which occasioned a few friends to meet (in a coffee-house of course) in order to hear something of 'the world', meaning England or America or wherever the honoured guest had just come from. Anton Webern arrived a little late, and by the time he joined us all the chairs around the marble-topped table were occupied. So he sat down quietly at the edge of the circle and carefully balanced his cup of coffee on his knees. As I moved over to give him more room, he stopped me: 'Please don't bother, I am quite comfortable in my little corner'.

In the twenty years that have elapsed I have not forgotten this casual utterance, for at the time it moved me profoundly. Only somebody who is wholly convinced of his own greatness could have sat down with such quiet contentment in his 'little corner'. It is true, though, that he only did so when he knew he was surrounded by friends. When he thought he was in enemy territory (which appeared to be almost everywhere except round one poor Café table) his unshakeable faith in himself sometimes took on more threatening forms. In such an environment statements which possessed a simple and an entirely self-evident logical basis in his own mind became disquieting paradoxes. The outer world considered his belief in himself a 'Credo quia absurdum', and this assumed absurdity made modesty and arrogance look confusingly like two sides of the same coin. It was only rarely possible to sense the self-torment which it had cost him to acquire this faith. But it was understandable that someone should in his turn draw an absurd picture of the world that had put him in the corner, and that such a person should arrive at opinions which were incomprehensible even to those who thought they understood him.

The remarkable anonymity which covers like a cloud many of the best Austrians hovered above Webern too. It still throws its shadow on his mortal remains. A few days ago Vera Stravinsky, the composer's wife, told me of a pilgrimage she had made with the young American conductor Robert Craft to Webern's grave during a short stay in Innsbruck. Arriving at the remote village of Mittersill over difficult mountain roads, they asked the way to the grave, expecting that it would be cherished by the inhabitants as a much visited national shrine. Nobody knew it. In vain they examined the more striking gravestones on the wall of the church. Finally they found an unpretentious mound among the graves of the natives of Mittersill, heeded by none. Under it rests the prophet of a new musical cosmos, torn from this world by a dastardly fate. But not from his 'little corner', from which he rules over the musical thinking of generations!

Los Angeles, June 1955.

FROM THE CORRESPONDENCE

Anton Webern to Emil Hertzka, Director of Universal Edition

5th March, 1916

I am turning to you on behalf of Schönberg. We must succeed in obtaining his release. I cannot understand why none of the people who have the power to do so, or at least the connections, have yet used their influence. They just sit by while Arnold Schönberg undergoes the agony of military service, ruins his health and wastes his precious time. For God's sake, does nobody realise what is at stake?

Added to this is the enormous material loss that Schönberg is suffering.

From today Schönberg is at Bruck-an-der-Leitha (Reserve Officers' School). No doubt they will find there that he is unfit for service. It cannot go on like this. Of course he has told no-one how terrible it is for him. But I know. He is wearing himself out.

It did not take long to get a Léhar released. This proves that it is possible to free Schönberg. And all the others: Reger, Pfitzner, the composers and conductors, etc., in Vienna, Berlin; not one is in the army.

So I beseech you to do what you can to get Schönberg released. But soon! It is high time already. I earnestly beg you.

You realise too, do you not, how impossible it is that Arnold Schönberg should be a soldier.

It is a disgrace that he was called up at all, whether it was in ignorance or in spite of who he is. To remove a man like him from his activity is the greatest harm a country can do its culture.

If anybody is 'indispensable' it is Arnold Schönberg.

Sincere greetings,

Dr. Anton von Webern.

Mödling. 3-I-1925.

When you recently enquired somewhat reproachfully about the children's pieces which I had promised to write, I had not time to explain why I have made no progress with them. I should like to make up for that now. Though I am very interested in writing these pieces – I had in fact contemplated something of the sort before your encouragement – I had to interrupt my work on them, as I have been so busy with something else, which, contrary to my original intention, I shall now have to finish first. I am working on a cycle of Latin songs and on songs with German texts.

I should be very hurt if you thought me ungrateful for your well-meant suggestion. No. Please be assured that the opposite is the case, and that I am at present prevented from writing these children's pieces only by the manner of my composition; for with me, things never turn out as I wish, but only as is ordained for me, as I must. One more thing: I intend to perform Haydn's 'Seasons' with my little Mödling Choral Society. It is naturally an expensive business for such a small group these days to obtain choral parts; would you have the great kindness to let me have them at a reduced price? How soon can I speak to you about all these matters? Living in Mödling and having no telephone makes meeting so much more difficult. Also in view of the high cost in time and money of the trip into town, I like to deal with several matters when I do have to go to Vienna . . . .

Mödling. 15-IV-1925

When Schönberg and I came to you the other day requesting you to recommend me for the Bochum post and to use your influence with Dr Bach, I unfortunately could not really explain my intentions to you through lack of time. So I permit myself briefly to make up for this now.

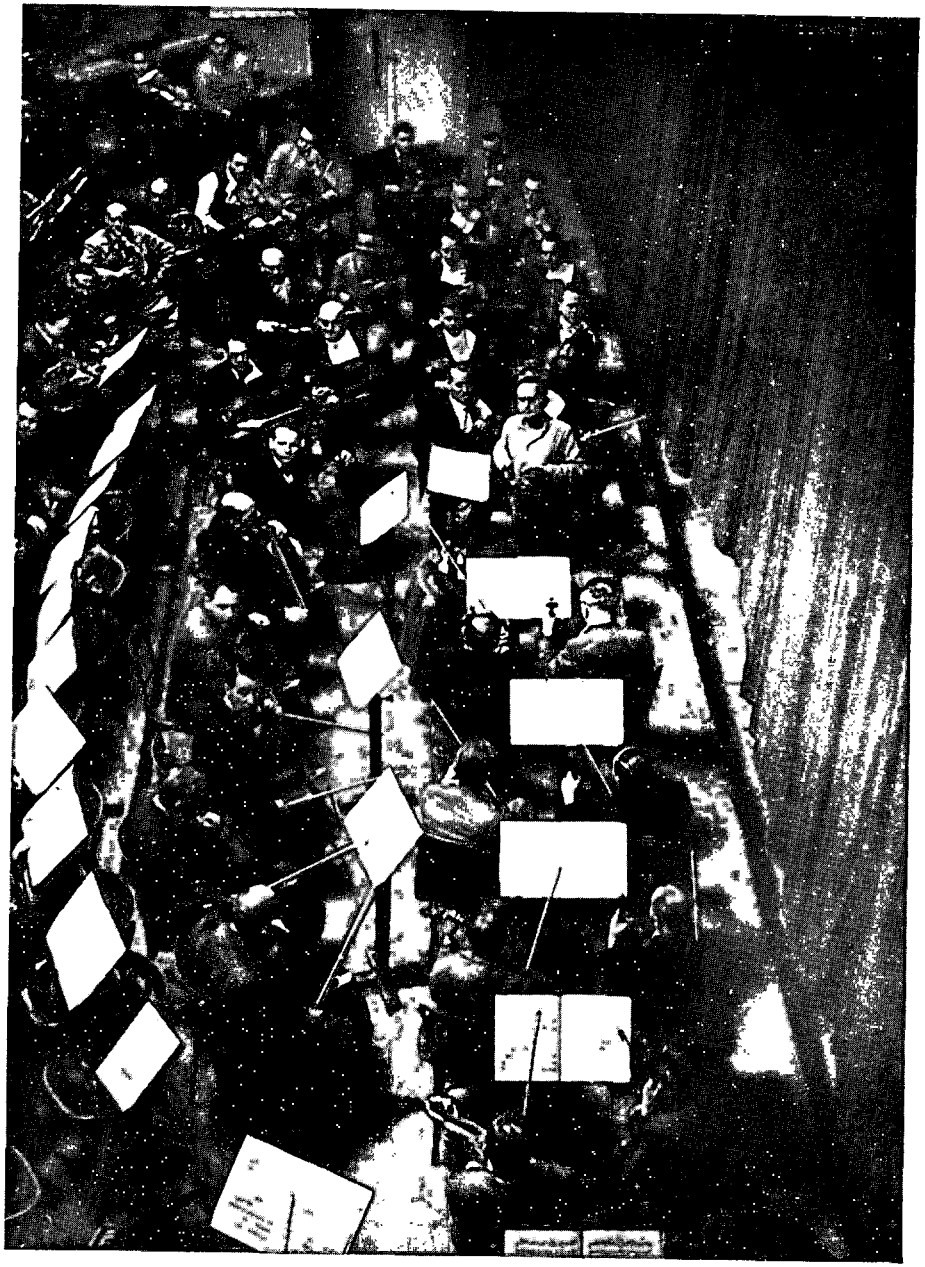
I am looking for a conductor's post; something like the so-called city music directors' in Germany. That is why I am thinking of Bochum. But I do not want to commit myself to something of this sort. All I want is to escape once and for all from my present financial insecurity and to find a suitable field of artistic activity as a conductor.

What a joy it would be to have a slightly easier existence! Do I really not deserve it at all? But I do not mean to be presumptuous.

And now I warmly entreat you to help me with these intentions of mine and to use your very effective influence on my behalf . . . .

Mödling. 26 Sept. 1926

I strongly and warmly beg you to continue the monthly advance of 100 Sh., which you granted me from May to September inclusive, into October. I do not know how I am to get through the month. Since there has been no change in the matter of lessons or other regular sources of income, I would only receive my pay from the Institute for the Blind (200 Sh.) and my fee as chorus master (80 Sh.): 280 Sh. in all! By November I shall have my first concert – Symphony Concert of the workers' orchestra (when I am doing,



Webern at a rehearsal of Mahler's 6th Symphony in the Wiener Konzerthaus, 23 May 1933

27. JAHR ARBEITER-SINFONIE-KONZERTE 1931/32

Dienstag, 21. Juni 1932, 19.30 Uhr
im Großen Musikvereins-Saal

ZU EHREN DES ZEHNTEN INTERNATIONALEN MUSIKFESTES

ORCHESTER-KONZERT

SCHÖNBERG . . . . . a) Friede auf Erden (Gedicht von C. F. Meyer)
b) Begleitmusik zu einer Lichtspielszene

BERG . . . . . Der Wein (Gedicht von Baudelaire) für Sopransolo und großes Orchester (Erste Aufführung in Wien)

MAHLER . . . . . Zweite Sinfonie

Ausführende:
Ružena Herlinger (Sopran)/Enid Szantho, Staatsoper Wien (Alt)/Freie Typographie/Der Singverein der Kunststelle/Das Wiener Sinfonieorchester

Dirigent: ANTON WEBERN

PREIS DIESES PROGRAMMES 40 GROSCHEN

Programme of the Workers' Symphony Concert conducted by Webern on 21 June, 1932. The concert included the first performance in Vienna of Alban Berg's concert aria *Der Wein*.

amongst other things, Mahler's *Klagende Lied*) – so things will become easier. But October! I ask you again to have another 100 Sh. paid to me. I am working on a String Trio, which I hope to finish in the course of the winter . . . If only I could be more financially independent, so that I could devote myself to my work! There is a marvellous remark of Goethe's to Schiller; '. . . we should do nothing but abide in ourselves, in order occasionally to bring forth something tolerable. Whatsoever is more . . . cometh of evil'. I hope the time is no longer too far off when I, too, shall with your help find a solution to this problem. How I could work! . . . .

6 Dec. 1927

I am eager to give you many and sincere thanks for your prolongation of the monthly payments for 1927 and for the rapid publication of my Trio; this faith you have again shown in my cause is my greatest support on a path which is surely no easy one.

But I should like to take this opportunity to reassure you by pointing out that, particularly in the last years, a difficult but steady and uninterrupted ascent of my cause has been visible. And is not this sort of success of more value than a pyrotechnic rise? Every year the number of performances of my works of all kinds rises . . .

I know, of course, that my work still has very little importance regarded purely commercially. The cause of this lies in its almost exclusively lyrical nature up to now; poems do not bring in much money, but after all they still have to be written . . .

The committee of the German chamber music festival at Baden-Baden issued a special appeal to composers to write for chorus with small orchestra – chamber cantatas, as they call it. So I have long fulfilled with my chorus what they are now propagating . . . I am very sorry that you could not hear my performance of Kodaly's *Psalmus Hungaricus* on the 6th of November.

Tomorrow (Wednesday) the Hugo Holle choir is singing my unaccompanied chorus '*Entflieht* . . .' in Vienna. Apart from once this year in Fürstenfeld, a little place in east Styria, it has never been done before: so this will be to all intents a premiere tomorrow, after 20 years. I wrote the chorus in 1908 . . . .

Mödling. 19 Sept. 1928.

Kolisch's news about an uproar when my Trio was performed (he telegraphed: 'First disturbance, then uproar, finally triumph') made me very excited on your account. Now your recent kind card convinced me of your unshakeable faith in my cause . . . In the meantime I have already turned to a new work; a concerto for violin, clarinet, horn, piano and string orchestra. (In the spirit of some of Bach's Brandenburg Concertos.)

If only I had a few months of free time ahead of me.

When shall I at last be sufficiently independent? How I could work! What could be more self-evident than the fact that a composer exists in order to compose? . . . At the Republic Celebrations of the Workers' Symphony Orchestra on November 11th I am performing Schönberg's chorus *Peace on Earth*, and Mahler's Second Symphony. Thus Schönberg's chorus is performed again in Vienna after nearly 20 years – for the second time . . . .

Anton Webern to Alban Berg

Berlin-Zehlendorf. 21-XII-1911

Dear Berg,

I am sending you a little Christmas present – Kant's letters. Do not be angry with me for this, for I feel I must.

There are few things as marvellous as Christmas. You must consider: after nearly 2,000 years, the night on which a great man was born is still celebrated by nearly all men on earth as a moment in which everybody says only kind things and wishes to do good to all. That *is* wonderful.

Should not Beethoven's birthday be celebrated in the same way?

I can only agree with your decision about the brochure on Schönberg. There is only one thing, this book will not appear before the Spring.

If I am to write on the *Harmonielehre* the publication will have to be postponed for a long time. I must read the book first, of course. And that will take me at least a month. I have always wished to write about it. But perhaps you or Jalowetz will do it, for he too wants to write about it. I shall certainly do so too, but my essay can be published somewhere else. You already know the book so thoroughly. Our brochure could then appear sooner. Kandinsky's book is excellent. I do not think I have already written to you about it; or have I? It is called *The Spiritual in Art*[1], published by Piper in Münich. Otherwise there is nothing new.

I am reading *Wilhelm Meister* and am deriving the greatest joy from this book. I often play the *Lied von der Erde*. It is incredibly beautiful. Beyond words.

So all good wishes for Christmas.

Your
Webern

I am giving you Kant's letters because I wish you to become acquainted soon with this splendid, remarkable mind.

I do not know very much of his, either. But I am striving towards a very exact knowledge of him.

It is remarkable that on the one hand Beethoven and Kant, and on the other Wagner and Schopenhauer were roughly contemporaries. I always feel a spiritual affinity. The influence of Schopenhauer on Wagner was really considerable. And in the other noble pair I feel a concord of minds, although of course Kant had no influence on Beethoven such as one could speak of with the other two.

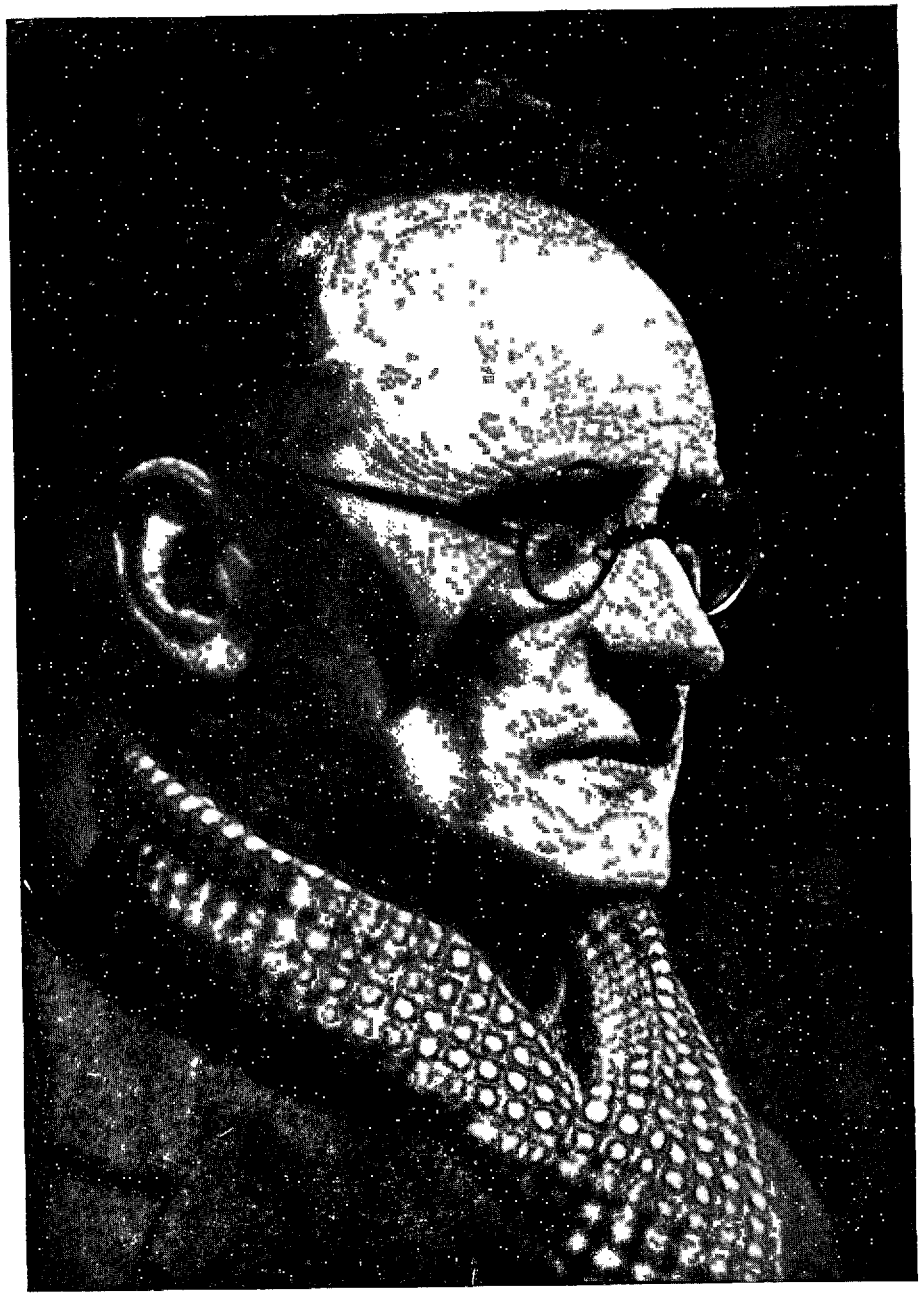
And Strindberg and Mahler?

Maeterlinck and Schönberg?

Also Strindberg and Schönberg!

Rays of God.

[1] *Das Geistige in der Kunst.*



x

Mürzzuschlag. 1-VIII-1919.

My dear Berg,

Many thanks for your letter. I am very glad that you have already got so far with *Wozzeck*. I eagerly await its completion.

I have been to Hochschwab. It was glorious: because it is not sport to me, nor amusement, but something quite different; a search for the highest, for whatever in nature corresponds to those things on which I would wish to model myself, which I would have within me. And how fruitful my trip was! The deep valleys with their mountain pines and mysterious plants – the latter have the greatest appeal for me. But not because they are so 'beautiful'. It is not the beautiful landscape, the beautiful flowers in the usual romantic sense that move me. My object is the deep, bottomless, inexhaustible meaning in all, and especially these manifestations of nature. I love all nature, but, most of all, that which is found in the mountains.

For a start I want to progress in the purely physical knowledge of all these phenomena. That is why I always carry my lexicon of Botany with me and always look for any writings that can help to explain all that. This physical reality contains all the miracles. Experimenting, observing in physical nature is the highest metaphysic, theosophy to me. I got to know a plant called 'winter-green'. A tiny plant, a little like a lily of the valley, homely, humble and hardly noticeable. But a scent like balsam! What a scent! For me it contains all tenderness, emotion, depth, purity.

I have written four songs to Trakl's poems. With accompaniment for E♭, B♭ and Bass clarinets, violin and cello, in varying combination: except in one song, all with three instruments. Two years ago I composed a Trakl song like this; by resuming I have completed a cycle of five Trakl songs (up to now), for this small combination.

Write to me again soon. Unfortunately my holiday will soon be at an end – most of it is over now. When are you returning to Vienna? I still want to have one more biggish trip in the mountains. Perhaps to the Ennstaler Alps. Or perhaps – but it's so expensive – to the Grossglockner (with my cousin Diez). If my father can not come here I shall certainly go to Klagenfurt. It was, of course, liberated yesterday. And perhaps you will come down for a day. I shall tell you in good time.

All good wishes for your work. May I too still succeed in much and good work.

Your
Webern.

Alban Berg to Anton Webern

12-10-25

What a great joy you have given me with your Op. 12,[1] my dear fellow. Once again – like everything of yours – it's real Webern. Even the combination of those glorious texts and the concentration into a whole! And then the music! Indeed I seem to see you in quite a new way. What atmosphere in the Strindberg song. And altogether what variety in all the four songs. The last, for instance, has such grace. One can truly say that it is to be found nowhere else in all music. A song of yours is a bringer of joy to me, a gift that radiates joy through my whole soul. Like the sun when it suddenly breaks through on a dull day, and you do not know why you are suddenly happy. It is just the same with the scent of flowers, and what you say about that are words of gold. Moreover your expression is always so pregnant that I repeatedly and bitterly regret that you do not 'write', at least about music. And what an infinite amount you would have to say!

[1] Four Songs for Voice and Piano Op. 12.

8-12-27

I did want to look in and see you last night. I had hoped to find you in the artists' room, but when I arrived there was not an artist left. Honestly. So I want to write to you quickly to say how enchanted I was by your chorus[2] – despite the mediocre performance. What a glorious melody! And what a beautiful effect when the repeat of the F sharp of the first soprano is at first avoided, only to arrive at figure 5 with mysterious power. Not to mention the low G of the basses. At that point I felt a shiver of awe at that mystery of nature – no, of your art. Thank you.

[2] *Entflieht auf leichten Kähnen* (Stefan George), Op. 2

19-8-32

You give me one pleasure after another:
1. The Quartet.[3]
2. The news of your apartment in Mödling.
3. Your stay in Fusch.

I have been wanting to thank you (for 1.) for a long time, but I was awaiting your arrival in Fusch. Yes, the Quartet is a miracle. What astonished me above all is the originality. It is no exaggeration to say that the whole world of musical composition never had anything to approach this 100-per-cent originality. I simply cannot stop looking at these pages of music; 1000 thanks, my dear fellow.

[3] Quartet for Violin, Clarinet, Tenor Saxophone and Piano, Op. 22

Anton Webern to Hermann Scherchen

Maria Enzersdorf, 1-I-1938

I am very glad that you are doing 'my' (I think I may call it that) Bach Fugue on the B.B.C. And more particularly that you have written to tell me so, which, anyway for me, reopens the contact between us that appeared to be broken after the unhappy days in Barcelona.[1] To think that absolutely nobody should have understood me then! How I felt right after Berg's passing, and that I was simply not up to the emotions aroused by the task of giving the first performance of his last work – so soon after his death!

Right up to the last moment I hoped to be able to stand it. But I was not to succeed.

Now for your question: the 'rubato' you ask me about is intended to indicate that I think of these measures of the Fugue subject as played with movement – every time, even with all the later additional counterpoints: accel., rit., finally merging into the 'poco allargando' of the last notes (of the subject). For I feel this part of the subject, this chromatic progression (g-b) to be essentially different from the first five notes, which I think of as being very steady, almost stiff (i.e. in strict tempo; for the tempo is set by this phrase), and which in my view find an equivalent in character in the last five notes. More precisely, I intend the 'rubato' like this: from g via f♯ to f faster, then holding back a little on the e♭ (accent given by the harp) and again rubato on the trombone progression (including the tied e♭ of the horn where the trombone has a crotchet rest in bar 6). By the way, g to e♭ is also 5 notes, and if you count the e♭, as a link, twice – (to the inner ear this first crotchet of bar 5, the tied e♭ on the horn plus the crotchet rest of the trombone, is heavily stressed, a dividing point, beginning and end, and I have orchestrated it as such); well now, if you count the e♭ twice, you again have 5 notes (from e♭-b). The construction therefore appears to me as follows: 5 notes, then 4 + 1 and 1 + 4, which is twice 5, and at the end another 5 notes!

i d e m

And these central twice 5 notes, the actual centre of the structure, I feel to be quite different in character from the beginning and from the end. The latter leads back with the poco allargando to the stiffness of the opening – now appearing in the answer. In dynamics this means that you must make a strong difference between the pp of the first 5 notes and the p of the central notes! And in the last five notes return molto dim. (>) to pp.

I hope I have made myself understood. I must add that of course the subject must not appear too disintegrated by all this. My orchestration is intended (and I speak of the whole work) to reveal the motivic coherence. This was not always easy. Beyond that, of course, it is supposed to set the character of the piece as I feel it. What music it is! At last to make it available, by trying through my orchestration to express my view of it, was the ultimate object of this bold undertaking. Is it not worth while to awaken this music asleep in the seclusion of Bach's own abstract presentation, and thus unknown or unapproachable by most men? Unapproachable as music! Let me know about your impressions and experiences in London. I shall listen! One more important point for the performance of my arrangement; nothing must be allowed to take second place. Not even the softest notes of the muted trumpet must be allowed to be lost. Everything is of primary importance in this work – in this orchestration . . . .

[1] I.S.C.M. Festival, 1936.

Maria Enzersdorf. 12-IV-38.

I am glad that you have undertaken to do the first performance of my choral piece 'Das Augenlicht'. The score is in London at the moment but is expected back in the next few days. The vocal score is already being printed. This vocal score is also to be used as a chorus part. Thus the chorus will have the entire work in their 'part'. I think this will make things much easier. But it is still unclear which choral group is to sing! In my view one should insist that the B.B.C. chorus do it . . .

It would be wrong to do it with soloists. That is only a last resort. You see, my dear Scherchen, there are still difficulties to overcome . . . Of course I should like to discuss the work with you as thoroughly as can be done in writing. Only for the moment I will wait until you have received the score and assimilated it, and I beg you to ask me what you like – preferably a lot of questions . . . .

Anton Webern to the members of the 'Freie Typographia'

Mödling. 15 Nov. 1928

You will all realise, I am sure, how sad I was not to be able to lead you to victory myself in the two concerts, after the long, hard and unusually enjoyable work of rehearsal.

But I wish to speak less of this than of the fact that although I had to abandon you, the two concerts were a most important victory for you. I had foreseen this with complete certainty, and it was my greatest consolation in my misfortune.

And look now: what more convincing proof of your complete ability to master your difficult tasks (I am thinking especially of Schönberg's 'Friede auf Erden') could have been found than such a victory without me, and indeed under a conductor whom you met for the first time shortly before the concert? Let anyone who has doubts be told: you have learnt Schönberg's chorus, my friends, with a degree of thoroughness which even I had hardly expected. But I must also mention my dear friend Erwin Stein, who saved the concert at the last moment and consecrated it by his artistry.

I hope that I shall soon be fully recovered and enabled to devote all my strength to you . . . .

Anton Webern to the mother of Ludwig Zenk[1]

22-XII-1933.

I thank you and your husband with all my heart for your good wishes and the splendid present on my 50th birthday. I want to take this opportunity of telling you how happy I am about Ludwig. His most recent works I consider amongst the most significant of the younger generation's products. Personally, they are my favourites.

Beyond this, he appears to me to be the only one who carries our path onward. For he is on this path, and it is no easy one. But we will do all we can to help him.

We hope that his Piano Sonata may be performed in Florence (October 1934). At all events the preliminary jury of the I.S.C.M. has handed it in; in fact as their first choice! These music festivals have a large international audience; his work will thus become known to the whole world. Time to work, which is what we are here for, is the most important thing for Ludwig.

Everything else will follow. This I know with absolute certainty.

[1] Ludwig Zenk, pupil and friend of Anton Webern; composer and conductor, died in 1949.

Anton Webern to Erwin Stein

Maria Enzersdorf. 23-VI-38.

I am very glad about your news and thank you warmly! This will be my fifth performance in London this year – the Bach Fugue, the Trio, the Quartet, 'Augenlicht', and now the Symphony! Could not Dr. Kalmus encourage the B.B.C. to repeat the 'Augenlicht' together with the Symphony, since the B.B.C. chorus and orchestra have already performed it? List tells me that the chorus was excellently prepared. I particularly mention this, because it seems that Wright, according to Reich, was very regretful that the performance was not broadcast. I have also since received more very pleasing reports on the performance of the Augenlicht! I was particularly happy about a most unusual letter from Peter Stadlen. Are these 'signs and wonders'?

Anton Webern to Hildegard Jone

14-V-1944.

Now, dear Hildegard, how happy you made me by what you wrote about my Cantata. I thank you. Above all, what you say proves that I interpreted your thoughts correctly. As you send them out they return to me, unchanged by the arrival of music. How you have understood all this! Yes, is it not like this: my music proves to you that I have understood you; that you have understood me is proved to me by your words!

Alfred Schlee, Director of Universal Edition, to Anton Webern

Vienna. 17 July, 1945.

I am using the first available opportunity to send you news[1]. Here we survived everything safely, but regret infinitely that you are not in Vienna. So much of essence to the entire future is being discussed and carried through that your presence would be of the most decisive importance . . .

It was unfortunately impossible to prevent very heavy damage to the apartment in Mödling. You can imagine that we, and especially your sister-in-law Frau Gross, have done our utmost to save what could be saved. We have also received exemplary support from the city, but one can achieve very little of practical value unless the owner of the apartment is there.

The I.S.C.M. has re-founded the Austrian Section and elected you president . . . Many other artistic problems also await you. As I say, all this, too, can only be solved when you are here . . .

[1] To Mittersill.

THE U.E. – READER

Extracts from opinions given by Webern to Universal Edition

X... Tanz-Capriccio.
Suffers from too many repetitions, and so appears rather primitive, but might – because of its tempo – be effective.

X... Ballet in one act.
Definitely more valuable than V's piece. But again the attempt at primitive effects (so much unison!). One would need to know the 'scenic' intentions.

X... Four Songs.
Entirely amateurish, miserable, cheap! Indescribable!

X... Violin Concerto.
I cannot recommend it. Invention clearly based on Grieg, at least in the 1st movement. In the 2nd and 3rd it is different again. So: who knows if the man really comes from up there? But further: how poor it all is! Harmonically: constant, irrelevant modulations, and generally this is nothing but falling by a fifth, which is the easiest method. If he tries anything else he fails completely. Since we are being driven about all the time there is no idea of form. Perhaps the theme of the 2nd movement is not too bad. The opening is quite warmly felt; but nothing is done with it! The last movement is no good at all. The orchestration is very suspect. In all, then: dilettantism! This is only a general view – I could of course give you detailed reasons. I looked at the thing thoroughly. After all, I am personally interested in understanding these things.

X... Quintet for Wind.
What is usually referred to as 'shoddy'.

X... Albumblätter.
Impossible!

X... Prelude for large orchestra.
One should see more of his; ask him perhaps to send in chamber music, songs, etc.

It is said of many an author that he has indeed technique, but no invention. That is wrong; either he also lacks technique, or he also has invention.

ARNOLD SCHÖNBERG
Problems in Teaching Art

The ultimate principle in the presentation of a musical thought is comprehensibility.

ANTON WEBERN

CHORALIS CONSTANTINUS[1]

ANTON WEBERN

The second part of the *Choralis Constantinus*, Heinrich Ysaak's[2] great setting of the Office, contains 25 Offices. They are arranged according to the sequence of the church year, beginning with the feast of the Birth of our Lord, concluding with the Immaculate Conception of the Virgin Mary. Polyphonic Graduals had indeed been written before Ysaak's time, but he was the first who undertook to make choral settings of the Gradualia for the entire ecclesiastical year. The motive impelling him to this task should be sought not exclusively in practical necessities, but also in the deep religiousness of the master and in his love of the beauty of these liturgical poems.

When the music of the *Choralis Constantinus* is examined, one thing is immediately apparent – the Netherland style. There emerges clearly and distinctly the element that gives its special value to the Netherland school, and that characterises to so high a degree the music of no other people; the highest polyphony. If one compares the *Choralis Constantinus* with works by Ysaak that belong to a different style – with the German, Italian or French songs – one feels clearly that in his great settings of the Office, in his Masses and other songs that are written in the Netherland style he does indeed give of his greatest and most deeply personal. Like Josquin, Pierre de la Rue and the other great masters at the turn of the 16th century, he takes root with every fibre of his being in the art of the Netherlands. The style of the German *Lied* was, however, closely related to the Netherland style; and Ysaak could thus produce German songs that belong among his best works and therefore occasion the theory that he was a German. But the majority of his work, and above all the crowning glory of his creative achievement, the *Choralis Constantinus*, marks him out as the purest Netherlander, and it seems almost incomprehensible that external evidence was needed to establish this. In the development of the technique of vocal writing from the second half of the 15th Century to the end of the 16th, Ysaak finds his place somewhere in the middle. There reigns in Ysaak's work, in comparison with that of Okeghem or Jacobus Hobrecht, a much greater liveliness and independence of the individual parts.

The stiffness of movement resulting from the 'note-against-note' method of handling the parts, from their continual simultaneity, so that they seemed like an impenetrable mass, has disappeared from Ysaak's masterpiece and left no trace.

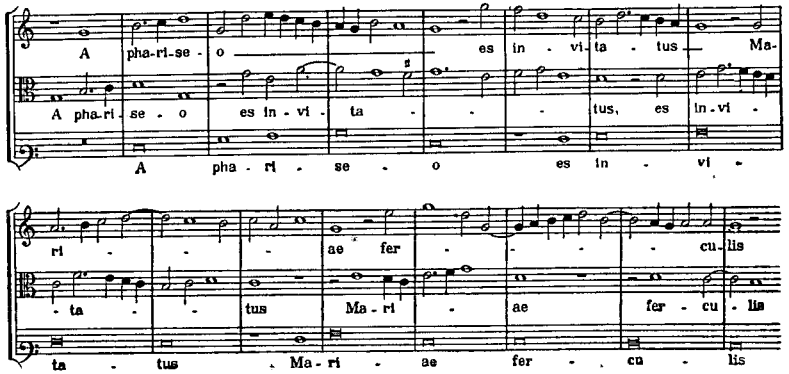
Here we experience that wonderful effect of polyphonic art that is achieved in the following way; the parts proceed alongside one another in complete equality, but that part comes to the fore which during its course is to be the most important, while as it recedes another begins to emerge; in short through subtle organisation of the interplay of parts. Ysaak's successors never made any fundamental advance on his polyphony. What they carried farther and to its culmination was the complete cleansing of the music

[1] From the introduction to Vol. 1 of the 16th year of the *Denkmäler der Tonkunst in Österreich*, by permission of the Gesellschaft zur Herausgabe von Denkmälern der Tonkunst in Österreich, Vienna.

[2] According to the arguments put forward by Dr Franz Waldner in 'Heinrich Ysaak' (*Innsbrucker Ferdinandeum-Zeitschrift* 1904), the correct spelling is not 'Isaak' but 'Ysaak'.

from the stiffness that in Ysaak and his contemporaries still to some degree adhered to it. A contributory factor here was the greater attention given to the sound the parts made together – a result of the ever more completely-developing requirements of harmony. In the masterpieces of Lasso and Palestrina the polyphonic style achieves its greatest clarity. But one can not draw an exact borderline here, and Ysaak wrote much that, in this direction too, shows the highest degree of perfection.

In the *Choralis Constantinus* Ysaak realised in a wonderful way the ideal of lively and independent part-writing. Each part has its own development, and is a completely self-contained, separately comprehensible, wonderfully animated construction. This can be seen from every page of the Office settings, but to illustrate how clear and well-proportioned is Ysaak's shaping of his vocal parts, I should like to refer to the phrase '*A Phariseo es invitatus Mariae ferculis saturatus*', in the Prose of the 14th Office.



The Discantus here is so expressive – one need mark only the utterly splendid melody, spreading itself out over an entire octave, at the beginning of the word '*ferculis*' – that one is inclined here to attribute to it, as the top part, more importance than to the other two parts; but in the bass the chant marches on in solemn breves, itself a wonderful structure – the descending movement on the word '*ferculis*' is particularly expressive, and the alto part is no less clearly organised and independent. The way in which the three parts are always worked into one another, in just such a way as to make the individual life of each stand out all the more clearly, this is the highest art, and the euphony of the piece is indescribable. To the ideal of making each voice an independent, highly individual entity Heinrich Ysaak dedicates every artifice of counterpoint, and it is from this ideal that the boldness of his technique springs. Open consecutives of similar perfect consonances are often found, and hidden fifths and octaves still oftener. Ysaak employs them in order to attain special effects of sound. I can not agree with the assertion, made in the Introduction to Part I of the *Choralis Constantinus*, that these progressions are 'at any rate unintentional'. Nothing 'slips past' a master like Ysaak, who has such a wonderful command of his craft, and if so-called incorrect progressions of this kind are present in his music, then he certainly willed them.

Ysaak uses canonic devices very profusely in the second part of the *Choralis Constantinus* – two-part canons at the unison, the fourth above and below, the fifth and octave

or the twelfth. It may happen that one part is so derived from another that, entering at the same time as the latter, it imitates it in notes of double the value, or, likewise starting at the same time, transposes the other to the third above. In addition Ysaak constructs three-part canons, a four-part one, three double-canons and finally two crab-canons. Close or more distant imitation, stretti, augmentations, diminutions continually occur in the Offices; initial imitation is the basis of the part-writing.

It is remarkable how Heinrich Ysaak achieves widely-differing tonal effects with the means at his disposal . . . Another element is the most delicate observation of tone-colour in the various registers of the human voice. This is partly the cause of the frequent radical crossing of parts and of their movement by leap. Thus it is noteworthy that in the *Choralis Constantinus* the chant constantly winds its way through Ysaak's music – always recognisable, despite all alterations, if one is following it, though because of its intimate relationship with the other parts it can only rarely be picked out by the listener. What is wonderful is precisely how Heinrich Ysaak grasps with the greatest insight the spirit of the chant, and so absorbs it into himself that the chant appears in the master's music not as something foreign to its nature but welded into the highest unity with it – a splendid witness to the greatness of his art.

The phenomenon of music is given to us with the sole purpose of establishing an order in things, including, and particularly, the co-ordination between *man* and *time*. To be put into practice, its indispensable and single requirement is construction. Construction once completed, this order has been attained, and there is nothing more to be said. It would be futile to look for, or expect anything else from it. It is precisely this construction, this achieved order, which produces in us a unique emotion having nothing in common with our ordinary sensations and our responses to the impressions of daily life.

IGOR STRAVINSKY
Chronicle of My Life
(Victor Gollancz, London, 1936.
U.S.A.; An Autobiography
M. & J. Steuer, New York, 1958.)

Webern wins over even those who can not be called partisan; he hears and gives shape to the formulae of a world which most people neither know nor apprehend. He speaks little, says everything.

PAUL STEFAN (*Anbruch 1922*)

Signed photograph presented to the Viennese *Freie Typographia* by Webern after the performance of Mahler's 8th Symphony in which they took part.

Oil painting (1945) by Hildegarde Jone

('Webern standing in the doorway of his house, a few moments before his violent end')

ANALYTICAL

A CHANGE OF FOCUS

HERBERT EIMERT

In Webern's life and work, the unobtrusive is a salient feature. Of the outward course of his life, a quiet path full of worry about his daily bread, and without artistic or material success, there is nothing remarkable to relate. After Schönberg's emigration, after Alban Berg's death, Webern withdrew completely; he almost vanished from the sight of the world around him. But in this unobtrusive descent beneath the surface of his time, there is no trace of any feeling of decline. The hard core of his being withstood the strain of his time – even his violent death ten years ago, by the bullet of a soldier of the occupation, seems to exemplify unbrokenness and unobtrusiveness; an abrupt, accidental death which amid the prevailing disorder was noticed only by those nearest him.

Webern's creative career, as presented to his contemporaries, also stands pre-eminently under the sign of the unobtrusive. Nothing in it foretells the leading position that must be accorded his work today. In thirty-five years of creative work, from 1908 to 1943, Webern wrote thirty-one works. None of them was a sensation, a landmark, a hit, or whatever else such an occurrence is called in the language of the daily press. None of them imprinted itself on the musical consciousness of the times, in either a good or a bad way. For Webern also has no place worthy of mention in the list of scandals and triumphs of the new music. There were occasionally a few protests at performances of his works – for example the Movements for String Quartet at the first Salzburg Festival in 1922 (the direct predecessor of the I.S.C.M. Festivals), or later at the first performance of his String Trio; and in the Schönberg number of *Anbruch* one can re-read what a Viennese daily paper reported of an uproar at a concert of the Schönberg School in 1912, in the large hall of the Wiener Musikverein: 'Herr von Webern also shouted from his box that the whole lot of them should be chucked out . . .': but all this is as inessential to the overall picture as the occasional 'successes', among which the performance of *Das Augenlicht* at the London Festival of 1938 might perhaps be classified, according to the hallowed usage of biography, as the 'climax' of Webern's modest career as a composer.

In the composer's life-time and almost up to the middle of the century, the prevailing picture of Webern shows only negative or at best neutral features. This is not altered by the important and happy circumstance that Arnold Schönberg was a loyal ally of his former pupil, and that around Webern the composer there was a small devoted circle of people who revered and loved him. If his compositions remained wholly hidden from any wider public, it was all the same remarkable that his name was always mentioned respectfully in the context of the Viennese School. The purity of his convictions, the consistency with which he relentlessly went his way, and his masterly abilities, these were never doubted. But that was all – no individual or even creative feature such as might have given form to the pale, impersonal picture. Webern simply belonged to the Viennese School – in his case this surely denotes as much a historic truth as the virtual anonymity of a

'student'. The quiet one of the family, given to abstraction and analysis, of whom one had unobtrusively to take note in order that the family should be complete – that is the picture of Webern to be found in all accounts of contemporary music until very recently. (One of them, which appeared in 1949, devotes to Alban Berg four and a half pages, and to Webern a single line!)

The same insufficiency prevails with regard to performances of Webern's works. Even when they made any progress at all in specialist circles, they remained without trace of any effect communicable to the general public, and they did not have even the advantage, as had those of Schönberg and other modern composers, of exacting a negative reaction. Like strange precious stones from unknown regions, they lay in the ground, not, as it were, ignored or neglected, but simply hidden from view. On occasion, serious students – well-informed propagandists of the new music, and favourable to Schönberg – tried to discover in Webern's music a trait of the comic, parodistic, and bizarre, or even of ironic clowning – in the very music where, through extreme condensation and abbreviation, the most concentrated lyricism was made manifest.

But worse than such misunderstandings are the ready-made concepts and handy prejudgments that are gained from incomplete impressions and can so easily be transferred to the whole – once printed, these are habitually reprinted, and provide indestructible material for stock concepts and formulae, such as the stereotype of Webern as the master of pianissimo, the melancholy virtuoso of silences, whose music is the ultimate stage short of aphasia. This is one of those half-pictures that are wrong because they are handed out as representing the whole. The thesis that Webern's music is 'an end' also appears quite early; it was first set out by Mersmann and was dialectically developed twenty years later by Adorno. This half-picture refers to the aphoristic Webern of the expressionist miniatures, the 'Pieces' and 'Bagatelles'; it is in this series of works, Op. 5 to Op. 11, dating from 1909-1914, that the sound seems to be overheard, and the muted, the utterly delicate, the softly-drawn, the evanescent, the scarcely-audible are raised to the level of performing-indications.

Webern countered the dangers of this pianissimo-psychography in a way that can surprise only him who sees in words set to music merely the usual facile combination of notes and words. In the eleven years from 1915 to 1926 Webern wrote only vocal works, principally groups of songs with from two to five instruments, also four songs with piano and two choruses with instruments. This series of works from Op. 12 to Op. 19 contains the full development and formulation of Webern's motivic style; the *Three Folk Texts* of 1924 (Op. 17) add to these unmistakably-stamped, specifically Webernian resources the twelve-tone technique.

In Webern's work, words and music do not enter into formal and emotional ties; their relationship points to a structural connection. The word is not a safety-belt for the composer who is going dumb, sinking into the silence of terror or impotence; rather is it incorporated into the musical structure – to outward observation, in a very instrumental manner, but really in such a way that within the static mirror-system of Webern's motivic language, the phonetic sound-tension of the words appears not as something set to music but as an interval-object that carries the structure. The word is not a pretext for form and the compositional flow – the text is taken literally 'word for word', and this is the reason why in Webern's vocal style the unsingable nevertheless impresses itself on us by a plasticity that stands in contradiction to all previous experience. Often

one is unable to get the vocal turns of phrase out of one's head, whereas with their wide leaps they should never, according to the theories about stepwise vocal writing, have got into one's head at all. The co-ordinated structure of phonetics and music demonstrates a totally new way of utilising language. Because of the logic of language and the physiology of the voice, the sung text does not lend itself to that disintegration and splitting-up of sound which lies within the power of instruments.

The last and most important group of works, from the String Trio (1927) to the Second Cantata (completed in 1943) contains, besides the choral work *Das Augenlicht* and the First Cantata, the most important of Webern's instrumental compositions, apart from the Trio: the Symphony for Small Orchestra, the Saxophone Quartet, the Concerto for Nine Instruments, the Piano Variations, the String Quartet and the Orchestral Variations. The last dynamic indication of the last work Webern completed is, indeed, again *verlöschend* (*dying away*), and how better could the poetically-inclined observer end his monograph than with one more tribute to the master of silence and aphasia? But even a superficial glance at these scores would needs reveal to him the truth – that in them, for all his real and subtle differentiation of sounds and of their degrees of intensity, Webern speaks a musical language of exactness, firmness and inner hardness. Just as in dry climes the sculptural qualities of plants emerge, so does the interval-object win, in the brittle, hardened material-atmosphere of Webern, so high a degree of plasticity that its qualities are transformed into new musical quantities – an extremely important moment in the history of the new music, perhaps the most important between the emancipation of the dissonance and musicians' discovery of the sinus-tone. With Webern's liquidation of the form-breeding, form-inflating ego-experience, music could again be grasped at its central point – form: palpable, 'animated' form, such as Webern described, on a historical level, in the balanced, measured hovering of the voices in Ysaak's chant-settings.

Now that a picture of Webern is at last beginning to form, not much should remain of the idea of the melancholy pianissimo-musician, hearing out the last twitchings of sound, struck dumb by terror and morbid anxiety – of the Webern of the ultimate *espressivo* stammer. In any case it is no longer relevant to seize, wherever they occur, on that aphoristic store of resigned sighs, mimosa-like delicacy and expiring breaths as the sole characteristic of his work, since for the most and vital part Webern's music is hard and thin, clear and exact, of expressive sensibility and the most minute formal exactness – not distilled from the volatile fumes of the *espressivo*, but comparable much more to the finesse and Apollonian strength of the wire mobiles found in plastic art – in its mature utterance a wonder of subtlety and severe formal fantasy, not intoxicated by any daemonism or euphoria contained in it but summoning up form as a regulated phenomenon out of the inaudible world of structural quantity-relations. Here precisely is the point where new claims and demands are raised, which among the younger generation, the 'Webernites', are long since over the danger of regressing to the stage of useless creative doubts and dialectical scruples.

This return to the sphere of material objectivity is not in the least incompatible with the fact that Webern's work is rooted 'in an almost exclusively lyrical nature', as the composer himself wrote in a letter. It is that scanty, undecorated, unrhetorical lyricism which in poetry, painting and even architecture represents the best and truest achievement of our time, a new lyrical involvement that remains 'outside' in order to embrace

the totality of existence, and no longer thrashes about 'within' in sterile excitement amid that dialectical jungle of experience lying between sentiment and nervous reflex.

In this respect, Webern's lyricism is in the highest sense an anticipation and prototype of a musical world which emerges uniquely and unmistakably from the times in which it was conceived – in Webern's life-time an unrecognised world, almost premature, an outsider's world in the extremest sense, existing only in the shadow of the Viennese School.

In the first positive references to Webern after his death – by Humphrey Searle (1946)[1] and René Leibowitz (1949)[2] the decisive facts are still not appreciated. When composers write about Webern and compose like Schönberg, one may be sure that they will figure out the picture wrongly. Nevertheless Leibowitz, with nearly seventy pages of analyses, wrote what was up till then the most extensive study of Webern; it contains many telling single observations, a mass of analyses that are seen from the point of view of Schönberg, and various astonishing errors of judgment, such as that it is hardly any exaggeration to say that before his Symphony Op. 21 Webern wrote hardly a page which could not also have been written by his teacher; with or without exaggeration, this amounts to making blindness the principle of seeing! In even the early Op. 9 not a bar could possibly have been written by Schönberg.

Only in the newest developments and the development of the newest composers have the invisible doors burst open, revealing a world of measured quantities, of intervallic mensural-fields, of complex forms of organisation replacing by 'structures' the material which, taken out of its usual context, has been, as it were, 'de-materialised'. On this decisive point Webern differs from all other twelve-tone composers (the 'Webernites' excepted, of course). He is the only one who in his music organised *more* than the stratum of pitch-levels; the only one who was conscious of the structured, spatial dimension where the antithesis of vertical and horizontal no longer exists. His fundamental structural element is not the note but the interval – the interval between two notes, conceived melodically, as a unit of measure; thus the two- or three-note motive presents itself as the true objective in the development of his working-material. To realise a structural web, Webern uses only the proved and the provable; everything else is rigorously excluded, and rightly, since it has no firm foundation. In intervals Webern discovered structure free from content, structure that is no longer the structure 'of something', that behaves much more as a pure phenomenon, something created – a discovery that is paralleled by certain all-embracing intuitive appraisals peculiar to our time: that of Planck, for instance – 'Whatever can be measured, must exist'. This seemingly insignificant and 'unobtrusive' phrase is the one by which, according to scientists, Planck exploded the scientific certainties of centuries. It could well be applied to the measuring-out of interval-distances and its musical consequences. But the objection to such parallels is justified; nor are they at all necessary, since, after all, their intersection at infinity lies beyond the sight of mortal men. As generalities they will unfailingly prove right, but in detail, here and now, in their insufficiently thought-out state, they give rise to more confusion than clarification.

In Busoni's *An attempt at a definition of melody* (in *The Essence of Music*)[3], we find the

[1] Humphrey Searle, *Webern's Last Works*, 'Monthly Musical Record,' London, December 1946.

[2] René Leibowitz, *Schönberg et son École*, Paris, J. B. Janin, 1949.

[3] Ferruccio Busoni, *The Essence of Music*, Rockliff, London, 1957

first, if hesitant, indication that rising and falling intervals, rhythmically articulated and in motion, exist as form 'independent of accompanying voices'. The identity of time and pitch was first stated exactly by Schönberg, who saw the unity of 'musical space' as a play of vertical and horizontal forces that were in substance identical. But obviously this acoustic 'space-time' can not be made real by conventional methods, with thematic figures that can be memorised, since at the thematic level, connection only exists within single lines; the interpenetration of horizontal and vertical is lost in performance, and it is this alone that can give rise to the unity of an 'objective sound', in which horizontal and vertical are the same. The link between series and theme, from which Schönberg's twelve-tone system arose, precludes the formation of 'objective sound' and consequently of an objective structure. Schönberg thematises his series, Webern de-thematises it; Schönberg uses it for that 'composition' from which Webern frees it (thereby establishing for the first time a link between interval-function and the overall structure). Schönberg builds his series out of the intervals from fundamental to fifth and their inversions, Webern out of the intervals from fundamental to tritone and their inversions, with the exception of the fourth, which with him never appears as a fifth. Schönberg lays out his serial construction with the lordliness of one who could do so as if there were no such thing as construction; in Webern, even the densest and most complex sound-structure is never construction but only projection into space and time. The musician who concerns himself seriously with Webern is here presented with very fine distinctions. If in Webern there were nothing but construction, his work would inevitably remain mere handicraft. But it is precisely this irritating artificiality, as it looks to the analyst, appearing to contradict everything 'natural', that reveals itself as a victory for form (which must remain caviare to the general), as the triumph of a newly-regained balance and humanity. Music 'possesses all the formal freedom of mathematics,' wrote Hermann Broch in the 1934 booklet in Schönberg's honour – 'it is the architecturising of the very threat to life, namely of time which leads us on to death'. From this point of view, Webern's two cantatas are eminently Viennese works.

Webern's transition to twelve-tone technique in Op. 17 does not indicate a change of technique or even of style but represents a completion of his technical means. It is very noteworthy that the typically Webernian interval function, this most momentous achievement of his music, is already in force in his early works, as in the Six Bagatelles for String Quartet, and even in the Four Pieces for Violin and Piano (1910), the second of which contains examples that point not only to this but to the equally typical mid-axial symmetry of a moulded acoustic space. From the very beginning there appeared in Webern's work, however many intermediate stages were still to be passed through, this will to an impersonalising objectivity; it is as if the flow of merely affective 'happenings' had been broken against the firmly-driven pillars of his note-objects. The first six notes of the *Passacaglia* Op. 1 – as Leibowitz has already observed – show clearly that the handling of the thematic material is proportionally determined, in fact they already contain the seed of the whole of Webern, who never proceeds by motivic, psychological paths but builds out of reflecting motivic cells a proportioned structure. In these six bars there sounds, like a prelude, the fundamental motive for the later monadic architect of mirror-forms, who could never demonstrate frequently or passionately enough the similarity of diverse objects and the diversity of the similar. From this earliest microcosm, this mirrored reversal within the *Passacaglia* theme, his development leads by a

firm inward train (if at first concealed by the expressionistic, vibrating convulsions of the surface) to the – doubly – 'motivated' intervallic proportion, which is no longer a vehicle for thematism but is itself an entity, a structural element. Webern's awareness of intervals fills out the 'intervening space', not inflating it with psychological tension but making the interval itself a relationship of notes hardened by objectivity – as it were, a pure object within the tension of the intervening space. Major sevenths and minor ninths (the spatially-expanded derivatives of minor seconds), minor and major thirds and their corresponding derivatives, these are Webern's principal intervals; with the final abolition of thematicism, from Op. 21 onward, they come wholly into the foreground. It is crystal clear how Webern achieves spatial tension by, so to speak, knocking in his acoustic objects right at the edge of the octave-gaps, thus creating for himself a complete system of barbed hooks, an autonomous, tightly-braced, freely-floating system from which the last trace of tonality has been erased. This is the way into the material itself, that intervallically 'motivated' material which does not begin to speak of its own accord (for it cannot begin of its own accord) but remains technically-prepared, composed material, with that Webernian characteristic of 'poetry from outside' – lyrical geometry in which it is not feeling that works up form but form that leads one to feel. This differentiated, firm, metallic imprint of interval consciousness explains why Webern's encounter with the twelve-tone technique proceeds almost uneventfully, to the sorrow of the Schönbergian analysts, who see in that Op. 17 the technique applied 'encore fort rudimentaire', whereas in fact after it had once been used extensively and subtly (in the String Trio) it became ever more rudimentary, up to its apparently artless termination in the three slightly-contracted variant series of the finale of the Second Cantata. Apparently artless! The mastery of metric poetry that animates such a movement: to be sure, that must needs escape an eye that simply stares at the lifeless framework.

Webern's arrival at total organisation is without triumph; it is not a hard-won victory such as was necessarily due to Schönberg, but a confirmation – it confirmed that the incomplete basic-shapes were not there to be completed and thematically built out, but had, within the unity of the complete series, to be so rigorously stripped down that the series itself could be proportioned. The creative parallels with Schönberg are easy to see – in the early expressionistic songs, in the shorthand style of the aphoristic works. During the long unproductive period while Schönberg was seeking equilibrium, Webern wrote only four groups of songs, and they too were a kind of rescue through reflection and reorientation. And before their inner ways finally part in 1928, with Webern's Symphony, there is one more parallel, not of style or medium but of weight, significance, of a creative stage achieved; the Wind Quintet and the String Trio: throughout, Schönberg is the earlier and mightier, Webern the later and slighter.

But this is only one aspect of the protean image of Webern. Of the three stages of development it has undergone, the first is the traditional one – Webern as the third of the Viennese School, hypersensitive, full of melancholy renunciation, rationalistic and anaemic; at the second, dialectical stage there is talk of the end of the line, not prophetically as once with the anti-Wagnerian movement, but as social criticism and historical reflection; Webern's music is seen as the senseless extreme of material organisation, as a transition to the 'non-historical', as a remnant which Schönberg left behind. The third, adventist, *avant-garde* phase marks the discovery of the 'real' Webern, the Webern of structurally-grounded music, to whom the younger composers

are attracted, and in whose magnetic field nowadays not only the young are found.

One can easily establish what it is that binds Webern to the twelve-tone tradition; incomparably more important is to say what differentiates him from it. In this respect he stands truly alone. Twelve-tone technique restricts itself to a note-ordering made manifest as a series; it is a single-line pitch-ordering determined by the order of the notes in the series. When we say that Webern organised more than the single dimension of pitch-levels, we should not imagine that, simply through drawing other strata of sound into his basic organisation, he arrived at a complete predetermination of the musical elements. That may appear so from the viewpoint of 'pointillist' music, and can pass for a smooth, convenient explanation. But Webern was as far from such an absolute procedure as the Schönberg of the incomplete basic-shapes was from writing 'linear' twelve-tone sequences. In Webern, ordering applies far more to the basic elements; his deep centre is interval proportion, from which his entire organisational system unfolds as from a single point. To this process of measuring there are subordinate: the interval; the manifold reflections of the interval motif ('the same, yet always different'), and their mid-axial grouping which opens up the time-continuum as 'space'; symmetric organisation of harmony, which marks the entry to real 'sound-composition'; the variable profile given the notes according to their intensity, dynamics and differentiated accentuation; in works for larger resources, the grouping of timbres (here the motivic-instrumental alterations of the sound are a fragmented legacy from '*Klangfarbenmelodie*'); and finally the motivic use of rests, which in the de-thematised structural system no longer relieve tension but must be regarded as architectonic rests – as it were, silent notes.

In music, measurement is an operation on pre-arranged material: at the same time it is more than that; with the advent of 'proportioning' it is transformed directly into structure. The thinner, the leaner Webern's music becomes, through its compulsion to extreme refinement, the more structure is manifest in it. Thus, at the last, the 'ideal' of structure becomes the composer's inspiration – this is one of the points closely preceding the practice of pointillist and electronic music, and at the same time the very heart of the musical process, completely protected from the dialectical assaults of the theorists of musical decadence since they have not even become aware of it as a target. The Wagnerian lament about 'the end' always characterises the same situation; when music has been perfected it is at the same time, as the word indicates, an end. Those who uphold the well-entrenched views about 'no more progress in this direction' (an element in literary education for the past three generations) are entitled to their opinion, but it has no bearing on the business in hand. In this respect, not only is there no difference between the 'aesthetic of musical impotence' of the 1920s and the current pronouncements on the 'senility' of the newest music – there is a close and obvious connection.

In Webern, 'sound-composition', which has become so significant in the electronic sphere, is present in rudimentary form. That elements of the series should mathematically reflect each other while sounding together, this is possible only when the concepts 'vertical' and 'horizontal' have been merged and so far broadened that the 'switch' into the one or the other dimension is understood as a temporal procedure, as the folding-together of a mensural-field made up of intervals and rhythms. A group of intervals comes together to make a proportioned sound – the combined sound is proportioned by component groups within the series; this is something quite unlike the usual practice of building chords out of the spare notes from the series, just as Webern's

thinking always stands in the sharpest contrast to twelve-tone automatism, to dispose of which it was necessary to bring into play every creative counterweight. In Webern, on the contrary, the musical elements do not separate one that is pre-formed, another that must be mastered to be productive; his basic element (the interval) is not mechanical, theoretical, pre-formed, preconceived, but sensory-objective, formed in space and rhythm, even alive to the question of register. The interval as the living seed of music – this is the only honest and genuine approach to Webern: in the music of the twentieth century it is not only a Copernican revolution but a moral one as well.

Because Webern was bound to the twelve semi-tones and the fixed sound-spectra of his instruments, the process of 'sound-composition' in his work had to remain an unrealisable ideal. This does not detract from his importance. In him there once again meet prophetic anticipation and adjustment to deal with the impossible (a part of the composer's ethical inventory since Schönberg) – with the important rider that here the composer comes to grief not through the opposition but through the very composition of his material. Thus the six-note chord at the opening of the Second Cantata must be considered one of the great visions of music, the gathering-together of an epoch at a single point, where it hangs suspended like a swaying scale; as it were, the Tristan-chord of the twentieth century. It consists of two dense clusters of three notes each; *A*, *C*, *D* – *B*♭, *C*♯, *E*♭: scored for muted Tuba, Bass Clarinet, muted Horn – muted Trombone, Saxophone, muted Trumpet; a harshly sounding structure, dissonant by traditional standards, accented *sf*, and at the same time the anticipation of a 'note-mixture' in the attempted proportioning of its frequencies, with the characteristic build-up (*sf*) and the muting that acts as a filter, reducing the sound-spectrum – all this as a makeshift, since realisation is impossible on instruments.

The picture of Webern, which up till now has only been seen in its relation to Schönberg, today enjoins a change of focus. But the prophetic side of his work must not be confused with anything merely temporary, for he is neither an adept nor a predecessor – rather does he stand isolated in his time, which could not be the time for him. Simultaneously-produced works of Schönberg and Webern, such as Schönberg's 4th String Quartet (1936) and Webern's String Quartet (1938) are worlds apart. The difference in their musical language is as great as that between 'Pierrot Lunaire' and roughly contemporary works of Reger and Strauss. We do not know from any utterance of Webern's that he had an inkling of his own situation and significance as a composer; that he must, in the painful triumph of renunciation, have realised it a thousand times over in the most distinct and clairvoyant fashion, for this his works are the single – irrefutable – proof.

FOR THE 15TH OF SEPTEMBER, 1955

KARLHEINZ STOCKHAUSEN

Unforgettable, the first encounter with Webern's music. One's mind runs back to the days when copies of Webern scores were handed on from one to another, when a shared passion for this music caused friendships to be sealed. Since then the circle around Webern has grown ever wider.

After the war, one could only with difficulty hear the first concerts in which, here and there, in between marketable pieces, one of his short compositions was tucked away – at some exclusive music-festival or every few months, late at night, on the radio. So far the situation has not basically changed.

Thus a strange state of affairs has come about: young musicians wish nothing more ardently than to hear Webern's music – but it is hardly ever played. If one should succeed in asking a programme-organiser or conductor why this is so, the answer is often that 'the public' doesn't want to hear that sort of thing. 'The public' is thus an anonymous body, a thought-projection on the part of those who find themselves personally challenged. In this way injustice is done to Webern, ever and again! If one asks musicians – 'whose business' it therefore is, and to whose store of education a knowledge of this music should belong – what they have in fact heard of Webern's; if one inquires how many concert-goers and radio listeners there are to whom the name Webern means something – what one will find is not distaste but ignorance. We have had many interested visitors to the electronic studio, and we have often played them music by Webern as well; one could have filled a few concert-halls with the visitors to whom Webern was completely unknown.

All the attacks brought to bear by polished reason, and well founded in it, are matched, if undemonstrably, by our love of this music. Whoever says it is dead, calculated, finished, is closing his eyes and those of others to the fact that hardly any composer is so admired by young musicians, life-affirming musicians, as is Webern. This enthusiasm is different in kind from that directed successively at Hindemith, Bartok, Stravinsky and Schönberg during the last ten years. Webern has been steadily and lastingly absorbed into our consciousness, after his music had made its initial fascinating impact.

Nobody can afford always to trust only his feelings or only his reason. Thus one's reason begins, soon after the first encounter with any music, to ask questions, to test, to compare. The result of all this has often nothing at all to do with pleasure; one understands some things well, but finds them less beautiful, other things move one strongly without one's knowing why. The often prosaic analyses of Webern must be taken as showing that our reason, too, is provided by his music with clear answers. Consequently one must only speak of what one actually sees and hears – what everyone can follow and test.

It is obvious that everything that has been and will be said about Webern's technique and musical style will not demonstrate that he wrote beautiful music. Thus many

musicians have not avoided the mistaken idea that the Concerto Op. 24, for example, or the Piano Variations, or whichever work it may be that facilitates particularly fruitful discussion of certain technical questions, is the one that they must under all circumstances regard as one of the most beautiful – even if that were an advisable thing to do in the first place. Often the works from which, in the course of technical, specifically-orientated interpretation, many things emerge as highly plausible, are just those which give less pleasure when heard. But often, too, an intensive preoccupation with a particular work, and the factual description of what is going on within it – these smooth the way to feeling. At some unexpected moment when one is listening, the spark takes hold, once preconceptions and acquired habits of thought have been corrected.

We have been accused of doing violence to Webern's music by reading into it something that is not there at all. This objection is comprehensible if one tries to grasp its reasoning and premises. But that Webern is now being seen by other musicians in other ways, heralds a change of thinking that one should also make some attempt to comprehend. There is not *one* interpretation but as many as there are points of view; and once we have begun to realise that we are not fallen from the sky, but are irrevocably tied to *our* – not to any other – tradition, then we recognise that it is Webern who has pointed most emphatically into the future. The fact that everyone discovers something different in his music and wishes to demonstrate it to others throws a useful light on the manifold ideas about Webern; and that, above all, his music allows of interpretation from the most varied points of view, speaks only for its vitality.

Let us concern ourselves with our common task, for it is unfruitful to make out of it a clash of philosophies. The matter in hand is to acquire a knowledge of the actual content of Webern's scores, to quicken our perception of it, looking from every possible angle. Out of the many details we perceive, there grows, bit by bit, the structure of a musical language worked out in cooperation and desperately needed.

Analyses of works, essays on special technical problems, these are of use primarily to composers and performers, who already have an interest in a clarification and an exchange of opinion on these questions, and who see it as their task to cooperate responsibly on the creation of a new basis for our technique of composition, but not to behave as though all were already well.

Yet another misunderstanding has arisen; when Webern's works are analysed, what is discovered tells us nothing about 'how it's done nowadays'. As regards this, one can always be sure that nowadays it is no longer done like that; and it should not cause surprise that in compositions of the present day, by Webern's declared followers, it is vain to look for what has been demonstrated in such detail from his works. This is a good thing in so far as it makes life unpleasant for those who like to number off the notes of series. At the moment when one approaches the roots of Webern's music, one also reaches the stage of insight into its uniqueness and completeness and its vulnerability to any attempt at reproduction. One must create something quite different, individual, and must have a courageous spirit, if one wishes to write even one note 'after Webern'.

Thus Webern becomes a yardstick: no composer can with a clear conscience be active, now or in the future, below the level of this music's language, and ignorance is no excuse. Whether over and above this a composer is in the end inspired to write good music does not lie with him (how often that has already been said). Everyone ought to be aware of the solicitude and artistry with which Webern went to work on his material;

how he left nothing out of account, and achieved a stylistic purity that is the precondition for great art of any time. One could demonstrate this just as well in other good composers, as he did in Ysaak. As for his own personal achievements as a composer, they are signposts, more generally valid and objective than any methods. For us the essential is not what methods he used, but how and to what end he sought and worked them out. Only from a knowledge of that can we realise the nature of his methods – which are bound up with his situation – and to that degree we shall be taking them, too, into account.

If in the most recent developments the ostensibly 'advanced' opinion has been put forward that Webern, too, is now 'passé' – as a few years ago we were told 'Schönberg est mort' – this can only trouble those for whom Webern is a principle of composition and not an artist whose imperishable achievement redeemed his time and eased its transition to the ensuing one. Not everything that cries out for contradiction should be taken too seriously.

Finally let us hope that Webern's music will be performed more than it has been. Even its devotees know only a fraction of the thirty-two works from hearing them. And every musician who loves this music may feel it his duty untiringly to bring it nearer to others, to communicate the joy he feels at having discovered it. Then Webern's music will be able gradually to radiate its innermost power, by drawing people together in shared astonishment at such beauty.

THE THRESHOLD

PIERRE BOULEZ

As to Webern – his epiphany is becoming more distinct, and will soon have dispelled the ignorance that, as the privilege of a discreet but effective ill-will, now obscures his face. Even now his work provides the keenest criterion for contemporary music, since it involves certain risks that are difficult, if not impossible, to overcome by guile.

Two obstacles have reared themselves, blocking the way from his music to its true effectiveness; the first, paradoxically, its technical perfection – the second, more banal, the novelty of its transmissible message. Hence the charge, a quite needless defensive reflex, that it is exacerbated and cerebral; the eternal action, always lost by those who bring it, yet forever brought anew.

The novelty of the musical perspectives opened up by Webern is merely beginning to be realised – and with some astonishment, in view of the work he accomplished. It has become the one and only threshold, despite all the confusion resulting from too hasty references to 'Schönberg and his two disciples'.

Why this privileged position among the three Viennese? Whereas Schönberg and Berg ally themselves to the decadence of the great German romantic tradition, and in such works as *Pierrot Lunaire* and *Wozzeck* round it off by the most luxuriant, flamboyant means, Webern – *via* Debussy, one might say – reacts violently against all inherited rhetoric, in order to rehabilitate the powers of sound.

There is indeed only Debussy whom one can compare with Webern – in their common tendency to destroy all formal organisation pre-existing the work itself, in their common recourse to the beauty of sound for its own sake, in their common elliptical pulverisation of the language. And if one can, in a certain sense, maintain – o Mallarmé! – that Webern was obsessed with formal purity to the point of silence, it was an obsession that he carried to a degree of tension hitherto unknown in music.

One could further charge Webern with an excess of scholasticism – a justified charge, were it not just this scholasticism that was the means of exploring newly-discovered realms. Should one note a lack of ambition in the generally accepted sense of the word – no vast works, nor imposing structures nor large forms – since this lack of ambition goes to make up the most extreme asceticism and courage? He has even been found cerebral to the exclusion of all sensibility – so it is as well to realise that his sensibility is so radically new that it indeed runs the risk of appearing cerebral at first.

We have mentioned silence in Webern; let us add that this feature is one of the most irritant and provocative in his work. One of the truths hardest to demonstrate is that music is not just 'the art of sound' – that it must be defined rather as a counterpoint of sound and silence. Webern's one, unique, rhythmic innovation is this conception whereby sound and silence are linked in a precise organisation directed toward the exhaustive exploitation of our powers of hearing. The tension of sound is enriched to the extent of a genuine respiration, comparable only with Mallarmé's contribution to poetry.

Entering a magnetic field of such attraction, before so keen a poetic force, it is difficult

to perceive any consequences but those most immediate. To come alive to Webern is an inspiring danger, just as it can be a dangerous inspiration. Third person of the Viennese trinity, let us beware of comparing him with the famous 'tongues as of fire': comprehension does not come so swiftly and surreptitiously.

We have called Webern the threshold; let us be clear-sighted and consider him as such. Let us accept the antinomy of powers nullified and impossibilities abolished. Confronted with his face, submission to hypnosis is less appropriate than dissection; all the same, it is a face that music is unlikely to allow to sink into oblivion.

WEBERN AND SCHÖNBERG

HEINZ-KLAUS METZGER

For students of music, professional critics and the like, there still exist 'the twelve-tone people', whose 'camp' numbers so many – Schönberg and Webern at their head. Differences in procedure are occasionally brought up by apologists to prove how 'undoctrinaire' is a system that recognises as legitimate such a variety of different temperaments. The reality is quite different. Just as the divergence between Webern's and Schönberg's ways of composing can not be reduced to one of temperament, though the latter may well exist, so the 'dodecaphonic' structure of a musical work is not even a secondary criterion. That a piece employs a twelve-tone row tells us nothing of its musical nature as conceived by the composer – this may in fact be found to be related to the twelve-tone row, but is in no respect determined by it. *Twelve-tone music is not a category.*

This last proposition might well tempt one to write a history of the decline of musical catchwords. Yet although the slogan 'atonality', against which Schönberg used to protest, has almost entirely gone out of currency today, how well it did in fact express what he brought to the world after in his work, as in Mahler's, the culmination of late Romanticism had been reached through every technical resource that could have been drawn from a great tradition. There have been various investigations and summaries, all of them correct, of the way in which tonal organisation was finally dissolved by the forces it had itself produced, so that it is not necessary for me to review the stages in the process. A word on the commentaries, however. For it is by no means true that in Schönberg's development the liquidation of the organising power of the tonic resulted in a method of composition using as its organising principle the relations of notes to each other – from which, in the last event, as it were, there arose the 'method of composition with twelve notes related only to one another'. If on the one side Krenek has made the valid correction that the coherence of tonality is not really ensured by the much-discussed relationship between notes and a basic note, but rather by a hierarchy of the chords to which the notes belong, it is true on the other that Schönberg never composed with notes 'related only to one another' but with motives, themes and harmonies related to one another; in short, his fundamental formal elements were already arrangements of notes, even though in his most advanced works (*Erwartung*, *Herzgewächse*, some movements of *Pierrot Lunaire* and the Orchestral Songs Op. 22) these may have been developed more in an 'athematic' manner. Thus the freeing of musical energies from their limitation to tonal functioning remains Schönberg's great achievement, comparable, historically if not in its actual details, to the revolution that Kandinsky brought about at the same period in the field of painting, by freeing the formal and colouristic fantasy of the painter from the obligation to represent objects. But just as Kandinsky held no less fast to the 'shape', even if now a 'freely invented' one, as the basic category in pictorial composition, so did Schönberg hold fast to the musical 'shape' – the thematic element and the method of composing he had developed. Logically enough he

understood his later serial technique as a means toward panthematism, as a practical idea that allowed him to organise a work's thematic unity right down to the last accompanimental figure.

It may be asked whether in fact this upheaval, whose impact still has much to teach us, caught every implication of the dissolution of the old principles. In Webern something else completely different made its appearance, quite early and perhaps unnoticed at the time. Not many people have observed that already in his Passacaglia – still in D Minor – there is no theme, in the true sense of the word; the 'passacaglia-ground' is set out rather as a structural prototype, into which the single variations each introduce some specific feature of harmony, counterpoint and rhythm, of dynamics and those of timbre, often complicated 'parentheses' of the utmost complexity. Out of these features the form is built; a process of structuring, and the work could well be called an early 'serial' document. The historical sequence of steps in Webern's development is thus the exact reverse of that in Schönberg: whereas Schönberg, after renouncing the form-building potentialities of tonality, had to look for 'new formal principles', which soon slipped back into the line of tradition, the opposite was true in Webern's work; it was new formal principles which forced him finally to abandon tonality. Just how, in view of this, Schönberg's influence is felt in Webern's works is perfectly illustrated by the *Movements for String Quartet*, Op. 5, which consciously quote from the thematic material of Schönberg's 2nd Quartet, only to include the latter in a structuring of interval relationships. For example, the third piece of the set, behind which there stands so clearly as model the Scherzo of Schönberg's Op. 10, is technically an unfolding, vertically, horizontally and by canonic displacement, of four three-note complexes, leading to a final unison exposition of the material. It is in fact the use of canon that points, as early as the Chorus Op. 2, to a key element in Webern's technique – the basic fact that it is possible to make identical material enter into horizontal, vertical and 'diagonal' relationships with itself, by means of constantly-varying displacement in time; to create an overall connection that would dissolve the different 'dimensions' (something that admittedly could only present itself clearly to composers after the liquidation of thematicism, since the latter concept never really permitted transformation into the vertical). Already, in these early compositions, there is the hint, the possibility of what Stockhausen, in Note B of his analysis of the first movement of the Concerto Op. 24, has called 'proportioning of sound' and has placed in the categories 'regulation of entry' and 'effective duration'. As if to establish by an extreme example that simultaneity is a special form of succession, Webern composed 'canons' with interval of entry zero, as in the choral sections of the fifth movement of the Second Cantata, and as a tendency this reaches right back to the outer sections of the Chorus Op. 2. 'Basic shapes', of the type first tested systematically by Schönberg in the Piano Pieces Op. 23, were already used by Webern in his *String Quartet Movements* (1909), but a quite different result was achieved. Historically, Webern's achievement is 'identification', the dissolving of counterpoint, harmony and form into a new concept. The three cardinal disciplines of traditional composition corresponded to the differences of the three dimensions; each of them sought from a different angle to control the process of composition. Each of these disciplines had to accept uncritically, as its basic elements, structures that were already complex; chords, whose sequence had to be organised, parts that had to be made to sound together, or formal elements, from motives upward, whose interrelation had to be

established. Certainly the category 'form' had already indicated that it might be a higher stage, in so far as every chord, every melodic detail and every relationship of parts could be determined according to its formal function within the whole. A conception of form in which harmony and counterpoint should themselves be dissolved would, however, have to lay open everything in music above the point where the distinction between the dimensions in fact falls; the relationship of note to note. Webern was the first to set foot on this virgin territory, and he recoiled repeatedly from it; his development from the early songs to the Choruses Op. 19 is a series of advances and retreats, now quite clear of tradition, now returning to it again. This working-out of a new conception, as from the *Sacred Folksongs* Op. 17, was assisted, inconspicuously, by Schönberg's discovery that the entire chromatic material could be transformed into a single series of intervals. Webern's new conception, completely developed, appears for the first time in the String Trio; accordingly this is the first of his works that can no longer be followed harmonically and melodically in the traditional way. For long passages the work can not be heard in parts,[1] since the instruments no longer maintain any fixed relationship of registers but rather indulge in constant register-changes, crossing often in wide leaps – and also because each part is itself broken up by the interpolation of rests and the subtly handled interchange of *arco* and *pizz.* The succession of vertical simultaneities is similarly interrupted; notes which go to make up an 'harmonic' event often enter successively – the ear is compelled to perceive the music as a proportioning of sound according to the notes' intervals of entry and effective durations. It follows, moreover, from what has already been said that in this work there are signs of the introduction of further dimensions which during the tonal era it was hardly obligatory for composers to take into account. The emphasis here should not be too much on the organisation of relationships between 'registers'; one important aspect of Webern's technique is certainly this application of the principle of multiple counterpoint to the voices themselves – not merely, as in the traditional technique, to the figures they present – and finally, of course, to the relationship between note and note; but it is never formulated systematically and coherently in his works. More decisive is Webern's emancipation of rests: this makes untenable the view of music as 'the art of sound'. He was brought up on music composed of sounding events in silence, comparable to traditional painting, which placed figures against an empty background. Only the greatest painters remained conscious of the fact that along with every elevated positive form there arose a negative one for the surrounding background; the latter had to be made equally significant from the point of view of composition, but its emancipation has taken place only in the most recent times. In just the same way, rests in music remained, apart from special forms like the Hocket and a few magnificent passages within the reigning tradition, rather the place 'where the music stopped'; rests were the means of expressing the caesura.[2] Though in Webern they also often keep this function, we find in his works, for the first time, rests of another kind; rests which, just like notes (with which they share the characteristic of exact duration), form component elements within a rhythmic structure and at the same time dynamic values (value zero, and describable as such in their

[1] The parts are a technical convenience for performing purposes – each is to be realised by one player.

[2] A state of historical consciousness, reflecting an authoritarian society, explains the fact that the background in painting was present so that the figures could stand out against it as the essential and dominating elements, and that, similarly, silences only framed the audible phenomena of music. The corresponding emancipation – which is found at its most complex and therefore most suited to detailed study in the paintings of Baumeister – is aimed directly against the principle of authority.

dynamic context). The rhythmic element, particularly the relationship between rhythm and metre, was also taken in hand in Webern's composition. In traditional music, despite everything, the relationships of vertical or horizontal note-complexes and the metric-rhythmic relationships had themselves been related; one has only to recall that the so-called 'species' of counterpoint were in fact exercises to work out systematically the relationship of metre or rhythm to voice-leading, and that harmonic concepts such as anticipation, suspension and the like are inconceivable outside such a relationship. That this relationship had meanwhile been broken was not so obvious in Schönberg's 'free atonality', since the spontaneity of gesture covered up the breach. Only with the development of his twelve-tone technique did it become evident that the latter could not of itself create a system for the ordering of time-relationships, could not produce a rhythmic-metric dimension, so that this element had to be imposed from without as a mere subjection of the sound-phenomena to metre or rhythm. Webern, on the other hand, concerned himself with this relationship as far back as in his Passacaglia, in that the structural foundation of the work, the 'ground', was at the same time set forth as a metre, so that rhythmic relationships could find a place in the structure and fill it out. The singular ostinati that often appear in early Webern always fulfilled this function, until his rhythmic relationships were so far developed as to be themselves constructive, so that the metrical element could be reduced to a purely abstract tempo. Dieter Schnebel, in his as yet unpublished complete study of the Piano Variations, has conclusively demonstrated how Webern developed a technique of rhythmic cells wholly akin to that once derived from Messiaen by Boulez, but that he used this rhythmic working rather like a counterpoint to a metre which itself hardly ever appears, and which he understood as a temporal 'cantus firmus'.

Webern's revolution may be compared only with that by which Mondriaan created a new kind of painting. The *Nieuwe Beelding* (*New Painting*) for the first time conceived a picture as an organised relationship of elements, a distribution of textures and colours. Schönberg, like Kandinsky, accomplished only one phase of this revolution, and the best period of each of these artists was when they were driving forward the process of liberation; the great moments of their later lives are those at which they recall their early works. For the rest, the only question is 'Why did late Schönberg go on composing "atonally"?', or 'Why did late Kandinsky go on painting "non-representationally"?'.

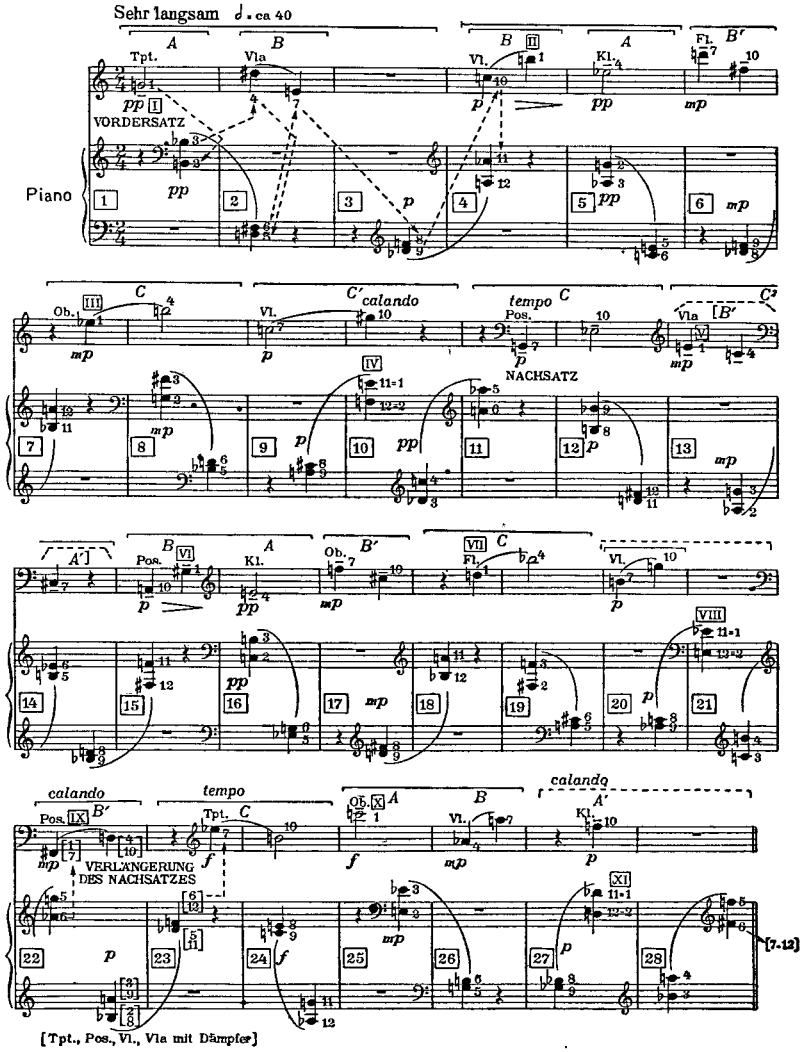
Perhaps some answer can be found to these questions. The so-called 'impoverishment' of which late Webern, like late Mondriaan, is accused has to do mainly with the proposition that there are indeed no more 'good pieces', in the sense of 'quality' that has been taken from the sphere of commerce and applied to artistic achievement. An extreme example may help to make clear what I mean. The painter Casimir Malewitch, after thinking around specific problems over a period of decades (a process that can be followed in his work), arrived logically at the extreme end-product, an 'absolute plane', represented by a blank canvas. Nobody would now consider this a 'good picture', though as a performance it was historically necessary and was for Malewitch the point-of-departure for a new technical development which once again broached the most fundamental problem in painting. Though Webern never carried the proposition to so absurd an extreme, his music has to a like degree renounced its exchange-value. And from such 'worthlessness' – in which, however, all our remaining hopes of Utopia are now firmly invested – Schönberg and Kandinsky recoiled.

ANALYSIS OF A PERIOD

LEOPOLD SPINNER

Concerto for 9 Instruments, Op. 24, 2nd Movement

The period to be analysed here is the first part (theme) of a three-part *Lied*-form, the 2nd movement of Anton Webern's *Concerto for 9 Instruments, Op. 24.*



Vordersatz = Antecedent. *Nachsatz* = Consequent. *Verlängerung des Nachsatzes* = Prolongation of the Consequent. Trumpet, Trombone, Violin, Viola muted.

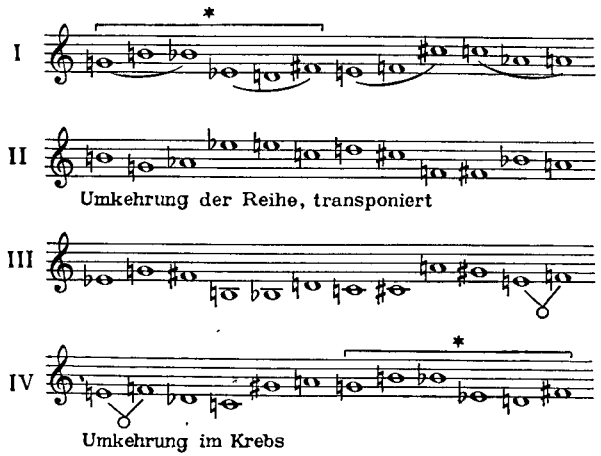
Example 1

The presentation of the period occurs throughout horizontally (homophonically), with a principal part and an accompanying part; the principal part is divided between flute, clarinet, trumpet, trombone, violin and viola; the accompaniment is taken over by the piano.

The antecedent is of 11 bars' duration (bars 1 – 11), and is composed of five phrases of differing lengths. The first phrase of 3 bars (bars 1 – 3) consists of two motive-elements, a minim (A) in the first bar and the motive B, consisting of two crotchets, in the second bar; the third bar consists of a rest equal in duration to element A or element B (a minim). In the following two-bar phrase (bars 4 – 5) the motive-elements A and B recur but in inverse order, the motive-element A following the motive B; the intervals are maintained exactly but again in inverse order, G, D♯, E (ascending minor 6th, descending major 7th, bars 1-2) being answered by C, B, E♭, (ascending major 7th, descending minor 6th, bars 4-5). The third phrase (bar 6) of one bar states motive B with a new interval, the descending minor sixth; in the two preceding phrases, motive B always consisted of a major 7th. Thus in bar 6, motive B is exactly repeated rhythmically, but thematically (as an interval) the major 7th is replaced by a minor 6th; the minor 6th was present in both preceding phrases, (G–D♯, B–E♭) though at a different point. In the following two-bar phrase (bars 7 – 8) motive B is repeated in augmentation and varied, with the minor 6th as in bar 6 but inverted (D–F♯, E♭–B); the variation consists in the augmentation of the two crotchets to two minims, and also in the division of the first minim into a crotchet rest and a crotchet (𝄽 ♩ | 𝅗𝅥 | . 𝅗𝅥 | 𝅗𝅥). In the following bars (9, 10) the previous two-bar phrase is repeated; this time the second bar is varied, the minim being replaced by a crotchet and a crotchet rest.

To sum up, the antecedent consists of five phrases built out of two motive-elements (A and B, since C is a varied augmentation of B); thematically, only two intervals are utilised, the minor 6th and the major 7th. The accompaniment uses only motive B, and the same intervals as the principal voice, the major 7th and major 3rd (derived from the minor 6th); these intervals are here presented not horizontally as in the principal voice but vertically. Though the motivic and thematic material is strictly limited, a rich variety of presentation is achieved by varied groupings and interchange of the motive-elements. The limitation of the motivic and thematic material is linked with closest established relationships in the application of the series. The principal voice and the accompaniment are constructed throughout from one set of twelve notes; the distribution of the notes between the two is constant – the notes 1, 4, 7, and 10 form the principal voice, the remaining eight notes of the series (2, 3, 5, 6, 8, 9, 11 and 12) forming the accompaniment. The series is formed of four groups of three notes; each group contains a major 3rd and a minor 2nd; the intervals of the first group, ascending major 3rd, descending minor second (G, B, B♭, see Ex. 2, I), are reversed and inverted in the second group (E♭, D, F♯, descending minor 2nd, ascending major 3rd); the third group repeats the intervals of the second group in inversion, and the fourth group is the third reversed and inverted. Thus the distribution of the twelve notes of the series between principal voice and accompaniment is made in the following way; the principal voice always uses the first note of each group (1st, 4th, 7th and 10th notes of the series), the second and third notes being utilised for the accompaniment.

Ex. 2 shows the rows used in the antecedent.



Umkehrung der Reihe, transponiert = Inversion of the series, transposed.
Umkehrung im Krebs = Retrograde Inversion.

Example 2

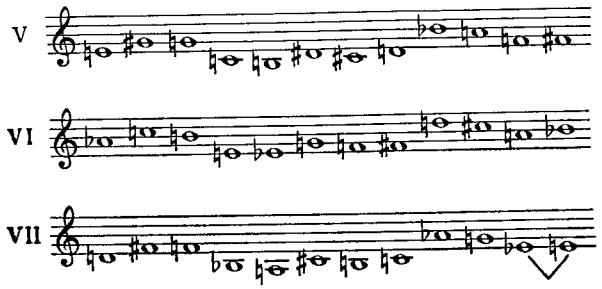
The first seven notes of row I appear in the three-bar phrase (bars 1–3); the remaining five notes of the row (8–12) appear in the first bar of the succeeding two-bar phrase (bar 4 with upbeat in the accompaniment in bar 3). With the second note of motive B (B in bar 4) begins an inversion of the row, transposed a major third higher (Ex. 2, II). In the two-bar phrase in bars 7 and 8 the row appears again in its original form, transposed down a major third (Ex. 2, III). The last two notes of this transposition (notes 11 and 12 in bar 10) are at the same time the first and second notes of the row in retrograde inversion transposed a minor second lower (Ex. 2, IV). Only the first six notes of this transposition appear in the antecedent; the 7th note (G, in bar 11), is already the beginning of the *consequent*.

The formal requirements for a consequent are here fulfilled in a quite unique manner. A comparison between the first row in bar 1 and the last-mentioned form of the row entering in bar 10 (Ex. 2, IV) shows that the second six-note group in the latter (G, B, B♭, E♭, D, F♯) is identical with the first six-note group of the original row, and accordingly is also the first half of the transposed row, identical with the second half of the original row. This relationship between the two forms of the series is exploited to introduce the consequent; the consequent begins with the last six notes of the last form (IV) of the series, which are identical with the first six of the original form in the antecedent; there thus results a literal thematic repetition of the first two bars of the antecedent.

Within this exact thematic repetition an interchange of motives takes place; motive C (a variation of B, as in bars 7–8) occurs in bars 11–12 and is varied in the following two bars, motive B replacing the minim (A). Literal thematic recapitulation of the principal part continues as far as bar 14; from here the following deviations are to be found – whereas in bar 4 of the antecedent the C rises a major 7th to B, in the consequent (bar 13) the C falls a major 7th to the C♯ of bar 14; furthermore, the B in bar 4 goes to E♭

in bar 5 (a descending minor 6th), whereas in bar 14 the C♯ goes to the A of bar 15 (an ascending minor 6th). From bar 15 onward there is an exact motivic recapitulation of the antecedent, bar 15 of the consequent corresponding to bar 4 of the antecedent.

To sum up what has been said so far about the consequent: the consequent begins with a literal *thematic* recapitulation, but the motives are varied and interchanged; it continues, from bar 15 onward, as a literal *motivic* recapitulation, but the thematic material is varied in that the intervals are transposed and inverted.



Example 3

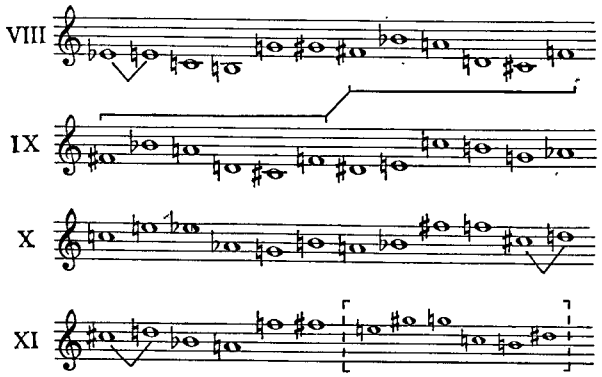
The original form of the series, transposed down a minor third, reappears as from the E of the principal voice in bar 13 (Ex. 3, V). In the literal thematic recapitulation the E of bar 13 corresponds to the E of bar 2, and simultaneously, as the first note of the series, to the G in the first bar of the antecedent; the C of bar 13 is similarly related to the C of bar 4 and the D♯ in bar 2. The G♯ in bar 15 introduces a further transposition of the original row (a minor second higher; Ex. 3, VI), and in bar 18 there begins a further transposition at the fourth above (Ex. 3, VII). Motivically, the two-bar phrase (bars 15–16) corresponds exactly to the two-bar phrase at bars 4–5 of the antecedent; the one-bar motive B′ in bar 17 corresponds to bar 6, and the two-bar phrase in bars 18–19 to the two-bar phrase in bars 7–8. The two-bar phrase in bars 9–10, the last phrase of the antecedent, appears in bar 20 varied, in fact diminished to one bar, in its original form B′; but with the rest in bar 21 the original length of the two-bar phrase is retained (cf. the rest in bar 3 and later in bar 28).

The recapitulation of the antecedent is thus completed in bar 21 and the end of the consequent is reached. The following bars (22–28) are to be regarded as additional bars in the sense of a prolongation of the consequent. The same mode of presentation and the same motivic and thematic material are retained; bar 22 brings motive B′, bars 23–24 the two-bar phrase C, bars 25–26 A and B in their original order and finally, in bar 27, there is a variant of A (𝅗𝅥 . 𝄽 ♩); bar 28 is one bar rest (cf. bar 3 and bar 21).

In bar 21, as before in bar 10, the 11th and 12th notes of the transposed row (E♭–E, Ex. 3, VII) are used as the first two notes of the following row (Ex. 4, VIII). The relationship between row IV (Ex. 2) in bar 10 and the original row, fundamental in introducing the consequent, is here used to effect a close connection in the prolongation of the consequent; at bar 22 the second six-note group of row VIII (F♯, B♭, A, D, C♯, F; Ex. 4) is identical with the first six-note group of row IX (Ex. 4), the F♯ in the principal voice at bar 22 is the seventh note of row VIII and at the same time the first

note of row IX (Ex. 4); the entry of motive B′ in bar 22 thus not only continues the consequent (with the 7th, 8th, 9th notes etc.) but, as the beginning of a new set of the series, introduces also a new structural element – a prolongation – whose introduction is analogous in function to an interrupted cadence in major-minor tonality. The 8th and 9th notes of row VIII (the B♭ and A in the piano part) are identical with the 2nd and 3rd notes of row IX, the 10th note D (in the principal voice) with the 4th note of row VIII, the 11th and 12th notes with the 5th and 6th.

In a true masterpiece nothing occurs once only, and here, too, a particular relationship between two forms of the series is used twice; such is the working of a great mind that in analogous passages the same relationship is made to serve different functions – 'the same and yet different' – in this case *functionally* different; the first time to introduce a literal recapitulation in the consequent, the second time to secure the closest continuity in the prolongation of the consequent.



Example 4

To complete the analysis of the period: the last-mentioned row of the consequent-prolongation (Ex. 4, IX), a transposition of the original a minor second lower, is followed in bars 25–27 by a further transposition of the original row to the fourth above (Ex. 4, X). As at the corresponding points – the last bars of the antecedent (bar 10) and of the consequent (bar 21) – the 11th and 12th notes of the row (bar 27, D♭–D in the piano) are reinterpreted as the first and second of the following form of the series (Ex. 4, XI). Like the antecedent, the prolonged consequent finishes with the sixth note of the current row; the two endings might thus be compared with half-cadences, the first (in the antecedent) occurring on the strong beat, the second (in the consequent) on the weak second beat. The second six-note group (notes 7–12) of the last form of the series (Ex. 4, XI) is used in the construction of the model of the succeeding middle-section of the ternary form.

WEBERN'S ORGANIC CHROMATICISM

HENRI POUSSEUR

We know what a decisive impetus Anton Webern's work has recently given to musical creation. Yet strangely enough Webern's poetical qualities, in the technical sense, have remained, if not unknown, at least inadequately described and formulated. There are indeed composers who have found in this poetry the principle and stimulus for their own questing; they have with due attention read and listened to the works of the master, and have succeeded in correctly understanding the lessons contained there. But for all the enthusiasm with which they have passed on the results of this contact, they have often been content with comments that were limited or superficial, general or vague, often unsure and mainly abstract. This is easily explained; intuitive knowledge was enough, in fact it was particularly well suited to their personal, concrete aims, and pedagogy was not their main concern – for the moment they could limit their theoretical efforts to the rudiments. Now that serial thinking is over its incubation period and shows the symptoms of a first crisis of development, one must consider whether the lessons that are still hidden in Webern's work would not gain in effectiveness from a methodical exposition.

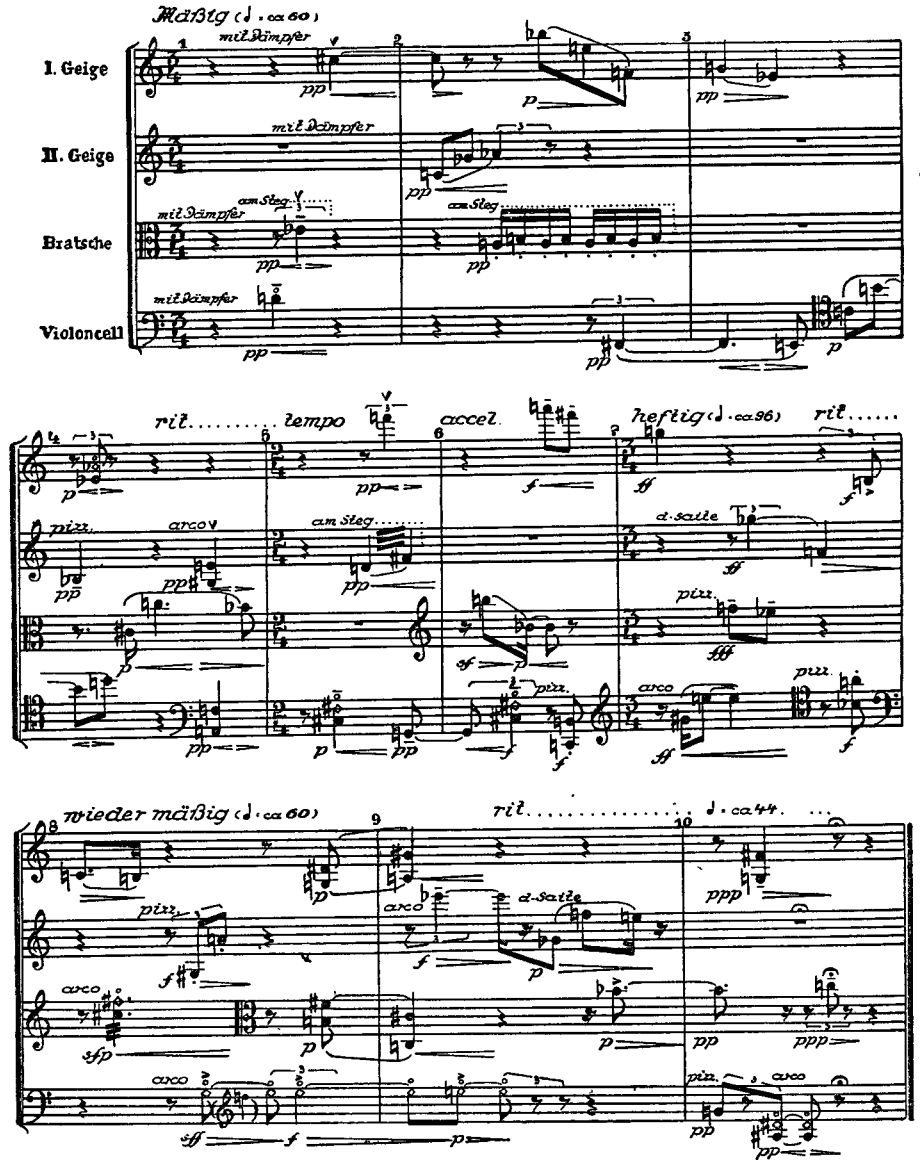
Attempts have been made to discuss Webern's poetry in terms of a particular handling of twelve-tone rows. This made it necessary to regard the pre-serial period as one of preparation for the serial works, and the latter as a first attempt toward a generalised serialism such as Webern never in fact imagined. But how could one explain from this point of view the stylistic unity which prevails in all his works, serial or not, which marks them all clearly off from the works of Schönberg and his followers, and which has so strongly influenced the younger generation? To give an example, Webern's Bagatelles Op. 9, composed in 1913, are far nearer to the String Trio Op. 20, or even the String Quartet Op. 28, than the latter are to the Third and Fourth Quartets of Schönberg. And the Bagatelles – are they any less representative of his most deeply personal innovations than his later works? Clearly the individuality, the radical newness of these innovations does not lie in their serial technique as such. Where, then, does it lie? To speak in this connection of impalpable qualities that go to make up a personality – this would be tantamount to sidestepping the question. For this personality to communicate to us its individuality and cohesion, to communicate it with the urgency we know, it must form itself before our eyes, must subsist wholly and solely in the material reality of the works. To search out its traces, its palpable signs, in this reality – that is the pressing task that alone can give us the key to Webern's expressiveness. Is it not likely that at the same time it will give us the essentials of an autonomous, homogeneous theory that is still needed for our new music? Might it not suggest answers to the questions that today occupy many composers?

In so short a study we can hope only to sketch rapidly the general way in which we think this enterprise should be carried through. With the help of a number of practical examples, a precise, limited question will be dealt with, but we think we can call attention to a basic phenomenon that has so far received too little notice.

Anyone who devotes a little attention to any work of Webern's will needs be struck by the extraordinary nature of the simplest sound relationships, above all what we may call the elementary *frequency-connections*. There is a wealth of chromatic relationships, principally major sevenths, minor ninths and the same intervals with one or more octaves added. It will further be seen that in Webern these relationships have a quite different meaning from that in Schönberg – that they are truly no longer the same sevenths, the same ninths (nor for that matter the same fourths or tenths). One has to admit that Webern breathes a new spirit into chromaticism, that he finally purifies it of all associations with post-Wagnerian chromatic harmony – that he seems finally to have restored its primal innocence. How can this have come about? What role do the above-mentioned intervals now play in the new articulation of sound? These questions arise when we examine the first of the Six Bagatelles for String Quartet. Our sensibilities have long since given us an empirical answer, but this we may treat only as a guide; it must hang in abeyance while we look for answers based on objective evidence. We have examined the piece closely, especially the network of chromatic connections of which it is entirely composed. From this we have drawn certain conclusions, which agree with those already arrived at intuitively. We believe they can lead us to the heart of the matter.

Perhaps there will now be talk of 'abstraction'; it will be objected that an isolated study of interval schemes can not give us the reality of concrete musical structures, since in the latter the various characteristics of the notes function in the closest dependence on each other. We can only agree, and beg a little patience. In traditional instrumental music, the frequencies of the notes must be seen as the indices of dominant oscillatory tendencies, to which timbre is subordinate as the resultant function of all the secondary vibrational phenomena. It therefore seems logical to study first the relationships between these most noticeable qualities of sound-phenomena (namely frequencies), and to consider (as we shall not fail to do) – inner structures (i.e. timbre) only in so far as they affect the functioning of frequencies within the higher organisation. On the other hand, we clearly do not intend to talk of pitch relationships in the abstract, without worrying about their possible influence on rhythmic and dynamic structural processes and the possible change of meaning they may undergo in association with the latter. We wish much rather to observe pitch organisation in its most direct effect on musical perception. We shall at once be obliged to include time in our system of coordinates, since we shall have to distinguish direct connections (in which the notes are heard simultaneously or in direct succession) from indirect ones (whose notes, though following each other not directly but only after a certain time during which other pitch-relationships are interpolated, none the less emerge with perfect clearness). The more progress we make in our investigation, the more we shall have to take into account the coefficients of duration and loudness. They will make it possible for us to grasp more clearly the various types of connection. Finally we shall be led to see the integral form of the piece, which is itself conditioned by the elementary organisation we shall be bringing to light.

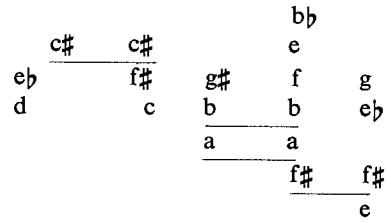
We had, after all, to start somewhere. A very material approach struck us as the best, because of the relative independence enjoyed by pitch connections in relation to the other parameters, because of the genetic priority they seem to show, and because of the special function they have in the elaboration of Webern's language.



Example 1

The note d, with which the first Bagatelle begins (see Ex. 1) is very soon brought into simultaneous relation of a second to e♭. The upper seventh c♯, to which a moment later the lower ninth c is added, follows directly. Thus the first four notes in fact form a chromatic *chain* of connection. Moreover each link in this chain is introduced differently,

in gradual augmentation; second, seventh, ninth. The result of this challenge to the ear can be only advantageous; an unequivocal aural attitude is suggested to it from the outset. The next note g♭, will be able to present a looser chromatic relation. Its double connection follows only two beats later, but in the particularly effective form of two minor seconds, the lower f, the upper g. The note g also stands in indirect relation of a second to the a♭ that follows this g♭, and which is superimposed on the a as a major seventh. This a is heard simultaneously with the b♭, two octaves higher (as is the b, which by its indirect but closely-spaced second-relation to the previous c also produces the first connection between this second chromatic chain and the relation-group already mentioned.) One can now follow the exposition of two more groups of connections; they start from the major second f-g, but one of them is already ahead of it, since the f counts as the second note of a falling seventh whose first note e is in indirect relationship of a ninth to the e♭ of the first and third bars (thus forming a new link between various parts of the chromatic chain); the second group, which is stated after the one just mentioned, is made up of a number of almost exclusively direct connections; the note g sounds above the low f♯, (that is also heard against f) while to the low e there is added an e♭ that has already been heard in the first bar at the same pitch. Thus the chromatic circle is closed. This event coincides exactly with the first main caesura in the piece; the structural importance of the latter is clear, and in order to make it still clearer we can take a number of synchronous sections through these two and a half bars. (Such a procedure may appear arbitrary; if the methodological advantage that one draws from it should not be enough, the existence of an *auricular retentivity*, enhanced by the isolation of the notes in several registers, would certainly make such a procedure permissible.) So we obtain the following succession of *harmonic fields:*



It will be easy to establish that both within each field and from one field to the next there is always at least *one* chromatic connection, and that the number of connections grows with the density of the fields.

Thus every detail of the musical development is conditioned by chromaticism, whose true nature will be illuminated by a new observation. The section we have discussed contains the twelve notes of the chromatic scale, but three of them are used twice. These three repeated notes, two of them at a different octave, are not the beginning of a new development of the 'chromatic total', but, as on their first appearance, fall into place in this first circle of connection. Their allegiance to varied chains of relation, to distinct harmonic fields, makes it possible to grasp them no longer as possible octave transpositions of the same note but as *absolutely different notes*. Here we must draw a radical distinction between the real pitch of a note and its chromatic value. The latter is a relative function, which results from the position of the note in the overall complex, and

which in turn makes possible the understanding of its relationship to the other elements in this complex. Actual pitch, on the other hand, is its own absolute, literal value. We are really and truly dealing here with *fourteen* different notes, between which there is a network of relationships whose metric unit is chromatic connection.

This shows us the futility of the orthodox dodecaphonists' insistence on an integral and constant unfolding of the 'chromatic total'. Such a procedure may be methodologically useful: we have just seen from our example that as a precondition for stylistic purity it is neither necessary nor, as we shall see later, even sufficient. We shall be told, moreover, that our example is taken from an early period of Webern's work, and that he was later to adhere strictly to twelve-tone serialism. But this objection robs our example of none of its weight. Two further examples from the Bagatelles can show us how conscious of these questions Webern already was in 1913: the opening of the third piece, where the twelve notes are stated one after another without any repetition (the notes b and f in the second bar are in effect simultaneous – neither precedes or follows), and the fourth and fifth bars of the second piece, where Webern with consummate artistry juxtaposes different octave transpositions of the same chromatic values. In fact in later, strictly twelve-tone works he constantly tried to break the mould of serialism and to achieve configurations such as those discussed here. There are many examples in which, through the superimposition of independent serial layers, certain identical chromata are brought much nearer each other than would be permitted by a strict twelve-tone procedure. They are laid out in different registers and yet *give no impression of octave doublings.*

But a more considerable difficulty arises here; if the various octave registers of *one and the same* note do not have the same absolute value, how then can we regard seconds, sevenths, ninths and so on as identical connections? We shall see later that there can in fact be no talk of identity. A functional distinction must be drawn between these various types of interval, and this distinction concerns to a certain degree their rhythmic qualities. On the other hand, it is clear that purely from the point of view of frequencies, a second is not heard as a seventh, nor even a seventh as a ninth; yet there exists between them an effect as of similarity. To give only one example; when the major third c-e is included in a complete chromatic chain (with c♯, d, e♭, even b and f), then the other links in the chain can be brought into more or less distant octaves, above or below, without the third's undergoing any essential alteration. All that will happen will be that its chromatic tension and its orientation will vary. On the other hand, it will be different in kind from a similar, identical interval c-e as included in a triad or a modal figure. Whence this similarity between the effects that the various types of chromatic connection have on the third?

Given the relative inexactness with which we perceive pitch relations, the various tempered intervals can by approximation be heard as simple intervals of the natural series of overtones. At least that is how we hear them when the music is not expressly written so as to make it impossible. Now, natural intervals are uni-polar, directed, and ordered in a hierarchy. One of their terms is subordinate to the other, related to it, characterising it, sacrificing to it its own independence and winning its own significance only from their mutual relation. This power of attraction decreases more and more as the terms diverge from the primary overtone relationships, the more complex the relationship becomes. The semitone, its inversions and octave transpositions are the

intervals with least innate orientation (the tritone certainly does not have *more*, and we find that in Webern's music a particular function is reserved for it; but it can be of only limited usefulness – a chain of tritones would not lead us very far). The task of strengthening or neutralising the intervals' naturally weak polarity is entrusted to the context in which they appear. It is well known how strong a directing force tonal music lent to chromatic relations. But when linked together and distributed among the various registers, certain intervals take on a markedly bi-polar character. Together with the tritone they are the only tempered intervals that can reliably ensure such a liaison. This is why we find them as the basis of a music from which the natural hierarchic connections have on principle been banished. Certainly the seventh draws its chromatic potentialities from its latent tension with the octave. But does this make the octave audible? If not, then surely it is legitimate to employ stealth to win from nature the beginnings of a new reality? To recall a favourite example of Schönberg's, an aeroplane does not fly because one day it was decreed that the laws of gravity should no longer operate, but because extra subtlety has been used in applying them, so that their original effect has been altered. Similarly it was not enough to proclaim the dethronement of the tonic and then arbitrarily to 'organise' the twelve tempered notes, in order to create a new, spontaneous order; any such order had to be introduced with the utmost strictness and its integrity had constantly to be ensured. For this one needed an adequate intuitive grasp of the deep-seated tendencies that make such an order possible. Thus a new force is often nothing but an inertia that has been canalised, exploited to hitherto unknown effect.

The similarity between the various types of connection described is above all one of effect. The term 'metric unit' that we used above is here found to be inadequate. We must speak rather of a *group of metrical basic processes*. The validity of this view will be further tested as our study continues. It is not necessary to go on with the detailed investigation we have carried out for the first three bars. The reader will derive greater benefit from pursuing this on his own; the understanding he gains will be all the more concrete. He will see that we have not picked on any exceptional feature, that what we have discussed is the very flesh and blood of the music. We shall content ourselves with giving an exact inventory of what one can discover in the course of such an investigation, and the conclusions that can be drawn.

63 out of the 73 notes in the piece take part in two chromatic connections; for 27, both connections are direct; for 33 others, one connection is indirect, the other direct; for one single note (g♭ in the second bar, one of the very few such cases in the whole of the six Bagatelles) both connections are indirect. The remaining 12 notes take part in only one effective connection, but in every case it is direct.

The *chromatic potential* of the piece is thus very high. It is distributed with strict economy and its formative power extends over the totality of the acoustic relationships. Through the way in which the latter are bound up in the texture of connection, apparently diatonic intervals such as thirds, fifths, sixths – even if stated in the most patently obvious way – are heard no longer as simple harmonic relationships but as indirect connections, derivates of elementary connections and resulting from the mutual influence of differing chromatic chains. Their very structure is in the process altered, becoming in turn bi-polar. To regard them as 'multiples' of a common unit (the semitone) would be to adopt a too mechanistic and restrictive approach. One must think rather of the organic equivalent of such an idea.

Let us return to our elementary connections. We have said that a graduated variation of rhythmic function is in operation between the varied types of connection (seconds, sevenths, etc.). To prove this we have tabulated the total of each of these types for each of the ten bars of the piece, separating the direct and indirect forms.

Bars	1	2	3	4	5	6	7	8	9	10	
Indirect 2nds	–	2	2	2	1	–	2	1	2	–	12
Direct 2nds	1	–	–	–	–	–	4	1	1	–	7
Indirect 7ths	–	–	–	–	–	–	–	–	1	1	2
Direct 7ths	1	2	1	3	1	2	4	2	3	2	21
Indirect 9ths	–	1	–	1	1	–	–	–	1	–	4
Direct 9ths	–	1	–	3	–	1	1	1	3	–	10
Indirect 14ths	–	–	–	1	–	–	–	–	–	–	1
Direct 14ths	–	2	1	–	2	2	–	1	–	1	9
Indirect 16ths	–	–	–	–	–	1	1	–	–	1	3
Direct 16ths	–	1	–	1	–	–	–	1	–	1	4

Investigation of the various divisions of this table is rather interesting. Of 19 second-connections, 12 are indirect; on the other hand, 31 of the 37 sevenths and ninths are direct, as are 13 of the widest intervals.

The smallest intervals thus seem best adapted to statement with a large time-gap. They are particularly suitable for the linking-up of successive *synchronous fields*. On the other hand the larger intervals show themselves less suited to large time-gaps. They are more useful for ensuring relations between different simultaneous strata, different registers or *diachronous fields*. As for the intervals nearest the octave, the sevenths and ninths, they are the most important components of our *metrical group*. Whereas the widest intervals almost always appear simultaneously, the sevenths and ninths appear equally often in successive, simultaneous or mixed form. They ensure the continuity of the transitions between the extreme types. The latter take over primarily the linking of different complexes; the sevenths and ninths being assigned rather the inner organisation of the complexes or their peripheral linking.

The investigation of a few examples, particularly the exceptions (direct seconds, indirect fourteenths and sixteenths) can either confirm or contradict this interpretation. Let us first examine the indirect large intervals. In all the four cases that occur, each of the two notes of the interval is drawn in to a second chromatic connection, which is always direct (in bar 4, for example, e♭ stands in a simultaneous relation of a ninth to d, while e overlaps with f). On the other hand, in two of the cases there exists between the notes of the intervals a *relatively direct relationship* which makes it easier to grasp the interval (this is the case for c♯-c in the 6th bar, both notes being heard *forte* while the note between, b♭, is played > p <). In the other two cases (see the relationship b-c in the

tenth bar) the notes of the interval sound at the upper or lower limit of the compass covered. Again they are emphasised by their extreme registers. Thus in each case pains have been taken to guard against the danger that might arise from the notes' separation in time. This proves that there really is such a danger, and that widely spread intervals are not suited to rhythmic tension. On the positive side, these examples show the extent to which it is possible to ensure connection between groups separated in pitch and each possessing its own chromatic structure.

In the last few years, registers have been regarded as fixed, pre-existing entities, into which one only needed to introduce 'absolute pitch levels' (as people called the chromatic values of notes). Our perceptions do not of themselves divide up the pitch continuum; at the most we draw a division between two or three rough zones – high, middle, low – and it is the task of composition to organise these zones, to mark them off or link them up. One knows the role that the octave played in doing this in tonal music. It was not the only means; changes of key – especially when accompanied by a more or less literal transposition of thematic material and of the compass used – have no doubt often to be regarded as changes of register. This would then occur by steps of a fifth or a third. In music that is integrally organised by chromatic connection, the latter must normally also ensure the organisation of registers. The diachronous investigation of different frequency-bands (with, for example, a compass of two octaves) would show their inner wealth of chromaticism. But if we wanted to follow every connection that starts within these frequency-bands, we should often have to trespass on the neighbouring bands as well. The localisation of registers is unclear; their borders are in a constant state of flux, continually overflowing into each other. In the same way, in the first structure we could carry out 'vertical' sections only at the cost of a succession of abstractions, since the 'harmonic fields', too, were in a continuous state of osmosis. The investigation of the other exceptions, the direct seconds, will again show us this clearly.

Of seven such intervals, three are heard as successions, 'melodically'. Since this type of phenomenon plays a particularly weighty part in tonal music, it is for us particularly heavily laden with convention. Its use is for this reason always rather dangerous, and here Webern avoids the danger in the following way: the first successive second, g-g♭, in bar 7, is only slightly prominent melodically; each of the two notes is played by a different instrument and has a particular timbre; they are separated by a short rest; finally, they are part of a dense group of more or less simultaneous seconds. The next example, b♭–b–c follows directly on this structure, with the effect of a final reverberation. This gives it an individual stylistic value – it is grasped as one of the three possible ways of presenting the interval of a second – simultaneously, successively and by partial overlapping. The last example, f–e in bar 9, constitutes a kind of recollection of the preceding one. It falls into place in the last section, which to some degree plays the role of a final complete exposition of the *metrical group*.

The simultaneous or mixed seconds, with the exception of the one heard right at the outset, all occur in bar 7, i.e. at the rhythmic and dynamic climax. This concentration, contrasting with the even distribution of the indirect seconds, is important. The seconds are here chosen on account of their greater degree of intensity, their enhanced rhythmic power. When an indirect second possesses roughly the same connecting potential as a direct fourteenth, then simultaneous seconds are bound to draw from their temporal juxtaposition a greater chromatic tension.

This brings us at last near to the idea of a *rhythm of connections*. The time that elapses between the sounding of the two terms of a chromatic relationship is felt as a period of expectation, as a silence fraught with tension. It is not as if here there were anything comparable to the power of attraction found in tonal music. It is simply that *only* chromatic relationship can counteract, or rather balance, the polarising tendency shown by the memory impression left by a note, and negate that impression. Such negation is in Webern's musical organism felt as a necessity, as a need, and it is this that gives their especial life to the *intra-connecting durations*. It is they that condition the subterranean rhythm of the musical development. This rhythm is seldom simple, since every single moment is filled out by the expectation of several connections, since several relational *tempi* are woven together in a pervasive counterpoint. (In such a perspective even strictly simultaneous connections could be regarded as time that has been 'condensed'.) The detailed study of related durations, and of visible agogic patterns, is quite incapable of leading us to even a partial understanding of Webern's music. Agogics have here the function of organising frequency relationships – and vice versa. The true rhythm springs from the mutual interaction of the parameters *pitch* and *duration* (to which one must to a small degree add the parameter *dynamics*, which can emphasise or weaken the others, if never basically alter them). The slightest alteration of these parameters' respective positions will exert a retrospective effect on the entire structure and have as its consequence a change in the folding of the entire acoustic web. A final glance at the first Bagatelle will show how Webern brings these corresponding energies into play, and what a subtle dialectic he establishes between the different parameter-functions.

The piece comprises six sections. We have examined the first exhaustively. It is squarely juxtaposed with the second, while a rest lasting one beat divides the latter from the third. By way of contrast, the three middle structures are closely woven into one another. It is impossible to define their borders exactly; we can only say that the transition from the third to the fourth lies somewhere around the beginning of bar 7, and the transition from the fourth to the fifth around the beginning of bar 8. The final section is again divided from its predecessor by a short breathing-space in the middle of bar 9.

The frequency connections between the sections can either strengthen or counteract these caesuras and agogic contractions.

The effective chromatic connections between the first two sections are few and relatively loose. This emphasises the caesura, outwardly not much emphasised, between the first section and what follows. A close network of relationships diminishes the effect of the rest between the second and third sections, overrunning the rest, as it were. Let us mention the seconds d–c♯, c–c♯, c♯–d, the ninths f–f♯ and g♯–g, the sixteenths e♭–d, and e–f (the latter are less effective, and we have not included them in our inventory, but they are not wholly to be ignored). In contrast, the agogic drawing-together of the two succeeding connections is expressly strengthened. The interval-connection here results from several direct relationships. Here it is worthy of note that the sixth bar has the greatest number of wide intervals, and that the beginning of the eighth bar sees the occurrence of the widest interval used – c′–c♯′′′′. Bar 7, which in contrast contains the closest spatial grouping, becomes through this conjunction the moment of maximum informational tension, around which the entire form revolves. This break, emphasised still further by dynamics, explains the solidarity of the other connecting forces, those of pitch and agogics. These forces will again join, but to

produce the opposite effect, at the break between the fifth and sixth structures; here a final relaxation of tension has to set in. We will mention only the second c – b♭, which is particularly effective because it sounds at the lower limit of the compass; and the seventh e♭ – e and ninth a–b, both of which are fairly loosely connected because of the notes lying between and distracting the attention. The rhythm of connections is still further weakened because three absolute pitch-levels from the preceding structure are retained in this structural field, if differently grouped; f♯, c♯, g. Naturally the effect of these unisons is exactly opposite to that of the chromatic connections. They do not wipe out our mental impression of the notes, they deepen and extend it by ensuring a certain stasis of the note constellation and effecting a slowing-up of the overall movement.

A fact worth mentioning is that many structures are particularly rich in one or two types of relationship. For example, the first structure contains major seconds and their various multiples – major thirds, tritones, minor sevenths – whereas the second section includes rather more minor thirds and sixths. This fact, conditioned by the section's individual chromatic structure, in turn conditions its outward character. We could next consider the place taken by this piece in the work as a whole, and show that the chromatic texture conditions in great measure the overall form. But that would take us too far afield. Already we can draw a final conclusion from our investigation; Webern, unlike Schönberg, was not content to announce the equality of horizontal and vertical and to use the same interval schemes in both these conventionally rigid dimensions (a process which could only further heighten the contrast between them). Anyone listening to Webern's music can grasp that the successive and the simultaneous, the smallest and greatest gaps of duration and pitch are like the ends of a fan, are the opposite poles of a progressive series of possibilities. This is made clear by the use of an operational basic group that creates links evenly, in all directions; through a number of types of connection – strict simultaneity, greater or lesser overlapping, indirect or direct succession (the relation of these types to the various sizes of interval has been indicated); further, through the way the diachronous fields constantly overlap, and finally through the possibility of gradually passing from one of these perspectives to another.

Let us risk a final, perhaps metaphorical but illuminating interpretation; there is here made most vividly present an *acoustic space-time continuum.*

The continuation of this study would have as its subject a work of Schönberg contemporary with the Six Bagatelles of Webern. That would be an opportunity to make a basic differentiation of the poetic qualities of master and pupil, and to realise the individuality of Webern's innovations. A glance at his earlier works, e.g. the pieces Op. 5, would strikingly show us his emancipation from Schönberg's atonality; it would make clear the precise extent to which the latter stimulated his speculative powers and sensibilities. The investigation of the later scores of both masters, particularly their twelve-tone works, would show the ever clearer divergence in their lines of development. Study of their personal serial technique (but also of the inner structure of their rows, and of their types of serial grouping), undertaken in the terms used here, would be extraordinarily informative.

A short study such as this one is not the place for so extensive an investigation. Perhaps the small amount of information passed on here will not be without value for a theory of serial music. Its usefulness will depend on how far one has grasped the facts in their most concrete reality. It lies finally with each one of us to use them to the best advantage.

MOVEMENT

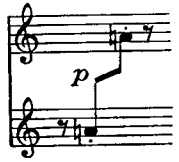
CHRISTIAN WOLFF

To write about Webern in 1955 seems unnecessary (let us continue to hear him).

But, while expressing my all but unbounded admiration and love for the music of Webern, I shall indicate a certain distance in my (present and variable) position from that music and its implications. Where admirable the music is wire-strong and tenuous, thin and concentrated, and very delicate. It is expressive only of itself: hence may extend and penetrate infinitely; it need have no extra-musical (historical, literary, psychological, dramatic, etc.) reference: which applies, generally, also to the earlier works where expressiveness is more obviously active, for there it is – before the use of contrapuntal and serial continuity – the function of structure.

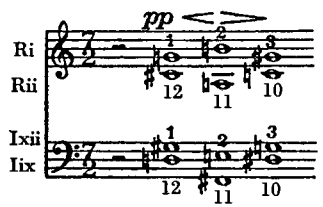
The music may involve a kind of dialectic between serial and contrapuntal continuity (which is linear) and extra-serial configurations (which are often spatial). The former is minutely controlled, the latter free, unrationalised, perhaps not precisely conscious.

So in the second movement of the *Piano Variations* Op. 27 the procedure of the cycles of twelve tones in pairs describes a two-part canon, a linear continuity. Simultaneously a static texture of sound is made by the repetition of pitch groupings. The notes cross-referenced by repetition originate at 'irrational', discontinuous points of the row sequences and of the contrapuntal logic. A non-linear, spatial configuration breaks out of, and is co-existent with, the linear continuity described by the row and canonic procedure. For instance, the pitch group

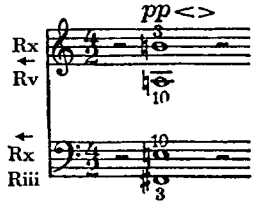


in measure 1 is repeated in measures 9, 13 and 19 (always *p* and *staccato*), a fixed point; but it also exists successively as the second pitch of Row ix and Inversion vii, the ninth of R ii and I ii, the fourth of R vii and I ix, the fifth of R iv and I xii. And five other pitch-groups are similarly repeated, leaving just eight of a total of thirty-one pitch groups unrepeated.

Compare the beginning of the *First Cantata* Op. 29, the first and seventh measures:

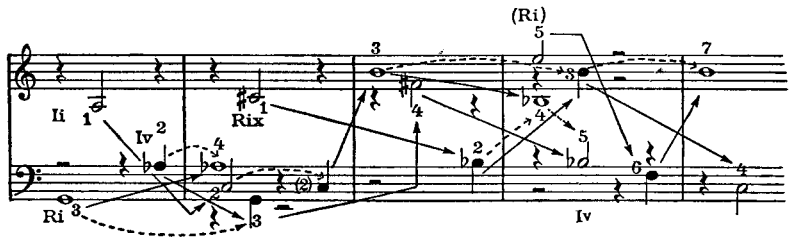


Ri = Basic series form 1.



Ixii = Inversion, form 12. *Etc.*

or, closer repetitions of notes (hence making less a spatial configuration than a kind of more or less linear melody which, unrationalised in origin, disengages itself from the serial and contrapuntal continuities), from the first movement of the *Symphony* Op. 21, measures 3 to 7:



The similar dialectic between linear timbre (i.e. the continuity of one timbre) and the spatial continuity (defined by serial and contrapuntal succession) of timbre (i.e. continually changing timbre, *Klangfarbenmelodie*) needs no examples (the *Symphony*, for instance, is rich in them). Here, unlike the instance of pitches, the control is most specifically on the spatial aspects of the sound, the linear timbre being less precisely rationalised.

For dynamics one may note the alternation (I know of no simultaneous use) of linear or progressive amplitude (an extension of sound generally defined by a constant, increasing or decreasing dynamic: often very close to drama, as in the *Piano Variations*, part III, measures 43–55 – climax – and the final pianissimo measures following) and the continual and discrete shifts of dynamics whose essential quality is fixity in space (so, e.g. the second movement of the *Piano Variations* in which only *ff*, *f* and *p* appear, changed for every pitch group).

Of durations, generally: they make at once a discontinuity and fluidity, a texture at once crystalline and moving. Rhythm, as an antiphony of sound and silence, forms a texture whose inner structure is spatial, which is multi-dimensional. On the other hand, blocks of rhythmic texture may dominate (due mostly to the contrapuntal procedure), extending an event in time rather than isolating it in space. The early works and parts of the *Second Cantata* Op. 31, where there are sharply defined, not successively repeated, single events rather than extended textures, are notable exceptions.

Such is an outstanding quality in the structure of Webern's music: the simultaneous action – so clearly expressed – of the linear and the spatial, the logical and the spontaneous: controlled movement around randomly fixed points.

And focused is the perception of the (inevitable) combination of continuity (automatically created by time as it passes) and immobility (perhaps the grand illusion of music, the re-forming of time).

My own position now differs in that linear sequences need not be logical, can be accidental (since continuity has to be), while spatial configurations tend to be calculated, made more or less specifically possible. A total structure generally static is defined and events are spaced in it, while the linear sequence is made in performance and in time: and here no correspondence to intentions is necessary.

With Webern one has come to notice that music is sound and silence, and that sound is pitch, duration, amplitude and timbre. Webern controls pitch minutely in linear serial

systems; and one may also extrapolate a suggestion of serial composition extended to duration, timbre and perhaps amplitude (as Stockhausen's analysis of the first movement of the *Concerto for Nine Instruments* has shown). Thus the awareness of the total actual elements of music has now produced the intention for a total application of the serial idea, a kind of total control of the musical material. This implication I do not see as necessary in the quality (at its best) of Webern's music. That quality, as suggested above, is more pertinently referred to the interaction of the linear and the spatial, of the rationalised and unrationalised.

The serial idea is not here excluded, but it is not indispensable.

Further, the total application of the serial idea may lead to excessively theoretical preoccupations, while the ultimate point of reference remains sound and silence (referring – subjectively, to be sure – to the actual sound of, say, the first movement of the *Concerto for Nine Instruments*, I do not find it especially good: the outline of the row's intervals and the incessant groupings of three are monotonously transparent; the incalculable seems lacking; also the balance in total timbre between the piano and the other eight instruments appears off – contrast the *Piano Quartet* Op. 22).

And the use of total serial control may introduce an irrelevant complexity. There is rather an inevitable natural complexity in things (cf. the structure of a tree); and it cannot finally be precisely indicated or controlled or isolated. To insist on determining it totally is to make a dead object. The spatial element is unpredictably flexible (though one may decide to calculate particular segments) and comes to life only when activated by outside (indeterminable) interferences. The complete control of a work, were it possible at all, would render it utterly impenetrable, put an end to its existence.

STRUCTURE AND EXPERIENTIAL TIME

KARLHEINZ STOCKHAUSEN

Now that the elementary processes of serial music have been made clear, the questions most immediately arising are those of musical organisation. A work of Webern provides a paradigm for one of the most urgent of them: what organic connection is there between structure and experiential time?

By *experiential time* we mean the following: when we hear a piece of music, *processes of alteration* follow each other at varying speeds; we have now more time to grasp alterations, now less. Accordingly, anything that is immediately repeated, or that we can recollect, is grasped more rapidly than what alters. We experience the passage of time in the intervals between alterations: when nothing alters at all, we lose our orientation in time. Thus even the repetition of an event is an alteration: something happens – then nothing happens – then again something happens. Even within a single process we experience alterations; it begins, it ends. The interval between beginning and end we call *duration*; the interval between beginnings of two successive processes we call the *interval of entry*. The perception of a single note rests in the last analysis only on the fact that we experience periodic or aperiodic fluctuations of the air pressure. In all perception we have to do only with variable alterations that have a particular structure; these various *time-structures* we experience qualitatively through various concepts (parameters). A repetition has the smallest *degree of alteration*, a wholly surprising event the greatest.

Experiential time is also dependent on the *density of alteration*: the more surprising events take place, the 'quicker' time passes; the more repetitions there are, the 'slower' time passes. But there is surprise only when something unexpected occurs: on the basis of previous events we expect a particular kind of succession of alterations, and then something occurs that is quite unlike what we expected. At that moment we are surprised: our senses are extremely sensitive to absorb the unexpected alteration, to adjust themselves to it. Thus after a short time a constant succession of contrasts becomes just as 'boring' as constant repetition: we stop expecting anything specific, and cannot be surprised: the overall impression of a succession of contrasts is levelled down to a single information.

The *degree of information* is thus greatest when at every moment of a musical flow the *momentum of surprise* (in the sense we have described) is greatest: the music constantly has 'something to say'. But this means that the experiential time is in a state of flux, constantly and unexpectedly altering.

An apparent paradox is immediately explained: the greater the temporal density of unexpected alterations – the information content – the more time we need to grasp events, and the less time we have for reflection, the quicker time passes; the lower the *effective* density of alteration (not reduced by recollection or the fact that the alterations coincide with our expectations), the less time the senses need to react, so that greater intervals of experiential time lie between the processes, and the slower time passes.

Experiential time is thus dependent firstly on the measured tempo (determining the speed of the shortest unit of measure for the time-intervals of the processes) and on the speed of the successive processes: experiential time can thus pass very slowly when there is a succession of extremely quick processes that, however, alter little or not at all (for example in regular periodic processes) just as, vice versa, experiential time can pass very quickly in a slow tempo or a slow succession of processes if there is a high degree of alteration.

Thus it is always necessary, in order to attain a high, effective degree of alteration and thus also a high momentum of surprise, that we have for a time experienced a certain logic of the flow, on the basis of which we begin to experience in advance, to expect something.

If we realise, at the end of a piece of music – quite irrespective of how long it lasted, whether it was played fast or slowly and whether there were very many or very few notes – that we have 'lost all sense of time', then we have in fact been experiencing time most strongly.

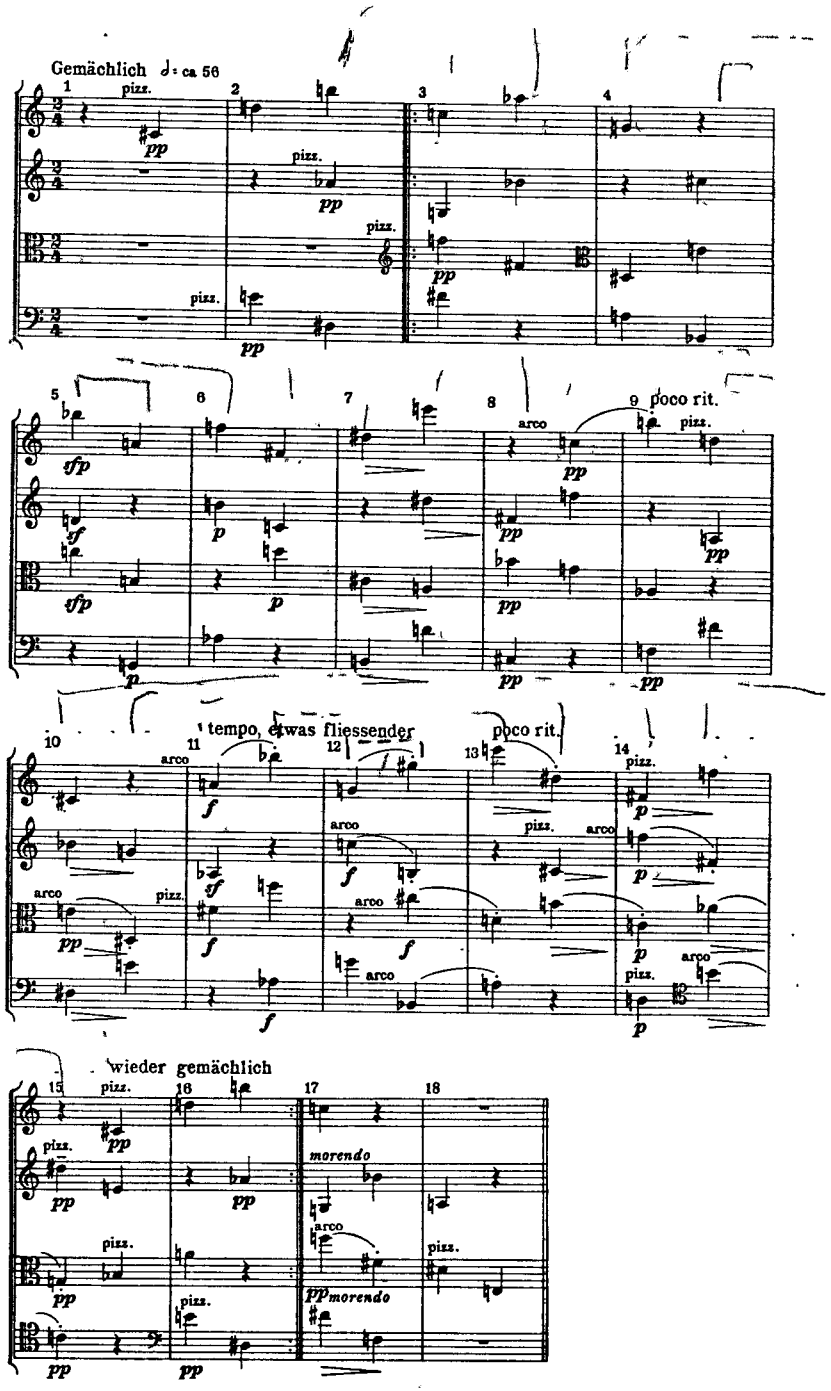
This is how we always react to Webern's music, and we would attempt to find in the structure some partial explanation for it.

Let us take a simple example: the first section from the second movement of the *String Quartet*, Op. 28. (Example 1.)

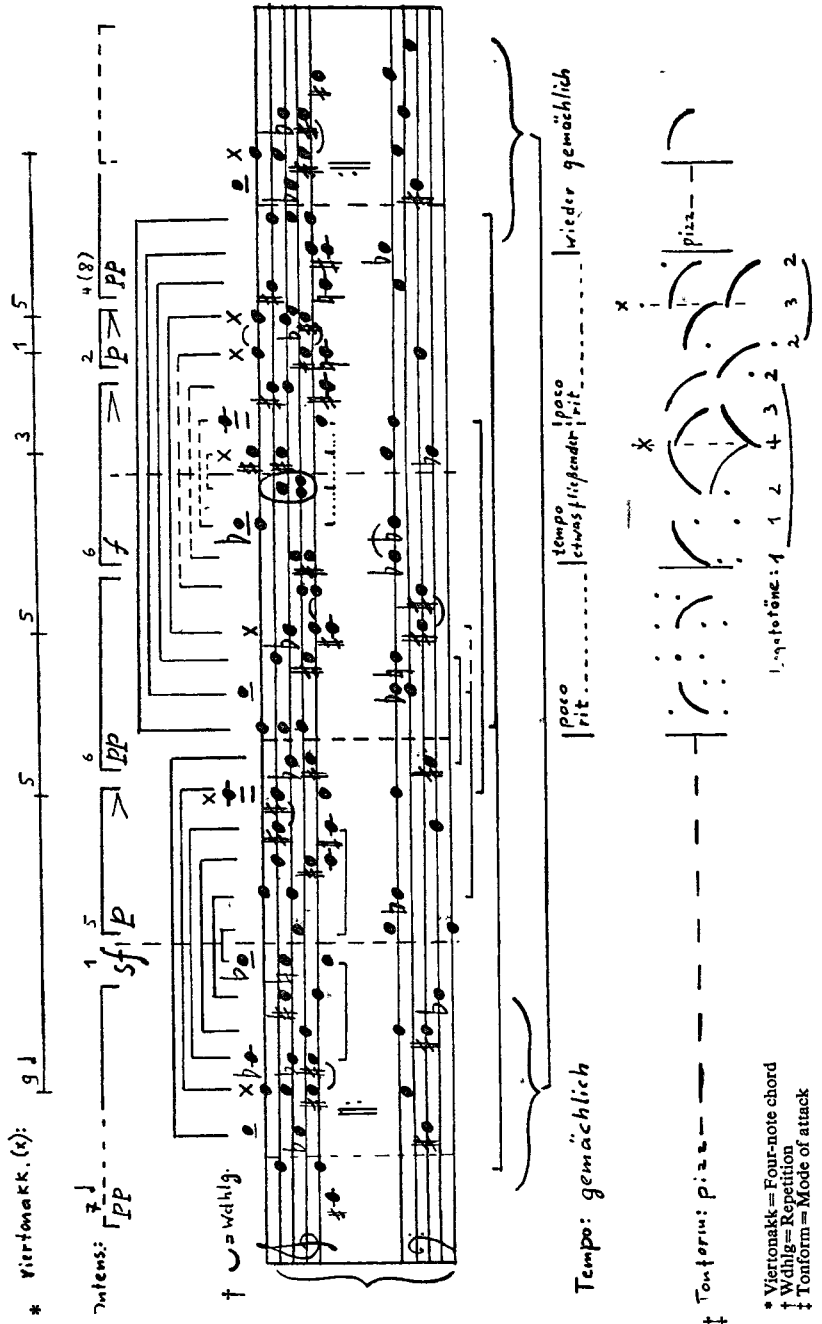
We hear a succession of thirty-five equal *time-intervals*. The distance between the individual processes of alteration thus remains constant. But after the first movement, in which the time-values are varied a good deal, we do not expect this unbroken succession of equal time-values, and the expectation of an alteration of note-value continues until the end of the section, so that the experiential time accelerates until roughly the middle and then slows down again: the intensity with which we expect a different time-value grows, then decreases. Thus in this case the constant repetition of equal time-values produces surprise, because of what has gone before. With the further repetition of the whole process this momentum of surprise falls away (though the repetition already acts as a preparation for the succeeding structure, a fact we do not know at a first hearing; as soon as we know the piece well, or by heart, our expectation covers more and more other things; finally we know everything in advance and the only alterations we notice are those in performance, etc., but fortunately this seldom happens, since one's memory can hardly retain every detail of a piece). The whole process we have described lasts hardly more than half a minute, and in none of his works did Webern go beyond this duration for the complete constancy of a parameter (in this case durations and intervals-of-entry).

When one parameter is constant, our attention is directed more toward the other processes; after 14 crotchets, all played *pizzicato*, the first *legato* occurs (in the first violin). Two crotchets later the second follows (in the viola) and the *legato*-groups become ever denser, to balance the decrease in their momentum of surprise; they die away again and lead back to the *pizzicato*. Thus the *mode of attack* participates in the time-moulding process.

A further criterion for experiential time is here the *vertical density*. Of 31 simultaneities (not counting the repeat) 23 are of three notes, 6 of four notes, and at the beginning stand a single note and a diad. The six four-note chords are so distributed that in the context of three-note chords they have a high degree of alteration: from each



Example 1



Example 2

four-note chord to the next, the three-note chords are collected to form *supra-ordered intervals* of experiential time, the intervals growing steadily shorter, then longer again. Starting at the double bar we hear the time intervals 9–5–5–3–1–3–5 crotchets.

The repeat provides a double opportunity to follow the processes of alteration: if the first time we took more notice of the alterations in attack (*pizzicato-legato*) our attention now automatically turns more to the noticeable alterations in chord-density as related to the alterations of attack (and vice versa).

Here it is already apparent that the music's *density of alteration* does not change in direct proportion to the *density of experience*. For example, if the time intervals between the alterations remain constant, experiential time becomes progressively slower; if the temporal density of alteration increases, the flow of experiential time remains for the moment constant, and its tempo increases only when the degree of alteration increases in potential. Consequently if experiential time is to pass at a constant speed when the degree of alteration remains constant, the temporal density of the alterations must increase; vice versa: if when the density of alteration remains constant the degree of experience is to remain the same, so that experiential time is to pass no more slowly, then the degree of alteration must increase. We find both processes in the example we have chosen. We see that when the individual chords come in (mensurally) even succession, Webern constantly alters the experiential time through supra-ordered processes of alteration; and we see how he does it.

The time interval between equivalent alterations of the same degree (juxtaposition of four- and three-note chords) decreases and then more quickly increases; i.e. while the degree of alteration remains constant, the time-density increases and decreases again.

Here the *legato* attack has a much higher degree of alteration than have the four-note chords, since it is introduced only after 14 *pizzicato* attacks, and one is already paying less attention to the mode of attack, which up till then has remained constant; the juxtaposition of three- and four-note chords, on the other hand, has been experienced from the very outset of the piece as a momentum of alteration. On this account the density of the alterations from *pizzicato* to *legato* increases much more quickly in order to attain the same level of information. The time-gap in crotchets is 3–2–2–1–1–1–1–1–2 (though the last number is 5 when the repeat is played), and when, through the five-fold occurrence of a gap of one crotchet between the entries of the *legato*-pairs, the density becomes constant, the degree of alteration increases in the vertical dimension: more *legato* notes are heard at once, the serial succession being $\overset{\text{2–4–3–2 / 2–3–2.}}{forte > piano >}$ Thus Webern here allows the degree of alteration to increase while the density of alteration remains constant. The experiential time of the whole section, as far as it already emerges from these two partial processes, proceeds by leap until bar 14, accelerating; moreover, from then on it becomes only slightly slower, since the density of alteration and the degree of alteration decrease more quickly than they increased, this itself constituting an alteration that counteracts the repetition of *pizzicato* notes and the greater time-intervals between the four-note chords.

In the *repeat* that follows, the curve of experiential time must thus follow a quite different path: degrees of alteration are noticed in processes that previously were less observed; memory enters as a factor that noticeably diminishes the information content of what is heard: one attempts to recognise things, the degree of surprise sinks, etc.

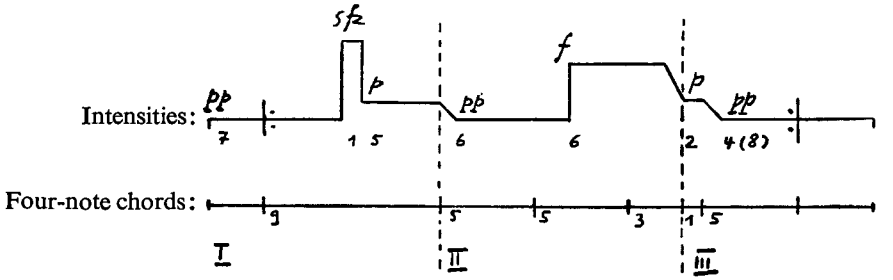
But in a structure the degrees of alteration and density of alteration result from the joint effect of *all components*, like vectorial values in a multi-dimensional field.

Having investigated the internal time intervals, the supra-ordered alterations of attack and the variable density of chords, let us now look at our example to see how far experiential time is determined also by the structuring of *intensities* and *harmonic alterations*. To this end, one should compare examples 2 and 3.

Alterations in loudness split up the crotchets into a number of groups:

7 *pp* – 1 *sf* – 5 *p* – 6 *pp* – 6 *f* – 2 *p* – 4 (8) *pp*.

(The repeat makes the group of four into a group of eight.) Superimposition of the two patterns of time division resulting from the groups of four-note chords and the alterations of loudness makes it clear that their points of coincidence give a new division of the experiential time into three *main groups:*



Example 3

The dynamic grouping is associated very directly with the harmonic structure. There are two harmonic mirror-symmetry groups, the first of 12 chords (6 + 6), the second of 16 (8 + 8); they arise through the mutual correspondence of chords that have a similar interval structure, based again on (vertical) mirroring, but with transposition and varying use of the octave registers. These groups are clearly divided by the introduction of *legato* attack at the exact point where the second symmetrical group begins (see Ex. 2).

The centre of the first symmetrical group is marked by a *sforzato*, that of the second by the only occurrence of a unison of two instruments and the resulting diad c″, g′ *pizz.*, g′ *arco* (greatest degree of alteration of vertical density: diad and four-note chord in succession). In the second group the mirror symmetry is shifted in its symmetrical balance; first by the irregularity of symmetry in the three middle pairs of chords, and secondly because the two four-note chords both occur in the second half.

The group-relationships within the symmetries are made clear through dynamics: the first half of the first mirror-group is *pp* – (2 +) 5 chords; the first chord of the central pair is *sf*; the second 5 chords are *piano*. The ensuing *pp* for 6 chords links the two symmetry-groups by drawing the last chord of the first group into the following one, and shows the exact extent of the symmetrical correspondence of chords in the second group; in the context of low dynamic levels, the *f* with high degree of alteration, like the *sf* in the first group, characterises the increasing asymmetry of correspondence in the three middle pairs; the two four-note chords are *p;* while the last symmetrically corresponding group is again *pp*.

This process is made still clearer by the handling of *tempo-alteration:* in the first symmetry-group there is no tempo-alteration; the moment the second group begins there is a *poco rit.;* with the irregularly symmetrical middle group (*forte*) the tempo becomes '*etwas fliessender*' (*rather more flowing*); at the first chord after the moment of maximum harmonic information – which is at the same time the centre of the second symmetrical group – there is again a *poco rit.* (greatest degree-of-alteration of chord density, diad to four-note chord and moreover from the surprisingly simple interval of a fourth to a differentiated four-note chord that lacks a symmetrical or semi-symmetrical mirror-complement such as has hitherto been the rule); the greatest degree-of-alteration of horizontal density (direct succession of two four-note chords) is followed by '*wieder gemächlich*' (*tempo 1 – leisurely*).

We experience in immediate succession the highest degree of alteration and the greatest density of alteration, simultaneously with a speeding up and slowing down of the tempo and a marked dynamic alteration that applies not only to the symmetric-asymmetric displacement but to the chord structure.

Here again there is a correspondence with the *legato* attack, which, together with the intervals' pitch-direction (see below) supplements the other forms of alteration. The first 5 chords of the second mirror-symmetry constitute a symmetrical group (rising *legato pizzicato*, falling *legato* ; then there is a group of six whose symmetry is telescoped: this group shifts the centre of gravity to the second half; then a group of three, linked to the previous one, with only falling *legato* bowings .

At the centre of both the group of six and the group of three, the greatest degree-of-alteration in the vertical superimposition of *legato* phrases coincides with the four-note chords marked X in Ex. 2. The latter are again differentiated by the compass (widest and closest possible) of the notes they contain:

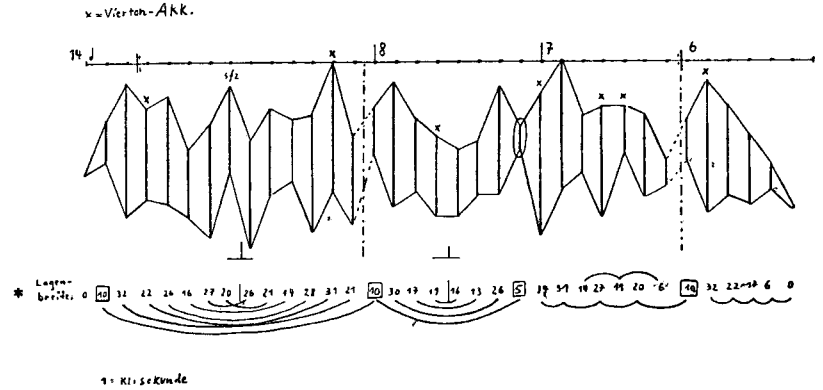
g♯″	f″
c♯″	b′
b	a♭′
B♭	f♯′

Summarising, we find the following: the harmonic symmetry-groups divide the flow of time into two sections (or, including the repeat, four plus an asymmetrical closing group), their length being (2 +) 12 and 16 crotchets. Whereas the first symmetry, whose dynamics accentuate its two halves and its centre, is *binary and regular*, the second and longer one is with regard to harmony, dynamics and tempo-alterations *ternary* and in its middle section *irregular*, with a *transference of weight* to the second half through the two 'out-of-step' four-note chords and the insertion of unequal *legato* symmetry-groups. The *separation* of the two major symmetries, effected by the introduction of the *legato*, is made *indistinct* by the taking-over of the last chord of the first group into the second, *pp*.

Whenever a slowing-up of the experiential time occurs because of a *lower degree of alteration in one parameter*, or through a repetition, the *degree of alteration in another* increases, in order, as it were, to catch up: the immediate repetition of a chord-structure in the middle of the first symmetry-group is linked with a *sforzato*; when in the symmetrically corresponding second half the various successive chords of the first half are repeated in reverse order and vertically mirrored, the intensity rises to *piano*; the second group is, with regard to its symmetrical structure, a repetition of the first, but is longer,

ternary, and irregular toward the middle – the centre, while remaining clearly marked, is no longer the point of balance, although it is precisely this group of chords that, on the analogy of the first symmetrical group, we expect to be most directly interrelated. Finally the *symmetrical part-structures* produce an *unsymmetrical overall form.*

Serialism in the succession of the intervals between the chords' highest and lowest notes is dependent on their *registers* and their *compass* (Example 4).



* *Lagenbreite = Breadth of register (measured in minor seconds)*

Example 4

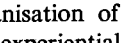
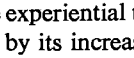
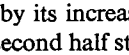
Through the combination of chord-registers and compass there arises a three-fold temporal division: (1 +) 14 – 8 – 7 crotchets (with a final group of 6 after the repeat). In the first symmetrical group, chords of very similar compass correspond to one another; the middle of the group is characterised by a marked change of registers, and this is also true of the linking-passage to the following symmetry-group and from the latter to the unsymmetrical third one. The links between the groups are marked very clearly by the compass of a seventh, or its half, the fourth (10 and 5)*. The first and second group, like the third and fourth, are linked by having a chord in common, while the second and third are divided by the greatest contrast of compass (5 – 34). The first group coincides with the first harmonic symmetry-group, the second and third correspond to the two halves of the second, which, however, *differ from each other* in so far as the first is symmetrical whereas the second is unsymmetrical (decreasing in compass); the second thus has a much higher degree of alteration because of the two preceding symmetries.

A typical feature is the constant alternation within the alterations of compass – in the first group this produces two corresponding pairs which interlock 27 - 20 - 26 - 21 and in the third a two-layered series of compass-decrease:

34 - 31 - 14 - 27 - 11 - 20 - 6 - 10

After the repeat, the closing group shows a still further decrease in compass, reminiscent of a coda.

In the latter half of the second (eight-chord) group the chords in the symmetry differ by an average of four units (i.e. a major third) from those in the first half to which they correspond – this is in contrast to the first (fourteen-chord) group, where the symmetrical pairs were very closely related.

Apart from this, the *average compass* of the chords is different in the three groups, as is *the way in which their register alters:* group 1 – compass alternately increasing and decreasing, register ; group 2 – compass decreasing and increasing again, average register narrower  ; group 3 – compass decreasing in alternation (see above), tending to go from the widest registers to the middle  ; final group – compass decreasing, register falling  .

Taken as a whole, the organisation of the chordal compass and registers thus confirms the moulding given the experiential time by the other processes of structuring; but looking closely we see that by its increasing degree of alteration it displaces the symmetrical relationship of the second half still more strongly than was up to now the case.

The combination of the instruments, and still more the structuring of absolute pitch show, moreover, that the overall distribution of notes among the registers (the register-density) places a large majority of the notes in the octave c′ – b′ – and as the outer registers of the total compass (three octaves and a major sixth) are approached, there are steadily fewer notes. The 106 notes are distributed as follows:

c‴– b‴	2
c″ – b″	29
c′ – b′	46
c – b	25
C – B	4

One can see from the register-diagram (Ex. 4) to what an extent the *average note-density* is in the course of this section displaced toward the middle register (with a rising 'stepwise' motion of the lower extremities while the upper extremities remain constant).

A process usually very important for the time-moulding in Webern's music is the fixing of each note in a constant octave-register, and alternation of registers at the most varying speeds; this is one of the most notable means of moulding experiential time, but there is in our example only a slight trace of it, as in this case it would not accord with the harmonic intentions. For the same reason the durations and the intervals of entry remain undifferentiated, though usually they are composed with the most varied alteration (through fixing, omission and the addition of single time-value groups for particular parts) and with the greatest variety of degrees and densities, which combine to give a quicker or slower rate of alteration.

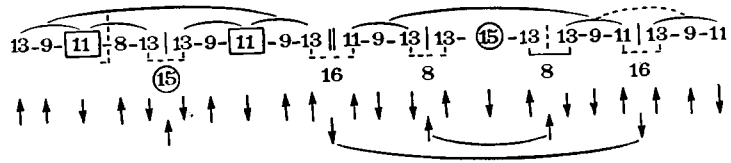
Note-repetitions occur only before or after the four-note chords, and point out the direction of the symmetry: in the first group, f♯′ is repeated after the first four-note chord and d♯″ before the second; in the second group, two notes each are repeated: after the first four-note chord e′, d♯, and before the last of the group f♯′ and f″ (anticipation).

The hold-up caused by these repetitions draws our especial attention to the four-note chords; moreover the note-repetition adds to each four-note chord the preceding or following three-note one, thus making a composite chord of 6 notes (2 × 3) – or in the second section only 5 – as if to balance the alteration of density that is setting in. As pointers, these note-repetitions give us an insight into the subtlest refinements of Webern's technique of composition (punctuation marks).

Horizontal interval-groups in the individual instruments are always divided by crotchet rests; there is a double canon between the first violin and viola and the cello and second violin (basic series and its transposition to the upper third, retrograde form and its inversion at the fifth above). In the first violin the succession of groups (in crotchets) is:

6 – 6 – 4 (2 *arco* + 2 *pizz*) – 8 (6 *arco* + 2 *pizz*) – 6 (4 in the repeat).

The groups differ in the *type* and *direction* of intervals used within the groups – minor ninths, major sevenths, major sixths, minor sixths and minor tenths; in the joins between the groups, minor tenths, major tenths and minor sixths (see Ex. 1 above). The groups are composed as follows:

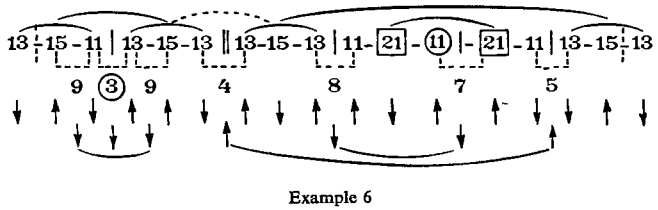


Example 5

Here too we find a symmetrical grouping – corresponding with all the others. But in contrast to the lay-out of the first mirror-symmetry group by harmony, registers, etc., its centre is here shifted one crotchet nearer the beginning, and thus the group-symmetries of different origin are made to overlap by one degree, like two grids (one is reminded directly of a picture of an object taken with a multiple exposure, so that all the contours, shifted a little one way, can be seen more than once). The linking-points of the groups, until now clear and variously emphasised, are thus made indistinct. The second group, which by harmony, register etc. has mirror-symmetry, has here axial symmetry (centre 15); the second note of the *one* largest interval (minor tenth) falls on the first chord of the harmonic *central pair*, the diad c″– g′, g′. Thus the second symmetry-groups again overlap by a crotchet. The interval-groups of the viola, corresponding vertically and symmetrically to those of the first violin (inversion of intervals) should also be examined.

In the cello we hear the group-succession (in crotchets); 3–2–2–3 | –4–4 (2 *pizz.* + 2 *arco*) – 3 (1 *pizz.* + 2 *arco*) – 3 (4). Within the groups the intervals used are minor ninths, minor tenths, major sevenths, major thirteenths (octave plus major sixth); the linking intervals between the groups are major sixths, minor thirds, major thirds, minor sixths and fifths.

Intervals and directions are related as follows:



Example 6

The first symmetry-group of 6 intervals (irregular in its central pair 11–13) is abbreviated in comparison with the first violin's first group (10=5+5 intervals) because of the

canonically delayed entry on which, however, the abbreviation of the second half also reacts. In the centre of this group (crotchet rest) there falls the *sf*, which in the harmonic group marked the first chord of the central pair; and in the following major group of 11 intervals arranged in axial symmetry (centre 11), the largest intervals (13ths) fall first on the second chord of the central pair of the second harmonic symmetry, and then on the two four-note chords that shift the centre of gravity. Thus the overlap and mutual blurring of the second *horizontal* symmetry-group (intervals and directions) and the corresponding *harmonic* symmetry-group is made one crotchet greater than in the first group. One should follow the course of the second violin similarly.

Thus we see how symmetries of the most various origin and form, occurring simultaneously and moulding the flow of experiential time, must be brought together before they fulfil their true function, that of coinciding only approximately and thus introducing into the work a variable degree of indistinctness such as is typical of any symmetry that occurs naturally.

What is like becomes only approximately like; correspondences only correspond approximately. There is thus introduced into experiential time a lastingly effective factor of alteration which at the outset of our investigations we outlined in general terms as a *desideratum:* that our expectations should be aroused through a logic of structural processes, one that can be experienced at the time, in advance and (as our example showed) still more in retrospect (since what has preceded reveals itself only through what follows, a reversal of causality); once our expectations are aroused, we are in a condition to assimilate information, and are thus provided with aural 'rules': only then do the ensuing displacements and effective alterations surprise us and to the corresponding degree give us information.

Along this narrow traverse between too much correspondence, repetition, and too much 'contrast' – i.e. too little retrospective logic: along this razor's edge the composer must be able to progress, if, starting from structure, he is to achieve mastery of experiential time, if he is to form his structure through experiential time. We no longer hear 'separate overlapping' structures, such as have been presented in isolation in this study; we do not experience simultaneous temporal processes, what we experience is *time, which is always more than the sum of quantitative alterations, since the essential factor remains indeterminable: the person who experiences.* Thus the ultimate possible creative control of structural qualities consists in the '*listening through*' that Webern always demanded.

Should a special dispensation be granted the composer – who for all his determining of individual details must hold fast to his aural conception of a complete, pre-experienced time-organism – then his art has received that indispensable essence that alone gives sense to 'structure'; and we are coming to realise the dreamlike certainty with which Webern accomplished this, starting from ever different premises and with ever different means.

If one now hears this excerpt from the String Quartet – however many times one has heard it before – everything seems 'simple', everything forms a whole, a unity. The multiplicity is welded together: it becomes *time experienced through sound: it becomes music.*

ANALYSIS OF THE SACRED SONG, OP. 15 No. 4

HEINZ-KLAUS METZGER

The text:

Mein Weg geht jetzt vorüber,
o Welt, was acht' ich dein;
der Himmel ist mir lieber,
da muss ich fahren ein.

Mich nicht zu sehr beladen,
weil ich wegfertig bin,
in Gottes Fried und Gnaden,
fahr' ich mit Freud' dahin.

is taken as the basis of a musical form in so far as to its eight lines there correspond eight mutually-related formal sections. Its articulation has accordingly been conceived in the categories of antecedent and consequent.

Line 1 – Section 1 (bars 1–2) – Antecedent	} Antecedent	}		
„ 2 – „ 2 („ 2–4) – Consequent				
„ 3 – „ 3 („ 4–6) – Antecedent	} Consequent	}	Antecedent	
„ 4 – „ 4 („ 6–8) – Consequent				
„ 5 – „ 5 („ 8–9) – Antecedent	} Antecedent	}		
„ 6 – „ 6 (bar 10) – Consequent				
„ 7 – „ 7 (bars 10–12) – Antecedent	} Consequent	}	Consequent	
„ 8 – „ 8 („ 12–13) – Consequent				

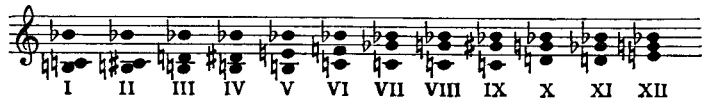
We need hardly demonstrate separately to how great an extent this arrangement results from the desire to make articulate the sense of the text, whose division into lines corresponds, moreover, to its syntactical divisions. The punctuation of the musical form is based on that of the text; but respirations, not made explicit in print, are also composed into the music (e.g. the rest succeeding the word *Himmel* in bar 5, or the declamation in bars 6–7); such expressive silences, which do not mark a caesura, are in Webern always to be considered, like notes, as 'values' within a rhythmic complex. From this example we can observe that expression and construction are identical, and that to oppose them to each other (that stock-in-trade of certain critics) is futile. Admittedly this lay-out, determined by the text, is applied literally to only the vocal part, is in fact conceived in terms of it, so that, from the point of view of the performance of a text the simultaneous parts for flute and clarinet can well be characterised as carrying out 'accompanying' – preparatory and interpolatory – functions, of which the latter in particular assumes importance when there are pauses in the vocal line – a division of labour familiar in the *Lied* tradition. But just through this the parts are given a periodicity that is displaced and overlaps with itself, and which determines the area within which a real interplay of three parts may be produced. In other words; in a song the vocal part, as the one concerned with the text, is made specially responsible for the meaning of the whole

structure, and this, at the stage in the history of composition with which we are dealing, became a problem, since there was as yet no idea of a 'principal voice' ('*Hauptstimme*', H); this problem Webern solved, working out the vocal part as a principal voice by textural means and yet treating it merely as one function of a structure that by its very nature denied the vocal part any privileged position. Webern did not postulate this as a solution, discovered once and for all, applicable forthwith to the process of composition and thus in a sense outside the scope of the latter. He much preferred to take his problems as he found them and to develop his solutions in the course of composition; the initial rhythmic parallelism of flute and clarinet, that has first to be dissolved and that establishes itself again at various points, recalls the conventional type of accompaniment, just as in the continuity of the vocal part there is a strong trace of the dominant 'melody', which only disappears because the other parts are highly complex.

This three-part movement is generated of such antinomies; in what follows, a few disconnected observations will be made about its construction.

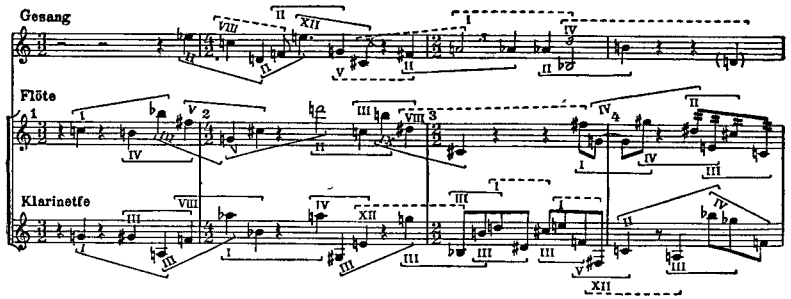
The music contains no hint of any thematic relationships. The three-part texture, however – the possibility of making three notes sound together – directly underlies its organisation. In our tempered system this possibility is determined by twelve interval-complexes (together, of course, with their transpositions, inversions, register permutations etc.).

Example 1

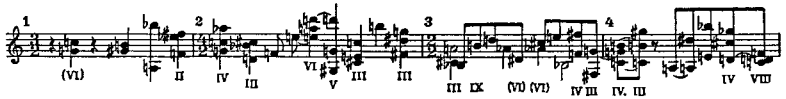


These are the real form-building elements of the song. Unfolded horizontally they make up the melodic cells within the parts, vertically the simultaneous sounds of the acoustic web, 'diagonally' (the expression will be explained later), its 'brackets'.

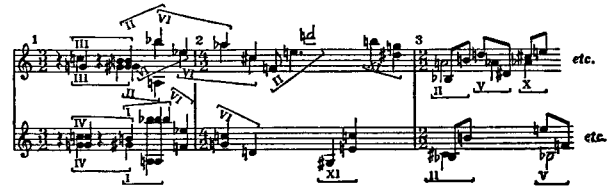
Example 2



Example 3



Example 4



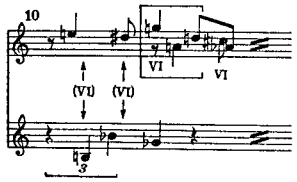
Example 2 shows that at first the flute and clarinet, as if to establish their presence, play note-against-note in exact inversion, each stating complex I. What is to follow is decided on the final crotchet of bar 1; the mirror-relationship is surreptitiously resolved as the descending major 3rd in the flute (b♭–f♯) is matched by the same interval in the clarinet – though in the form of an ascending minor 6th, to maintain the contrary motion. At this point the principles of voice-leading are suspended and raised to a synthesis. The same moment marks the entry, in the instrumental parts, of IV (flute) and III (clarinet), stated one against the other. It is now that the voice enters. Its arrival brings about the first vertical triad – the complex II (cf. Ex. 3), the interval-relationship which is the fundamental element in its own unfolding during the first antecedent-consequent group. Before proceeding to a detailed analysis of the construction of the vocal line, which will, incidentally, by the first crotchet of bar 4 have included all twelve notes, let us note that the germ of the whole development of bar 1 may be found 'inside' the music itself. This piece contains passages where vertical connection is not in fact represented by simultaneity of sound (cf. bar 3, in the mensural region of the 2nd and 3rd crotchets), so that the ear has to hear it as a kind of 'diagonal relationship' of the parts, by a combination of horizontal and vertical adjustment ('hearing diagonally'); it would therefore be a good idea to include this mode of hearing in our analytical equipment – it is a matter of a 'subcutaneous' stratum of connection, not conveyed by notation, whose exhaustive demonstration would in this piece require a score of perhaps ten or twelve staves, but which would furnish the most exact information about the motivation of the form at any point in the work.[1] Example 4 reproduces merely a few of these connections, selected entirely at random; it will be seen from this example that the juxtaposition of IV and III, which in the second half of bar 1 is made explicit in the flute and clarinet parts, is already present, in fact doubly, in the first two successive diads, thus in a mere four notes (the complexes are, in our example, set out on two staves): that furthermore, in the second and third diads both complex I, which begins the movement, and complex II, which as a vertical sound first appears on the sixth crotchet and then appears openly in the vocal part as the constituent melodic-cell of this section, are each presented twice in a 'hidden' way. As Ex. 2 shows, the vocal part is built out of permutations of complex II, the three-note cells being linked by one note or more in common. The 'complex of connection' regulating the succession of the permutations of II is ordered according either to this same interval-relationship or to other relationships which are present also in the other parts. The latter case is shown in our example by dotted brackets, as are the complexes which do not take an active part in the organisation because their continuity is interrupted by 'dead intervals' ('dividing'

[1] In certain works of Boulez one will notice attempts to make this stratum communicable by notation. See in particular, in the 2nd Piano Sonata, the notation in the section 'Mouvement dédoublé' of the third movement.

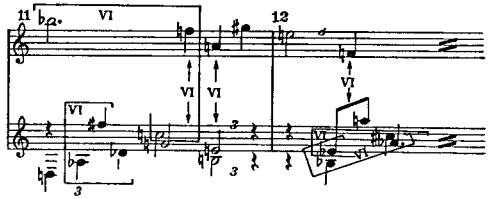
rests, as between the antecedent and consequent). This construction is broken up only by complex XII, which ends the small antecedent; this deviation the following consequent is left to rectify – the form-building sense here is compelling. (The complex IV, in bars 3–4, marked with a dotted bracket, is a link with the ensuing section.)

The corresponding disposition of the instrumental parts may be seen directly from Ex. 2. With their great diversity of interval-complexes they stand in contrast to the vocal part, which in this section is developed from a single basic relationship.

Example 3 summarises the chordal succession, which in this section is essentially determined by the juxtaposition, already mentioned in another connection, of complexes IV and III, and whose interplay with the horizontal construction is clear throughout. Complex II occurs at only a single point, the already-discussed last crotchet of bar I – characteristically, at the entry of the vocal part. Complex IX, which sounds for a moment on the second quaver of bar 3, follows directly from its preceding melodic presentation in the flute part (across the bar-line 2–3), while complex VIII on the last quaver of bar 4, as the last sound of the 'antecedent-consequent' group, refers back to its melodic appearance right at the beginning of bar 2 in the vocal part (linking-complex); this relationship seems to 'draw the form together'. (As regards this appearance of Complex VIII, it has already been demonstrated that the phrases overlap in the parts, so that here the new section, which in the vocal part begins with the upbeat to bar 5, begins in the flute and clarinet only with the bar itself, characterised by crotchet movement.) The two-part textures in bar 1 and at other points during the song can hardly be regarded as 'lacking' anything, since the notes which would be necessary for their completion directly follow or precede them – thus the 'completion' is composed, as I have tried to demonstrate in Ex. 4. However, the bare fourths, marked in Ex. 3 (VI), require special treatment, as their formal function is not local but has to be discovered in the context of the piece as a whole.



Example 5



Example 6

Examples 5 and 6, taken from the closing section of the song, characterise the instant when the arch form reaches its greatest tension. The singularly self-sufficient formal character of this composition, felt in spite of the renunciation of any claims to symmetry in the formal working-out itself, results not least from this treatment of fourths. The exposition of these intervals (both preceded and followed by rests, emphasising, as it were, their special status which is later to become apparent) is the point of departure for the piece. (No other interval in the song is introduced in this way.) Example 4 shows the way in which it is developed beneath the surface of the structure, as from the 4th crotchet of the 1st bar – it is expanded into the three-note complex VI, which is then stated explicitly as a triad on the 2nd crotchet of bar 2 ('climax' of the phrase), only to be reduced to bare fourths again in the following bar. This whole process is repeated as

a preparation for the end of the piece, and in a much extended form, as can be seen from Exs. 5 and 6. In the overall form, VI thus functions similarly, though with incomparably greater power, to VIII within the first antecedent-consequent group.

In what has so far been said we have already touched on those points at which the music shows itself to be made up not of three parts but of a vocal part with 'accompaniment'; we found it was possible to describe the first section principally from the structure of the voice part, and this was an implicit confirmation of the above thesis; one can single out in the same way the features that show the other sections to be similarly constructed. In the vocal part of the latter, it is mainly a question of permutations of complexes III, IV and V, while in the instrumental parts, as Ex. 2 showed to be the case for the work's opening, a greater variety of combinations is the rule. But the real means by which the traditional relationship of 'melody and accompaniment' is suspended operate at the very heart of the music, through those 'hidden' relationships which in Ex. 4 we have to some extent illustrated as they apply in the first few bars. I should like to quote here, even if out of context, a sentence from a treatise written more than 100 years ago by a theorist of music – one, indeed, long since relegated to obscurity by the musical world – the Hegelian Moritz Hauptmann:

'We thus obtain a harmony[1] of successions as a succession of harmonies – once again, opposites brought together in unity, the concept of everything that is real in its essence.'[2] The fact that Hauptmann considers counterpoint as a 'harmony of successions' and not as one of 'parts' is indeed empirically a consequence of his commitment to harmonic thinking, as is the circumstance that he understands counterpoint as resulting from harmony – which, for that matter follows (for him) from metre. But we now have the elements assembled from which, summing up, we can determine what is the technique of composition in this song of Webern's. In the traditional technique the succession of chords resulted at best from the parts, just as, vice versa, the latter might be motivated by the progress of the harmony, without the two dimensions' being always necessarily derived one from the other; and the impression may be given in Webern's music that this is still so. In actual fact the 'diagonal' relationships are not only 'brackets' which bind to the tightest consistency the 'succession of harmonies' and the 'harmony of successions'; in this song they not merely make of an ostensibly 'accompanied' melody a texture in three real parts – that is to say, a structure whose precondition is the possible simultaneity of three fields of relationship – but they reach out, as Ex. 4 demonstrated, far beyond three-part writing and the whole idea of part-writing. That, for instance, Ex. 4 taught us more than did Ex. 3 about the 'vertical' connections in bar 3: that the successive juxtapositions of two forms of complex XI in bar 2 can be seen *only* from Ex. 4; this is enough to show that the piece can not be grasped by a 'horizontal' and 'vertical' approach (these pre-existing dimensions are here finally shown up as false analogies from spatial perception), but only through its genuinely temporal relationships, within which simultaneity signifies a time-gap of zero.

During this phase of Webern's technique there is developing, in an 'inner musical dimension' the prototype on which Stockhausen could later base the idea of 'sound-

[1] *Trans. note.* Hauptmann's term is *Zusammenklang* – a 'sounding together'. Elsewhere in this volume it is translated 'simultaneity', but in the context of nineteenth-century musical thought it had a stronger meaning, akin to that of 'harmony'.

[2] M. Hauptmann, *Die Natur der Harmonik und der Metrik. Zur Theorie der Musik* 2nd Edition, Leipzig 1873. (The work was completed in 1853).

proportioning'. It is the first music that made real Hauptmann's ideal of sound-relationships within a polyphonic texture, and thus, as it were, dissolved the 'dimensions' which, though his work postulates them as unreconciled, Hauptmann was concerned to bring into unity.

WEBERN'S PIANO VARIATIONS, OP. 27. 3RD MOVEMENT

ARMIN KLAMMER

Our investigation will not take in the thematic structure of the piece, since that is something quite foreign to serial thought, and has nothing to do with Webern's personal achievement. So we will leave it to those observers whose orientation is historical.

The last movement of the Piano Variations, Op. 27 is formed out of six '*group-aggregates*'.[1] They contain 47 *groups* in all: the six aggregates consist of respectively 8, 12, 5, 5, 9 and 8 groups. The first 8 groups, i.e. the first group-aggregate (see musical example, page 92), will here be presented in detail; the remaining groups are to be briefly discussed later.

The table here given indicates the various *characteristics of groups 1-8*.

Groups	1	2	3	4
Number of notes ..	4	5	3	4
Intervals[2]	$4_{I}\ 1_{i}\ 4_{i}$	$1_{iI}\ 6\ 2_{I}\ 3$	$4_{iII}\ 1_{i}$	$4_{i}\ 1_{I}\ 4_{i}$
Note values ..	4 1 1 4	1 1 3 2 2	3 1 1	4 1 1 4
Intervals of Entry ..	3 1 1	1 1 1 2	2 1	3 1 1
Length of rests between groups ..	1	3	2	1
Modes of attack[3] ..	— ⌒ —	. . ⌒ —	> ⌒	⌒ —
Dynamics	p	f	p	f

Groups	5	6	7	8
Number of notes ..	5	3	6	6
Intervals	$1_{iIII}\ 6\ 2_{I}\ 3$	$4_{I}\ 1_{I}$	$1_{i}\ 4_{iII}\ 2_{iI}\ 3\ 2_{I}$	$1_{i}\ 1_{i}\ 4_{iI}\ 1_{i}\ 4_{I}$
Note Values ..	1 1 3 2 2	3 1 1	1 1 3 3 2 2	1 1 4 1 1 1
Intervals of Entry ..	1 1 1 2	2 1	1 1 1 2 1	1 0 2 1 2
Length of rests between groups ..	3	1	0	
Modes of attack ..	. . ⌒ —	⌒	⌒ ⌒ —	⌒ — ⌒ .
Dynamics	f	p	f	p

[1] A 'group-aggregate' is the summation of a number of note-groups which are related to one another through supra-ordered formal criteria which they have in common. Each group within the group-aggregate is itself the summation of a specific number of notes.

[2] *Notation of intervals.* 1–6 = semitones (minor 2nd – tritone); I, II, III = 1, 2 or 3 octaves added to the interval; 'i' = inversion of interval. E.g.; $1_{i\ I}$ = major 14th (major 7th + octave).

[3] *Mode of attack* = performing indication. ⌒ . — <

The sum of the notes of the first three groups is a twelve-tone row with 6 different intervals: minor 2nd, major 2nd, minor 3rd, major 3rd, 4th (the interval between the 12th and 1st notes of the basic series, and also between the 12th of the basic series and the first of the series that follows it), and the tritone. Minor 3rd, perfect 4th and tritone each occur once, major 2nds twice, major 3rds three times and minor 2nds four times.

To sum up the first group-aggregate (groups I-VIII); there are

A Series of 4 different numbers of notes per group; 3, 4, 5, 6

A Series of 4 different note values (in ♩); 1, 2, 3, 4

A Series of 4 different values for intervals of entry (in ♩); 0, 1, 2, 3

A Series of 4 different lengths of rests between groups (in ♩); 0, 1, 2, 3

A Series of 4 different modes of attack:

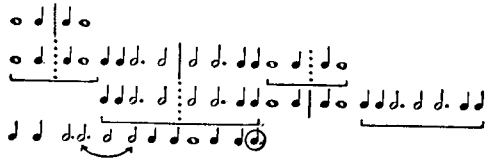
A Series of 4 different occurrences of intervals per series; 1, 2, 3, 4

A Series of 6 different intervals in the series (1=minor 2nd, 2=major 2nd, etc); 1, 2, 3, 4, 5, 6

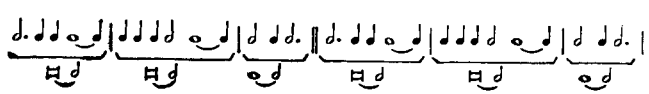
A Series of 12 different notes

The *harmonic field* of the group-aggregate shows a predominant construction by thirds, especially minor 3rds (we shall return to this later). The Aggregate has a markedly *legato* character. In each group there is a major 7th or minor 9th; the second interval of each group ascends; further on there is a crotchet metre, *legato* character and polyphonic structure. All this makes us feel an organic connection. We hear the different structures in terms of the ordinal number 4, and relate each group to all the others through their common factors.

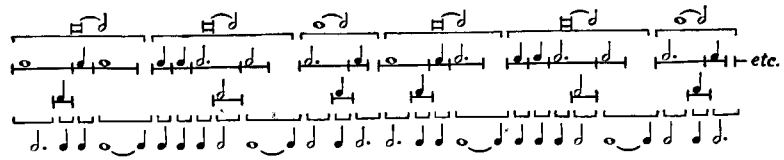
The succession of note values in groups 4, 5 and 6 is an exact repetition of that in the first three groups. If the 24 effective note values of the six groups are written out, we discover a telescoped cancrizan symmetry.



The last two groups, 7 and 8, together form a cancrizan of the first three groups. The fourth and sixth note values are interchanged and the last is diminished by ♩. (see below). An irregularly structured sequence of intervals of entry destroys the symmetry of the cancrizan by counterpointing the sequence of effective note values. The *intervals of entry*, distributed in two groups which repeat each other (thus forming a new symmetry), give us the following note values.



At the same time the example shows the *interval of entry from group to group;* its ratio is 5:5:3/5:5:3. Let us superimpose the *effective note values* and intervals of entry:



Symmetries become asymmetrical; asymmetries are combined to give new, supra-ordered symmetries! We think here of symmetrical forms and complexes of forms which are internally asymmetrical, 'statistically asymmetrical'.

The movement's overall formal layout, like that of the first 8 groups, shows this cancrizan symmetry, though again as an approximation and conceived in different terms. The duration of each group-aggregate is 11 bars, giving a total of 6 × 11 = 66 bars.

The movement's cancrizan symmetry, already indicated, is composed as shown in the following table:

Group-aggregate	I	II	III	IV	V	VI
Bar-numbers ..	1–12	12–23	23–33	33–44	45–55	56–66
Number of groups	8	12	5	5	9	8
Number of series	3	7	5	5	7	6
Formal character of group-aggregate	polyphony, note against note	homophony, vertical note groups of 1, 2, 3 notes	chords against single notes	chords against single notes	homophony, vertical note-groups, 1 & 2 notes	polyphony, chords against chords

As regards the number of groups, aggregates II and V (with the two highest numbers, 12 and 9) deviate from each other, and in their number of series, Aggregates I and VI (3 and 6 series) deviate; as regards formal character, I and VI (note against note, chord against chord) correspond by their polyphony; Aggregates II and V (vertical groups of 1–3, 1–2 notes) correspond by their homophonic structure. The central Aggregates III and IV correspond in all three particulars.

The tempting assumption that the number of series determines the number of notes per group-aggregate is found to be incorrect. The average numbers of notes per group are completely different:

Group-Aggregate	I	II	III	IV	V	VI
Number of series	3	7	5	5	7	6
Expected number of notes ..	36	84	60	60	84	72
Actual number of notes	36	77[1]	53	62	70	59
Number of attacks	35	49	44	50	55	25

The difference between the effective number of notes and the total expected (on the basis of the number of series) is due partly to notes in common at the joins between two successive forms of the series and partly to the repetition of notes within a series (the above-mentioned g♯′ in bar 18, the b′ in bar 38, the d♯′ in bars 41, 42). The repetition

[1] In Aggregate II the upbeat g♯′ in bar 18 is a repetition within the series and is not counted as a new note; it is, however, counted as an attack.

of notes not only to join two forms of the series but also within the series (to avoid giving the joins a predominant position) results logically from the conception of the series as an endless 'circulating' structure.

Four types of series appear in characteristic groupings within the movement; basic series, inversion, retrograde, retrograde inversion. The retrograde and the inversion are utilised in three, the basic series in four and the retrograde inversion in five different groupings. Aggregate I contains basic series, inversion and retrograde; Aggregate II, basic series and retrograde inversion; Aggregate III, retrograde and retrograde inversion; Aggregate IV, inversion and retrograde inversion (the last series – basic form – belongs by type to the succeeding aggregate); Aggregate V, basic series and retrograde inversion; Aggregate VI, all forms. Compare the table of forms of series:

I	S (× 1)	I (× 1)	R (× 1)	—	3 series
II	S (× 2)	—	—	RI (× 5)	7 series
III	—	—	R (× 3)	RI (× 2)	5 series
IV	—	I (× 2)	—	RI (× 2)	4 series
V	S (× 4)	—	—	RI (× 4)	8 series
VI	S (× 1)	I (× 2)	R (× 2)	RI (× 1)	6 series

(Observe the serial ordering of the numbers of series: 3, 7, 5, 4, 8, 6). The inversion alters the direction, the retrograde the sequence, the retrograde inversion both direction and sequence of intervals. Further differentiation of the group-aggregates results from their characterisation by the interval direction which tends to occur most often. In the first aggregate, seven groups commence with descending, one with ascending intervals; their second intervals all rise; the third go by successive pairs, descending, ascending, descending; of the final intervals the first and last are both ascending while those in between are descending; Aggregates III and IV have as a specific characteristic the repetition of notes; V has mainly descending first intervals (only one ascending); Aggregate VI, on the other hand, has mainly ascending first intervals (only one descending). The diagram gives the exact directions of intervals.

Group	Aggr. I	Aggr. II	Aggr. III	Aggr. IV	Aggr. V	Aggr. VI
1	DAD	DAD	RDRDDAD	DADADD	AAAADDD	AAD
2	AADA	DDAD	DDADAAD	DDDRAAADA	DDADDA	AAD
3	DA	AAA	RDRDAADDD	ADARDRADDD	DDADD	AAD
4	DAA	AA	DARDRDAAD	DDARDAADA	DDAADDD	ADA
5	DAAD	DA	ADAADAA	DRAADDADAAD	DAAAAA	DAD
6	DA	DA			DDA	AD
7	DADDA	AA			DDD	A
8	DAD	DA			DDA	
9		DA			DDADAA	
10		DA				
11		DADDA				
12		DADDADAD				

(A = ascending interval, D = descending, R = note repetition)

Let us examine more closely the joins between forms of the series. These joins can produce either

1. New intervals;
2. Elimination of notes; or
3. Note repetitions.

The disposition of the joins per group-aggregate is regulated accordingly. Aggregates I and V utilise types 1 and 3; the other aggregates, a combination of all three types;

Aggregates III and IV contain repetitions and eliminations of notes; Aggregates II and VI contain eliminations and new intervals; Aggregate VI combines all three types. When notes of the series are eliminated, an important feature is how many notes are carried over from one series to the next. In Aggregate II the joins are mainly by one common note; in Aggregate III there is only one join, with one note in common; in Aggregates IV and V there are only joins with two notes in common, and in Aggregate VI mainly joins with four notes in common. This serves to vary the average interval pattern per group-aggregate.

Group-aggregate	No. of notes of series eliminated	Note repetitions	Constitution of 12th interval
I	—	—	4th and major 2nd
II	2, 1, 1, 1, 1	—	Minor 3rd
III	1, 1, 1	2	—
IV	2, 2	2	Minor 2nd
V	2, 2, 2, 2, 2, 2, 2	—	—
VI	4, 4, 4, 1	—	Minor 2nd

Let us now extend our observation of the groups in the first aggregate and present the *overall group composition of the entire movement:*

Group-aggregate	I								II												III				
Number of groups	8								12												5				
Bar number of beginning of groups	1	2	4	5	7	8	9	11	12	13	14	15	16	16	17	18	19	20	20	22	23	25	27	29	32
No. of notes per group	4	5	3	4	5	3	6	6	6	6	5	5	5	5	4	7	4	7	11	12	11	11	13	13	11
Number of attacks per group	4	5	3	4	5	3	6	5	4	5	3	3	3	3	3	3	3	3	6	9	8	8	10	10	8

Group-aggregate	IV					V										VI								
Number of groups	5					9										8								
Bar number of beginning of groups	33	35	37	39	41	45	46	48	49	51	52	53	54	54	56	57	59	61	62	63	65	66		
No. of notes per group ..	9	13	13	13	14	8	7	10	8	7	6	7	7	10	8	11	8	9	5	7	6	5		
Number of attacks per group	7	10	11	10	12	8	7	6	8	7	4	4	4	7	4	4	4	4	2	3	2	2		

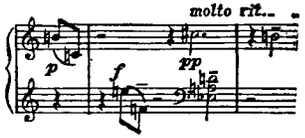
Compare the table of numbers of notes and attacks per group.

In the group-aggregates – which already contain differing numbers of groups – the differing *number of notes per group* is noticeable. It again shows a characteristic arrangement of the aggregates by size: 3–6; 4–7, 11, 12: 11, 13: 9, 13, 14: 6–8, 10: 4–9, 11. The same is true of the number of attacks per group (2–12), which acts as a counterpoint to the number of groups (with differing degrees of deviation), but also shows once again, with regard to the number of attacks, the relative proportions already found to be typical: 3–6: 3–6, 9: 8–10: 7, 10–12: 4, 6–8: 2–4. The number of notes and the number of attacks constitute contiguous serial progressions (terms from 3–14 and 2–12 respectively):

There are four ways in which the *number of notes* and the *number of attacks* interact.

1. Repetition of the number of notes with a different number of attacks.
2. Identity.
3. Repetition of the number of attacks and variation of the number of notes.
4. Variation of both numbers (see Aggregate II, where all four methods appear in the above order).

In Aggregate IV the groups are further divided into sub-groups. Whereas the caesuras between groups are emphasised by *ritardandi* the sub-groups are separated by rests and variations in dynamic intensity, e.g. the first group of the Aggregate: 2–2–4–1 (9)

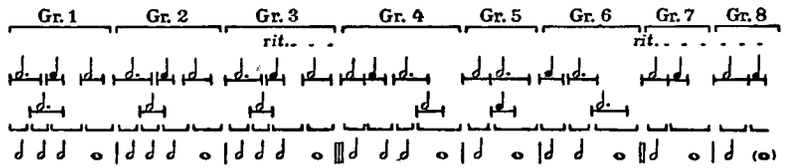


Number of subordinate groups per group:

Group	1	2	3	4	5
Different notes per group ..	9	9	9	9	12
Number of subordinate groups	4	5	6	5	6

The first four groups each contain nine notes, the last contains twelve (repeated notes within the groups are not counted). Subordinate groups of four notes appear in three different forms – with 1, 2 or 4 attacks.

Whereas in the first Aggregate (No. 1) the effective note values, because of the cancrizan symmetry, had a regularity which was, however, destroyed by the intervals of entry and transformed into a supra-ordered symmetry, in the last Aggregate (No.6) the *irregular effective note values are brought into a regular scheme by the intervals of entry.* The semibreve interval of entry acts as the dividing value between the groups:



The intervals of entry, again expressed numerically are (unit 𝅗𝅥): 1–1–1–2/1–1–1–2/1–1–1–2///1–1–1–2/1–2/1–1–2//1–2/1–1(2).

The intervals of entry, together with the ritardando indications, thus give us a supra-ordered organisation; three identical groups (3 𝅗𝅥 + 𝅝), three groups serially laid out (3, 1, 2, 𝅗𝅥 + 𝅝) and two final groups (1 𝅗𝅥 + 𝅝). Each aggregate is moulded in time by a characteristic form of duration structure. The *duration structures* result either from a selection of the effective note values of Aggregate I (𝅗𝅥 𝅗𝅥 𝅗𝅥. 𝅝) or from substituting a ♪-series for a ♩-series, or from the superimposition of both these time-series.

Group-Aggregate	I	II	III	IV	V	VI
Effective Note Values	𝅗𝅥 𝅗𝅥 𝅗𝅥. 𝅝	𝅗𝅥 𝅗𝅥	𝅗𝅥 𝅗𝅥.	♪ 𝅗𝅥 𝅗𝅥.	♩ (♪ 𝅗𝅥) 𝅗𝅥. (𝅗𝅥 ♪)	𝅗𝅥 𝅗𝅥 𝅗𝅥.

The 𝅗𝅥-value of Aggregate IV may be heard as two ♩-values of the preceding, or four ♪-values of the succeeding one; the ♪-values as unit-values of the following aggregate: the 𝅗𝅥.-values as triple values of the preceding aggregate. In Aggregate V the ♩-values are equally ambivalent; they are related to Aggregate IV as double values and to Aggregate VI as unit-values.

III ♩ 𝅗𝅥. | IV 𝅗𝅥 𝅗𝅥. ♪ | V ♩ ♩. | VI ♩ 𝅗𝅥 𝅗𝅥.

Thus the time elements of one aggregate are constantly being taken over into the succeeding one, so strengthening the overall connection.

In traditional music there were genuine connections between pitch-structure and time-structure; these arose from the constitution of tonality. These traditional relationships are eliminated when tonality is replaced as the basis of composition by the serial principle. We are thus compelled to seek fundamentally new possibilities which must arise from the series itself.

A twelve-tone series relates the twelve notes of the chromatic scale to each other in a fixed structural relationship measured in intervals. The idea of unfolding in time is immanent in the series, which presents a non-constant magnitude that is only to be grasped statistically. As soon as we make time a participant factor we alter the situation with regard to the series (this is equally true of all other parameters of the composition); it is impossible to alter the durational structure without transforming the interval structure. Webern overcame this space-time problem by composing either groups with different note values but similar interval structure (e.g. Op. 24, 1st Movement), or, conversely, groups with different intervals but similar note values (Op. 27, II); or (when neither parameter is neutralised) by relating the different divisions within the series *to the intervals themselves – through linking up note values and intervals.*

Thus in Aggregate I the ♩-note value is linked with the minor 2nd; the 𝅗𝅥 and 𝅗𝅥. to the major 2nd (when the interval of entry is ♩) and to the minor 3rd (when the interval of entry is 𝅗𝅥): the 𝅗𝅥. with the latter interval of entry (𝅗𝅥) sometimes also occurs with the major 3rd; the 𝅝 coincides with the major 3rd. In this linking, the pitch intervals are exactly reflected in the duration relationships of note values. Thus in Webern's work there is heralded a unitary space-time continuum.

The relationships mentioned are thus altered in each group-aggregate; thus the interval effect is in turn slightly altered. The building up of chords is to be understood as the linking up of intervals of entry that are zero and (pitch) intervals drawn from a certain section of the series, within a briefly effective harmonic field that is orientated toward that particular section of the series. In the course of the movement all the intervals of the series are thus projected vertically.

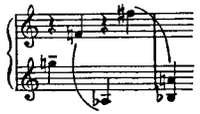
The greater the number of note values used and the greater the disparities between

them, the more important becomes a rationally planned *relationship between note values and the intervals of the series.* The degree and significance of these relationships in the separate group-aggregates must be assessed accordingly.

Here are several examples of the linking of pitch and time per group aggregate.

Aggregate II: ♩-value is linked with major 9th (or minor 7th) and

major 6th (horizontally).

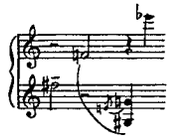


Bar 13

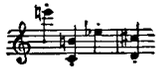
The same vertically:

Bar 14

♩-value linked with minor 9th



♩-value linked with major 7th (vertically)



Bar 12-14

♩-value linked with major 7th and major 3rd (vertically)

Bar 18

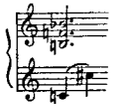
All simultaneities occur on ♩-values.

Aggregate III: ♩-values are linked with the tritone and fourth (though the perfect 4th is not an interval of the series, and occurs only vertically.)

Section of series:

Bar 24

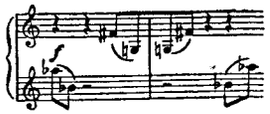
From it the following chord



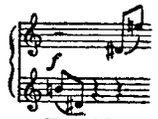
Bar 24

The note not ringed round is related to a preceding note to give a major 7th or minor 9th. The notes always have a duration of one crotchet. All simultaneities occur on ♩-values.

Aggregate IV: ♪ values are linked with major 7th (or minor 9th), minor 7th and in the second half also minor 6th.



Bars 35/36



Bar 38

All simultaneities occur on ♩-values. The perfect fourth and tritone are the vertically projected intervals.

Section of series.

From it the following chord:

Bar 34

In Aggregate V there are only small differences in note value (♩, ♩.); in Aggregate VI the interval of entry within the groups is constant. Relationships with intervals are indifferent in both aggregates.

We notice, furthermore, the links between *modes of attack* and intervals, and those between *modes of attack and note values.*

Aggregate I: major 7th and minor 9th *legato.*
II: mainly descending intervals *legato.*
III: major 7th and minor 9th *legato.*
IV: major 7th, minor 9th, minor 7th, minor 6th (always) *legato.*
V: only descending intervals *legato.* As simultaneities, minor 3rds and tritone *staccato*, major 7th and minor 7th *portato.*
VI: descending major and minor thirds *legato.*

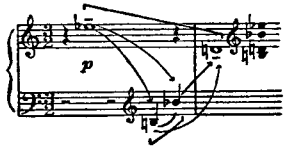
In addition, in Aggregate VI, ♩ values are linked with *staccato* and ♩ values with *portato* or *legato.* No mode of attack is ever indicated for ♩. values.

In our examination of the relations between pitch and time, the building up of chords drew our attention to the vertical dimension; we defined a chord as a phenomenon within a brief harmonic field, related to a section of a series. On this we can now base a generalisation; the horizontal dimension is regulated by the sequence of notes within the series, the vertical by the field-distribution of notes within octave registers. The horizontal and the vertical are extreme limits. Between them lie the different degrees of overlapping, i.e. differences between intervals of entry and effective durations. The relationship between dimensions is one of indistinctness. In the middle register, at slow to moderately fast tempi, the series predominates, and the interval impression is determined by the series. When the notes succeed each other more rapidly, or are more widely spread, and also where there is a denser polyphonic texture, the field-distribution gains in importance. In the same way, the selection of particular notes of the series, with identical dynamics, modes of attack, rhythmic durations, octave register or timbre acts as an interval-fixing that contradicts the series (e.g. in Aggregate IV, specific interval

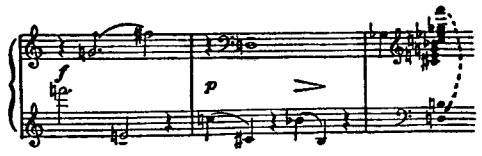
effects result from the isolation of 𝅘𝅥𝅯 note values, *legato* and at the dynamic levels *pp, p, f, ff*). When sequences of notes are performed at great speed, the series can give contour only to their statistical note-content; their interval profile is more or less lost, being transformed into supra-ordered interval relationships. Structures with, as it were, infinitely fast intervals of entry, namely simultaneities, make the series-section absolutely indistinct. The factor of interchangeability, which was already perceptible at high speeds, becomes completely effective. Consequently it is self-evident that one reacts in the same way to sequences played at great speed as to the building up of chords; within specific groups, notes may be interchanged in proportion to the degree of aural control and vertical thinking. A diad retains the interval of the series but obliterates the relationship of preceding and succeeding note; in chords of three notes and upwards, the constituent intervals, too, are no longer serially determined. The extreme example, the twelve-note chord, is, *ipso facto* the dialectical negation of serialism. Looking at serial thinking from this point of view, we realise how necessarily it is bound up with polyphony, which has replaced that homophonic way of thinking in individual parts that previously dominated musical language.

This leads us again to our analysis.

In the first group of the movement, notes 1 and 4 of the series are in direct interval-relationship; they are characterised by the same note value (𝅝) and mode of attack (–); similarly the relationship of notes 2 and 3 is emphasised by 𝅗𝅥-values and *legato*. The supra-ordered interval relationship of the two time-pairs results from their intervals (9th and 7th). Thus there are altogether *three different interval relationships* in this group; one, serially determined, between note and note, another between the two time-pairs and a third, an interval function resulting from the field-distribution of the notes.



The various components are effective in proportion to the rhythmic structure, speed, dynamics, polyphonic density and register distribution. In the example cited above, the field-distribution is relatively insignificant. At the moment in Aggregate I when the polyphony is most dense, i.e. at the climactic moment, a small field of thirds is built up:



(In the succeeding aggregate there are corresponding fields of 2nds.)

It is a fair generalisation about intervals in serial music that generally the major 7th and minor 9th are the supra-ordered intervals and are heard as such. All other intervals are felt only as colouring this dominant interval-experience. Each illuminates differently the two interval-constants, which in their functional significance are one.

The average magnitudes of alteration, which determine the *experiential time*, are:

Aggregate I: Moderately strong alternation of registers; wide span of intervals and rapid alternations of time-durations, intervals of entry, dynamics and modes of attack. Experiential time; moderately fast.

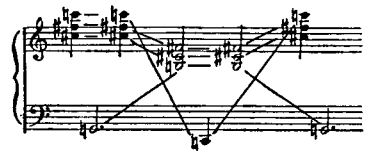
Aggregate II: Strong alternation of registers; span as before, fewer note values and entry values; more varied dynamics; as to mode of attack, strong contrasts of *legato* and *staccato;* introduction of chords. Experiential time; fast.

Aggregate III: Many note repetitions; alternation of registers as in II: rather wider span than in II; note values as in II but fewer entry values; larger groups with identical dynamics; less variation of mode of attack, but introduction of a new mode of attack with a strong surprise-factor (⩤) Experiential time: slower than in II.

Aggregate IV: Many fixed registers, mainly notes at the extremities; note repetitions; one time-duration and two entry values more than in III; much use of *molto ritardando*, most extreme differences between note values; dynamic alterations; *staccato* mode of attack disappears. Experiential time fluctuates considerably; in general still slow owing to the lack of movement in register positions, long note values and *molto ritardando*.

Aggregate V: Fastest experiential time (*wieder im Tempo, doch bewegt*, 'a tempo ma andante', realised in the music) owing to rapid alternation of registers and wide spans; few but short note values; correspondingly few intervals of entry; strongest dynamics; almost exclusive use of high loudness levels, relatively the longest dynamic transitions (*dim.*)

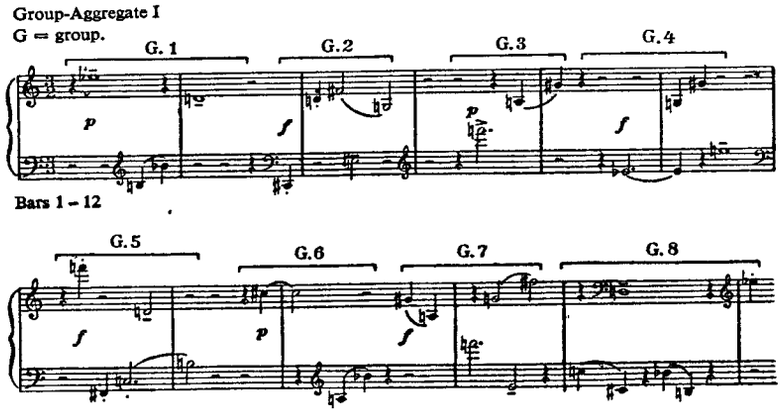
Aggregate VI: Slowest experiential time (*wieder ruhig*, 'calmly'). Notes are fixed until the final bars, with the exception of 4 notes in the following register-alternation:



Moreover, three different note values; now only two different intervals of entry with long durations; quietest dynamics, in long groups with only slight variation; the introduction of a new mode of attack ⁀ causes a hold-up of the rhythmic flow.

Webern invented his own type of variation form which corresponds to his serial thought. Historical continuity may be discerned here: Webern adds his 'total variation' to the Baroque polyphonic variation, the figural variation of the Classical period and the Romantic character variation. But at the same time this means the dissolution of the variation form itself. The result of this development is, within serial thinking, a way of composing with various degrees of relationship, extending from permutational alterations of something that remains constant, to the building of opposites by stepwise mutation. To our questions about organic connections in music, Webern thus gives

entirely new answers. Whereas in traditional music *determining applies mainly in a forward direction* – for example, in the harmonic field the resolution of a dissonance, rhythmically in the regularity of the bar and thematically in structures such as 'question and answer' – with Webern *we find it working retrospectively as well.* To demonstrate this in detail, when in Aggregate I we hear the second group as following the first and the third as following the second, we observe that the second interval of each of the first three groups ascends. The groups are thus related to each other through the structuring of interval directions. However, this does not give us any information concerning the pattern of interval directions in the succeeding groups. Only when all eight groups have been heard can we say that an ascending second interval is an unfailing characteristic of Aggregate I:



Thus, what is to follow cannot be anticipated, but every new term is, in retrospect, a factor in a new organic connection. This is the explanation of the alternatives – the asymmetries and the freeing of directions from any general tendency; they are there in order to make it impossible for the listener to do any predetermining. The use of the matrix in serial music after Webern means just this; through purposeful determining, to make everything that is to come indeterminable by the listener. I repeat – *by the listener;* and that is, in the last event, what is decisive in music.

This new sort of determining is founded on the nature of the series, and, running parallel to it, in the nature of statistics; what is valid in the particular should also be valid in the universal. Thus thematic formal structures and thematic repetition must automatically be excluded. This implies a criticism of Webern's determining; in his work, serial thought is contradicted by the remnants of thematic thinking. Traditional and serial formal principles are intermingled (in this respect his earlier works are often the more 'advanced'). But in the most deeply personal of his methods of composition he broke up the ground for new, non-thematic types of musical configuration. That is why his work is so relevant for us today.

In Memoriam Anton Webern; our work is his memorial, for something of his spirit remains with us.

INTERVAL PROPORTIONS

HERBERT EIMERT

String Quartet, 1st Movement

The first movement of the String Quartet Op. 28 consists of 112 $\frac{2}{2}$ bars; the tempo of the minim varies between 66 and 84. Though the piece may be subdivided into several sections, characterised by various clearly recognisable motives and types of movement, notes and rests are evenly distributed throughout, and statistical analysis shows that the number of notes within each bar of the score lies between 1 and 9, each instrument playing an average of one note per bar.

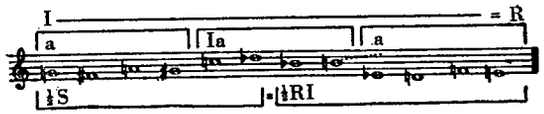
112 Bars (plus upbeat)

	Notes	Rests
Vln. I	112	63
Vln. II	117	61
Vla.	118	65
Vc.	114	60

This distribution of notes and rests demonstrates that the texture is widely-spun, light and transparent. There are no 'principal' and 'subsidiary' voices (HF, NF). The music is almost always in three parts; only eleven four-note chords occur, one for the length of a minim, the other ten for the length of a crotchet.

The basic series of the movement (and of the entire work) makes use of the many mirror-relationships present in the intervals of the B–A–C–H motive (B♭–A–C–B).

Example 1



The series falls into three four-note groups derived from the B–A–C–H motive; the first and third contain the B–A–C–H intervals, the second is their inversion. The series has the characteristic that its retrograde form is, as regards intervals, identical with its inversion. The same is true of its two halves; the one is the inversion of the other, and they again contain the identical forms R (retrograde) and I (Inversion); the retrograde form of the first half is in its interval-relationships the inversion of the second. But the piece, besides using these four-note motives, also derives from the series two-, three- and six-note motives which each dominate a particular section. The series is easily detectable throughout. There is only one literal statement of the B–A–C–H motive, in the first violin, bars 66-68.

Webern did not invent this series in order to base his music on it in any traditional way; one can tell this from the fact that he makes little use of the intervals of the original series – plainly he wanted nothing to do with the finger-wagging practised by most composers who use the B–A–C–H motive. The eleven intervals of the series are made up of

four descending minor seconds, two ascending minor seconds, two ascending minor thirds, two ascending major thirds and, at the turning point between the two halves (each of which spans a tritone) a descending minor third. Webern does not distribute his notes with an eye to traditional considerations of contrast and varying tensions; above all, he does not distribute them mechanically and then produce a *tour de force* of 'expression' in order to overcome the pull exerted by his material. Rather does he think *a priori* in terms of interval-proportions. This does not abolish the determining-power of the series; it ensures that the series acts as a kind of reservoir of interval-shapes instead of being a stiff framework unconnected with the flow of acoustic events. The interval becomes a 'shape' (*Gestalt*) in the sense of something concretely present, which exists in only one single form and cannot be transposed. Since, however, Webern's prime concern in his composition is with the transposition of such shapes, he is constantly inventing new ones, innumerable and each different from all the others. By doing this he was the first and only composer of his time who was able to leave behind him the idea of a contrast of construction and 'expression'. One may use inversions, octave-transpositions, derivations and the like as useful makeshift terms which can facilitate technical understanding as soon as it has been clearly realised that there are no mechanical interval-transpositions in Webern's work. Thus the number of interval-shapes in the first movement of the Quartet coincides exactly with the number of motives that are present at all. Their profusion is so great that in the entire movement (by a miracle of architecture!) there is not a single repetition of a concrete interval-object. Each of the fourty-four ascending, each of the fifty-one descending sevenths has a different shape! Even the very few literal repetitions are subjected to a change of dynamics or timbre (descending sevenths in bars 45-46, Vln. II, and bars 51-52, Vln. I: descending ninths in bars 67-78, Vln. I, and bars 74-75, Vln, II; or ascending sevenths in bars 69-70, Vln. I and bars 77-78, Vln. II). A statistical survey of the intervals gives us the following picture of the movement:

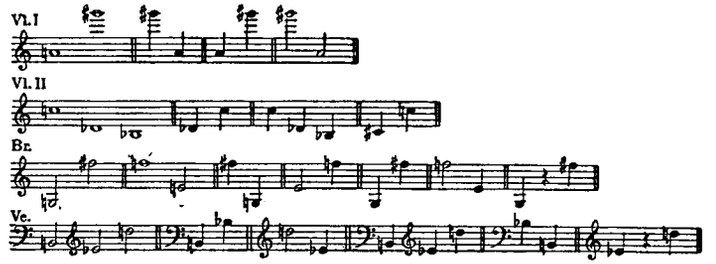
	Asc.	Desc.		Asc.	Desc.	
Min. 2nd	3	10	Min. 10th	2	3	
Min. 3rd	20	8	Maj. 10th	8	1	
Maj. 3rd	11	4	Min. 13th	–	3	(=8ve. + min. 6th)
Min. 6th	—	15	Maj. 13th	1	1	(„ maj. 6th)
Maj. 6th	10	12	Maj. 14th	9	8	(„ maj. 7th)
Maj. 7th	44	51	Min. 16th	6	7	(„ min. 9th)
Min. 9th	29	37	Very wide intervals	–	3	

This table embraces, of course, only the interrelated motivic intervals of the series, not those intervals, characterised by their extreme variety, between the final notes of one motive and the beginning of the next. The statistical table shows a definite preponderance of major sevenths and minor ninths. Of a total of 306 intervals, 161 are either major sevenths or minor ninths, as opposed to 145 other intervals. Within the range of a ninth, the minor second is the interval used least. Of the compound intervals, 14ths and 16ths again predominate.

In the first 16 bars of the movement (upbeat and bars 1–15; see Ex. 5) Webern presents a perfect example of his interval-technique; in practically no other work of his can we find this in so radical a form, reduced almost to a formula. It is as if he were going out of his way to present us with a blueprint containing the essentials of his interval-technique.

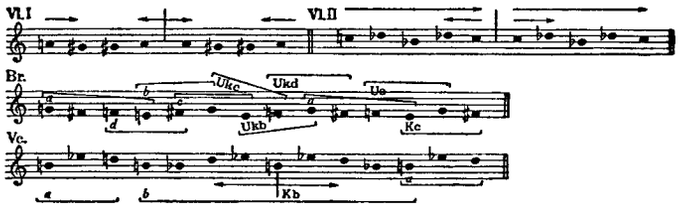
Twenty-one two- and three-note interval-motives are used, each differing from all the others. (Here again the dynamic mutation — D♭–C, *p. decresc.*, bar 8, becoming C♯–C, *f. decresc.*, bar 14). The interval-motives in the four instruments are as follows:

Example 2



The notes being laid out in this way, the series' high degree of mirroring produces in the individual parts the following connections between its component motives:

Example 3

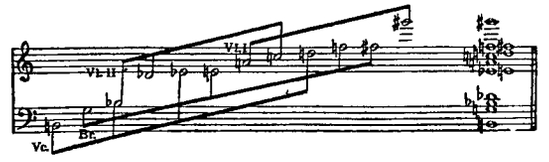


U = inversion
K,k = retrograde

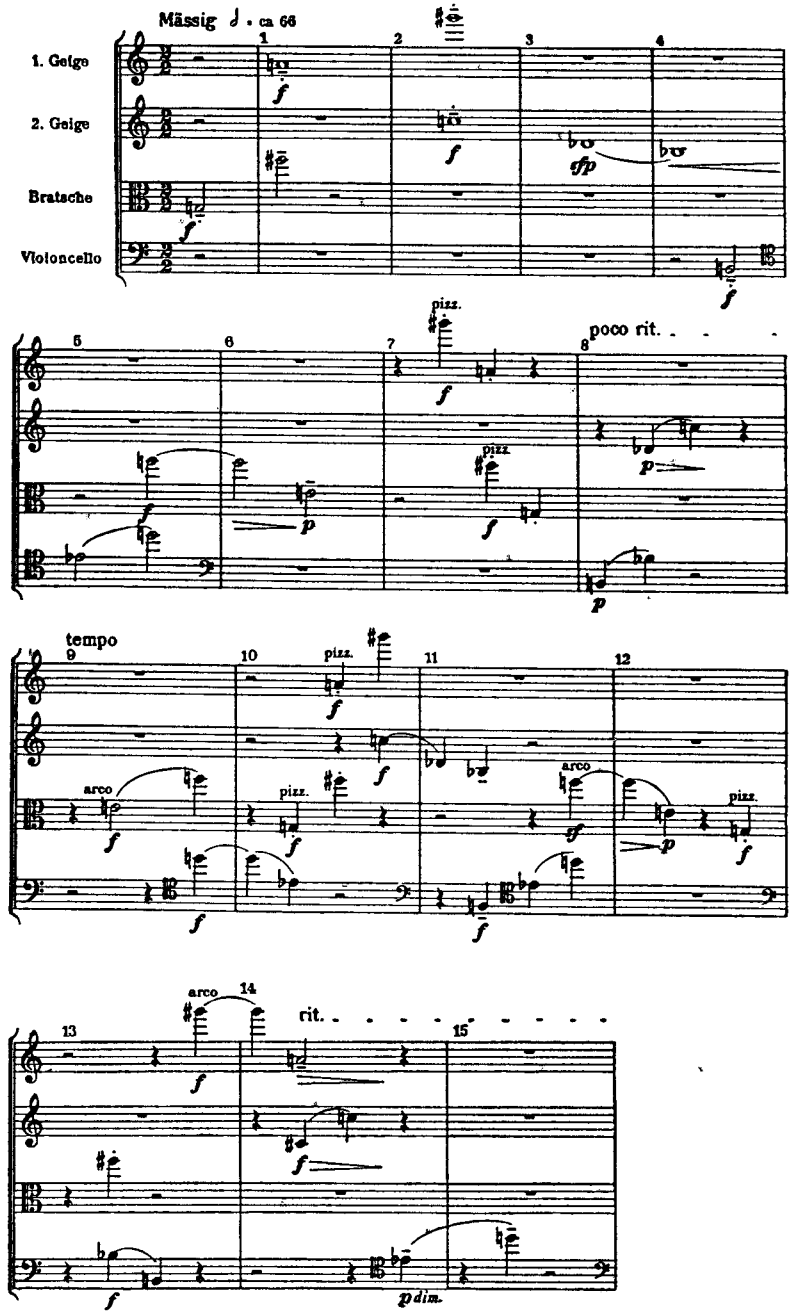
When two or more notes sound together there is a comparable symmetry, as regards both their interval-proportioning and the selection of the points at which they occur – see the first and last diads of the first series (bar 1, F♯–A; bar 5, F – D), or the three-part symmetrical arrangement of the second series (bars 7–10). The simple exposition of the series at the beginning is limited 'harmonically' to diads, as is the first polyphony of crossing series in bars 16–21. Triads first begin to predominate in the transition to the motivic six-note group (bar 33) and in this group itself, and an analysis of the harmonically emphasised 'coda' would support our thesis about the proportioning of positional values and intervals.

The first series in the movement (bars 1–6) can be imagined as an instrumental line (horizontally) and as sound (vertically).

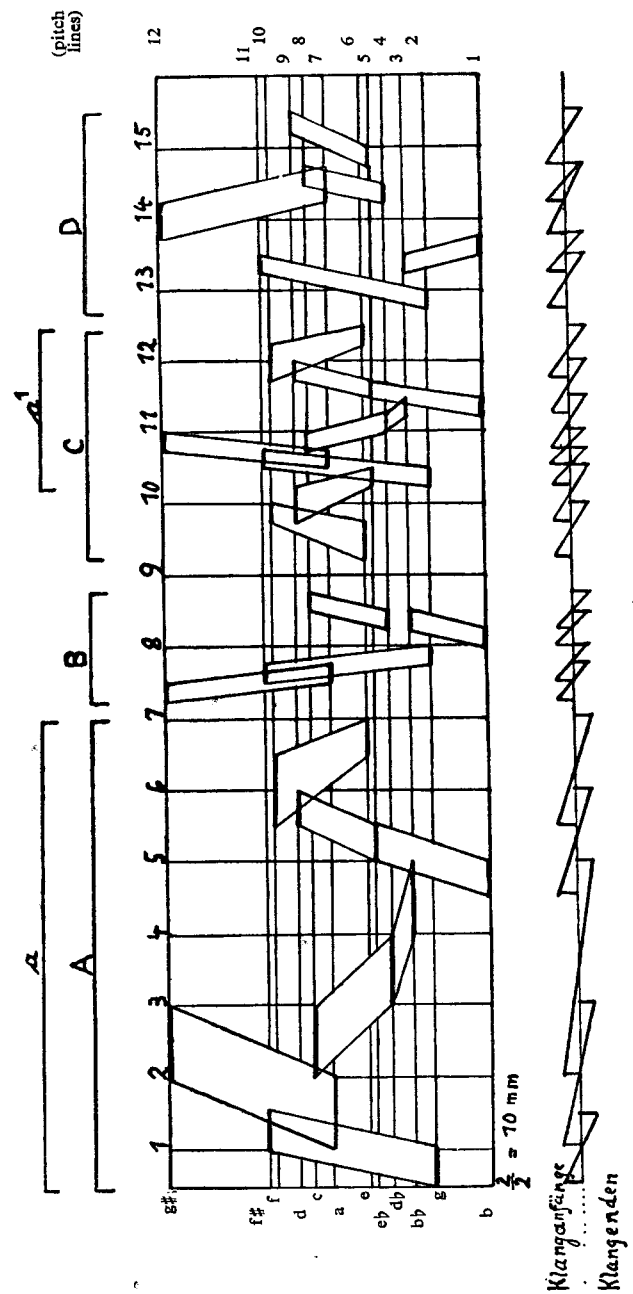
Example 4



But there are no such textbook simplifications in Webern; a merely mechanical approach to the twelve-note compass would be quite foreign to him. For him the



Example 5



Example 6

horizontal and vertical are not ready-made academic concepts but the opposite extremes of a time process that runs its course between them, infinitely differentiated and rich in shapes. Since the vertical twelve-note chord abolishes any positional value of the notes, it is no longer recognisably related to the series except as a harmonic generalisation of it. We may adopt here the 'electronic' viewpoint that every sound picture is guided by the time factor, and that consequently once the twelve notes have been squeezed vertically together into the shortest possible time, even the slightest tendency to make them horizontal again will begin to restore their positional value, in the typical form of 'build-up processes' which are decisive in determining the character of the sound.

In the diagram (Ex. 6), the pitch levels, durations, interval-spaces and sound relationships of the first 16 bars are presented schematically. The 'structure' is thus most strikingly revealed. 'Serial' organisation is found even in the lay-out of the twelve notes over their total compass of 45 semitones (B – g♯‴); the gaps between the pitch-lines (1–12, see Ex. 6) vary, three being wide and the other eight smaller – counted in semitones they are:

8 3 3 2 1 **5** 3 2 3 1 **14**

Into this proportioned sound-system are now fitted the interval-motives which are arranged in four two- and three-note groups; in the diagram they extend between the following pitch-lines:

2–11	12–7	2–11	2–11
7–12	11–2	7–12	3–1
8–4–3	1–3	8–4–3	12–7
1–5–7	4–8	1–5–9	4–8
10–6	6–10	10–6	5–9
	9–5		

(The linking interval 10–6 of the third group must be added to the incomplete fourth group.) The proportioning of the intervals is as clearly revealed to us by the diagram as are the increasing density after bar 7, the quicker motion in bars 7–12 (a′) which ensures an exact correspondence with bars 1–7 (a), and the slight decrease in density in bars 14–15. The doubling of tempo in a′ (beginning with 2–11, 7–12) will hardly be prominent when the work is heard, because the ear will refer back to bar 7 (12–7, 7–12) which, psychologically speaking, seals off the section. When one hears the work the natural sequence follows that of sections A, B, C, and D (B and C may also be regarded as making up one self-contained section).

The lay-out of the attacks and releases of sound corresponds exactly to these sections. Between each attack and release there lies one motive. Here there also emerges with particular plasticity the ordering of single and simultaneous notes. In the diagram the small rhomboids represent simultaneity – here again we observe a precise ordering that extends down to the last detail. The proportioning of the overall sound area is complete. One could extend further the investigation of proportion and apply it to the temporal and durational relationships of the highest and lowest notes (g♯‴ four times, B four times), or the notes in the middle (between G and f♯′), or to the 'serial' alternation of the four instruments (3, 1, 2, 4, 3 – 1, 3, 4, 2, 3, 4 – 3, 1, 2, 4, 3 – 3, 4, 1, 2, 4). We see the principle of serial proportion everywhere, and even if Webern did not apply or know

such concepts, this weakens neither our thesis nor the certainty that in Webern's mind they existed as a vividly imagined ideal. We see here, too, that his mode of working is the exact opposite of total pre-determination; he does not raise patterned manipulation of material to an ideal but starts from the living seed, which contains all the possibilities that are to be made music, which controls and guides them and brings them to a wonderful florescence. To realise how great is the variety of what is hidden there, one would have to continue the analysis bar by bar as has been done for the first sixteen bars. To do this, one is bound to take as a point of departure the varying motivic structure, which is the real organising factor in the work (with clearly recognisable divisions at bars 17, 33, 48, 66, 80, and 96), and not the remnants of traditional form which can be found even in Webern's last works. But one may analyse only what is in the score and manifest as sound; concepts introduced from outside help little, and are none the better for being taken from the golden treasury of fugue and sonata, in order to arrive comfortably at yet another of those well-loved 'syntheses' of the two.

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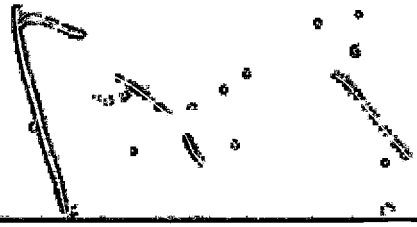

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* Translated by Cornelius Cardew

† Translated by Leo Black

THE COMPOSER'S FREEDOM OF CHOICE

HERBERT EIMERT

If we were to examine musical history with an eye to finding out how much freedom of choice the composer has enjoyed, we might well come to the conclusion that mediaeval polyphony was a game played according to narrowly restrictive rules that left the composer a good deal less freedom than do, for instance, those of present-day serial composition. Of course, historical perspective is notoriously subject to optical illusions – these creep in, particularly, when one interprets history in terms of 'progress', instead of considering the relationships between men and the times they lived in; and the conclusion mentioned above could well be one such illusion.

If in the Middle Ages the question of choice was basically a theological one, today it is on the whole an exact concept in mathematical basic research, where the question is one as much of freedom, as of restriction of choice. The theory of games, closely related to cybernetics, has been especially concerned with these automatic or human functions of choice and systematisation, which are vital if even the most mechanical sender-receiver relationship is to work. Without choice, all that can exist are mere reflections. It is no accident that in the fascist dictatorships, where free choice was suppressed, artists were obliged to paint the sort of 'undistorted' portraits that are so hopelessly like photographs. The feeling of shelter, of free security, is produced only when the process of choice can function, and when there is enough latitude to make free choice possible.

Extraordinary difficulties are met in applying the theory of choice to the composer's inductive behaviour, and to the behaviour of the elements he uses; for here the pioneer voyages of discovery have yet to be made – voyages in unknown regions, exploration of realities and complexes of meaning that have never been examined. We have practically no musico-theoretical knowledge of the composer's strategy when he plays with notes. Apart from a few general studies undertaken in America, this is also true of musical information theory, which bears the same relation to musical theory as does a complete house to the foundations and basement; this is something that needs most urgently to be developed and given a firm basis. In some places, indeed, musical information theory has already begun to develop, but only as vague, unreliable hints that have not even got as far as providing elementary definitions. One recent addition has been a study by the Parisian physicist, A. Moles; he formulates some concepts defining musical information theory as a scientific field, but produces no more than a few usable general concepts, plus a number of mathematical formulae which will, for the most part, not be understood by the only people they concern – the musicians. He draws no conclusions about music that could not as well have been drawn from the criticism of musical style, and what he says about basic physical sound-quanta is traditional and formalist, without any real insight into musical significance.[1]

[1] Cf. *Nachrichtentechnische Fachberichte*, Vol. 3, Braunschweig, 1956, pp. 47 *et seq.* Since then, in April 1957, the experimental electro-acoustical studio in Gravesano has held an eight-day seminar on 'Information Theory and Music', whose programme operated with a complete theoretical 'superstructure', from 'chords, timbres and themes as symbolic masses of information', to 'individual variants in the reception of sound', and 'socio-cultural background'. The danger of mere 'O.K.' abstractions can only be seriously countered by exact scientific examination. The basic question is not whether existing musical concepts can be included in the conceptual apparatus of information theory, but whether one can use information theory to say anything, about even the smallest musical process, that it has not yet been possible to say, using hitherto existing resources of analysis, musical theory, formal observation or communicative cognition.

Even the questions of twelve-tone technique gave rise to certain musico-theoretical views that went beyond counterpoint and harmony as usually taught; all the same, as a system that employed notes of pre-determined pitch, it could be regarded as related fairly closely to a free, rhythmically variable cantus-firmus technique, and could be illustrated by text-book examples on traditional lines. 'Serial' technique, on the other hand, can no longer express itself aright in the comparatively plastic world of sound to which such academic lessons belong, since it has reached out and laid its hand on the basic elements, the 'repertoire'. We have now to deal with 'guided' patterns in sound, that make up an abstract system of relationships, a structural web; to bring the latter to its optimum compositional state is what is meant by 'to compose'. Hidden machinery is at work here; art criticism refers to the same thing when it speaks of the 'dreamed clockwork' of old animal ornamentation; one might say that this combination of dream and exact thinking is the pattern, the artistically coloured pattern, for the aforementioned functions of system and choice. But even if we stay on strictly theoretical ground: games, too, are neither purely arbitrary nor wholly mechanical; they are not even a cross between the two. In serial music this becomes clear as soon as one sees clearly that while the composer is still bound to the elements intelligible to him, he is at the same time carrying out compositional strategy. When the basic elements begin to cast their spell, they have no use for outmoded erudition: they create new wisdom.

When we examine some of the judgments passed on the most recent 'serial' music; when we see how veteran propagandists of what used to be the new music can no longer 'keep up', it may appear reasonable to say that about 1950 there began a new age of music – of music that obviously has far less in common with the 'new music' immediately preceding it than the latter had with the last remnants of the romantic era. Will the age of fugue and sonata now be immediately followed by a golden age of serial composition? Many young people think so, but on the whole this is pure speculation that can not be supported by any process of reason; rather does it suggest a mechanistic way of thinking. Moreover, since one of the essentials of the process of choice is that one should allow for the unknown, such speculations suggest remarkable theoretical ignorance. All the same, once the unknown were correctly allowed for, then if one assumed that history has any general plan of action, one could not exclude from it the musical plans of action with which, as new formal principles, we are here dealing. The serialisation of the basic elements has not yet provided composers with a new musical form: but it is itself the basic element in constructing new forms, and is thus something new in music, the only new thing that has so far begun to pull clear of the previous great period of form. Let us for once refrain from seeing things in historical perspective, conceiving them in terms of 'necessity'; if we succeed in looking at them systematically without evaluation, as if they belonged to some overall plan for music, then we see that when classical twelve-tone music aimed at a fusion of the series with traditional forms it was rather too early to start doing so. For this link-up with history took place before the new way of shaping music had been anywhere near exhausted. This shows the crudeness of twelve-tone rules, a crudeness only conceivable if 'history' could be advanced as its excuse. Such rules were number-games, that had to be accompanied by a deal of sticky emotionalising, since on their own they would of necessity have degenerated into

mere play with material – and that, as we know, is the deadly sin, 'materialism', anathema to the dogmatists of twelve-tone theory.

Now that the true essence of serialism has been seen to lie in the basic elements, such degeneration has ceased to threaten; it has lost its sting, since it no longer happens. To raise serial technique from its primitive state, the impact of the basic elements was necessary. It makes a lot of difference whether one is occupied with arithmetic or mathematics, whether one numbers things off or sets out in search of the infinite. The series of basic musical elements includes infinity in its calculations; how near will it get to the line of history, and thus to humanity? That is a decision which can be blithely left – to history. What is important now, on the other hand, is to give a sound theoretical basis to the new formal phenomena. In this volume one can find the first contributions to such a theory; they adopt the standpoint of musical craftsmanship, and there is to be a second volume of *Die Reihe* under the same title. It will be realised that there is here no attempt to lay down definitive terms of reference for the description of musical craftsmanship. But however varied the means, and the methods, and again the lines of thought concerned, one thing will make itself clear – that these all converge at one point, the elemental repertoire, the all-inclusive programme of basic elements. Individual writers may see things in different ways: they may explain their craft, the craft used in one particular piece, or their basic craftsman's concepts; but they will invariably be concerned with practice in the well-nigh infinitesimal counterpoint of the elements, never with primitive rules, or the unfailing, mechanical solution provided by a formula. The concept of 'craftsmanship', that once had to do with instruction in writing 'composition exercises', has now shifted so far that it takes in the knowledge of music's semantic elements and their ordering in time: so it will always be correct to speak here of 'craftsmanship'.

It would be a mistake to think that Anton Webern was already aiming at such 'ordering in time'. What Webern brought into being was a functional system of note – and motive-connections that worked within their own fundamental terms of reference. In his composition, truth no longer lies merely in a plausible psychological symbolism, a 'likeness': it is also constructive resolution, 'rightness'. The rightness of Webern's twelve-tone mathematics is a subsidiary matter; the one important thing is the rightness of his note- and motive-connections, which are thought out and calculated with the utmost variety. These calculations, which before Webern were unknown, are based on the fundamental unity of all acoustic material – on the recognition that everything is identical; such a unifying approach to the composer's material can fairly be called 'visionary'. Webern was the first composer for whom the basic series was more than a row of notes in one dimension; he did not even adapt the series to a three-dimensional world of sound, but rather created 'space'. By telescoping a series that was originally in one plane and split up into fragments (motives), he achieved an interwoven structure, like a relief, firmly held up by its acoustic material; the full significance of this type of material construction, and of this method of effecting connections, has only lately been appreciated.

Four years after Webern's death, Olivier Messiaen wrote a work for piano (*Mode de Valeurs et d'Intensités*) that was based on a complete serial model, the first ever to apply

to more than one dimension. Messiaen did not therefore arrive at the work's organisation unconsciously, and then derive from it an abstract system; his insight consisted of applying an *a priori* method to give form to musical data in the three parameters pitch, duration and loudness, aiming at the best and most musical solution. This he did by providing modal indications for various definite successions of notes (pitch), note-values (duration), and intensity values (loudness), plus modes of attack. This is the natural, 'scientifically' exact way to define a note – the negation of all idealistic thinking; and let us be quite clear that it resulted from an instrumental work, not from electronic music (since at the time there was no such thing). Notes do not function, they exist. This does not mean that in music, from now on, psychology and physics are entirely separate; that would be far too simple. If we are to gain from an acoustic process the impression of order, there must be effective communication between our perception and the details of the object perceived; nowadays this must always be borne in mind when we take the plunge into music. For composers, the new way of defining a note has revolutionary implications that will have to be considered later.

The too rigid modality of the procedure employed by Messiaen has condemned it to sterility – even the composer has not gone beyond this one prototype; but it brings to light a fundamental problem. The emotional orientation of twelve-tone music is toward the past, and this has obscured the issue; but now the vital question arises unavoidably and for the first time: what is to be the relationship between the 'guided' elements and the composer's freedom of choice? Traditional twelve-tone technique concerns itself mainly with models for varying a basic structure that is already complex; serial composition is more akin to a worked-out plan of action, and this latter can only gain its full significance where musical processes are based on absolutely basic elements that admit of no further splitting. This might appear to limit severely the possible effectiveness of the process of choice, since by chaining down the elements not only in linear sequence (as with twelve-tone technique) but in several serial strata (at the very least, those of pitch, duration and loudness), one would finally reduce to zero the latitude for possible choice, and leave only mechanical working-out, 'total predetermination'. But in fact the exact opposite is true; every new serial stratum brings into play countless new possibilities of connection; with each newly introduced serial compulsion, the coefficient of choice grows and becomes more differentiated. To prove this exactly would be a task for the information theorist, who would also have to inquire all the more closely into that useful device, the matrix-diagram,[2] in which all the elements, when ordered and inter-related, could fall into place and provide a 'texture' for the whole acoustic process. The effect of overall textures is felt at every moment; they guide everything that is organic and that grows organically in time. In them, time is manifest. This, as applied to music, means that it is time itself that guides itself within the elements. 'The loom of time'[3]; that would indeed be the perfect matrix for composition.

This is no mere theoretical speculation; if musical theory is to keep pace with the state of composition, it will have to concern itself with these problems. That a composition should unfold from one single seed, is indeed an age-old idea. It has not hitherto been looked at from the standpoint of serial composition, mainly because nobody has known how the basic elements function. Their constitution and ways of working

[2] *Trans. Note:* 'A block or array of numbers, real or complex'. Cf. Pousseur's article, Ex. 12-19.
[3] Goethe, *Faust*, Part I, Scene I: 'Am Webstuhl der Zeit'.

demand a new vision on the part of musical theorists, for nobody could base a textbook of composition on the parameters we have mentioned. If, instead, we accept that composition is a plan of action according to a programme, this means, among other things, that we know the workings of the process of choice.

If we put the question in its most elementary form, one simple phase is enough to illuminate our problem: 'where notes exist, there can be music'. But can there? Do notes exist? Or do they first have to be made, before music can be made? Doubtless both can be true. One can sing a tune: at the other extreme, if one takes notes of pure existential quality, such as those given out by an electronic generator, rational musical order can be produced. It makes no difference that one does this in a series of discrete stages, using recording tape, since anyone who writes a score is obliged to do the same – to put things together. The mean of the two processes would perhaps be embodied in Stravinsky's example of the bell-ringer, who pulls on a rope without worrying about the result (a 'plan of action' not to be recommended for the Boat Race!). In the case of the singer, there is guidance in a simple poetic motto: 'If you've got a song, sing it'. But suppose one has notes, and has to make music with them – to compose? No end of notes, and all different in pitch, loudness and duration? One must choose from among the notes, arrange them, bring them into coherent relationship to each other, according to some definite system. A 'system': now the trouble really starts, for there is no musical significance in systems with a purely private logic – they can not help us to establish standards, norms, and in order to arrive at a legitimate musical system, one has to know how notes behave, and how the ear behaves in relation to notes. Then, when at last one runs up against the question of time – of time-relationships and of the timely introduction of the basic elements within them – then it is time to start creating textures and behaving as if one were a composer. It would be absurd simply to compose with notes as they 'exist', as they present themselves to the naïvety of our intellect; time being the fabric of all music, there are no such things as notes, but only abstract relationships, from which pitch, loudness and duration can be evoked (in such close interdependence that when even one of these three characteristics is lacking, the existential quality of the note is extinguished).

Guided models are well known throughout music and musical history; only it was not necessary to give them the name, since the sound-continuum, indispensable if a theory of composition was to crystallise, remained undissolved by any of them – cantus-firmus technique, fugue, ostinato or variations. On the other hand, many composers have recently worked out their own private twelve-tone rules to regulate pitch, not to mention mechanical ways of measuring time by so-called variable metres or other conventions; one can devise any number of these, but they are all mere formulae – rather empty formulae, which seem to prove only that there are ways of overcoming the musical handicaps they impose. In fact it is astonishing how much composers have achieved, not through their formulae but despite them. Such arithmetical manipulations are nothing but peripheral symptoms, empty makeshift constructions, unseeing methods, and composers often keep them a secret, to prevent the world from finding the key, not only to their coded formulae but also to their bad conscience at playing so ineffectually with the shadow of the substance. Their abstract schemes of relationship would like to claim kinship with modern physics, where abstract ideas harmonize so admirably. But that is precisely where things fail to work out; in our world, where both

standards and symbols are becoming ever rarer, musical calculations can not simply be thought up – they must agree with the raw material, with what information theory calls the 'repertoire', with the general programme of the basic elements. Thus the heart of the matter can be reached only via the one crucial point, whence music unfolds as ordering in time, and whence it enters the dimensions to which it alone is suited. One can not hope that mere arithmetic will provide more than the crudest rules of thumb. Truly musical calculation – which has to include infinity – begins from the basic elements, is always tied to them and guided by them, allowing ample scope for choice; Stockhausen's analysis of time has at last made clear the truth of this as regards the paradoxical relationships between pitch and duration.

As we come to understand the coherence of nature, we find it to be identical with that of music. To look into this more closely is the task of a new musico-theoretical way of thinking, that can no longer be craftsmanship in the old sense; though nobody should think that the latter can now be discarded, or that from now on the one trump card is mathematical correctness based on atomic theory or cybernetics. Certainly the only people able to speak are those who have due regard for the facts, and who accept the new task the latter impose – that of getting to understand the switches and circuits of musical structures and time processes, and of preparing them in a planned programme of composition (to revert to our guided model).

All the same, when a composer writes notes, he practises craftsmanship. The term has hitherto been used only by Schönberg, and since it defies any close historical and musico-theoretical definition, we preserve it all the more willingly. It has a colloquial flavour, and has therefore never been dignified by elevation to the level of specialist language. Yet there is no need for elaborate inquiries as to its meaning. People love to talk of noble, soulful, proud craftsmanship, but that kind we can ignore, since it is a mere adjunct of artistic creation. Whoever speaks of craftsmanship, means without question the technical side of music, that can be subjected to conceptual systematisation, and that proves, in its most general and all-embracing form, to be 'musical theory'.

Musical theory embraces many fields; but in the one point at which it is dominated by craftsmanship, it is nothing but musical theory, the objective passing-on of what can be learned and known in terms of musical technique. For the ancient Greeks, the appropriate place for musical 'techne' was somewhere in the superstructure of human thought; they would certainly have had a word for the way that nowadays this 'technique' is being diligently given a quite inappropriate superstructure by well-meaning people who find its dry data unsatisfying on their own. Certainly nobody demands that even a student's essay must have 'soul', be 'creative'; but this makes such qualities all the more questionable when they are dragged into the technique of composition as admonitions or to provide moral encouragement – or when, on the other hand, composers who are bad or mediocre see themselves condemned, in addition, to put on record their own chronic lack of creative talent. The simple answer here is that a composer either 'has something' or else he hasn't. And pen-pushers who insist that one 'must' have it, or even that one can acquire it, are spouting idle words, not worth the paper they are printed on. The only remarkable thing is that here, in the collective unconscious, psychic twelve-tone complexes are already being abreacted; we need not repeat what is all too familiar – that you can't bring an automaton to life with a watering-can: this is

the nature of the contradiction left behind when one builds a mechanical structure out of notes and then adds 'soul' to it. When the terms in a spiritual equation are the dregs of uncontrolled material, this is indeed a matter for both philosophical and psychological comment; but from the point of view of musical theory and craftsmanship, everything lying beyond the bounds of theory must be sternly rejected.

In twelve-tone music, the element of automatism is to a large extent suppressed; the more this happens, the more the twelve-tone method tends to be praised. In fact, one can easily conceal its infamous tendency to get out of hand; one takes as basic ingredient a motivic technique derived from late Beethoven, adds late-Romantic emotionalising, and beats the mixture to a sticky consistency typical of expressionism. But when the basic acoustic elements are the *dramatis personae* in a plan of action, whose end is composition, there is no longer any point in seeking support from the past, as expressionism does. It will therefore be as well to take note of something that is well known to mathematicians, and that has been exactly defined – the fact that between automata and living beings there are certain similarities, certain things in common and certain clear distinctions. These connections are not in fact found where most people might suppose; they are made clear in the mathematical concept of the process of choice, and thanks to the absolute reliability with which they have been calculated, they leave no doubt as to where human beings stop and machines begin; or *vice versa*, where the apparatus of automatism stops and human control becomes necessary. We know the remarkable qualities of electronic brains, but we also know exactly where, and when, machinery has to own itself beaten by even quite simple tasks.

The only way to get a correct idea of the possibilities of musical automation is to look closely at popular music of all kinds – motoric or pedagogic, entertainment-, dance- or background music. These are fertile fields, but the amount of effective variation could hardly be said to exceed that of one of the 'better' automata. The consolation is the variability of those people who refuse to be levelled down, who stay outside the conventions; they are found to be, in this respect, as little limited as they are to be pinned down. It would be natural to make the same assumption in judging how many acoustic elements there are; in former times, one was only too glad to regard them as infinitely numerous. Since then, however, it has become clear that they are of finite number, and furthermore, that in practice, the fact that they have to be heard causes them a considerable loss of information.

Any student's exercise provides a simple illustration of the necessity for a programmed plan of action in music – but a system stemming from tradition gives enough certainty to make only textbook rules necessary; the various problems then arise in due order, and with them, their solutions. But only integral variation- and connection-models, whose co-ordinates are frequency, sound-pressure and time, can reveal to us the rules governing the relationships between the basic elements; only then do we see the way these relationships function as an elemental musical system, into which the composer's freedom of choice is already built, in the shape of a conflict between material and the guiding intellect (a conflict that can be kept under control by rules, but which is always present). Can cybernetic and statistical methods be of any immediate use here? It will be impossible to tell, until there is a musician who is in command of the elements and who is also at home in the field of mathematical operations. Certainly, linguistics

and phonetics have found that these methods can give vital assistance in gaining new insights; this has been shown, for instance, by the mathematical analyses of linguistic elements, language style and languages, carried out by the Aachen physiologist W. Fucks, or the investigations into the structural models of speech, by the Geneva cybernetician B. Mandelbrot.

It is not to be doubted that information theory, which springs from the same sources – structural observation, and the new 'measuring' craftsmanship – and which starts from the recognition of the physical laws of information, could give rise to a specialist musical information theory of far-reaching significance. For it would embrace much more than mere musical theory; it would take in everything appertaining to music, from the simplest time-phase and the logarithmically perceived differences between the lengths of notes, via the significance and aesthetics of sound, to musical communication of any type. It would be the unquestionably valid way to train one's powers of thoroughly understanding the process of music and everything resulting from it.

Of course, in order to acquire a theoretical understanding of the composer's act of choice, not only *vis-à-vis* the laws of musical material, but also as regards spiritual and social functions, one would need to have very many musical information-concepts, and very varied ones. Then one would also see that it is not merely irrelevant but downright stupid to conjure up the familiar bogey of a so-called 'calculated' music, and to argue that post-Schönbergian music is mere organisation and total rationalisation of material.

There are many who, even today, religiously insist that early expressionism is the ideal of style – and to them, it does in fact seem that the constructivist pointillists (who may nowadays be rosy-cheeked, maturely lined or grey-haired) content themselves with static balance-sheets, paper music, and that they lack all awareness of articulated time, its semantic methods and order-relationships; whereas the truth of the matter is that they have discovered the function of silent rests in Webern's music, and, proceeding far beyond it, have become the only people whose contributions to the analysis of musical time are worthy of mention (in so far as one is inclined to take note of the volumes in this series).

But if, stubbornly or against their better judgment, people refuse to take note, they find themselves faced with a blank wall; a tempting surface on which to splash alarming pictures of the new music, making it look like a mathematical automaton that has got out of hand; and if, in addition, they are getting a bit hard of hearing, then when they are informed that musical composition now has to be standardised, controlled, they reply, 'Yes, modern music is growing old'.[4]

Associated with 'standard patterns' we find aleatoric scatter. And in the psychic field there is not only freedom but also standard patterns. But standard-forming criteria can never have an 'absolute' basis; and musical information theory would have to determine the point at which reasonable practice became the basis of choice. This would end all the talk about 'pre-musical' sound, supposedly existing as quanta rather than qualities, and also the conception of a 'scientific' music – an idea surpassed in silliness only by the superstition and morbid fear that a calculated levelling, a 'Gleichschaltungs-terror' of the musical elements might correspond to similar developments in politics. A little thought and attention to the facts will show that in totalitarian states, music is

[4] See the article so entitled, by Theodor W. Adorno, in *The Score*, December 1956.

encouraged solely as a means of refreshment, and only as long as it limits itself to the ground between classico-romanticism and mass music. The crippling collectivisation of musical energies makes use of all the tricks that in the nineteenth-century tradition counted as the most advanced, the 'free-est'. This is itself enough to make nonsense of the kind of arguments mentioned; they are seldom logically worked out – only worked up with an eye to cheap literary effect.[5] It is, however, not sure that such freedom is lawless, or is merely a world of compulsions, with all manner of liberalistic escape-holes for oneself; here again we find the twelve-tone catastrophe, where material governs by force, and expressive spiritual values groan under the strain. The only true freedom lies in the guidance provided by one's own personal strategy; one does not draw up the musical elements according to a statistical inventory, and then superimpose any obscure, artificial pattern of order; one decides what to do, as a composer, with the elements, in order to produce an audible, functional system of ordered time-relationships. Today, to 'compose' means to derive this kind of serial ordering from the overall system in which the musical elements develop, to do so by personal strategy which knows how to come to grips with the now discovered 'nature' of the elements, to make choices accordingly. For the post-expressionist composer, that is how things are. Are they better or worse than in the good old days of early expressionism? It is scarcely of interest to know, so long as ignorance of the elemental musical repertoire disguises itself as self-righteously moralising naïvety, deluded into believing that it can still defend oases that have in fact long since been conquered by the spreading desert. There is little to choose between 'advanced' expressionist music and the stagnant bourgeois reaction to it; today, either music exists as it is in the vanguard, or it does not exist at all. This is not a 'totalitarian' alternative; it is the simple truth.

[5] At present it is the fashion for empty-headed critics to make out that the systematic 'management' of musical material is identical with the terrorist rule of force in totalitarian political systems. 'Total', 'totalitarian' – here there is room not only for staggeringly ingenious word-play, but, if one so desires, for turning upside-down the relationship between a proposition and its necessary precondition. Thus it is possible to produce at will any connection between the apostles of total musical organisation and the nihilistic fellow-travellers or propagandists of totalitarian powers. One such 'social critic' of music has in fact attributed to the twelve-tone system the power to produce detailed programme music, whose only suitable counterparts would be concentration camps, machine-shops and the world of Kafka; and logically enough, his next step is to proclaim that the great 'human themes' are birth and growing-up, love and maturity, age and death – all the oratorio-titles of late-romantic liberalism, now converted into the corresponding clichés of official propaganda-music. *This* is the sort of argument that belongs to the thought-control and slogan-propagation of the most recent past, in which nothing was more precious than 'Nature'; not the second nature which is ruled by the more-than-natural authority of the artist (and this is sometimes what we, too, mean by the term), but the old Adam, pseudo-ontological, near-Dionysiac, Nature with all its categories – The Race, The People, Blood and Earth. This misuse of the word may be one of the reasons why art can no longer be brought back to a state of nature. It is not reason and order that are the allies of despotism; it is slogans like 'Back to Nature': or, to quote Günther Anders, 'The rule of terror uses as its favourite word, "Nature".' To listen to music in which there is systematic order, and to hear in it the counterpart to political totalitarianism, is just as witless as to appeal to 'Nature' when what one really means is textbook harmony.

.....HOW TIME PASSES.....

KARLHEINZ STOCKHAUSEN

Music consists of order-relationships in time; this presupposes that one has a conception of such time. We hear alterations in an acoustic field: silence – sound – silence, or sound – sound; and between the alterations we can distinguish time-intervals of varying magnitude. These time-intervals may be called *phases*.

In order to compare one group of phases with another, we make a distinction between 'periodic' and 'aperiodic' phase-groups, and, between these extremes, we distinguish a greater or smaller number of transitional stages (as deviations from either periodicity or aperiodicity, depending on which predominates).

To differentiate various phases, we compare one phase-duration with another. We measure time in phase-durations, or in durations of phase-groups. Our sense-perception measures shorter or longer phases. Proportions serve for more exact definition – one phase is twice, thrice as long as another. In order to fix proportions, one chooses a unit-quantum, and this is usually based on time as measured by the clock; we say one phase-duration lasts one second, two seconds, a tenth of a second.

Our sense-perception divides acoustically-perceptible phases into two groups; we speak of *durations* and *pitches*. This becomes clear if we steadily shorten the length of a phase (e.g., that between two impulses) from 1″ to $\frac{1}{2}$″, to $\frac{1}{4}$,″ $\frac{1}{8}$″, $\frac{1}{16}$″, $\frac{1}{32}$″, $\frac{1}{64}$″, etc. Until a phase-duration of approx. $\frac{1}{16}$″, we can still just hear the impulses separately; until then, we speak of 'duration', if of one that becomes extremely short. Shorten the phase-duration gradually to $\frac{1}{32}$″, and the impulses are no longer separately perceptible; one can no longer speak of the 'duration' of a phase. The latter process becomes perceptible, rather, in a different way: one perceives the phase-duration as the 'pitch' of the sound. $\frac{1}{32}$″ phase-duration makes us, say, 'a "low" note'. If a musician has learned to hear 'absolute' pitches in the scale system as we have known it up to now, he will say that he hears approximately double-bass B (,,B). But to recognize a pitch, the ear requires at least two equal phase-durations, otherwise it cannot 'tune in' – the 'note' is too short. Our sense-perception cannot react to a single phase quickly enough to perceive it as 'duration', so it summarizes several quanta to give the sensory quality 'pitch'. Steadily shorten the phase-duration still further, from $\frac{1}{32}$″ to $\frac{1}{64}$″ (,B), $\frac{1}{128}$″ (B), $\frac{1}{256}$″ (b), etc., and the note ascends as a glissando from 'low to high', and we can still speak of clearly recognisable pitches with phase-durations up to approx. $\frac{1}{6000}$″. We can perceive still shorter phase-durations up to approx. $\frac{1}{16000}$″, but exact pitch-orientation gets lost in this time-sphere. Higher still, we do not 'hear' any more.

Thus one differentiates phase-durations up to approx. $\frac{1}{16}$″ as durations, and, in music up to the present time, so-called 'metre and rhythm' (the time-ordering of durations) took place in the area between approx. 6″ and $\frac{1}{16}$″. The time-area in which phase-proportions were defined as pitch-relations – harmonic and melodic – extends from approx. $\frac{1}{16}$″ to $\frac{1}{3200}$″ phase-duration; instruments with higher notes have not been used.

Thus the transition from one time-area to another causes a change in our perception of phases. This observation could form the basis of a new morphology of musical time. The *notation of durations* has involved the use of signs that correspond to the system of whole numbers. Thus, different durations were only indicated in so far as each long duration was the whole-number multiple of the unit-quantum, of a defined shortest duration. The absolute duration of the shortest time-quantum either remained indefinite, or was metronomically defined. Thus, if the sign ♪ was selected as the smallest unit, then with a given metronome marking ♪ = 60, it meant $\frac{1}{60}$′, 1″. And all the other signs – ♩, ♩., 𝅗𝅥, 𝅗𝅥⌒♪, etc., were whole-number multiples of this: 2″, 3″, 4″, 5″, etc.

A second type of indication took as its starting-point not a *smallest quantum* which was *multiplied*, but a *largest quantum* which it then *divided*. Thus if the sign 𝅝 were selected as largest unit, then with a given metronome marking 𝅝 = 60, it meant 1″, and the fractions of this duration were designated 𝅗𝅥, 𝅗𝅥³, ♩, ♩⁵, etc., as $\frac{1}{2}$″, $\frac{1}{3}$″, $\frac{1}{4}$″, $\frac{1}{5}$″, etc.

But our powers of discrimination cannot register the fact that, in themselves, two differences are of equal size; one has to take into account the absolute lengths of the durations involved. Thus if a first phase lasts 1″, and a second phase 2″, there is a difference of 1″. Two phases of 11″ and 12″ duration have the same difference of 1″. But we perceive the difference between 1″ and 2″ as relatively large, whereas the same difference between 11″ and 12″ is hardly perceptible. This means that we do not perceive differences, but rather proportions: 1:2 is the larger proportion, as compared with 11:12.

For a *scale of durations*, whose dissimilarities shall be perceived as equally large, one must use logarithmic relationships. The interval, i.e. the size-relationship, is thereby defined: a scale with the constant interval of perception 2/1 from duration to duration would be $2^1, 2^2, 2^3, \ldots$ (2, 4, 8, . . .), hitherto designated as ♩, ♪, 𝅘𝅥𝅯, . . . Such a scale-interval may not, however, be too small, because our powers of discrimination impose limits; with relationships of approx. 15:16 we perceive durations as almost the same length. This interval 15:16 corresponds to the relationship which is decisive for the discrimination of 'duration' and 'pitch' (at the 'threshold of hearing'[1]). The same interval is also approached in the chromatic scale of pitches used up to now, where the 'semitone' (approx. 15/16) is defined as the smallest perceptible quantum.

In the time-area where phase-durations are designated as pitches, music has hitherto used a severely limited selection of phase-lengths. As a result of long development, we today find a chromatic system, at the basis of which the simplest phase-relationship 2:1 (the 'octave') is the main proportion, and where each octave is once again logarithmically divided into twelve intervals ($\sqrt[12]{2}$), perceived as equal. Most people who today write pitches in this system are not aware that they are giving form to time-proportions. This is primarily the fault of the one-sided development of instrumental music, and of instrument construction. Instruments with prepared scale-tuning, and an increasing mechanisation of note-production (tabular notation, etc.) have eradicated the consciousness of what really happens when the 'pitch a'' is produced, with a phase-duration of 1/440″.

This should be discussed further. We are familiar with the pitch-keyboard, on which

[1] *Trans. Note:* 'Threshold of hearing' should not be confused with 'threshold of audibility' – a standard used for the phon-curve on a decibel-frequency graph.

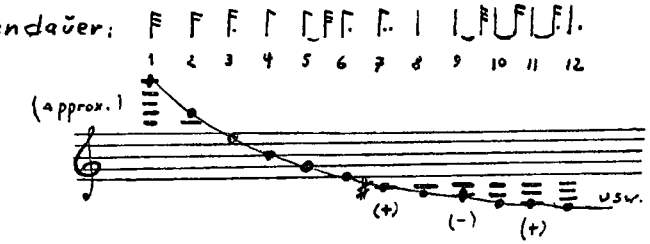
it is possible to present a chromatic scale of 88 pitches with a constant phase-relation ship $\sqrt[12]{2}$; where every thirteenth chromatic step is perceived as 'twice as high, or lo as the first. If the development of the duration system were equally advanced, the would correspondingly be a keyboard having a scale of 88 'durations' with a consta phase-relationship $\sqrt[12]{2}$, where likewise every thirteenth chromatic step would b perceived as 'twice as short, or long'. If it should be objected that there is no sense i imagining a duration-keyboard unless we also imagine something that is to have dura tion, we must not get annoyed. It is a question of turning a familiar idea upside-down one depresses a key, and the pitch is determined by which key is pressed down; on th piano, a string then vibrates periodically with a certain phase-duration, and this con tinues as long as the finger is held on the key. Now let us imagine the reverse: on depresses a key, and this releases a mechanism which measures a defined length of th note; and one determines the pitch – i.e., the time-duration of a single phase – by th variable pressure of the key (mechanically, this would mean that through the variabl key-pressure, the vibrating string would be lengthened or shortened). It would then b irrelevant how long the finger remained on the key.

Up to now, the pitch of a note has mainly been produced mechanically (and we hav mentioned the fact that this is true not only of keyboard instruments), while larger scale phase-relationships (i.e., durations) have taken shape through the direct conver sion of feeling into an action of some given length; as an adequate complement, on could imagine a system, working the other way round, for the representation of pro portioned durations; the most useful thing would be an instrument bringing togethe both these scales. But this is not the way matters have developed so far, and such con siderations bring us on to something else.

In *serial music* an attempt is made to put the time-proportions of the elements in order by means of series. The beginnings of serial control had to do with that sphere of time proportions which is perceived as pitch. The system of twelve notes in the octave wa taken as given (in what follows, the relationship 2:1, or simply the number 2, will b substituted, when the context requires it, for the term 'octave', which has really becom meaningless). The twelve notes were a reasonably limited number of magnitudes. Fro these magnitudes one could construct a series, and the distribution of the interval between each pair of magnitudes would produce relationships peculiar to that particula series. Between the one extreme, where all eleven intervals are the same (chromati series), and the other, where all eleven intervals are different (all-interval series), there was considerable latitude. The work for which the series was constructed would have a characteristically uniform pitch-structure, corresponding to the layout and distributio of the intervals in the series. Almost thirty years later, and after many detours, i occurred to composers to extend this principle into that sphere of time-proportions tha we distinguish as durations. A *scale of twelve durations* was then added, which wa intended to correspond to the chromatic scale of twelve pitches in 2. This scale, how ever, could neither be related to a system that already existed, nor could it be developed into one that would correspond. It was arrived at by the *multiplication of a smallest unit* from 1 to 12 / 1 to 12 / 1 to 12 / etc. What is such a scale?

We have already mentioned that durations are distinguished by the relationships, not

by the differences, of phases. In a series from , we automatically perceive a hierarchy; the relationship : (1:2) is the largest and simplest (the 2 of durations); the relationship : (11:12) is the smallest and most complicated. Let us see what such a scale of durations really is, in the sphere of smaller phase-lengths: if the shortest phase-duration were $= \frac{1}{2000}''$, one twice as long would be $= \frac{1}{1000}''$, thrice would be $\sim \frac{1}{666}''$ . . . twelve times would be $\sim \frac{1}{166}''$. This is called a *subharmonic series of proportions:*



Phasendauer = Phase duration

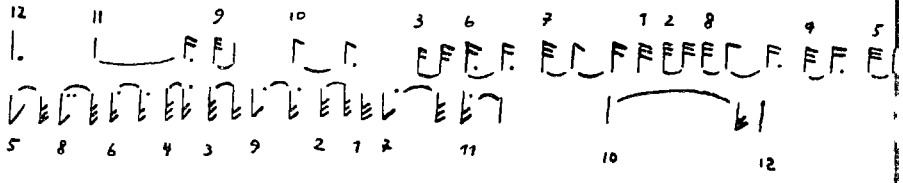
Example 1

In comparison with a scale built on chromatic intervals, the subharmonic scale is a *mode*. The composer Messiaen was well aware of this when he characterised such scales as 'modes' in his fourth Study for piano.

A scale from 1 to 12 has eleven intervals that we perceive as being variously large, and that correspond to those of the subharmonic series. What scale of durations would correspond to the chromatic scale in the hitherto-existing pitch-system? It could by no means be presented with the traditional signs for durations, since these are built on a system of whole-number relationships. We should have to divide the 2 of durations ('time-octave') into eleven apparently equal intervals, i.e., to fix twelve logarithmic values between and , between and , and so on.

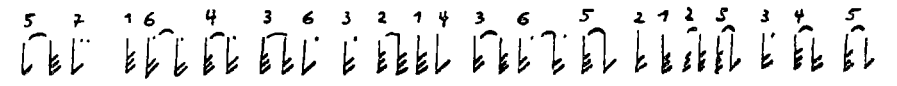
The attempt to use a subharmonic scale of twelve durations as if it corresponded to the chromatic scale of twelve pitches leads to major contradictions, particularly when such a scale is adopted and used uncritically. It was not surprising that in a time-structure formed with such a series of durations, the long values devoured the short ones; and that, even where the smallest unit was extremely short, the result was a slow average speed. Furthermore, the proportions were completely uneven, and hierarchically preordained. It was recognised as an immutable stipulation, if these proportions were to be at all perceptible, that the absolute duration of the shortest phase of such a series of proportions should be fixed, i.e., that the tempo should if possible be fixed metronomically, or at least kept constant. When structural changes occurred, one willingly altered the tempo; that is, the whole subharmonic scale slid 'up or down', so that one did not continually travel around in the same mode: the scale was *transposed*. If a 2-relationship were required from scale to scale (an 'octave-transposition'), the sign for the smallest phase was changed; instead of etc., one now wrote . (if the transposition were upwards), or . (if it were downwards). Or one made a 2:3 ('fifth') transposition, where the smallest interval was 'dotted', thus: . etc. This much was possible with the means of traditional notation.

Composers were more or less conscious that within the subharmonic duration scales, from which series arose, proportions were uneven. They found a truly drasti way to escape from the difficulties into which such irrevocably slow time-structures ha led them. Various such subharmonic series of proportions were simply piled on top o one another, so that, through the correspondingly multiplied number of alterations, greater *average speed* would be achieved. These series either had the same smalles phase (𝅘𝅥𝅯) and were merely arranged in different proportions:



Example 2

or series in which the shortest note-values were different were superposed. In the latter case something similar to polymodality arose, on a basis of subharmonic scales, but in the process the original intention of forming phase-relationships serially was nullified. The result, apart from the stylistic inappropriateness of using modal and polymodal time-structures, is that the intervals stemming from such a superposition give anything but serial proportions. We see this in the intervals resulting from the superposition of the two series above:



Example 3

Such a procedure corresponds exactly to the treatment of pitch-series that was criticised in the popular 'twelve-tone' method: it is the remains of the stylistic practice of thinking in parts, while handling very questionably the effect they make together.

Nor is there any sense in attempting to conceal such superposition of 'parts' by making the parts cross a great deal, and by making great differences between the phase-durations and the real 'note-durations'. (The latter is a real distinction; a note can, independently of the interval of entry of the next note, have reached its minimum intensity earlier – 𝅘𝅥𝅯 7 𝅘𝅥 – or can still continue after the next note has began – 𝅘𝅥𝅯 𝅘𝅥𝅯; thus the effective note-duration is determined by the number of phases of the same duration – if the note remains at the same pitch – that succeed each other. We can therefore describe a note-duration as a *phase-group*.) The density of a simultaneous superposition of series was varied; this was justified on the ground that one could thereby regulate the changing average speeds.

A much more significant consequence, however, was that not all the elements were used at every moment of a work – that the same series was not reeled off continually; supra-ordered series were introduced – series of series – that made *selections of elements* for the respective *structural phases*. In a first structural phase, only the elements 1-5, for example, were used; in a second, only 1-7; in a third, 1-11, etc., so that the relationship of long to short values was always differently handled, and the overall result was an

organically perceived time-structure. Correspondingly, series were sub-grouped, as had already become the practice with pitches; i.e., supra-ordered series selected elements in groups from the element-series. If, for example, the *element-series* ran thus: 12, 11, 9, 10, 3, 6, 7, 1, 2, 8, 4, 5/11, 10, 8, 9, 2, 5, 6, 12, 1 . . . and 5, 8, 6, 4, 3, 9 . . . was selected as the supra-ordered *group-series*, this meant that five elements would be used in a first structure, namely 12, 11, 9, 10, 3, then eight, namely 6, 7, 1, 2, 8, 4, 5, 11, then six, namely 10, 8, 9, 2, 5, 6, etc. Either the phase-durations of the structures, in which such groups of elements would be used, were pre-selected (e.g., 30″, 2′, 60″, etc.), or a *multiplication-series* was taken in addition, to regulate how often each group of elements should be permutated. If the multiplication-series was 8, 11, 9, 7, . . . ,this meant that the first group of five elements would have eight permutations, the second group of eight elements would have eleven permutations, the third group of six elements would have nine permutations, etc. These series with various functions could either be identical, or be derived from a common original series. It was quite natural that phase-proportions, at first composed only between the single elements (in the 'pointillist' style), should be applied to all the phases of the supra-ordered structural sequences; and that all the micro-time processes should be made to accord with those in macro-time ('group-composition').

To compose separate parts as *polyrhythm* is a stylistic error; and this criticism led to a result which is certainly the most relevant for further developments. One said to oneself: when, in an initial phase of the structure, three such subharmonic time-series overlap, and in a second one, five, etc., there results an overall impression of varying density, and the average speeds are a complex result of serial density-relationships. It is also possible, in the process, to take the parts so far from their original function as 'voices' – i.e., their 'register' – that they become merely inextricable threads in a network, and this network must be audible only as such, and not as a superposition of parts. If in the end one carries such polyrhythmic complexes so far that 'pointillist' hearing of the individual duration-relationships turns into structural hearing, then serial method will be concerned, above all, with such *statistical form-criteria*, with average relationships.

A corresponding procedure was followed in the sphere of pitch; there were structures in which single notes and the intervals between them could not be heard 'pointillistically', but for which the average properties of the groups – of the 'flocks of notes' in particular pitch-fields – were decisive. This could lead at times to a complete suspension of recognizable phase-relationships – to structured 'noise'. Reports on the methodic consequences of this conception of structure and structural hearing can be found elsewhere (in the programme book of the Bayerische Rundfunk, 6th Year, Series 23, and in the late-night programme on 'Webern and Debussy', WDR/NDR). So we will go no further into the details of such experiments in method.

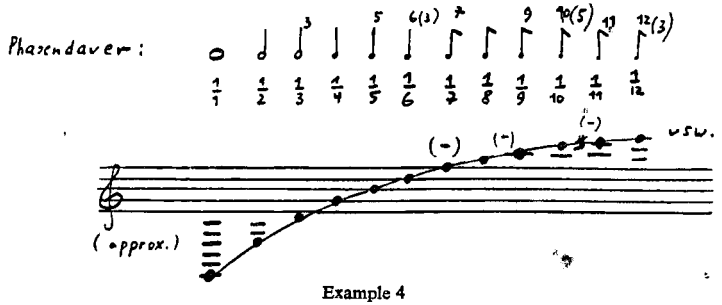
Our musical perception reiterated that something was not in order in the work being done on time-structures, and the mistake was sought in the compositional method: it did not occur to anyone to return to the elements, to duration-proportions themselves – to ask whether perhaps the contradiction lay in the basic tenets, in primary scale-relationships. The outcome was indeed an extraordinarily rich expansion of the serial method, many of whose results will remain valid. The real question, however, remained unanswered.

Let us examine the second possible way, mentioned above, of matching the chromatic pitch-scale by a corresponding scale in the sphere of durations; the process of *dividing a largest time-quantum*, instead of multiplying a smaller one, in order to arrive at a scale of durations.

In what follows, a sub-divisible time-quantum will be called the *fundamental phase*. Let a fundamental phase of 1″ duration be ○; divide it by whole numbers in the order 2, 3, 4 . . . , and the following scale of durations results: ○, 𝅗𝅥, 𝅗𝅥³, ♩, ♩⁵, ⁶♩₍₃₎, ♪⁷, ♪ ♪⁹₍₃×₃₎, ♪¹⁰₍₅₎, ♪¹¹, ♪¹²₍₃₎. The notational symbols for the uneven values (1/3, 1/5, 1/7, 1/9, 1/11) have hitherto been called *irrational values*. It can be seen from this, how exclusive the dominance of the 2-proportion has been in the music of the past. Even today, it is quite impossible to make a musician play a single 1/3 or 1/5 of a fundamental phase ('counted value'); this would mean, for example, that he would have to play first 1″ = ○, then $\frac{1}{3}$″ = ♩³, then $\frac{1}{5}$″ = ♩⁵ etc.: ○ 𝅗𝅥$\frac{1}{3}$ ♩$\frac{1}{5}$. Still less would it be possible to combine multiples of these values (2/3, 3/5, 5/7, etc.): ○, ○$\frac{2}{3}$, 𝅗𝅥.$\frac{3}{5}$, 𝅗𝅥$\frac{5}{7}$♪ etc. The reason for this is that we did not perceive a particular duration as a whole, but automatically quantified it, and attempted to bring it, together with the neighbouring durations, into line with a common smallest or largest counting unit. Thus 1/3, 1/5, 1/7 were described, in comparison with 1/2, 1/4, 1/8, as 'irrational' values, because no common smallest counting-value could be found. But this only means that this common counting-value has slipped out of the sphere of perceptibility as a duration, and is so small that it can be described as 'the irrational of perception'.

The dominating *2-relationship* seems to rest on a fundamental principle of our sense-perception, to be the acoustical 'golden section'. In the sphere of micro- and macro-phases, of pitch and duration, all proportions based on the 2 are felt to be the 'simplest', to be regulative. 'Twice or half as high (a pitch-octave) or long (a duration-octave)' appears to us as the purest proportion, to which all others are related.

What is such a series of proportions, 1/1, 1/2, 1/3, . . . 1/12 . . . , when applied to time-phases? Let us once again take a helpful example from the sphere of micro-phases, because here the musician has much more conscious experience. If the fundamental phase is ○ = $\frac{1}{100}$″, then the half-phase is 𝅗𝅥 = $\frac{1}{200}$″, a third of a phase as ♩³ = $\frac{1}{300}$″, and a twelfth of a phase is ♩¹² = $\frac{1}{1200}$″ etc. But that is nothing more nor less than a *harmonic or overtone series:*

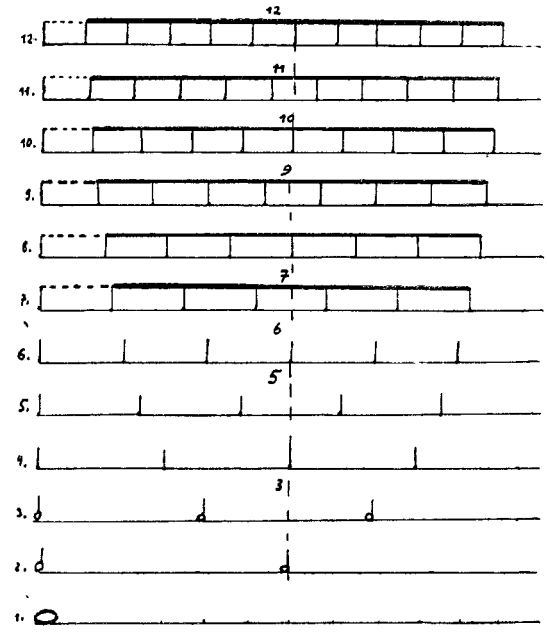


Example 4

It is well known how little there is in common between a harmonic series of proportions and a chromatic series as actually perceived. Consequently, in practice, metrical notation

excluded almost all single proportions other than the 2-relationships: ○ 𝅗𝅥 ♩ ♪, the 'duration-octaves'. But what was the function of the irrational values, when they were used?

Because the fundamental phase serves as the unit of perception, the divided values are always referred to it. Thus the fractions must always repeat themselves until they reach the total fundamental value. There are two halves, three thirds, etc., to one fundamental phase. We define such a formation as a *harmonic phase-spectrum*, both when it applies to micro-phases (pitch) and macro-phases (durations).

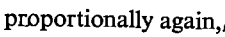
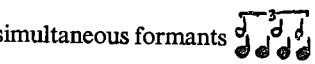
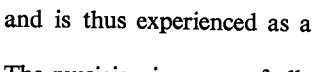


Example 5

In the harmonic spectra of pitch, the fundamental phase is also described as the *fundamental tone*[2]. We choose the term *formants* for the single 'harmonic' divisions. Thus the first formant is the fundamental phase itself, the second formant is the fundamental phase divided by two, etc. When not all the formants are contained in the spectrum, the special expression *formant-spectrum* will be used instead of 'phase-spectrum'. The duration of a phase-spectrum is defined by the fundamental phase (e.g., MM. ○ = 60 = 1″), and the individual durations in the formants are the result of dividing the duration of the fundamental phase by the ordinal number of the formant.

It is important, for what follows, that a single formant (such as ♩ ♩ ♩) remains unrelated; it is heard as a repetition of the same phase. But two formants are already heard, automatically, as related to a common fundamental phase. We begin to perceive

[2] *Trans. Note:* Or simply 'fundamental'. The full expression is used here to avoid confusion with other 'fundamentals'.

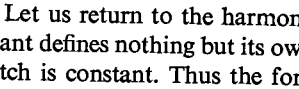
proportionally again, and orientate ourselves to the largest common unit. The sequence of formants  is thus related to the fundamental phase ○:3/3:4/4 = 1. The same holds good for simultaneous superposition. A completed phase with two simultaneous formants  defines the fundamental phase, even if the latter is not itself included in the formant-spectrum as a duration. We can make this clear as follows: every beginning of a fundamental phase is marked by a synchronization of the formants and is thus experienced as a corresponding increase in intensity: 

The musician is aware of all this when he remembers the earlier definition of a 'bar'. Thus it is easy to see that the more formants are contained in a spectrum, the clearer the fundamental phase will become.

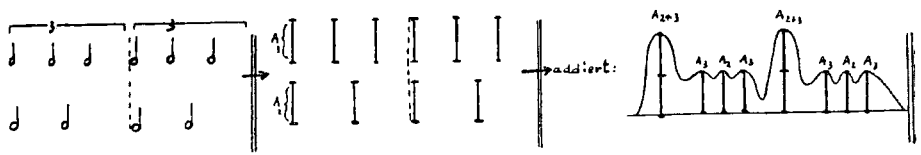
One can now also define as harmonic phase-spectra all sounds used in music up to now (but not noises). The duration of the fundamental phase defines the pitch of the fundamental tone. The number and combination of formants defines what is commonly called the *tone-colour* of the spectrum. Very few musicians are conscious of the fact that tone-colour is the result, in the first analysis, of micro-phase structure.

Since we have now come up against the direct connections between macro- and micro-acoustical time-relationships (even if at present only in the very limited sphere of 'harmonic' phase-spectra), we must remember this: when we speak of recognizable 'pitch', this means there must be at least two complete phases. Normally, we hear many more equal phases in succession, if a note continues at the same pitch. Thus we arrive at the duration of a note or a sound. The shorter the note-duration, the more difficult it is to recognize pitch: if, finally, the note-duration goes below $\frac{1}{16}''$, the perception of pitch gradually disappears. Here we again meet the 'dissolving interval', already mentioned more than once (for a more exact evaluation of these threshold quantities, we must first define what sort of note we are dealing with, or to be more exact, whether it is a 'pure' tone, a 'sound' or a 'noise', etc). In our divergent researches (separating pitch and duration), which take sense-perception as their point of departure, we always presuppose that this threshold must be crossed neither in the one direction, upwards, nor in the other, downwards.

Let us return to the harmonic spectrum. As far as pitch is concerned, a single formant defines nothing but its own phase, which repeats itself more or less often when the pitch is constant. Thus the formant is itself a fundamental tone; in this case, to say 'formant' is unnecessary, and it is called a *pure tone*.

A phase-duration was described in the opening paragraph as the time-interval perceived from one alteration in an acoustic field to the next. Let us imagine these alterations as perceptible alterations of sound-pressure. The phase-duration would then be the time-interval between two intensity-maxima. A 'pure tone' – a series of simple time-phases – has only one intensity-maximum in each phase: Two or more formants, however, define not only themselves, but their common fundamental tone, and they do this through the phase-interval between the *main maxima*, which result from the simultaneous superposition of the formants, where two or more phase-maxima fall simultaneously:  . But further *subsidiary maxima* come into existence

within the fundamental phase, through the summation of the intensities of the formant-phases. A periodic sound-process which has several intensity maxima (of various sizes) per fundamental phase, is no longer called a 'tone' but, more precisely, a 'sound', a 'spectrum'. We obtain a resultant *intensity-curve*, that returns periodically when the same phase is repeated. If we suppose that each phase-duration is the time-interval between equally large intensities ('amplitude values', A), then we can obtain the following intensity-curve from the superposition of a second and a third formant (such a curve is also called an 'envelope curve'):



Example 6

Just as the combination of duration-formants makes us perceive their common fundamental phase (which can also be described as the 'combination-duration', the 'tactus' or 'bar' of earlier times), the combination of pitch-formants similarly makes us perceive their common fundamental or *combination-tone*.

The important thing for the musician is that his perception of tone-colour is aroused by the intensity-curves of phase-spectra, and that these intensity-curves result from the superposition of formants: that 'tone-colour' is the result of time-structure: and that he can intervene compositionally among these complex connections – as is the case today in electronic music.

In the sphere of traditional metric-rhythmic relationships, the correspondences with harmonic relations are quite familiar. The whole allusive richness of pitches in cadential music resulted from the intervals of the harmonic series, and the same is the case in the sphere of durations. The bar corresponds (as a metrical fundamental unit) to the fundamental phase of a time-spectrum. All definitions of 'accented and unaccented parts of the bar' (resulting from 'main and subsidiary maxima'), of syncopations and their resolution (phase-displacement and restoration of phase-periodicity), etc., originated in the practice of 'part-writing' (which gave rise to the problems of harmonic time-spectra). In it, the bar, as fundamental phase, was rendered (through *time-formants*) in various ways, if mainly through the 'consonant' formants – the octave (duplet), fifth (triplet), later the third (quintuplet), and at most the seventh (septuplet); i.e., with up to seven formants.

The difference between *metre* and *rhythm* is exactly that which we discern between the 'fundamental tone' and the 'tone-colour' of sound-spectra: the fundamental phase (metric fundamental) is defined by the periodic main intensity-maxima (the heaviest accents), and these result from the formant-structure. The relationships of the subsidiary to the main maxima (subsidiary to main accents) define the 'tone-colour', i.e. the rhythm. 'Tone-colour' is a confusing idea, that could well be replaced by 'sound-rhythm', and one should use the general term 'formant-rhythm'.

Let us call to mind a few well-known theories of acoustics and acoustical perception. How can these help to answer the question whether a serial duration-structure can be added to serial pitch-structure, without the two contradicting each other?

Exactly defined, a twelve-tone series is a sequence of twelve fundamental tones, so long as the question is one of harmonic formant-spectra. Such spectra characterize almost all the sounds (not 'tones', which are hardly ever found 'pure' in nature) used in music up to now. The same harmonic series of proportions (also 'overtone-series') was the standard in 'tonal' music, both for the formant-spectra of the sounds used, and for the intervals that connected such sounds; spectral proportions were identical with the proportions of the fundamental tones, both simultaneous ('harmony') and successive ('melody'). With the introduction of the chromatic scale system, this identity steadily disintegrated. Finally, in the twelve-tone system, harmonic-melodic 'laws' were formulated that totally contradicted the spectral structure of the instrumental sounds used; the instrumental sounds' *harmonic scale of perception* was irreconcilably opposed to the *chromatic scale of perception* of the twelve fundamental tones in the octave, whose steps were serially composed. Here the earlier identity of material and composition fell completely apart. This is what is really meant when the 'emancipation of the fundamental tone' is mentioned. (Schönberg's occasional regression to tonal harmony and melody could be explained not least by the contradiction demonstrated above. His metric-rhythmic composition was always 'tonal', a classical cadential rhythm with merely a lot more unresolved syncopations, equivalent to a tonal harmony with lots of 'wrong notes'.)

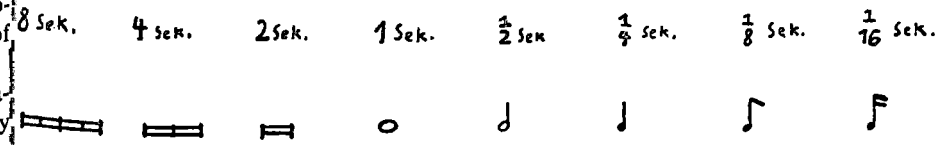
'Rhythm', however, developed in such a way that no-one thought at first of doing anything that would correspond, in the sphere of macro-phases (durations), to twelve-tone composition. This would have meant 'tempering' the fundamental phases (the 'bars') of the duration-spectra to an equivalent of the chromatic scale of twelve fundamental phases per time-octave, and composing them serially, while the formant-spectra of the durations still remained harmonic. Once again we are at the basic problem of our investigation. What would a scale of fundamental durations, corresponding to the scale of fundamental tones, look like? Furthermore: how would the duration-spectra have to be structured over these fundamental durations, in order to achieve a complete correspondence (befitting the present state of instrumental composition) between the chromatic system of fundamental tones and the harmonic formant-system, in the realm of both micro- and macro-time perception?

In tonal music, the total duration of a work was divided into *tonal fields:* one fundamental tone – central note, tonic, dominated for a while, then another, and so on. By and large, the transposition of such fields was called *modulation.* These relations were ruled by a system of hierarchical functions. Modulations came to predominate more and more, and finally, in twelve-tone music, there was 'modulation' from each fundamental tone to the next. No note was more important than any other, over a time-phase that was at all long. Similarly, a *fundamental bar-length* – the fundamental phase in macro-time – continued, in tonal composition, to dominate for particular *metrical fields* (e.g., a $\frac{4}{4}$ bar). Subtleties of cadence were used as details, just as on a larger scale there was modulation from one metrical field to the next, and finally, from one movement to the next, etc. Modulations were made to the 'dominant' (3:2 – triplets), or to the 'subdominant' (2:3 – dotted values). This modulation, too, proceeded ever more

rapidly, and finally, via Debussy to Stravinsky, there are fundamental phase-relationships in which the phase-duration changes from bar to bar. Now, this could not correspond to the twelve-tone chromatic connections of fundamental tones, because evolution had produced no 'tempered system' for durations. So, in serial composition of fundamental phases ('bars'), one lapsed into sub-harmonic modality, as has been demonstrated above for durations in general. We meet the scale of 1 𝅘𝅥𝅯 to 12 𝅘𝅥𝅯 not only from one individual duration to the next (in the 'formants'), but also, in certain serial works, in written-out series of bars (e.g., bars from $\frac{1}{8}$ to $\frac{12}{8}$).

So durations have now been included in the serial system: the latter should be extended to take in metric-rhythmic relationships, despite the contradiction between fundamental-tone composition and the nature of sounds. For this purpose a *tempered chromatic scale of durations* would be necessary. How could this be represented? We can only approximate to a chromatic time-scale, so long as we have to rely on feeling, and are not assisted by a duration-keyboard. We take a pocket metronome, which can be quickly altered while still in motion. We fix eleven duration-intervals per 2, in such a way that they are felt to be equal. As long as we use the traditional signs for duration, the only possibility is to take the same sign (e.g., 𝅝) for all twelve chromatic time-values, and to differentiate its duration metronomically. If we choose a logarithmic scale of 12 ($\sqrt[12]{2}$), within a 2 from, for instance 𝅝 = 1″ to 𝅝 = $\frac{1}{2}$″ (2:1). we get:
M.M. 𝅝 = 60, 63.6, 67.4, 71.4, 75.6, 80.1, 84.9, 89.9, 95.2, 100.9, 106.9, 113.3, 120.
For the last value 𝅝 = 120 we can also write 𝅗𝅥 with 𝅝 = 60, and the same chromatic scale sets out, with this value, into the next 2. Thus we obtain the 2-transpositions of the scale ('octave-transpositions') by altering the sign for the fundamental duration: 𝅝 = 60-113, 𝅗𝅥 = 120-226, ♩ = 240-452, etc.

The sphere of *duration-composition* has not hitherto exceeded 2^7 (seven duration-octaves); fundamental phases longer than 8″ or shorter than $\frac{1}{16}$″ are seldom required ('playability' sets a bourn here, and we have seen above that the perception of duration passes over into the perception of pitch at this point; equally, our powers of recollection impose limits on the length of time-phases, ruling out fundamental phases that are much more than 8″). Thus, the composition of durations has at its disposal a *chromatic scale of durations over approx. seven octaves*, between 8″ and $\frac{1}{16}$″:



Example 7

and in every 2:1 relationship, the chromatic scale of twelve durations, fixed by metronome markings, repeats itself.

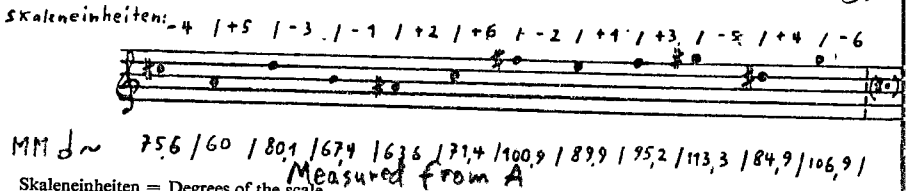
Together with the seven or eight pitch-octaves, *musical time* would thus be circumscribed in fourteen or fifteen *time-octaves*, in which the composer proportions phase-relationships both in the sphere of duration and in that of pitch.

With the aid of the metronome, we have used normal note-values to fix a scale of durations that corresponds to the twelve-note scale. What is to be done with it?

The notion of a fundamental phase – and, in a narrower sense, of a fundament duration and a fundamental tone – was derived from the concept of a time-spectrum. corresponded to the earlier 'metre'. Moreover, we now know the nature of tim formants in the harmonic spectrum. We have substituted formant-rhythm, in pitch an duration, for tone-colour and rhythm; this was to maintain the contradiction betwee harmonic spectra and the chromatic relationships of fundamental phases. And now it time to discuss the question of applying the serial system to *fundamental durations.*

No fundamental tone holds sway over the others; none of the twelve pitches per 2 repeated before all have had their turn. Correspondingly, no fundamental duration no metre – will be repeated before all twelve per 2 have had their turn.

Let us choose the simplest case, when a series of fundamental durations is directl proportional to one of fundamental tones. The metronome markings apply to ♩;

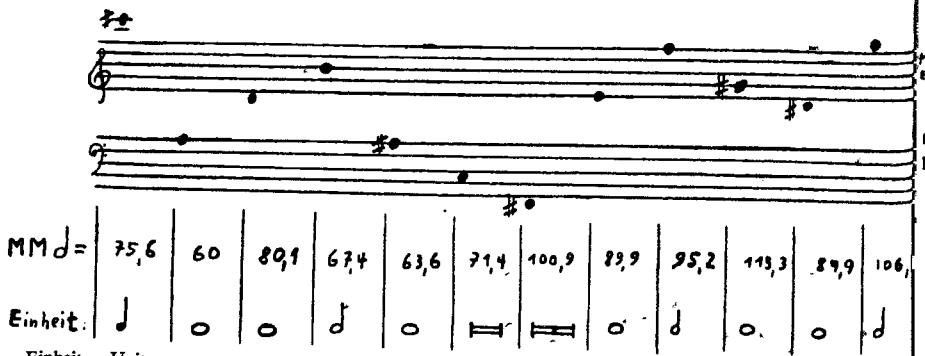


Skaleneinheiten = Degrees of the scale

Example 8

These would be fundamental durations, just as in pitch we must think of fundamenta tones.

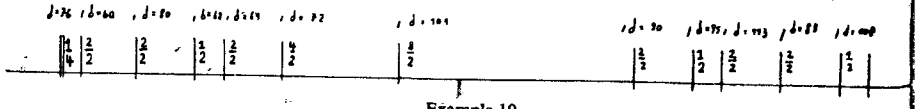
In the composition of fundamental tones, it is exceptional to confine the series to on octave, and this is equally true of fundamental durations. The fundamental durations o our series must be distributed among the duration-'octaves'; their *time-register* must b defined. The pitches are once again given as a visual aid. Let us select a disposition o the registers:



Einheit = Unit

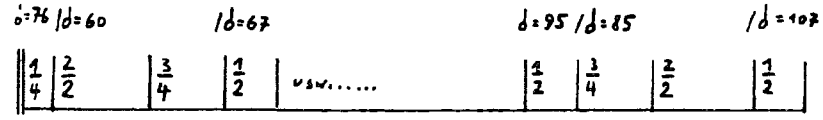
Example 9

If this were barred normally the result would be the following metrical series:



Example 10

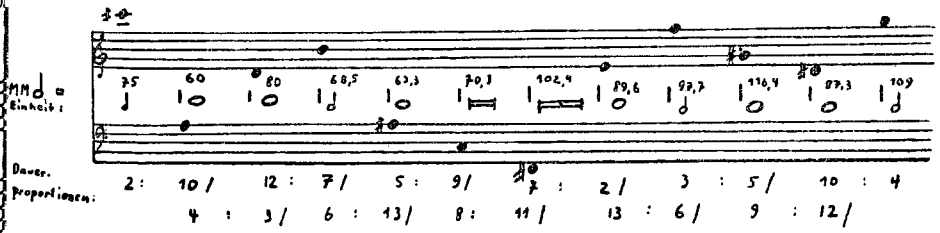
A harmonic proportion that can be expressed in familiar note-values (𝅗𝅥 : ♩. / ♩ : 𝅗𝅥) only appears twice in our series (between the second and third, and between the tenth and eleventh durations), and in these two cases we can alter the note-value instead of the tempo.



Example 11

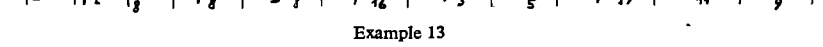
In a series where the proportions 3:4 or 2:3 appeared more often, several metres could be comprehended in one tempo, by using bars of varying length.

In our example of a duration-series, we started by including all the twelve chromatic steps of a 2. We were not concerned with particular interval-proportions. Next we fixed the register of the durations. This is the normal method in the twelve-tone technique. One is misled into doing things in this order because the chromatic scale with the unit-interval $\sqrt[12]{2}$ (Ex. 9) is simply presupposed. In reality, it is less interesting, when listening to series, that at some time or other all the chromatic steps should appear (this is true of every series), than which proportions are chosen between durations or notes, and how these proportions are distributed, how they are composed in relation to each other. If, however, a *proportion-series* of intervals is taken as the point of departure, the register of each duration is already chosen with every step. We should examine the above series from the point of view of its interval proportions. We shall then recognise eleven *intervals*, of various sizes, *from the harmonic series*. The comparison with pitch is now only approximately accurate, for we proceed with pure intervals that deviate to a greater or lesser extent from the chromatic tempered system. This will be seen if the following metronome markings are compared with those in Example 9:



Example 12

The relationship of one fundamental duration to the next is expressed in the following eleven harmonic proportions: 2/10, 4/3, 12/7, 6/13, 5/9, 8/11, 7/2, 13/6, 3/5, 9/12, 10/4. Measured in seconds, the fundamental-durations are approximately:

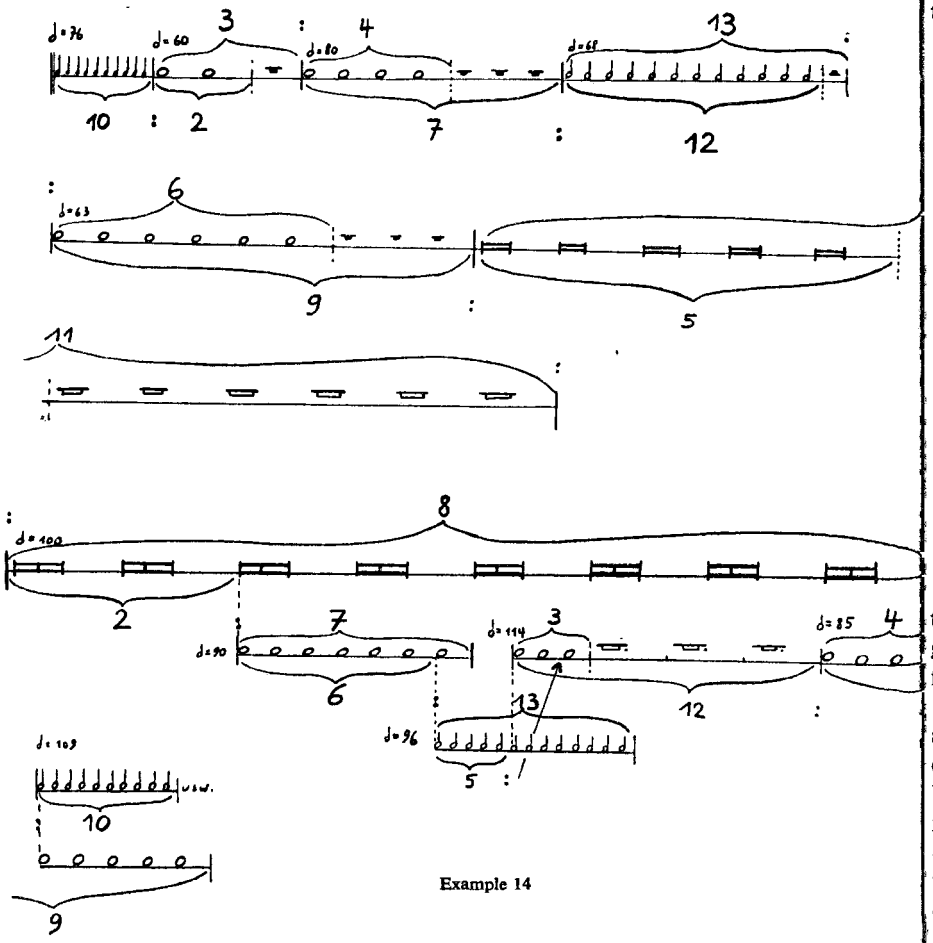


Example 13

It seems sensible to retain the metronome values of the chromatic series ($\sqrt[12]{2}$), because further derivations from the series of harmonic intervals will produce further deviations from the tempered scale, and thus more and more new tempi, instead of which we could always operate with the same twelve tempi, even when a series is transposed.

However, the presentation of intervals in harmonic proportions becomes essential as

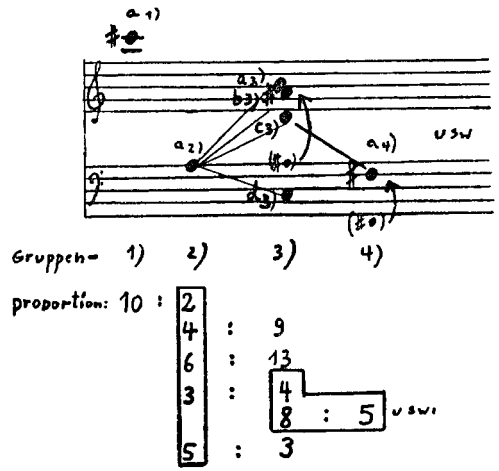
soon as we relate single fundamental durations to *groups of fundamental durations*. Th could happen in the following way, among others. The proportion 2:10 means that t duration of a first phase is two-tenths of the duration of a second fundamental-phas i.e., five times as short. But it also means that two phases of a second fundament duration are equal to ten phases of a first. We can therefore reverse the proportio (10:2/3:4, etc.), because now we refer not to the duration-relationships of the sing fundamental durations, but to the relationships between the numbers of fundament durations in each group. If such *formant-proportions* are presented *successively*, varyin numbers of equal durations add up to groups: these are the same length from one grou to the next (the first ten are the same length as the following two, etc.). But each grou with the exception of the first and last, is ambiguous; each is the hind-limb of a fir interval (10:2) and the fore-limb of a following interval (3:4 ...). The result of th ambiguity is either a rest or an overlap. The selected series of proportions gives th following groups of fundamental values:



Example 14

In groups of fundamental durations, changes of tempi extend over much longer time-phases, and such groups meet normal playing requirements better than a series of single fundamental durations. Let us remember that it is a matter of fundamental durations, of metres, each of which will have a formant-spectrum; and therefore that the realization of our example requires three chordal instruments, or, better, three orchestras, that would at times play independently of each other, at differing tempi, orientating themselves to the others only at the points where they entered. Before each entry each group – or each conductor – could prepare for the next tempo without difficulty (with a metronome). Spatial separation would result naturally from the need to make various time-strata appreciable.

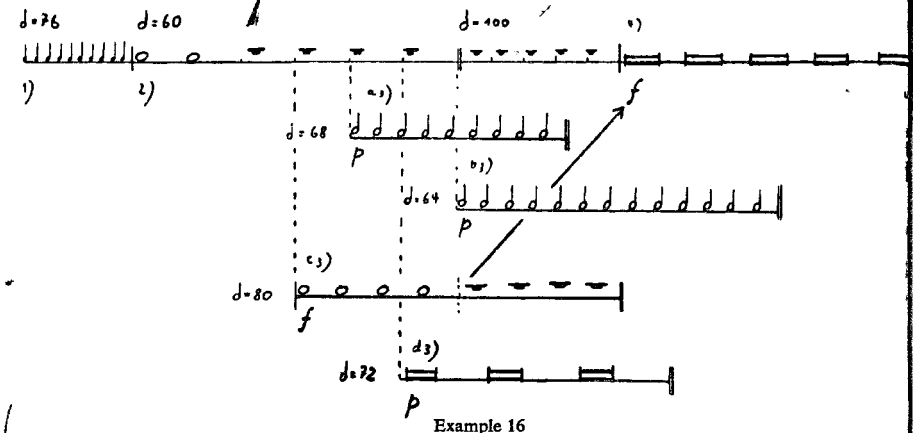
Each *proportion* value, however, can not merely be ambiguous but can have many meanings: i.e., different intervals can spring simultaneously from the 'limbs' of the proportions. Here there are new proportions that must be taken into account. The numbers again refer to the number of fundamental values in a group. For the sake of comparison, the same thing is also presented in terms of pitch.



Example 15

One can settle freely or serially the question of whether all four intervals, or a selection, or only one, should be operative for the proportion from the third to the fourth group. If we choose that there shall be only one link, there is room here, perhaps, for a function of intensity – e.g., to make clear the linking groups c^3) and a^4). (Ex. 16)

We described the durations in each group as fundamental durations. Now we have to ask what sort of *formant-spectra* these fundamental durations will receive (just as in the case of fundamental tones we had to ask which instrument – which 'tone-colour', or, better, which *formant-rhythm* – should be linked to the fundamental tones, or which instrument to which fundamental tone). If it were still a question of single fundamental durations, as in Exs. 8 and 9, then in the simplest case, each fundamental duration would be given its own formant-spectrum (cf. Ex. 5). But the fact that there are *groups* of fundamental durations means that a formant-spectrum must be related to the



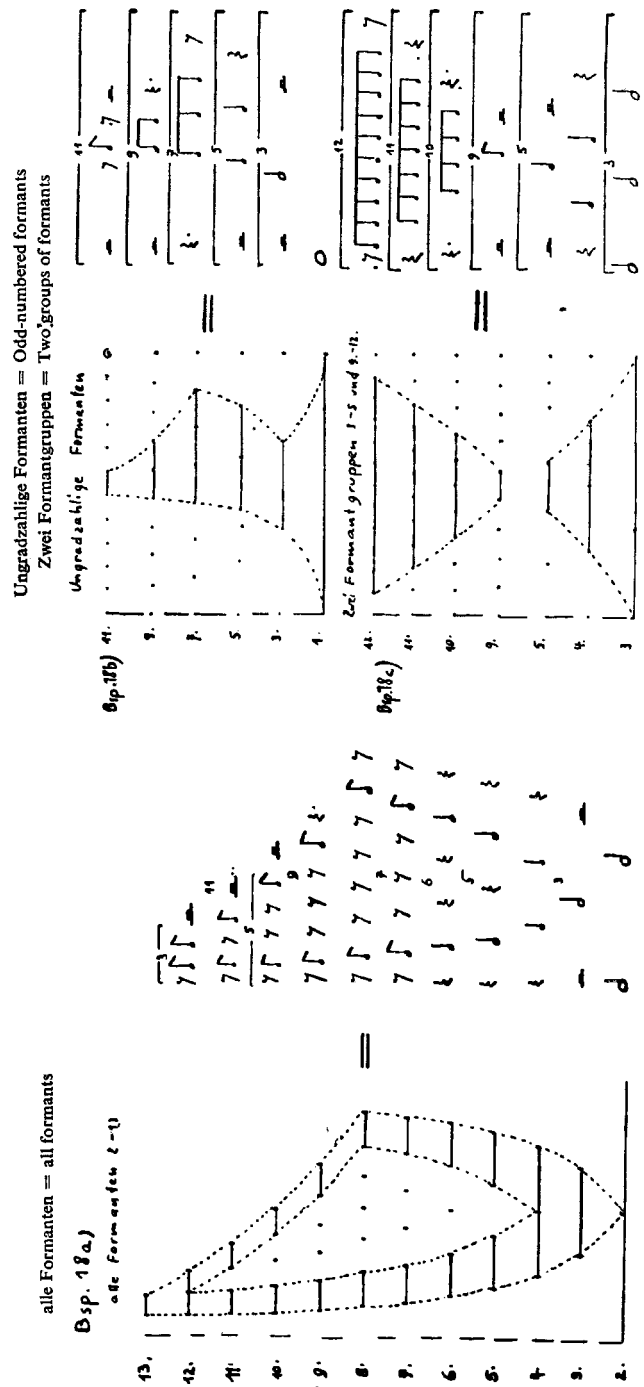
Example 16

supra-ordered duration of the whole group, i.e., to the *group-phase*. The spectrum to b composed is then called a *group-spectrum*. It may help if one pictures a group of fund mental durations as the formants of a virtual fundamental phase that lasts, in mo cases, so long that it lies far beyond the boundaries of musical time.

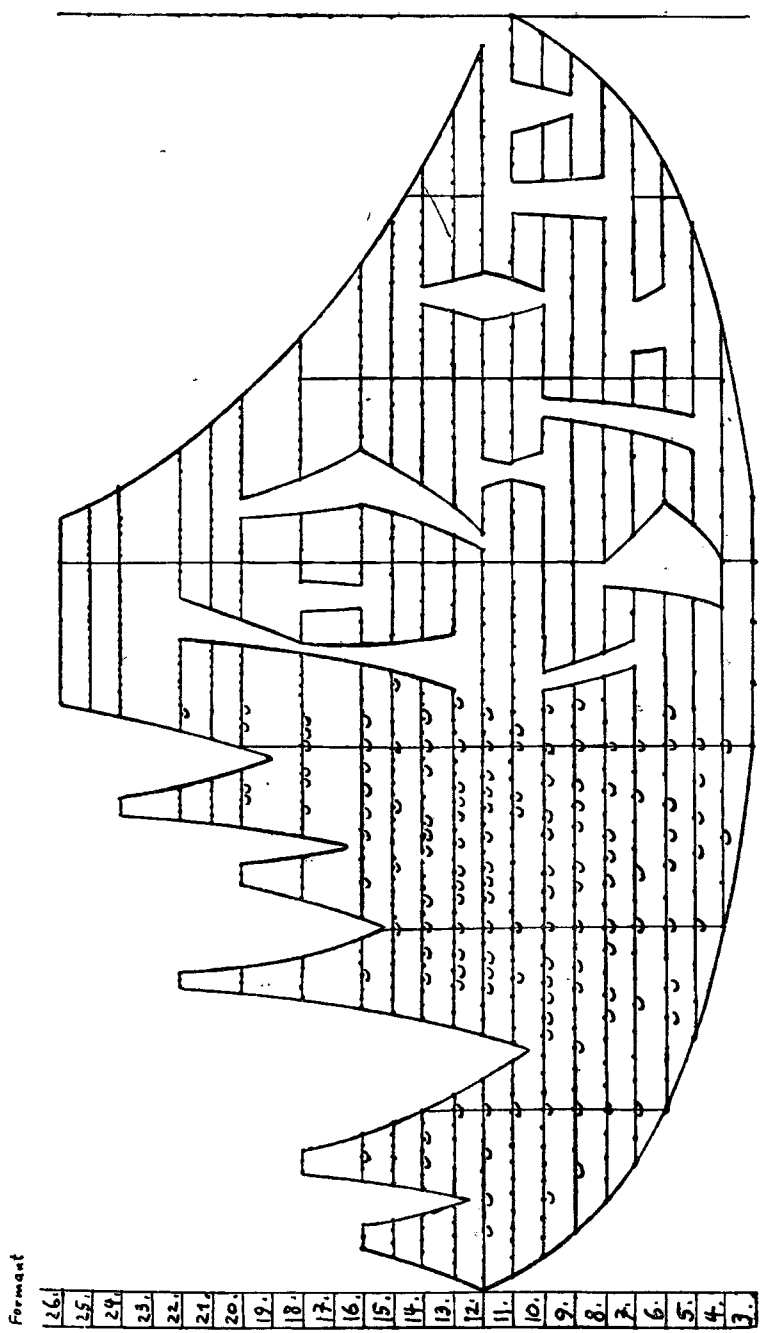
Finally, an entire piece can be imagined as the *one* time-spectrum of a single fund mental duration, of a 'tonality', as was in effect the case with tonal music. (Natural this must not be confused with serial compositions which are notated in even metre t make performance easier, but in which the function of a constant fundamental metre nullified; the mental filling-in of bar accents, too, is here senseless and a distortion, bu basically, we find the principle of 'tonal' metre and rhythm in any work where a co stant fundamental duration perceptibly defines sections of the whole work, howeve well such a metre may be effaced by emancipated syncopations.)

The most diverse methods of serial composition can be used in deciding the numb (the shorter the fundamental duration, the fewer formants!), the combination, th register (fixed or movable formants), the changes of register (!), the intensity-relatio ships, etc., of the formants. A formant-spectrum will then be seen as a unitary tim complex, characterised by its total duration, envelope-curve (see Ex. 6), average spee speed tendency, average intensity, density, density progression, sonority (which grou or combination of instruments), sound-form, movement in pitch, harmonic field, and s on. The resultant of all these compositional details is what we have described general as the formant-rhythm (instead of the notion of 'tone-colour'), and this will be heard either the *rhythm of the sound* or the *rhythm of the bar*, depending on whether it has t do with pitch or duration. That is why we represented formant-rhythm as a sing intensity-curve (Ex. 6).

Special reference must be made to one of the formal criteria most essential to seri composition of such envelope curves. The form of the entry and exit processes o formant-spectra is highly important in the presentation of extended time-structures, i which one has to recognise particular forms of the formant-spectra when they retur There follow three examples of formant-spectra on single fundamental durations (E 17), and one of a group-spectrum over seven fundamental durations (Ex. 18): it superfluous to translate Ex. 18 into normal note-values.

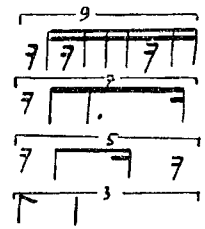


Example 17



Example 18

It is now obvious, as regards the varied serial structuring of the formant-spectra, that not all durations are used all the time in the individual formant-spectra; differences between particular families of spectra are produced by either omitting durations or 'tying' them. Here, successive series of sub-harmonic intervals can arise; since these can be reduced neither to whole-number relationships nor to any perceptible smallest unit, they make listeners feel the formant-rhythm to be 'irrational'. This means that, in any formant, one can do away with periodicity, and thus with the 'harmonic' effect of the whole formant-spectrum; one composes the time-counterpart of 'noise'.



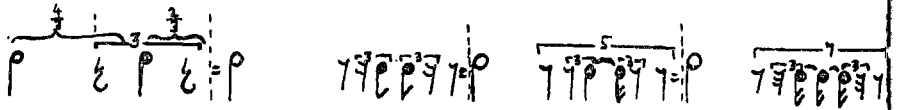
Example 19

This enquiry started by developing the idea of a new morphology of musical time. On this basis, we tried to see how far it is possible to reconcile accepted methods of structuring time, in the sphere of durations, with methods used in the serial composition of pitches. We came up against a contradiction between pitch- and duration-composition. A second fundamental contradiction appears, between material and method, i.e. (ultimately) between instrumental music and serial music. To surmount this second contradiction, we have attempted to bring the method of duration-composition to a state commensurate with that of pitch-composition. Here we had to take into account the conditions imposed by nature on the representation of time by instrumentalists. The result was the idea of manifold simultaneity, whose tempo-strata could in practice be represented by orchestral groups under separate conductors, or by smaller, independent instrumental groups. There remains the question: how does the composer of serial instrumental music stand with regard to the second unresolvable contradiction – will he return to 'tonal' composition? Or will he accept the contradiction, and take just this dialectical relationship as his point of departure, since it often seems more fruitful to work from a contradiction than from the definition that 'two times two make four'? Or will he completely renounce instrumental music, and compose only electronic music? Or will he seek a completely different path in composing for instruments, through a conception of musical time that is absolutely new? The last seems the most likely candidate for the mainstream.

Up to now, serial composition has presupposed regular scales of time-magnitudes (phases of musical micro- and macro-time as pitches and durations). All differences in magnitude were defined by a constant unit-interval (arithmetical or logarithmic). A series defined the proportional relationships between the magnitudes, so that every individual magnitude had to be exactly measured, and fixed by a discrete value in each dimension (one pitch, one duration, one loudness). Thus, time and intensity were

presented discontinuously. Each time-value was either a counting-value or a multiple of a smallest time-quantum, and each time-relationship could be represented by two *discrete values* (e.g., 2:3). As regards the notation and measurement of individual magnitudes, however, this was quantitative only in the case of durations (e.g., ♩, ♪, since for pitch one simply named a degree of a given scale, and for the description of micro-time, phase spectra, one simply named an instrument.

In some recent scores, the notation of duration-relationships has become extremely differentiated. The result has been that, with an increase of metric-rhythmic complexity, the degree of precision in playing correspondingly decreased. To put it differently, the more complicated the way in which a time-value was indicated, the less sure the performer was about when it should begin and end. A simple example will explain this. Not only can various time-values be expressed variously, but one and the same value can be notated in quite different ways, since it can be related to any of a number of smallest time-quanta. If one defines 𝅝 = 30 as the metronomic unit, the relationship of 4/3:2/3″ can be notated in triplets, quintuplets, septuplets, etc., simply by writing the beginning and end of the second value in various ways.



Example 20

In an attempt to play each of these examples as exactly as possible, the first will come closest to the proportion 4:2, and the last will show the greatest deviation from it, compared with mechanically-measured time. If one enquires more minutely into such *factors of dubiety*, one can ascertain the different sizes of the zones in which the accuracy of performance is subject to such 'scatter'. These zones may be described as *time-fields*, and the sizes of the zones as *field-sizes*. Thus, from the mere relationship between various methods of notation and the resulting degrees of precision in performance, there arises a fluctuation in one's conception of time, a fluctuation that cannot be described simply in terms of discrete values. For the moment, the main point about our example is that one and the same time-proportion fluctuates to a varying degree, and, furthermore, that the factors of dubiety depend progressively on the method of notation.

How can one determine such field-sizes more closely? It cannot simply be said that an increasing complexity of notation effects a corresponding increase in the size of the field. The best thing to do is to have several good instrumentalists play – each one as often as possible at various times – a sequence of equal and unequal time-proportions, notated with varying degrees of complexity. The results are recorded on tape. One then makes a note of the deviations between the time-proportions as notated and as played, and measures the order of magnitude of each deviation. One does in fact obtain a more or less typical scale of deviation for each instrumentalist, and these scales can be compared with the scale of degrees of complexity in the notation; but, among the various instrumentalists' scales, there also appear common factors in the relationship between field-sizes and the different ways of notating durations. It is best to pursue such researches, however, with tape-recordings of compositions that already include such

field-proportions. For one thing, the player no longer feels that he is a guinea-pig, under artificial conditions; and for another, the musical context, which is of the greatest importance for field-proportions, can be taken into account in determining the size of the fields – one and the same degree of notational complexity can produce different field-sizes, according to the context in which, and the frequency with which, different or similar fields follow each other or are superposed. The more experience a composer has accumulated from such research, the clearer his composition of time-fields will be. And it is a secondary question, whether, perhaps, in the course of time, the instrumentalists achieve, in playing such music, a generally higher degree of precision: secondary, because a scale of field-sizes is regulated, not by the absolute sizes of the time-fields, but by the proportions of one time-field to another.

One could now choose a *series of field-sizes*, starting from a field-value scale that would have, in each case, to be defined. This series would be valid for a time-structure, instead of, as hitherto, for single 'pointillist' values. The field-sizes would not be 'incidental' (like the latitude left for 'interpretation' in music up to now), but rather functionally included in the time-composition, and proportioned. This actually occurred at a relatively early stage in the serial composition of time. It does not, however, apply to all compositions that exhibit, at a first glance, a complicated rhythmic texture. Each case would have to be examined to see if relations of dubiety have in fact been structurally composed, or if they result, as 'chance-criteria,' from the interpretation of a consistently complex notation of time-proportions. Anyway, it is easy to see what idea of time underlies those serial compositions in which the composer has 'simplified' the originally complex notation of time-relationships to make it easier to play.

At first, the relationship between the degree of notational complexity and the exactness of performance appeared unimportant, but after observing it, we have drawn conclusions that are decisive for the further development of instrumental music, and that open up a new path, separate from that of electronic music.

Let us now see what are the further possibilities of presenting field-proportions with the aid of the existing system of metric-rhythmic notation. Phase-relationships are regular as long as the metronomic definition of the fundamental-phase remains constant. When discussing the development of the time-spectrum in the sphere of serial fundamental durations, we have already met the problem of what would happen when several groups of instruments – if possible, separated in space – played simultaneously in different constant tempi. Here there is obviously a relation between the durations of the *tempo-strata* and the definition of the field-proportions; the longer two orchestras play in different tempi, the more probable it is that the time-strata will get out of step, be displaced. Even apart from the fact that such displacements require a corresponding control of field-harmony, field-intensity, field-density, etc., the method of time-composition must aim at regulating such *field-times*. Clearly, the flow of time can no longer be imagined as 'quantified'; displacement can come about gradually and continuously within particular time-fields, and the associated field-sizes can not be thought of as a sort of discrete succession (the time-alterations 'flow', as it were, continuously past an 'acoustical window', like a motion-picture).

If the metronome markings for the relationships of fundamental durations (the *tempo*), are composed *flexibly*, much more complicated field-proportions arise than in the previous example. We have evolved the term formant-spectra for durations; each

single formant is quantified into regular durations, that are related to a fundamental phase. Now, if the single time-quanta of the formants are no longer in a constant relation to each other, but speed up or slow down, moreover in various degrees, then the formant-rhythm becomes more or less diffuse. Different field-sizes result, according to the number of *variable tempi in the formants*, and according to the degree of their alterations, in which the original harmonic phase-relationships can no longer be traced back to a scale of discrete time-quanta. For example: a first duration-formant has a constant tempo, a second is 'as fast as possible', a third speeds up and a fourth slows down, and all are to be played simultaneously; and only the fundamental duration of such a time-spectrum is exactly measured as a single value. Time-structures will result in which one composes simultaneously with both a series of discrete fundamental durations and another series of proportions for the simultaneous field-sizes. Each measured fundamental duration would be associated with a *simultaneous time-field* (e.g. field-size 0 = all formants have constant tempi: 1 = four formants with constant, one with variable tempo: 2 = three formants with constant, two with different variable tempi, etc.).

Combinations of the aforementioned possibilities result automatically if, finally, *successive and simultaneous* proportions of the field-sizes coincide, i.e., when both the fundamental phases and the formant-spectra are composed, and suitably realised, as smaller or larger time-fields in a time-continuum (phase-displacement within defined limits).

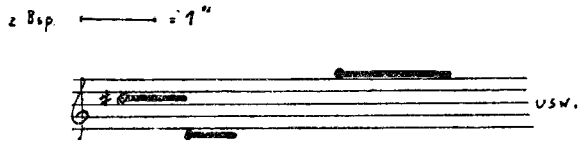
A move toward this sort of time-composition was already recognizable when, in connection with the composition of formant-spectra, we spoke of 'statistical' criteria of form. By this we meant that, with a particular chronometric density of singly-defined phase-relationships, a formant-spectrum would be presented and perceived as a 'complex', i.e., it could no longer be broken down into single proportional connections. We spoke of group-spectra whose fundamental phases were 'perceived irrationally'; of time-complexes that would be heard not as the sum of the single durations (be they simultaneous or successive), but rather through their structure as a whole. The necessary condition was that a certain number or mass of details were crowded into a short time. However, as soon as one can hear through such processes, or follow them slowly enough, they are, and remain, nothing but 'periodic, harmonic, sub-harmonic, tempered-chromatic and other' relationships of regular, individually-defined facts. Here, then, mass-structure is a special case of a unitary structure that is, at bottom, individually determined. 'Complex' time-processes are thus the result of heaping up exactly defined time-'points' more or less densely in time. Mass-structure means, then, merely the momentary opacity of a group.

Such a switch, from 'pointillist' to 'statistical' perception of time has become a further occasion for the *statistical composition of fields*. But this means that the elements themselves are no longer presented as discrete degrees of some scale or other (whether as discrete pitches or durations, i.e., as a measured duration and number of micro-time phases – phase-duration = $\frac{1}{440}''$, and number of phases = 220, giving an a′ lasting $\frac{1}{2}''$). Rather, a field-size, in the sense described above, is substituted for each discrete value (field-duration from $\frac{1}{440}''$ to $\frac{1}{550}''$ – i.e., a possible pitch between a′ and c″,) and fundamental-duration between $\frac{1}{2}''$ and 1″, etc). Such field-sizes are now the 'elements', and composition thus includes the *statistical character of mass-structure among the elements*. A 'pointillistic' time-structure can now be presented, vice versa, as

a special case of mass-structure – the case when field-size equals zero, and each time-process is fixed in the time-continuum by a *point* instead of by a *field*.

Let us again recall the example in which differing field-sizes resulted from degrees of notational complexity. It would be more reasonable to *describe such field-sizes directly*, by choosing a suitable notation. This is possible neither for duration nor for pitch, if one uses the signs used hitherto, because we have only discrete values in discontinuous scales. Actually, to fix any event in time (e.g., the beginning of a duration), one would need not one datum but at least two, to define the limits of a time-field. If, for example, two time-phases follow one another, the point in time where the second begins has hitherto been fixed by the note-value of the first phase (♩ ♩); the first phase could, of course, also be a rest (𝄽 ♩). If the beginning of the second phase had to be defined as a time-field, rather than as a time-point, the duration of the first phase would have to be more or less indefinite, according to the size of the field; one would have to state the limits between which it was indefinite, but this does not mean that the indefinite value would once more have to be made quantitative or countable.

Something else must still be mentioned, before we go into the possibilities of a notation for field-proportions. The composer John Cage, in some of his more recent works, has used time-proportions that are evidently influenced by statistical ideas. Thus, among other things, time-durations are drawn to scale, so that no attempt can be made to quantify them.



z. Bsp. = e.g.

Example 21

Here, the beginning and end of each duration are played with much less certainty than before. Instead of 'counting' – dividing up the durations into quanta – the eye measures the time-proportions, and converts them into the action of playing. Optical size-relationships must be translated into acoustical relationships of durations. Each event in time does indeed receive a field-size that is psychologically determined, but this field-size is the same for all time-proportions, and is thus not proportioned. It has always been customary for interpretation to include zones within which time-values as realised deviate from those notated (in so far as the latter are measured in metronomic or 'clock' time); all Cage has done is to extend these zones slightly. He makes *all* proportions less distinct than ever before (logically enough, he is in fact not at all interested in proportional time-relationships), and the result is a continual disorientation in time, as a result of which the duration of a time-lapse is felt unusually strongly. Instead of the suspension of time-consciousness, perhaps intended, time is bound to one plane, and is therefore equally strongly present at each moment.

However, the concept of field-composition will only become meaningful if one does something more than merely substitute a crude system for a more differentiated one, in the hope of giving the time-structure greater 'vitality'. If, however, a point could be seen to be the shortest line, and a line were thought of as an extended point, and if this

could be communicated to the performer – i.e., if a series of field-sizes served to present a time-structure in which the composed fields mediated between the pointillist and statistical extremes –, then we should really be dealing with a new musical time-continuum: time as a discontinuum – and time as a continuum would then merge in a supra-ordered concept of serial *field-time*.

What are the possibilities of *notating field-sizes* in the sphere of durations? Like all the reflections described, those that follow have been triggered off by 'purely coincidental' processes in earlier compositions. One wrote something or other, and was then startled by the way certain things hung together. Differentiated field-sizes had, in fact, already been presented, even with the normal signs for notation.

There was the small note, for one, written independently of the other, measured time-values – the 'grace-note'. If its tempo was 'as fast as possible', and if it were not only single but came in groups of various sizes, either before, over or after a measured time-duration, then these groups of grace-notes would take over the function of a second time-stratum 'fading in' to the measured durations. Here, each individual grace-note in the group received its own field-value in time, determined in the following way: the pitches of a group were distributed on the piano in such a way that the player's hand had to make movements of very different magnitudes over the keyboard. The larger the pitch-interval, the larger the time-interval from note to note, for everything was to be played 'as fast as possible'. Besides this, the instructions mentioned the fact that each note should be distinctly recognizable in pitch, thus automatically making the lower notes somewhat longer than the higher ones. Thus, instead of notating all the various durations, one used performing indications of a quite different kind, in order to produce a proportional series of field-sizes within the groups of grace-notes. The size-relationships of such a series depend, of course, on the time it takes for respective performers to react, and also on the instrument, and on space (the more resonant the room, the more slowly the grace-notes must be played, if they are not to become indistinct); but just because of this, the composed proportions continue to exist. Again, this example is a special case for series of relatively short field-durations.

The search continues from here. The decisive factors in determining field-sizes were as follows: the duration of each grace-note can vary within certain limits; their duration is not quantified; their proportions must be directly experienced through the degree to which they fluctuate, rather than being compared with a beat (counting-measure) that is either actually available or read into the flow of time. The limits of the field are set by the movement of the pianist's arm from a low to a high register, which take a variable amount of time; i.e., by action-durations. And for each note, or small group of notes in a larger group, such an action-duration is different. So, in order to obtain field-proportions of a larger order, more time would have to be taken by the action of preparing the sound that was to be played. A series of field-sizes would correspond to a series of actions taking various lengths of time. This would depend, for example, on the number of *preparations*, etc.

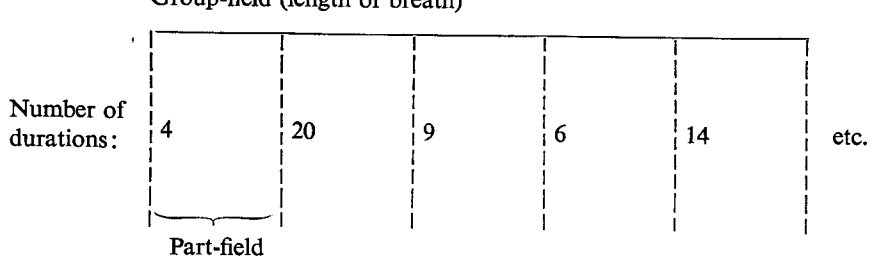
But what, then, are *rests*? The field-size of a rest would result from the fact that it is in the nature of a struck note to stop sounding, while the preparation of the next sound takes more time. Such preparation can be either mental (where the musical notation is more or less esoteric), or practical (as when movements are necessary in the course of the various preparations of resonating bodies, mechanical 'registrations', etc.).

Such proportioning of larger field-values can already be seen in some serial scores – not to mention Cage, in whose compositions there appear many such procedures, which are, however, 'exposed' rather than composed, and are left to chance. We find them in places where, besides the durations that are notated normally, there are single unmeasured durations, that have particular instructions about the mode of attack. Sometimes the preparation and execution of such an attack takes a relatively long time (e.g., 'engage the right-hand pedal, attack the note staccato and immediately allow the pedal to spring just so far back that the note goes on sounding softly as an echo'). Depending on the pitch of the note and the intensity of attack, there is considerable room for the composer to differentiate still further the field-sizes of such modes of attack. Other modes of attack again give quite different field-sizes, and one can merge a second, third, fourth, etc., series of field-sizes in the time-structure, which is already doubly determined: 1, by metronomically measured durations; 2, by first-order field-sizes, applying to grace-notes; 3, by a second (and further) order of field-sizes applying to the modes of attack, etc.

In any work, we can arrive quite naturally at a large number of different series of field-proportions, if we observe the requirements of the available instruments, and of their technique, from such a point of view.

The concept of a group has cropped up again in the example of grace-notes and modes of attack. A particular number of single field-sizes gives a *group-field*. Here the size of the group-fields depends on the number and size of the single fields. Similarly, it is possible to start from group-fields of various sizes, and from these to arrive at the magnitude-proportions of the single fields. Let us again give an example of this. We take as our point of departure the fact that a woodwind player can not play as long as he likes with one breath. If we ignore physiological factors, the duration of a breath depends on the register, density and loudness of the notes to be played. The lower and louder the notes, and the fewer sustained notes there are to play, the shorter the duration of the breath is. When the tempo indication 'as slow as possible' is given, this means that a group of single durations must be distributed over as long a total duration as possible, depending on the duration of the breath. The length of the breath would determine the group-field; but the different magnitude-proportions of such group-fields would result from the way the register, density and intensity of the groups were composed. And the proportions of the single durations in the groups could either be relatively measured, or could again be determined in detail as field-sizes. But if here the detailed field-proportions depend on the field-size of the group, then they can no longer simply be given by the action-durations. The different field-sizes would have to result, rather, from a completely different notation of durations. By selecting the size of a group-field of blown notes, one has fixed, as we said, the number of durations in the group. Now the group-field can be split up into a number of *part-fields*. To take the simplest case, the part-fields can be of equal length. Further, the number of durations must be determined for each part-field, and these durations can be accommodated with relative freedom in such a part-field (for example, with the restriction that no periodicity may occur). The fewer durations per part-field, the more possible it is for the player to distribute the durations in various ways; the more durations per part-field, the narrower the scatter of the field-size of each single duration.

Thus the single durations are not notated at all, only the number of durations to be



Example 22

distributed over each part-field. If one desires, generally, to keep the field-proportions very small, one chooses many short part-fields; but if the field-proportions are to increase in size, one chooses fewer part-fields. If the number of part-fields is also determined statistically, the process would run something like this: 3-5 (in the first part-field); 15-20 (in the second), etc. Either the size of the part-fields is constant and the number variable, or vice versa, or both can be variable.

Finally, a longer time-structure, and even the total *overall structure* of a piece, can be composed in *field-proportions*, when a correspondence is sought between the individual time-structures and the whole. Again, let us give an example of this. It is best to describe the formal concept. A particular number of note-groups have, at first, no fixed total durations, intensity-curves or modes of attack for each group; these group-properties are, rather, to be variable within chosen limits, and the field-sizes of a group are to result from the last group preceding that to be played. Consequently, the structure of the piece is not presented as a sequence of development in time, but rather as a *directionless time-field*, in which the individual groups also have no particular direction in time (as to which follows which). Thus all groups are composed simultaneously, each beginning of a group being a possible continuation of each end of a group. Within a group, several series of field-proportions (using very varied indications) fix the relative time-proportions, and thus also the number aad succession of pitches (individual durations and pitches are *not* interchangeable, but have 'direction'). But no tempo is prescribed for the durations measured in note-values (some of which are normally notated), nor is the intensity-curve or the mode of attack given. Only *after* each group come the instructions how the following group – any one of the others – is to be played: for example, 'from ♩ = ca. 40 get faster and then slow down again'; 'make a diminuendo from *mf*'; 'r.h. *legato*, l.h. *staccato*' (or any other indication). Then the groups are irregularly distributed on a piece of paper of a particular size, and the general instructions are: 'play any group, selected *at random*, quite freely as the first, then, equally at random, look the paper over and play the group next seen, but observing the directions given at the end of the group played first, etc. When any group is seen for the third time, the piece is over'. As it is probable that several groups will be played twice, the pitch-structure of some groups is, in parts, notated twice; when a group is played for the second time, some single notes drop out, others are interchanged (the ones in brackets), whole groups are shifted one or more octaves (by ignoring octave signs), etc. The field-structure of a large form like this will become clearer, naturally, if it can be

compared with that of other pieces in a cycle, or, above all, when it is played several times in succession.

Other concepts combine structures that 'flow' and time-structures that are undirected. Thus, one can now imagine not only the synchronisation of simultaneous *proper times* – i.e., time as an organism of spatially graduated strata – but also a serialisation of successive proper times – i.e., time as a developed unfolding, *and* as a statistical, undirected condition of continuous time-fields. (Here, 'simultaneous' and 'successive', are useful analogies with spatial presentation, and, as such, may be exchanged or identified at will; what is really meant here is the difference between 'present' and 'absent'.)

Thus it is possible for the musician to establish, between *time-quanta* as measured and *field-time* as experienced, a connection whose closeness will vary; by means of variously graded field-proportions, he will mediate between the two principles, those of indicating the duration of sounds and the actions to be carried out in order to produce them.

Degrees of freedom for the instrumentalist are apparently linked with field-composition. It might be thought that, with fields of varying size, the composer had left the instrumentalist a share of 'improvisation' – doses of various potency. If one examines this more closely an unmeasured time-field is no occasion freely to invent something in addition to the composed structure.

It is rather that rationally guided measurement of time – counting – is reinforced by a spontaneously reacting utterance of time – agitation of time. Whereas up to now the action of playing (and of hearing) had to orientate itself to time-relationships that were measured in durations, there are now, to some extent, cases in which time-proportions arise *only* through actions. In other words: up till now, one could see from the score the time-relationships composed in a piece of music, quite independently of its realisation in sound, and the 'rightness' of a realisation in sound could be checked against the time-notation in the score; but in a field-composition, the parts of the score in which actions are notated give no information at all about the measurement of time-proportions – the latter come into existence only at the moment when they are realised in sound, when they are played. In this case, the 'rightness' of a realisation is checked against itself; tested, that is, in order to find out whether the action-times in the moment of playing stand in an organic relationship to the sound-times to be produced. Of what, then, would the degree of freedom of an instrumentalist in a field consist? When, for example, he must play grace-notes 'as fast as possible', and pay attention to the fact that all notes in all registers must be distinctly recognisable as pitches, then he must decide – according to his musical feeling – what he considers to be 'sufficiently distinct'; and this depends, as we have said, on many factors. The same applies to the notation of attacks, preparations and to the precept 'if possible, only aperiodic time-relationships to be played in the part-fields', etc. Finally, there is the injunction to 'look the sheet of music over at random and play the group next seen'.

Whether one leaves the instrumentalist to use his musical judgment to decide that a certain sound has lasted exactly the right amount of time, and that the next must now sound; whether one attaches a certain degree of freedom to this 'weighing' instead of 'counting' of durations, is of no consequence. One might just as well say that, in his actions, the musician answers the 'proper time' of the sound, and, instead of mechanically quantifying durations that conflict with the regularity of metronomic time, he now

measures 'sensory quanta'; he feels, discovers the time of the sounds; he lets them take 'their' time.

That is obviously what is meant by 'freedom'. For how is it that the instrumentalists who have played the first compositions of this kind feel much freer than hitherto, although they are more engaged?

It can be a profitable working method for a composer to select a *series of degrees of freedom* for a work. The act of composition itself moves in 'action-fields' of various sizes. The popular conception of one person's working 'freely', and another's working 'more strictly', and a third 'schematically', springs really from a time when freedom itself was schematized. Thus there were 'free' and 'strict' forms, 'free' and 'strict' interpretations, etc. If a composer experiences musical time as multi-dimensional time, his composition has itself become multi-dimensional; for him measured and perceived proportions, time-fields and -quantities, systematic and 'chance' determinations, are extremes, between which there are many stages. Thus, in a work, one can successively compose part-structures, in which one can freely choose from a larger or smaller number of possible configurations. Such *fields of choice* – of any proportions – can mediate between totally predeterminate and indeterminate structures. Choice itself, distributing the weight in various ways, combines rational measuring with weighing according to perception. A proportion-series of fields of choice would then be peculiar to one work. How could it happen that a musical conception of time at last exists, if it did not spring from the act of composition itself?

At the outset of this investigation we outlined a morphology of time, and in view of this, one could apply to the sphere of pitch all the foregoing reflections about field-composition in the sphere of durations. But it seems superfluous to treat each detail all over again, and to introduce, instead of the field-definition of duration, the *field-definition of pitch*. However, certain consequences should be specially mentioned.

As soon as a pitch is thought of as a field-size, rather than as a discrete magnitude, no instruments with fixed scales can be used (these would include the piano), but only instruments on which *pitch* can be presented *continuously*. A discrete pitch would then, like a measured duration, be the special case in which field-size was zero. Here again, there are the two possibilities: to arrive at the group from the individual field-sizes, or to arrive at the individual pitches from the group-field. Either an interval in pitch results from a prescribed action – e.g., the size of a movement over the keyboard, and here the spatial spread of the keyboard could be built in various sizes – or the graphic notation marks pitch-fields with more or less exactly defined ambit, and indicates the group-number of pitches per part-field. Here again, fields of individual pitches result from the relationship of number and ambit in a part-field (see Ex. 22). The direction in pitch of a group of notes can be either indeterminate or indicated by a directional diagram (rising, falling, combined).

Not every pitch, however, is simply a periodic sequence of equal fundamental phases. This would mean once more that the fundamental tones are treated not as measured discrete sizes in a scale, but as fields of fundamental tones; that, however, the fundamental tone, once reached, would automatically be constant in pitch – i.e., a group-sequence of equally-long fundamental phases. Here, the individual fundamental duration (in micro-time) would be a field-size, but one fundamental phase in a group would be exactly the same as another. It would then be an exception, in

field-composition, for pitch to remain constant in the course of a duration. That would only be the case where no field-proportions came into play in a phase-group, but where all the phases were equally long, and no room was available for phase-displacement. What follows from all this?

A new instrument would have to be built, on which, for example, different pressures on a continuous band produce oscillations with phases that are more or less constant. The location of the pressure determines the pitch. If one presses only very lightly, the oscillation keeps a constant phase – the pitch remains the same. The heavier the pressure, the more irregular become the phase-relationships and the more indeterminate the pitch. This means, in fact, that this kind of continuous *phase-modulation* gradually transforms a *tone* into a *noise*. The strength of the pressure then corresponds to the spectral width (the field-size) of the noise. Maximum pressure finally obliterates any perception of pitch, and 'white noise' is produced. Minimum pressure produces a 'pure tone'. This would make possible field-regulation of fundamental phases.

Just as in field-composition with the formant-spectra of macro-time durations, we require field-sizes for simultaneous micro-time phase-relationships. Thus it must be possible to alter the register and number of the formants in a time-spectrum continuously, and therewith the formant-rhythm ('tone-colour') of a fundamental tone. Thus the minimum pressure on the band not only produces a 'pure' oscillation with a constant phase-length, but also a *continuum of 'tone-colour'* on the same tone. This is easy to imagine. The secondary oscillations would be added to the fundamental oscillation by pressing near the front or near the back (of the continuous band-keyboard), and when the sounds have several formants, these are controlled by the number and distance apart of fingers exerting pressure simultaneously. These secondary oscillations, too, would vary in the constancy of the phase-lengths, according to the amount of pressure exerted by the individual fingers. Lastly, the intensity of the oscillations could be continuously altered by the use of a pedal.

Such an ideal instrument would meet all the requirements for continuous alteration of time-proportions: for fundamental macro-time phases (durations), by the duration of the action; for fundamental micro-time phases (pitches), by the location on the continuous band-keyboard; for micro-time phase-relationships (the transition from 'tone' to 'noise'), by the amount of pressure on the band; for micro-time formant-rhythm ('tone-colour'), by the location of the pressure-point, and the number and distance apart of several pressure-points across the keyboard; for the amplitude of the oscillation (loudness) by pressure on the pedal. Formant-spectra of durations (superposition of various processes in time and in sound) would be achieved by several of such instruments playing together.

The builder of instruments can not be expected to have any idea of what sort of instrument the musician needs; the musician must tell him. It is impossible to say how long we shall have to wait; but one may expect that some day such an instrument will exist.

For it does not seem very fruitful to founder on a contradiction between, on the one hand, a material that has become useless – instruments that have become useless – and, on the other, our compositional conception. Some prefer to reconcile their craft with a new musical time-concept, rather than tilt at windmills, or devote all their efforts to building on a compromise. They need fear no rules, then, nor prohibitions, no system,

no theory, no constraint, for they inhabit this time-order, and their music gives answer to the nature of sound, if it reveals itself to them; if they realise . . .

(The article . . . *How time passes* . . . was written in September and October 1956, and refers particularly to the compositions *Zeitmasse* (*Time-measures*), *Gruppen für drei Orchester* (*Groups for three orchestras*) and *Klavierstück XI*).

TO DESCRIBE THE PROCESS OF COMPOSITION USED IN 'MUSIC FOR PIANO 21-52'

JOHN CAGE

1. Given ink, pen, and sheets of transparent paper of determined dimensions, a master-page (without notations) is made, having four total systems. 'Total' here means having enough space above and below each staff to permit either being bass or treble. Thus, there being the conventional two staves (one for each hand), each has enough space above it to accommodate 9 ledger lines (as equidistant as those of the staves) and below it to accommodate 6 ledger lines plus (leaving room for the extreme low piano key and string). Between the two there is a narrow space, bisected by a line, allowing for the notation of noises produced by hand or beater upon the interior (above the line) or exterior (below the line) piano construction. Measurements are such that the entire sheet (within margins) is potentially useful.

2. Laying the master-page aside, chance operations channelled within certain limits (1–128 for *21–36*; 1–32 for *37–52*) which are established in relation to relative difficulty of performance) – derived from the *I-Ching*[1] are employed to determine the number of sounds per page.

3. A blank sheet of transparent paper is then placed so that its pointal imperfections may readily be observed. That number of imperfections is intensified with pencil corresponding to the determined number of sounds.

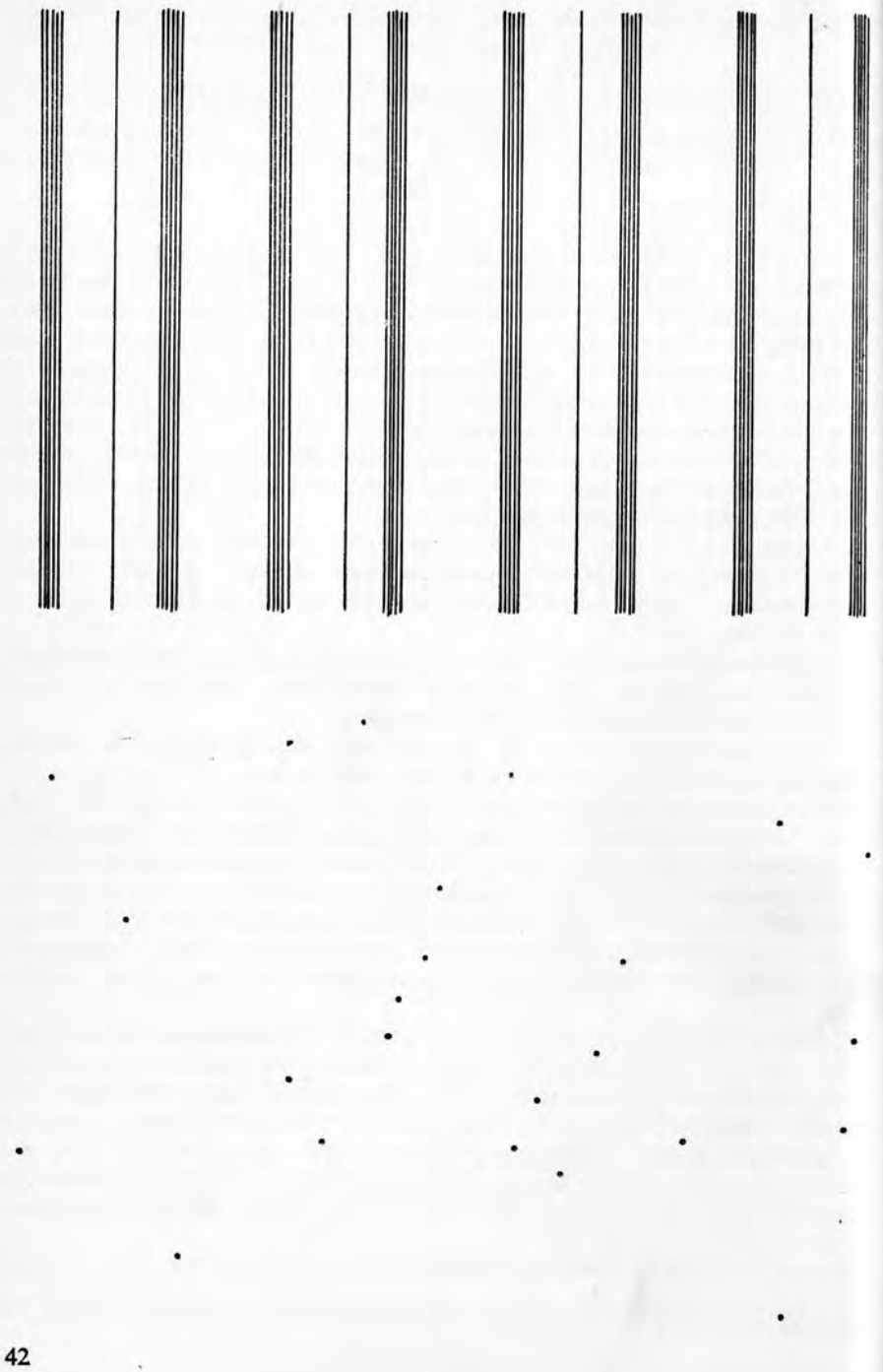
4. Placing the pencilled sheet in a registered way upon the master-page, first the staves and inter-line and then the ledger lines where necessary are inscribed in ink. Secondly, conventional whole notes are written in ink wherever a pencilled point falls within the area of staves or ledger lines, inked-in notes (crotchets without stems) being written wherever such a point falls within the space between the two staves. This operation is done roughly, since, through the use of conventional lines and spaces, points falling in the latter are in the majority. Thus it is determined that a point, though not on a line, is actually more nearly so than it is at the centre of the adjacent space.

5. Eight single coin tosses are made determining the clefs, bass or treble, and inscribed in ink.

6. The 64 possibilities of the *I-Ching* are divided by chance operations into three groups relative to three categories: normal (played on the keyboard); muted; and plucked (the two latter played on the strings). For example, having tossed numbers 6 and 44, a number 1 through 5 will produce a normal; 6 though 43 a muted; 44 through 64 a plucked piano tone. A certain weight of probability exists in favour of the second and third categories. Though this has not appeared to be of consequence, it indicates a possible change in 'technique'. The categories having been determined, notations (M and P) are conveniently placed in reference to the notes.

A similar procedure is followed to determine whether a tone is natural, sharp, or flat,

[1] The *I-Ching*, an ancient Chinese book, has been translated into German by Richard Wilhelm (into English by Cary F. Baynes) accompanied by an introduction written by C. G. Jung.



the procedure being altered, of course, for the two extreme keys where only two possibilities exist.

7. The notation of the composition is thus completed. Much that occurs in performance has not been determined. Therefore, the following note is fixed at the head of the manuscript: 'These pieces constitute two groups of 16 pieces (*21–36*; *37–52*) which may be played alone or together and with or without *Music for Piano 4–19*.[2] Their length in time is free; there may or may not be silence between them; they may be overlapped. Given a programmed time-length, the pianists may make a calculation such that their concert will fill it. Duration of individual tones and dynamics are free.'

[2] The composition of these pieces followed a different procedure and, furthermore, did not include interior and exterior construction noises.

COMMENTARY

A performance is characterized by the programmed time-length calculated beforehand and adhered to through the use of a stop-watch. This is primarily of use in relation to an entire page, secondarily of use in relation, say, to a system; for it is possible that, though the space of the page is here equal to time, the performance being realized by a human being rather than a machine, such space may be interpreted as moving, not only constantly, but faster or slower. Thus, finally, nothing has been determined by the notation as far as performance-time is concerned. And, as concerns timbre (the noises, the three categories) next to nothing has been determined. This is especially the case where P is interpreted as meaning a plucked *muted* string or M a muted *plucked* string. Nor, indeed, have the points on the strings where these latter operations are to be made been indicated. And, and this may be considered a fundamental omission, nothing has been indicated regarding the architecture of the room in which the music is to be played and the placement (customarily distant one from another) of the instruments (how many?) therein. All these elements, evidently of paramount importance, point the question: What has been composed?

OUTLINE OF A METHOD

HENRI POUSSEUR

1. *Introduction*

Composers' explanations of their craftsmanship are like statements made in confidence. At the same time they are something more: comparisons between methods are designed to test their general validity. This is the only way in which craftsmanship can develop further. The aim of such statements is not only to make public the composer's few private observations, and to bring to light his methods; the aim is rather to pass on, for the consideration of anyone competent, his own conceptions and modes of procedure, in order to stimulate fruitful and constructive criticism, and to gain from this exchange of opinion the maximum intellectual benefit for himself.

A composer may seek to become clear in his own mind about his way of working, or he may be showing others the way, but in either case, a definition – a very exact definition – of his main directions and lines of force seems indispensable. Intuitive insight is indeed possible; or he can work purely empirically. But in the first half of this century there were all too many composers who started with every advantage, and never made good their early promise; theoretical reflection was not exactly at a premium then. Theory, as we now understand the term, was hardly practised at that time; this kind of theory is dynamic and dialectical, prepared for all the new efforts demanded by craftsmanship. It is not a collection of recipes, but a means of investigation, that is immediately called in question as soon as it shows itself incapable of assimilating new and concrete experiences. Theory is the ambiguous field where there is no longer anything completely inexplicable, and yet nothing can be unfailingly 'seen through'. Its main task is not to describe the achievements of the past, nor to offer formulae to examination candidates. It is based, rather, upon unerring trust in a structural solidarity that exists between the world and our intellectual tools. Thus its primary function is prospective, heuristic. It absorbs experiences, in order to transform them into living tissue; it constantly accepts new wagers, never ceases to venture into new 'daydreams', and recognises that it can only make progress through a dialectical relationship to its objects.

This theoretical attitude is comparable to the one that Gaston Bachelard, in connection with the new scientific state of mind, has called 'super-rationalism'. This new sort of reason remains conscious of the danger to which theory is exposed in its constant contact with reality; the danger of being exploded. It is aware of its constant imperfection, and of the fundamental truth that problems are best solved by accepting them in their full complexity, not by avoiding them. So, in the following outline, theoretical perspectives and aesthetic horizons will first be defined. In connection with this, we shall consider special questions aimed at the specialist techniques of composition.

Nowadays, we find that the ultimate criterion for all musical thinking is perception – the fact that we can experience a structure in sound. If a theory claims that its predicates

re correct, it must correspond as exactly as possible to the truth of direct consciousness. Our efforts must unquestionably be directed toward a phenomenological theory. Since composition aims at nothing less than the exhaustive 'information' of our perceptive faculties, theory will act as a means of investigation, that will help musicians to recognise the necessary conditions for information.

Here there is valuable help to be gained from the work of Gestalt psychologists. In fact the latter scientific doctrine has taught us that perception is not a chaos of amorphous impressions, needing an act of the intellect to give them form and significance. Our sensibility, our concrete consciousness of the world, is innervated by laws which serve as organising forces, ensuring 'rightness', the unconditional and immediate coincidence of our sensibilities and the objects they perceive. These laws result directly from our physical nature, from our constructive adaptation to the world, from the basic, irreducible fact of our taking part in a network of relationships that is unalterable and already given. These relationships are as independent of our will as of our habits, our education, our culture. They are always there already, prior to any exertion of intellectual, volitional organisation, which they in fact alone make possible; only because these laws exist can we adopt habits, can there be such a thing as education, in fact our entire culture. They alone make meaning possible – make it, above all, *comprehensible*, communicable.

It has been established that, because of the laws of acoustical perception, musical structures are not apperceived as a mere aggregate of transitory elements, but make up a meaningful pattern, accessible to the consciousness of anyone suitably disposed.[1]

But here we are already faced with a serious objection, one that has been formulated with especial authority by the aesthetician Boris de Schloezer.[2]

If the meaning of a structure depends in a real sense on objective psychological factors, then how does it come about that musical structures are meaningful to certain hearers, while to others they are incomprehensible? Why, for instance, is a clearly comprehensible phrase of Schönberg's not accessible to everybody at a first hearing? Why did even Berlioz call the opening of the Prelude to *Tristan* an absurd succession of sounds? Does this not prove de Schloezer's thesis that musical meaning results from reconstruction, from a more or less laborious intellectual synthesis, of which, since it requires a special training, not everyone is immediately capable? Does this not contradict the part of Gestalt theory that proves the immediacy of Gestalt organisation – thus disproving Gestalt theory as a whole? We shall see that Gestalt theory had itself disarmed this objection before it was ever expressed.

For Gestalt theory teaches that our 'perceptual field' is already 'informed' by earlier experiences. In musical terms this means that, at all times, our conception of music is predetermined by that with which we are already familiar. Each new acoustical structure, by force of habit, is altered, twisted to make it resemble what we knew before, and this happens all the more when the prevailing system is highly self-sufficient and balanced. Tonal music is undeniably one of the most homogeneous musical systems.

[1] K. Koffka, *Principles of Gestalt Psychology*, Kegan Paul (London), Harcourt (New York), 1935.
W. Köhler, *Gestalt Psychology*, Bell (London), Liveright (New York), 1929.
W. D. Ellis (editor) *Source Book of Gestalt Psychology*, Routledge and Kegan Paul (London), Humanities Press (New York), 1938; particularly the contributions by K. Gottschaldt (*Gestalt Factors and Repetition*), and M. Wertheimer (*The General Theoretical Situation* and *Laws of Organisation in Perceptual Forms*). These are abstracts of papers originally printed in full in German scientific periodicals. The book also contains other articles by Köhler and an introduction by Koffka.

[2] Introduction à J. S. Bach (Essai d'Esthétique Musicale). Gallimard (Paris), chapters, I, §8, and III, § 5.

This inner cohesion it owes to the circumstance that it holds fast to the simplest and most symmetrical types of articulation. This is why the professional musicians who have reacted most violently against the new music have been those with the exactest knowledge of the old academic rules. The pedagogy of new musical idioms, unknown modes of expression, must therefore be dominated by the need to clear the ground, to reject, to make contact with people's consciousness. And it will be found that in this respect the most fruitful hints are purely negative ones – hints as to what the listener must not expect, types of recollection that he must exclude. This encourages a new organisation, puts the existing one in parenthesis, and renders it harmless. One does not work at the gradual comprehension of a piece, and perform an act of will that synthesises one's 'sensory impressions'; there is a sudden revolution within one's perceptual organisation, an abrupt illumination of one's consciousness. The understanding of a single phrase, of a single stylistic element in Schönberg, immediately makes all his works accessible (with the exception, indeed, of those containing stylistic elements that are foreign to the types of articulation that we have now grasped). But perhaps Schönberg is not the most fortunate example to choose. Schönberg's music, because of its transitional position in musical history, is the perfect model of a semantically ambiguous, uncertain, partly contradictory structure. With or without wishing to, Schönberg calls unceasingly on traditional organising energies, constantly refers back to the types of meaning that he wished to abolish, and these relationships are forever coming between the hearer and the structures the composer originally aimed at. It is from this typically expressionistic tension between two mutually exclusive semantic regions that twelve-tone music derives its special, characteristically grating power. And it is also remarkable that Webern's music, which completely shuts out the traditional region, and organises itself about a single and new 'etymon', a single relational axiom, often strikes unsuspecting listeners as accordingly less 'dissonant', less 'out of tune' than Schönberg's – 'not so ugly'. These listeners may not immediately appreciate it as 'music', as positively 'beautiful', since these expressions they reserve exclusively for experiences acquired in their habitual semantic field; but at least they allow that Webern's music has an undeniable, if bizarre, freshness, a logic within its own strangeness, a perceptible coherence. In a certain sense they have got the point.

For Schönberg never found a way to overcome the dichotomy of the principles of classical theory, which had been only partly liquidated, and his new concepts of order (I have demonstrated this at length in an article 'From Schönberg to Webern; a mutation'[3]); the solution was reserved for Webern, who realised the need for a radically new rule of law – for the exclusion of everything that could have prevented his making real the project of integral non-tonality. This is true of even his early works, the *Songs* Op. 3 and 4, above all the *Five Pieces for String Quartet*, Op. 5. He alone, throughout his whole creative career, remained faithful to this realisation, with wonderful clearness of sight, without regard for the isolation into which it forced him. Webern's chromaticism can from now on prevent any collapse of the relational system, any polar convergence.[4] In this connection we have singled out multi-polar equilibrium as the resource actually employed in a necessary act of liberation, a creative choice that had not existed before. Proceeding from this first, specifically harmonic innovation, we can

[3] In Italian; *Incontri Musicali*, Nr. 1, Milan, 1956.

[4] Cf. H. Pousseur, 'Webern's Organic Chromaticism'; *Die Reihe*, Vol. II. Theodore Presser Company, Bryn Mawr, and Universal Edition, London, 1958.

show that the same semantic endeavour is present in all the dimensions, and with regard to every way of articulating musical events. Many factors are involved; aperiodicity of chronometric articulation – with regard both to major structural sequences and to 'bars', even to a basic beat; abolition of any polyphonic-linear web of parts; constant variation of vertical density; constant transformation of instrumental colours; finally, ever new articulation of the macro-structures. Each of these factors, in itself, means the destruction of a particular 'strong' form, that had simply imposed itself upon our consciousness as a relational system for this or that dimension, considerably reducing the wealth of sound material, and ultimately making the latter appear as the accidental result of a static, purely ideal basic order. Webern lavished particular care on this abolition of concrete schemes and binding regularity (here, apparently, is the real reason for his quantitative economy, the briefness of most of his 'processes'); we must regard this abolition as the reason why to many listeners his works appear, on a first hearing, devoid of all musical sense. But precisely where Webern is negative, he opens up new horizons. The perceptual type to which this music appeals is no longer the understanding of an abstract form, heard 'through' the material and standing in transcendent relationship to its actual incarnation – a quasi-eternal archetype; one must attentively grasp, in its particularity, every single moment of 'here and now'; one has the wonderful experience of feeling time shoot forward – the field of consciousness constantly renews itself; phenomenal reality is constantly regenerated; one enters a world that is held firmly open, imperfect until further notice, constantly breaking-up.

Such a project presents to the composer a technical problem which can be conceived as the problem of ceaselessly awakening sensory energies, as the problem of complete unpredictability. But, as Boulez remarked several years ago,[5] and as Stockhausen has recently demonstrated anew,[6] the solution to this problem of unpredictability can not be separated from the specific consideration of structural necessities. Seen from a higher level, a succession of abrupt alterations would in fact have the appearance of a new predictability, a particularly boring succession of repetitions. As we shall show, unpredictability over long stretches of time is a project that can only be realised by constant checking and renewal of the degree of predictability, applied to the subordinate structural indices. If one can speak of a multi-polar structural model in Webern's harmony, it is only because the composer did not abolish the subordinating effectiveness of the natural intervals, but rather discovered a means of exploiting this effectiveness in the highly original way we have just described. Webern not only sensed the possibilities of generalising the serial system, he undertook to apply them (in a thoroughly positive way, that is to say in the varying strata of musical shapes[7]); and the serial system is nothing but a theoretical tool, that can be adjusted to a multiplicity of factors, and to forms that are often unexpected, at the same time taking into account the problem of surprise.

This is the perspective in which present-day musical theory is growing to maturity, in which it tries to shoulder the formidable problems bequeathed by Webern; this is the

[5] 'Eventuellement'; special number of *Revue Musicale*, 1952 (Paris), devoted to 20th Century music.

[6] 'Structure and Experiential Time'; *Die Reihe*, Vol. II.

[7] *Trans. Note:* As, in this article, the author uses Gestalt theory only as a means of elucidation, without attempting to apply it strictly to music, we have thought it best to translate the German '*Gestalt*' by 'shape'. Nevertheless, the following double quotation may be of interest in showing the direction of the author's thought: 'A Gestalt . . .''a concrete individual and characteristic entity, existing as something detached, and having a shape or form as one of its attributes'' . . . is therefore a product of organisation, organisation the process that leads to a Gestalt' (Koffka *op. cit.*, 1935, p. 682, quoting from Köhler, *op. cit.*, 1929, p. 192, English editions in each case).

direction in which certain musicians are today developing their methods of composition and their craftsmanship. It appeared wholly appropriate to speak first of the aesthetic bases and the historical origins of craftsmanship. The world intended by the artist can never be approximated to nature in the raw; rather does it stand in need of that reality which passes on to us a historically educated consciousness, and that makes it possible for us to understand our own situation in its cultural context. Starting from this basis, we can then turn to the particular questions of composition, that can be couched in terms of an exactly defined outline. I should now like to describe my own labours from the moment when I gained a clear view of the questions and principles discussed here; i.e., since writing the article on 'Organic Chromaticism', at roughly the same time as I began work on the *Quintet in Memory of Webern.*

2(*a*). *Quintet in Memory of Webern: Problems and Solutions*

The decision to compose a work often depends on the composer's experiences immediately beforehand; these may have led him to the recognition, but not as yet the solution, of new problems. Other factors can play their part – perhaps older technical problems that could not be dealt with in the preceding work, theoretical reflection on the creations of some of his contemporaries, and more general considerations that are less closely bound up with current practice. Ignoring the outward occasion,[8] ignoring also any deeper necessity, of a kind not to be examined here, the *Quintet in Memory of Anton Webern* was directly motivated by reflection of two kinds; a reaction, such as has just been outlined, against an earlier work, the *Symphonies à Quinze Instruments*, and a stricter theoretical reflection, which, as we shall see, holds together, and shares a common factor, with this reaction.

The problems left open after the completion of the *Symphonies* – and thus open for the next work – were various, and yet related to greater or lesser degree. They concerned:

1. *Form*, i.e. macroscopic articulation of successive structures, chronological distribution of the larger stretches of the whole time taken up by the work.
2. *Polyphony*, in the sense of the partly simultaneous relationship of independent structural strata that are already capable of a certain chordal density, an inner 'vertical' dimension.
3. *Chronometry*, by which is meant the totality of duration-relationships, seen in themselves; this definition frees the word 'rhythm' from the confusion attaching to its meaning, and makes it available for the expression of a more complex significance.
4. *Harmony*, by which is meant pitch-relations in all directions, whether successive, simultaneous or both together; thus the time factor is borne in mind.

The point is that the *Symphonies* are seven relatively short pieces; the longest lasts only four and half minutes, some of them take hardly sixty seconds. They are distinguished from each other in character by the varying choice of instruments (none of the pieces uses all fifteen instruments); this in addition to their inner structure, the variations of chronometric density (statistical speed), the play of polyphonic densities (that is made possible by the alternating groupings of the instruments), and the variation of the acoustic regions (register- and tone-colour-groups). The question now posed for the

[8] Commission by the Südwestfunk, Baden-Baden, for the Donaueschingen Music Festival, October 1955.

Quintet was how to arrive at the construction of a single piece, a major form,[9] whose broad articulation would be due less to the multiplicity and variability of instrumental colours[10] and combinations than to other criteria of characterisation, alteration and co-ordination, which will yet have to be defined.

Indeed, the polyphonic composition of the *Symphonies* had already brought to light similar problems, in connection with the general way they unfolded in time. In pieces 1, 5 and 6, the instrumental groups are individualised by their homogeneous timbre and also, to a lesser degree, by a certain autonomy of their inner polyphonic and chronometric structure, but are all the same subjected to a very palpable process of standardisation. The overlapping of the groups was always governed by the divisions resulting from the time-division common to them, and at any given moment they were all affected by the same index of chronometric density.

Example 1

	♪.	𝅘𝅥𝅯𝅘𝅥	♩.	♩
Woodwind		3	2	4
Brass	5	3		4
Strings	5			4

(N.B. Here we are dealing with simplified schemes, which are not present in this form in the *Symphonies*!)

Here, then, one was in fact always dealing with only a single stratum of occurrences; its density and colouring were subjected to constant variation, but complete groups never entered into a genuinely polyphonic relationship to each other. As far as this compositional factor is concerned, pieces 2, 3, 4, and 7 introduce, in various ways, a greater looseness. Either the indices of speed within the various group-strata were distributed independently, divergently (even though the latter were still subject to a common division of the time);

Example 2

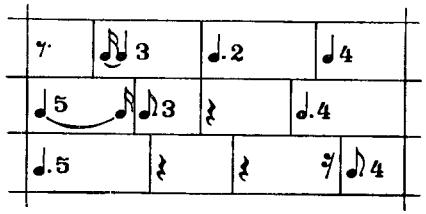
♪.	𝅘𝅥𝅯𝅘𝅥	♩.	♩
	5	4	1
5	3		4
3			2

[9] The commission was for a work lasting 12 minutes; this was slightly exceeded, and the work lasts just under a quarter of an hour.

[10] The work is scored for Clarinet, Bass Clarinet, Violin, Violoncello and Piano.

or each of the various groups, all of which showed a common density-ordering, had at its disposal a particular time-division, independent of the others', so that only a number of 'caesuras' coincided;

Example 3



or both these processes might be set to work simultaneously. Although this method achieved a real loosening, it could not be regarded as a sufficiently general solution of the problem presented. While in the first example the time-articulation remained absolutely simultaneous, in the other, numerous articulations still occurred simultaneously, because the group-lengths were always relatively simple 'rational' note-values, 'irrationals' being introduced only in their subdivision. The problem of wholly independent time-structures, which should be able to overlap in a far more supple way, to begin, end and change within far more variable, even 'irrational' lapses of time – in fact the problem of a much more differentiated inner chronometric articulation – was left outstanding.

This also brings us nearer to another question. Since the polyphonic overlapping was of such a simple kind, the aperiodicity of the group articulations had to be ensured by constant use of irregular bars (with variable beat), and of changes in time and tempo. If greater asymmetry were now achieved by other means, then the latent metric subdivision could, in fact had to, work out more simply and regularly, since as applied to the structures now perceived, it would no longer possess the same function, but only be an exterior means of orientation for the performers; this greater simplicity and regularity would, of course, be a suitable medium in which to express the irregularity of the real chronometric processes.

Lastly, the *Symphonies* had made clear another dialectic, between structures' degrees of density and the harmonic exigencies of an authentic non-tonal music. The resultant conflicts had been smoothed out in a purely empirical way, by the plentiful and systematic use of the large intervals derived from the semitone – major sevenths, minor ninths, etc. In the *Quintet* it was now a question of rationalising the empirical modes of procedure used in the *Symphonies*. The analysis of Webern's *Bagatelles* had meanwhile made the theoretical background of this question a great deal clearer (see Footnote 4.)

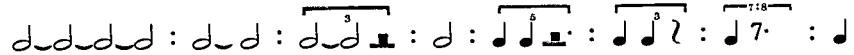
The basic series of Webern's *Quartet*, Op. 22 – a work whose instrumentation, for its part, is very similar to that of the *Quintet* – conditions the entire unfolding of the latter, not so much with regard to pitch itself as to chronometric density (and, to a lesser degree, polyphonic density). The dedication contained in the title of the work was thus made concrete. At the same time, part of the solution of the harmonic question was found. We have said that it is necessary to make an initial differentiation between the density specifications of the various groups (the degree to which the actual chronometric organisation multiplies this differentiation will also be shown); and we have said,

too, that the omnipresence of chromaticism had to be ensured (since this seemed at the time the only possibility of realising a multi-polar harmony; in fact it coincided essentially with the very idea of the latter). The intervals of Webern's series, subjected to particular permutations of order, and constantly developed further in the same direction, were accordingly 'completed' through all the intervening steps, i.e. through the fragment of the chromatic scale that they contained. Each interval, 'filled-out' in this way, constitutes the harmonic material, the frequency data of a group, conditioning first the latter's density, the number of notes it consists of (which can vary from one, in the case of a minor second, to eleven, for a major seventh), and guaranteeing the chromatic integrity of the group's structure. The serial succession of these completely included 'partials' is left free, but in the course of composition it has to be fixed so as to give, on the one hand, the best 'vertical' superimpositions (particularly those of notes belonging to different polyphonic strata), i.e. the best 'harmonic fields', and equally, on the other hand, the best successive forms, i.e. the best 'melodic figures' (these depend on various factors, including the mobility and particular technique of the individual instruments). In the same way, the register distribution of the notes of the groups is left free; the resultant harmonic fields are thus the result of an apparently empirical mode of working. Yet even a mere glance at the score allows us to see that this work, too, is carried out in accordance with extremely strict measurement; that the harmonic fields show a highly developed unity of shape, a great homogeneity. This can be explained without more ado, from the fact that the chromatic relationships arising within a group are represented as major sevenths or minor ninths, and that all other intervals – major seconds, minor sevenths, thirds and sixths of all kinds, fifths, fourths and tritones – are produced by the crossing of different chains of these basic intervals.[11] Both the serial succession and the register distribution of the notes were influenced by the desire to allow certain of these non-chromatic intervals to occur more often in certain structures; these two criteria are thus subject to laws strict enough to make any further systematisation appear superfluous; the relative freedom maintained here is designed, on the contrary, to meet all structural claims, and to resolve any contradictions that could arise between them.

It has already been remarked above that the chronometric density of the structure, which is determined in its subordinate texture by the intervals of Webern's series, is also differentiated by an independent time-articulation that is to be imposed upon the ordering of the groups; thus it is in a certain sense to be over-determined. The piece, notated throughout in 2/4 time, is in fact subdivided into inflexible metres of four bars, in hard and fast divisions that make possible a direct check on such overdetermination of the density. For the metres themselves can be given 1-8 equal subdivisions. Into these various subdivided durations[12] the groups are now introduced; the density of the groups can constantly vary between 1 and 11, according to the number of partial notes they contain, as determined by the intervals of Webern's series. The lowest density, or greatest slowness, is consequently established if a minor second coincides with the subdivision 1, i.e. when for four $\frac{2}{4}$ bars a single note is available; while the greatest

[11] It is easy to see the close connection between this method of composition and the analytic process to which the *Bagatelles* of Webern were subjected – see the article in *Die Reihe* II already mentioned.

[12]



density, the maximum speed, results in the places where the density index 11 – the major seventh – coincides with the subdivision 8, i.e. where eleven partial notes have to be made to fit into a single crotchet. The densest groups are also the shortest, but this is compensated by the fact that they occur correspondingly oftener, so that there is felt to be a definite average density over an entire metre. The regular repetition of the metres does not, however, make itself felt. It is concealed by the variation in density – the alteration of the index, within a metre, from one group to another – and also by the fact that the number of successive, identically subdivided metres varies greatly; finally, as we shall see, there is the possibility of introducing into the subdivided durations not groups of notes but rests, which are completely free to occur at the beginning, at the end, or in the middle of a metre, and can again vary as to the number occurring in succession. It should in addition be mentioned that the inner chronometric articulation of the groups is generally contrived so that an increase or decrease in density is perceptible.

We still have to show the nature of the contribution made to the overall form of the piece by the density organisation that arises from the factors mentioned. The piece is divided into four main sections, each of which contains roughly the same number of bars (and metres). But the number of groups, however they may be subdivided, alters from one section to the next, so that the density is differently apportioned in each section. Seen as a whole, the average density-variation between the four sections could be reduced to the scheme 2 – 1 – 3 – 2. It will, however, be found that this scheme, too, is again obscured to a certain extent. In the first and fourth sections, the various metric subdivisions are arranged very irregularly. Thus it is possible to juxtapose or even superimpose structural sequences of most contrasting character. On the other hand, in the two middle sections the density ordering is much more regular. Although one can not speak of strict progressions (for there are delays, pauses, retrogressions and sudden jumps), it is indeed true that the slowest metres in these two sections are found at the beginning of the second and at the end of the third, while their meeting-point (the centre of the piece) shows the greatest piling-up of the subdivisions and the greatest densities, thus being quite clearly marked out as the climax. The two middle sections are thus welded together in a single broad movement to and fro, in a rise and fall of the statistical density, while the outer sections build a firmer, stationary frame around this process of development.

In addition, the overall form of the piece is further conditioned by the fact that its structure is genuinely polyphonic. The instrumentation is divided throughout into three autonomous groups, of which two are variable in their constitution; the piano always makes up a group on its own, while the grouping of the other four instruments alternates, being now by register (1st and 3rd sections, violin and clarinet on one side, cello and bass clarinet on the other), and now by timbre (clarinets and strings separated, 2nd and 4th sections). Each of these instrumental groups proceeds independently, having in each section its own scheme for the metric subdivisions, and also for their degree of density. In the outer sections this independence, together with the average distribution of the indices (as already discussed), leads to extraordinarily variable overlappings. On the other hand, in the middle sections the already-mentioned regularity is set out in different ways in the three groups – this does not rule out the possibility of certain tensions in the polyphonic superimposition of strata (see, for example, the very lively structure, like a cadenza, which appears in the solo violin at the

beginning of the second section; in context, between much calmer passages, it is like a foreign body). In any case, the three instrumental groups are not used uninterruptedly. As has already been mentioned, many variable and conventionally fixed intervals of Webern's series motivate not groups of notes but rests. In the permutational play of this series, such intervals can occur several times in succession, or can drop out for a time. In addition, their true duration depends on the metrical subdivision to which they are related. Lastly, they occur in the three instrumental strata quite independently of each other. All this leads to a great variety of superimpositions, of mutual interpenetration and intersection of the various structural strata.[13] But there was yet another final problem; the alternation of the instrumental groups, which takes place between the major sections of the work, was rather schematic and rudimentary, incapable of producing real structural vitality. It had to be enriched, given finer nuances, yet without endangering the resistivity of the basic organisation. In the two middle sections (or to be more exact, in the first two-thirds of the second, and the latter two-thirds of the third section), certain structural sequences were entrusted not to both instruments of the group concerned, but to only one of them, without, however, any alteration in their density specifications. The first effect of this limitation consists in a reduced polyphonic density, and a greater speed, in a 'horizontalising'. Apart from the creation of new types of shape, it also has the important advantage of obscuring the divisions between the principal sections; it makes the alternation of the instrumental groupings less arbitrary. Although this horizontalising does not necessarily begin simultaneously in the three groups, these structural types are sometimes used for really long stretches in two or even three instrumental strata simultaneously (the piano being also used in a more linear, 'monodic' way than at other times). Thus the second section, for instance, begins, and the third ends, with this type of three-layer horizontalising. When such superimpositions occur, each instrument is chosen, as sole representative of its group, according to the criterion opposed to that defining the group; if the instruments are combined according to timbre, the solo instrument in all the groups will be chosen according to the same register index – and vice versa.

Thus the general development of the work was extensively varied and regulated in its most important articulations; it was sufficiently unpredictable, and at the same time continuous; in short, it was organic. It realised the project in a satisfying way, and resolved to a certain degree the intellectual tension from which it arose. But we would not say that a final solution had now been found for the problems posed, rather that this work cast new light on them, and made it possible to express them in clearer terms, on a sounder basis.

2(*b*). *Quintet in Memory of Webern: Notation*

The most urgent question that arose after the completion of the *Quintet*, especially at the time of its first performance, was that of chronometric notation. Although this was not exaggeratedly complex, making use of only the simpler irrationals (the most difficult were only quintuplets and septuplets), and though even changes of time-signature

[13] Such intersection in time, and the constant mixing of register- and tone-colours, means that one is ultimately dealing with a unitary sound material, which undergoes a process of constant alteration, constantly being differentiated and brought into accordance with modal schemes that are variable and always unpredictable.

were excluded and the beat remained constant,[14] the question still arose – did the work's complexity, such as it was, stand in unexceptionable relationship to the perceptual results aimed at? Would not other means be more suitable, allowing the desired end-product to be more directly represented, loading the performers with fewer problems of a quantitative nature, fewer purely mechanical difficulties? Reflections about multi-polarity, about the exclusion of all repetition, about aperiodicity as a factor in the new musical language – all this cast a new light on the problem. The larger chromatic intervals – major sevenths, minor ninths, etc. – owe their specific 'irrationalising' power to the fact that they are 'impure', out-of-tune octaves. By drawing our attention to points in sound that lie very near the octave, they effectively distract us from imagining or expecting (as we are never far from doing) privileged shapes, regulating-relationships, and the 'straightline' perspective that such relationships automatically bring with them. Even when the data of the tempered chromatic scale are used as material – and on condition that the overall acoustical texture is organised in accordance with the specific power of these intervals – it is still possible to perceive a 'vaulted' sound-space, akin to that metaphorically outlined by Boulez.[15] The mathematical details of the tempered intervals can here vary within perceptible limits (this is not true of the rational intervals of tonal music, which had always to appear as absolutely pure relationships, quite simple, quite regular shapes.) The realm of chronometry, which in tonal music was subject to no less rational a control than was harmony, must likewise contain functional possibilities of this type. To give only a simple example; in an integral multi-polar structural type, one may write two successive notes, crotchet and dotted quaver, within a group of seven semiquavers, not so as to suggest to the hearer the exact comprehension of a numerical relationship 3:4 (which would of course mean the perception of a common factor, a regular pulsation), but so as to make him aware of two durations, approximately equal and yet palpably different, and to prevent the establishment of any apparent periodicity. Thus the relationship between the two note-values loses its quantitative character and becomes a connection exclusively between different time-qualities, a time-tension of essentially dynamic character – whereas pulsation is indeed movement, but is stationary, and thus the most static of all possible forms of movement. The numerical ratio of the two members is therefore significant only in so far as it decides their qualitative relationship, and altering them will only have relevance (positive or negative) in proportion to the perceptible alterations it produces in qualities actually present, and in the dynamics of their confrontation. One may accordingly ask whether it would not be more promising to find a more direct form of representation for determinant formal qualities and the dynamics of their co-ordination – a qualitative notation of time-phenomena as we perceive them. Such a notation, relieved of the demand for absolute quantitative exactness, would make use of every possible and acceptable threshold of approximation. It would free the performer from a whole series of difficulties that are merely those of communication, unconnected with the meaning of the work. Certainly it would impose on him other problems, new difficulties of

[14]After the first performance, in which the tempo was constant at crochet 60, tempo alterations were made; these were first tried out at the Paris performance in 1956, under Pierre Boulez, and were intended to make clearer the differences between the major sections (macroscopic differences). The first and fourth sections, in the final form of the score, were given the metronome marking 56, the second and third sections are at 48 and 64 respectively, while the last bars of all, in which the whole piece may be said to die away, were given the slowest tempo – 48.

[15]'At the Ends of Fruitful Land', *Die Reihe*, Vol. I, Theodore Presser, Bryn Mawr, and Universal Edition, London 1958.

understanding and imagination; in particular, he would be faced by the task of finding and respecting not the letter but the spirit of a musical text. But is it not true, even in the case of the most precise and complex *quantitative* notation, that a performer, in order to attain a really satisfying interpretation, must work out, through minutious faithfulness to the text, his understanding of its *qualitative* wealth, its effective dynamism that is not reducible to number-relationships? Let us think of the double, even triple, irrationals – for they are included in a scheme of constant changes of time – in Stockhausen's first piano piece! (No.2, I). In these days, when there are a number of interpreters aware of the 'semantic kernel' of the new style, is our imagination not able to do without the help of exclusively numerical communication? Can it not appreciate a symbolism which, after an initial sacrifice of a certain amount of precision, would bear within it the possibility of suggestion, the possibility of *qualitatively* exact description of a work's real informational character? It is, however, already clear that the problem is couched differently for solo works and those for ensemble. But here, at the right moment, new perspectives will open to view.

2(c). *Quintet in Memory of Webern: New Problems*

But in the realm of harmony, too, of pitch relations themselves, another problem arose. We have seen that in the *Quintet* the harmonic structure of the groups was directly connected with their density, with the size of the fragment of the chromatic scale that fixed their specifications. We said earlier that in certain cases, for reasons of characterisation, it might appear desirable, during the final detailed composition, to allow this or that non-chromatic interval (third, fourth, etc.) to come more strongly into the foreground; but this was only possible in so far as the interval was contained in the relevant fragment of the scale – something that was always dependent on the latter's size, and thus on the density-index of the group. If, for example, in a group (i.e. in one and the same polyphonic stratum, since the intervals resulting from the crossing of several strata were less directly predictable), a single tritone was to occur, then the group had to number at least seven notes. As a consequence, the chromatic intervals were by far the most numerous, then major seconds, then minor thirds, etc. This hierarchy was in a certain sense the product of will, and was in accordance with a certain attitude to the meaning of chromaticism, but was still rather mechanical and rigid. In this single case, satisfaction could be found in the characteristic homogeneity it ensured; the treatment of registers had extracted from the fundamental stiffness a maximum of liveliness; but at the same time it was clear that to carry this method any further would quickly show up its insufficiencies. The variability of the possible harmonic forms was limited very drastically; in fact it was mostly a question of one single type of possible pitch-field, to which an appearance of changeability was given solely by the other parameters. Once this was appreciated, it was a matter of finding a way to make the 'non-chromatic' intervals enrich, differentiate and functionalise the harmonic structure. This was not an isolated demand; in the second cycle of his piano pieces, Stockhausen also explored the possibilities of characterising and differentiating the harmonic fields through a statistically privileged use of this or that interval. But, although there is an unmistakable relationship – in this case, in the realm of harmony – between the results of our researches, their points of departure differed in essence. Stockhausen started from the point of view of statistics, and gave the same value to all

intervals; for example, the chromatic intervals did not have a special place, but had rather the function, just as had the other pitch-relationships, of characterising particular sections. But in the reflections that occupy us here, the non-chromatic intervals could occur only as secondary characterising phenomena, and even this only after the multi-polarity of the sound-texture had been ensured, particularly by the specific use of large intervals of chromatic origin. Even after the dissolution of their exclusive dominance, these intervals play a leading role in the organisation of harmonic phenomena. Again, the compositions of Stockhausen, Boulez and certain other post-Webernian composers show, when analysed – and moreover when heard – common characteristics in their articulation and functionalisation. (Perusal of the *Zeitmasse*, in which these endeavours are very apparent, should be particularly instructive in this respect). The only basic difference is in the formulations at the very outset. One would have to investigate what significance is to be attached to this dissimilarity in theoretical presentation.

The problem selected here – the characterisation and differentiation of harmonic structures, within an undeniable stylistic homogeneity whose criteria are multi-polarity, aperiodicity and unpredictability – was merely one aspect of a more general problem, brought to light by Boulez' article 'Recherches Maintenant', especially with the introduction of the concept of 'formants'. We have seen that in the *Quintet* the organisation of the various parameters, and the mutual interference of these different organisations, produced great variability in the resultant evolutional types. Although the initial organisational foundations were settled by voluntary acts of invention, as clear-sighted as possible, and with penetrating and all-inclusive foresight of the effects to which they might lead, it was, all the same, impossible for them to keep track of every detail of these effects. The resultant sound texture was conditioned to a certain degree by chance, i.e. by the insufficiently controlled introduction of certain mutually independent factors. Certainly during the final detailed work one could take liberties in order to counteract these effects of chance to a certain extent. But it became desirable to gain a more direct control over the characterising elements and their distribution. A first solution of these various problems, still a very intuitive one, was attempted in a short piano piece that received the title *Impromptu*. This piece was intended to open the way to a view of more general solutions, clearer in articulation and more lasting. It was to be followed by a series of other pieces, an extended cycle *Exercices de Piano*, in which these problems were to be treated from all possible sides. The composition of these pieces is already so far advanced (1956-7) that they can be discussed in detail.

3(*a*). *Impromptu. Problems and Solutions*

Certain difficulties would arise if we tried to sketch the development of the *Impromptu* in the same way as that of the *Quintet*. The technical schemata, the point of departure for the composition of this short piece, were only partially followed; more often they were noticeably distorted as the result of a more concrete, all-inclusive imagination. So I shall limit myself to describing the elements (from the initial rational organisation) that are still audibly present in the final form of the piece, and that confirm the validity of those methods of development which are still of relevance to the understanding of the ensuing pieces.

Five chromatic elements of characterisation are at work in the piece, five non-chromatic intervals, representing multiples of the whole-tone; the whole-tone itself, the

major third, the tritone, the minor sixth and the minor seventh. Yet, as we have said, there is always a demand for great chromatic multiplicity (a specific chromaticism). Every third note, or at least every fourth, is therefore brought into a relationship of a major seventh or a minor ninth to a note of the characteristic interval, and in such a way that the characteristic interval is 'bracketed' by the chromatic one. For example, if a figure is conditioned primarily by the major third C-E, the third note will be either B or C sharp, if it is above, or F or E flat if it has to lie below the third C-E. Intervals that are neither chromatic nor multiples of the whole-tone are thus produced by the overlapping of the defining interval with the chromatic interval 'bracketing' it.[16] Each defining interval produces in this way two other different intervals, according to whether it is included in a major seventh or a minor ninth.[17]

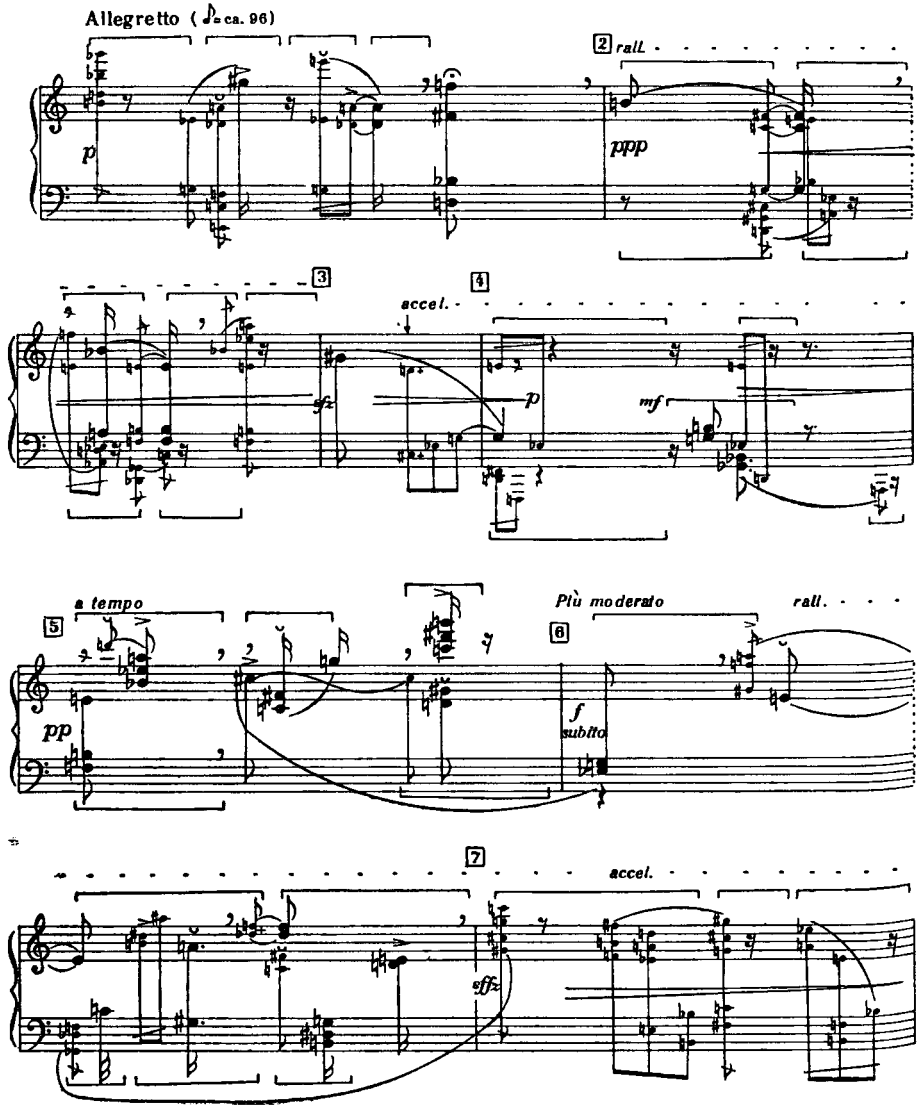
Thus one finally obtains ten harmonic triad-figures, related to each other in various ways, but all defined by at least one chromatic relationship. Harmonically, each section of the piece is built up from one or two of these figures. It is thus unambiguously characterised, yet all the same the sections are related in ways that extend beyond simple, homogeneous multi-polarity, and result from the distribution of those non-chromatic intervals that can not be reduced to a basis of whole-tones; this distribution does not run parallel to that of the characteristic intervals. There can also occur harmonic figures in which the chromatic relationship is established only at the fourth note, while the first three notes result from the doubling of the defining interval; if, for example, one places two major thirds or minor sixths on top of one another, then, provided they have a note in common, the three members of the resultant field (augmented triad) produce an 'alternating circuit' that excludes all polarity. Here we find an example of a figure that, without being derived from chromatic intervals, can still possibly be multi-polar. However, it will be immediately seen that the exclusive multiplication of such a figure would not lead very far; one would very soon find oneself producing octaves, and unwanted short circuits would affect the note-relationships. These figures can therefore fulfil only an assistant function within the structural whole, and in the *Impromptu*, when the fourth note is added to such a figure, it is always brought into *chromatic* relationship with one of the three others.

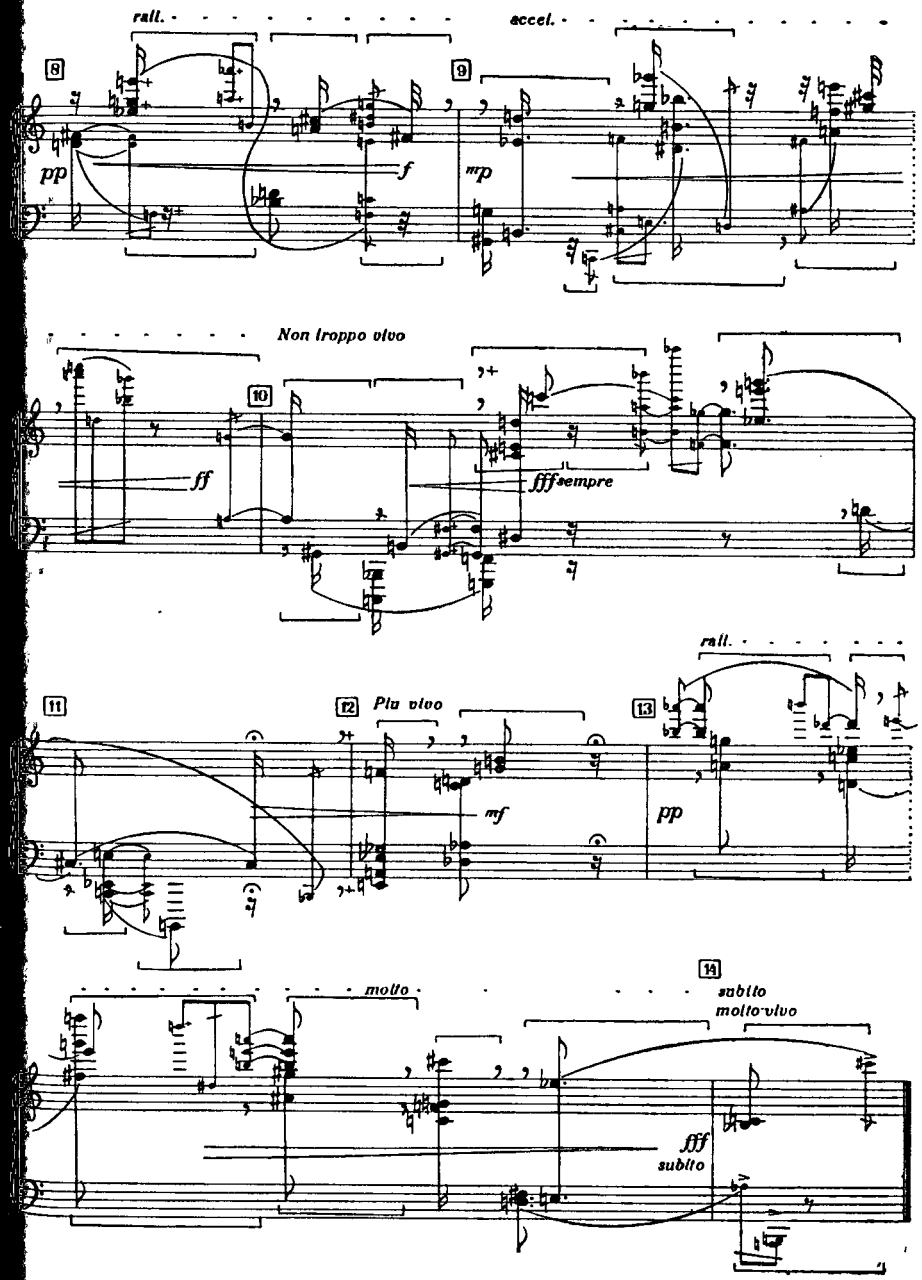
Shortly after the composition of the *Impromptu*, I systematically analysed, with an eye to privileged three- and four-note figures, works by Webern from various creative periods (among them Op. 5, 16 and 27), and nearly all the serial forms he used. This analysis – whose results were also compared with examples from Schönberg's works – confirmed my conclusions (cf. Footnote 3). These figures can in fact be regarded as the ultimate cells in Webern's type of sound-space, and as susceptible to no further reduction. In tonal organisation, the triad ensured unconditional convergence in the polarity of more than two notes, and was thus the basic figure; in just the same way, these groupings are genuine hearths of divergence, nodes, maxima of non-polarity.

An organisation can be built on them; apart from this, the harmonic fields in the *Impromptu* can also be defined by means of the concept of the 'chromatic total'. The piece can be analysed as a succession of fields, which are not only adjacent, but often run into one another, in that the last two, three or even six notes of one field represent at the same time the first notes of the ensuing one. This possibility – or perhaps necessity –

[16] E.g.: Defining interval C-E; bracketing (chromatic) interval C-B, producing major fifth E-B.
[17] Cf. above; E-C sharp could just as well be produced as E-B.

IMPROMPTU


Allegretto (♪= ca. 96)
rall.
accel.
a tempo
Più moderato
rall.
subito
accel.


rall.
accel.
Non troppo vivo
sempre
rall.
Più vivo
molto
subito
molto vivo
subito

is conditioned by the fact that in this piece each harmonic field is typified by only one characteristic interval, while the remaining articulation of the same field, as we have seen, is to a certain degree left free. In the succeeding pieces, the characterisation of the fields is made more certain; by duplication of whole groups, in which two intervals, or even three, remain in a quite unchanging relationship to each other (even as regards their register); through the unfolding of these groups in all directions; and through the (often multiple) justification that this lends to all the notes. Thus there arise types of field in which certain notes can be repeated, with a change of octave register, long before the chromatic total has been completed, and without doing any harm to the multi-polar structure of the field; this confirms what we have already remarked in the article on Webern's chromaticism in *Die Reihe* II. The octave, in this case, is no longer grasped as a first-order degree of tonal relationship, a privileged liaison. Two observations made by Gestalt theorists allow us to explain this phenomenon without any difficulty; first, it was established that perception of the similarity of two phenomena is made harder or easier by the structure of the intervening field. If this field contains phenomena that are also related to both the elements concerned, the identity of these two elements is harder to grasp, or can even be completely obscured.[18] Thus, if in a harmonic field there appear notes that stand in chromatic relationship to the components of an octave, they can destroy the privileged relationship of the octave. Moreover, the Gestalt theorists had also established that the overall significance of a figure can completely alter the local significance of many of its details (however simple, symmetrical and rational the latter may be), if it stands in strong contrast to them. Here one could mention the famous 'optical illusions', in which one fails to perceive that lines are parallel, or that parts of a straight line are equal. The dynamic of the whole, the influence of particularly 'strong' parts, or groups of parts, has given them a different qualitative value, and it even seems that their objective, quantitative relationship has shifted. These discoveries strike us as vitally important for our further research in the realm of multi-polar harmony – and particularly on a basis of non-temperament.

In the *Impromptu*, registers, dynamics and alterations of tempo were also prepared at the outset, in the same way as the harmonic fields, i.e. according to five-point parametric scales. The degrees of these scales were arranged schematically, but if the motion of the piece was truly to develop, these schemata had more often than not to be altered in the course of composition. Thus it would be difficult, both for analysis and in listening, to deduce the initial schemata from the work as actually developed. The schemata served only as stimuli, they were points of attack for my imaginative powers – whereas here we are interested only in the motions that arose from them. But we should beware of regarding these motions as merely statistical processes that would owe their function only to their general direction, magnitude and rapidity; this would in fact amount to new types of inertia, that had merely taken on the appearance of linear developments. Although statistical observation is another of the factors that can assist the composer in deciding the overall layout of his work, and in preventing time from splitting up into undifferentiated atomistic moments, it must never be regarded as a criterion of perception; it is not desirable that a piece should be heard statistically, for this would ultimately mean it was being heard merely superficially. This would be the

[18] W. Köhler and H. von Restorff: *Über die Wirkung von Bereichsbildung im Spurenfeld. Psychologische Forschung* XVIII, Berlin, 1933.

direct opposite of the aesthetic stipulation that we formulated at the outset; the hearer would once again be distracted from actuality, from the 'here and now', if he were to attend only to the surface of developments that were in fact planned on a large scale, or let himself be merely carried along. The outward statistical factor in processes of development is less important – this factor can be reduced to a few very general formal types, valid for a great number of concrete musical structures that are very different from each other; far more important for perception are the particular modalities of such processes, the manner – specific, unique, in a sense personal – in which they fulfil themselves, the detours to which their course is subject, even the standing conflict between 'irresistible' energies, tending to level everything down, and the differentiating, creative resistance of the local data. In analysing, as in hearing, a piece such as the *Impromptu*, it is therefore a good idea to follow carefully not only the direction, magnitude of the developing motions, but their individual paths. For example, the concrete shape of 'statistical' pitch-movements, overall 'melodic' directions, is also conditioned by the harmonic fields, whose non-statistical organisation has already been emphasised. Similarly, rhythmic structures (which are, however, prepared in a less precise way than the specifications of the harmonic fields) play a part opposed to that of tempo movements and global chronometric variations of density, a role comparable to that of harmonic fields as opposed to register movement. Not all the alterations in the general speed occur in the same way, and its inner, momentary structure, reducible to no other, is at least as essential as the general degree of alteration.

This structure, too, is conditioned by two further characterising parameters. One, which adds noticeably to its differentiation, is the play of the elements' 'morphological behaviour'. This can considerably alter the real duration of the notes, and, with it, the overall impression of speed. If, for example, notes that are attacked with little time between them overlap strongly, are in fact prolonged, then there results an impression of great polyphonic density, and yet of a relatively slow tempo. On the other hand, *staccati*, even when they are separated from each other by fairly long rests, create a rather nervous impression, as of a rapid passing of acoustic events with a minimum polyphonic density tending in fact toward zero. We see here an example of the deep influence that the different parameters exert on one another, of their mutual solidarity, that can not be further analysed, and yet can still be controlled – the result of Webern's new conception of a polyphonic continuum, a musical space-time.

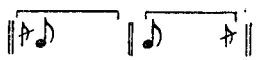
We were going to consider another mode of characterisation – this can be defined as the specific polyphonic handling of the structures. Successive groups may contain from one to three polyphonic strata, whose successive elements are already capable of a certain chordal density and of various modes of morphological behaviour in relation to other elements. Yet over the entire length of the piece, the vertical density that results is basically the same, apart from the occasionally significant fluctuations that can occur momentarily between directly neighbouring elements, irrespective of the number of strata. This evenness has its basis in the fact that the average polyphonic density of each stratum is dependent on the number of strata; in a three-layer structure, for example, the density of the individual strata will be so measured out that their superposition will give rise to roughly the same mean density as would a single-layer structure. Thus, when the number of strata alters, the only change is in the inner polyphonic articulation. If, as will be the case in the succeeding pieces, the index of the mean overall density can now

be made to vary from one structure to another, this index will be handled independently, according to the polyphonic articulation, the number of the stratum, with which it coincides; thus one will be able to determine and control the true polyphonic density independently of the number of strata. By preparing the parameters with regard to the total effect of their mutual influences, it will become possible to exercise a much more direct control over the resultant characters. But before we illustrate this in more detail, referring to the *Exercices de Piano*, we must deal with the types of specifically chronometric notation which were used for the first time in the *Impromptu*, and which have developed further, always closely bound up with the composition of the ensuing cycle.

3(*b*). *Impromptu: Notation.*

The search for an appropriate notation was conditioned by two factors; on one side, reflections on the problem of defining a 'qualitative aperiodicity'; on the other, particular problems that were presented by the systematic use of 'grace-notes' in Stockhausen's second cycle of piano pieces. The questions, put in their broadest form, were: how can one leave the interpreter a certain freedom in determining the characteristic note-values of a rhythmic structure? And how can this freedom be given precise limits, in the form of conventions that will give the player guidance, rather than tie him down? Thus it was necessary to decide how exact his approximation was to be. The idea in the first version of the *Impromptu* was to use 'grace-notes' in the usual form with a stroke through the stem; these were to be used as quick notes, shorter in duration than the shortest 'written-out' notes in the piece (semiquavers in this case); but not necessarily 'as fast as possible'. The choice of effective durations was left to the interpreter; in different performances, he could in fact vary them according to the inspiration of the moment. This freedom was now limited by certain relationships between 'grace-notes' and 'real' note-values; horizontal brackets indicated whether the grace-note(s) had to be fitted in at the beginning of the ensuing notated value, or at the end of the preceding one, which would be shortened by the length of the grace-note(s):

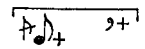
Example 4.



If there were no brackets, the 'real' note-values remained as notated, and the length of the grace-notes was added ('*valeur ajoutée*'). 'Commas' were to be short rests; they were also fitted in to the measured note-values. The latter, too, were notated in various ways. They could be prolonged or shortened, not only by the addition of grace-notes or the use of horizontal brackets, but also by the frequent use of alterations in tempo (i.e. approximate alterations of the latently felt pulsation, which could be determined gradually, or else suddenly); also by pauses (fermatas) to differentiate notes whose notated length was identical. This notation presupposes, in the interpreter, both an understanding of the semantic kernel from which all our structural principles are derived (namely the demand for an integral aperiodicity), and a clear idea of what, as a means of fulfilling this demand, is in fact possible and in accordance with our sensory apparatus. But it became apparent that the latitude allowed the duration of grace-notes was just as dependent on the tempo as was that of the smallest notated value, since the latter had to be longer than the duration of a grace-note. Sometimes, at slow tempo,

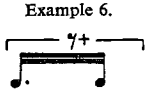
such latitude was exaggeratedly great, and did not produce the desired rhythmic effects. It was also desirable to find a simpler method than changes of tempo for making minor alterations in the length of 'real' note-values. The search for a better notation of thresholds of freedom, by means of a more direct and exact description of information qualities, finally led to a genuine proportional system applying to approximate shapes. Grace-notes and commas are retained, but further differentiated; with a transverse stroke through the stem, they are 'as quick as possible' (thus independent of the tempo, but directly dependent on the magnitude and complexity of the movements that have to be carried out); without a stroke, their duration can vary between that of a 'grace-note with stroke' and a demi-semiquaver (which is hardly used), and thus depends on the tempo; without a stroke, and with ensuing prolongation sign + , their duration can vary between that of a demi-semiquaver and a semiquaver (the latter is in effect used as the smallest notated value); without a stroke and with a fermata, their duration can be prolonged at will, beyond that of a semiquaver. Notated values are now subjected to further individual alterations of the same sort; the duration of a semiquaver, with prolongation sign + , can vary between its own and that of a quaver; with a fermata it can be freely prolonged even further. All other values, such as quavers, crotchets, minims, with prolongation signs, are correspondingly variable between their normal and their dotted durations. With a round fermata 𝄐, they vary between dotted and double length, with a square fermata 𝄐, they can be freely prolonged beyond double the length. The system of horizontal brackets, for the inclusion of one or more grace-notes, or rests, within the measured durations – so that the notated value denotes the total length of several notes or chords – is still further extended, in that the durations can themselves be varied. A value that has already been altered can again become the total duration of a chronometric group, if the grace-notes (or 'grace-rests') are included under the bracket.

Example 5.



The asymmetry of perception is now no longer determined by symmetry based on constant assimilation of a regular beat, a latent mensural unit; the interpreter's idea of time must be aperiodic from the very outset. A new version of the *Impromptu*, as of the two ensuing pieces, *Variations I* and *Variations II*, has been notated in this way. For the pieces at present in preparation, further refinements are intended, through the use, here already heralded, of various types of approximate irrational value. The total length of a chronometric group will no longer be written as a basic note-value, as the 'real' notational symbol of a group, from which the grace-notes split off parts that are long or short, but will be included in the horizontal bracket as an abstract symbol. Several 'real' values, whose mutual relationship has to be respected, can then be included under one bracket. By this method, the use of altered durations will produce a further departure from the customary way of writing 'irrational' values, and one with particular characteristics: either the defined duration of a group within a bracket will in itself be approximate, and strict proportion will apply only in the way it is subdivided;

Example 6.



or else the duration of a group will be determined by an exact, non-altered note-value, and can be subdivided into a succession of notes, in which the length of certain individual values is fixed only approximately, so that their ratio is only partly defined.

Example 7.

This would be useful, above all, when several players had to play at once. A special case (perhaps the only one where it could be interesting to combine both possibilities) would thus be found when, within a bracket, there was a special marking for the inner agogic alteration of the group (*accelerando* or *rallentando*), and yet the total duration could still be strictly measured. There are thus certain notational possibilities, varied and supple enough to reproduce the qualitative exactness of all desired 'multi-polar chronometric fields'. When one superimposes several polyphonic strata, each constructed in this way, the approximate shapes in one stratum can give a degree of exactness to those of another. If, for example, a crotchet and a semiquaver-with-+ overlap with a crotchet-with-+ (in such a way that they completely exhaust the duration allotted to them), then there is a fifty per cent decrease in the freedom open to the latter prolongation. In the reverse case, the freedom of performance would be more strongly emphasised by superimposition. (In certain cases this freedom can be more extensive than in others). The degree of quantitative precision will then become still smaller, and will allow free play to a pure suggestion of the virtual rhythmic structure. This is especially true when one superimposes various successions of durations, in which several durations are free. Finally, another scale of approximate tempo-indications was used, and this provided enough nuances to specify every possible alteration in the dimension of time; here the performer is given the task of ensuring, by the choice of effective tempo-indication, the maximum effectiveness of these nuances:

Lento:	max. 60	measured in quavers
Andante:	60-84	
Moderato:	ca. 84	
Allegretto:	84-108	
Vivo:	min. 108	

The scale, which is in itself elastic, is made still more supple by markings such as *molto lento* (or *vivo*), *molto* (or *poco*) *più* (or *meno*) *lento* (or *vivo*), and every possible indication for alterations of tempo.

The dimension of dynamics is, within its much more limited borders, handled analogously. Besides its supra-ordered, static or dynamically alterable indices, markings can be used for still finer alterations; $>$ for 'softer than the given degree of loudness', or $\cup$ for 'louder than the given degree of loudness'.

4. *Variations I*

Whereas the *Impromptu* lasts roughly 60 seconds, the *Variations I* last about ten minutes. Their structure is much more complex, and it requires a much greater number of elements that can be theoretically formulated. To give as exact a description as possible, we now treat several phases in its composition as if they had been successive;

preparation and standardising of the material, then the planning of the processes by which this material was arranged, and of the schemes according to which it was distributed, and lastly the final work of detailed composition. But it must be expressly emphasised that such a division does not correspond to any such division in the creation of the piece. The aforementioned stages ran more or less simultaneously (or in alternation). Certainly, when work begins, the initial conception of what is to be the end-product is still very vague (a result of, among other things, the problems to be faced); it will become more precise, and can in fact considerably alter, in the course of work, and only when all the details are fixed does the piece take on its final form. Yet it remains true that the initial conception – or, better, the dialectical relationship between conception and gradual realisation – is always the ultimate criterion to which one's labours are related, on which they orientate themselves, and through which they are finally to be brought to a successful conclusion.

This correction makes it possible to counter the criticism directed at 'preparation' of musical material. It must be emphasised that in such 'preparation', musical material (or musical forms, which amount to the same thing) are not analytically split up into a series of amorphous, inert elements – without effect on our perception, since, in any specific instance, when combined they would not be equal to the sum of their individual characteristics. On the contrary, it is a matter of determining the active informational moments of our powers of hearing; these include the factors of material and form, which, each in its own way, are capable of characterising and differentiating perception, and also the irreducible and yet controllable interferences between the various psychological 'parameters'. To want only to adopt a method of description, and so also of composition, that were exclusively 'statistical', would be to misunderstand the deepest meaning of Gestalt theory, to misuse various of its basic principles, and to neglect other equally important ones which are intended to make the others more precise, or even to limit them. One would then forget that

> 'This psychological theory does not force anything into an abstract mould; on the contrary, it tries to distinguish between relationships that are real (those of perceptible *Gestalten*) and those that are purely theoretical, without any measurable effect; its intention is to describe the boundaries of objects and of things existing in Nature, to draw up a picture of the whole, from which the details emerge as they are in fact organised; it looks for the lines of division and the natural contours of objects; it alone strives after description and measure. The principle of general relativity can aid the progress of science only when it is applied with caution. Applied indiscriminately, it leads to the idea that all analysis is invalid, and for practical purposes this extreme opinion is just as sterile as the view that some mode of analysis is the only valid one. Opposed to both these two extreme tendencies, Gestalt theory confirms the belief that, in what is real, there exist quite definite degrees of dependence and articulation.'[19]

If a method of investigation did not permit one momentarily to keep the various formal factors separate, without losing sight of their function within the whole, then one would be able to use in composition only the categories of repetition and wholesale transposition – both are orientated backwards on a thematic conception of the musical process – , or to make use of the categories of contrast through the simple opposition of

[19] Paul Guillaume, *La Psychologie de la Forme*, Flammarion, Paris, pp. 34-35.

partial structures that had no measure in common. The last-mentioned categories make threadbare even the slightest attempt at repetition. They are nothing but another form of thematism, namely multi-thematism, whose new capacities are still more questionable than those of a simple, pure thematism. Fundamentally, such conceptions are nothing but feelings and modes of thinking that look back to base themselves on inherited musical practice; they are bound to appear foreign to the aesthetic criteria mentioned above. Work with the parameters, on the other hand, leads to an infinitely finer differentiation, and relationship in far more strata, for all the shapes that contribute to the specific wholeness of a work. For Gestalt psychology,

> 'The problem of perception consists in determining the constellation of the stimuli that correspond to any form perceived; in what way, and to what extent, does a perceived *Gestalt* alter when there is this or that variation in an objective constellation of stimuli?'[20]

If we can control the individual characterising factors, the various resultant structures will be very much at our command. In music, where there are to be very many degrees of similarity, extremely variable characterising intervals, and where the continuous variability of the phenomena can be consciously perceived – in this sort of music, even very closely related shapes will be grasped as specific events, not to be identified with each other; their differences will be stronger than their similarities; any impression of a repetition (even of one that is varied, which is indeed only a secondary characteristic) will be excluded, and one will no longer be conscious, neither between the various structures nor between the elements, of a favourising, periodic and polarised hierarchy of events. This in fact appears to be the essential condition for a correct attitude to the new musical sensibility.

Thus it is not a matter of subjecting creative imagination to any totalitarian process of reason, from which it had previously freed itself; musical hearing is not merely to pass on abstract organisation, whose completeness and balance are in themselves enough, and that lead to a kind of intellectual satisfaction derived from observing purely numerical proportions (though this is the way many people imagine that composers and even listeners behave toward serial structures). On the contrary, it is a matter of making reason into an instrument sufficiently pliable to be of use to the composer's procedures. In the end, this can only mean that it is no longer possible to make a distinction (or at least a fundamental one) between musical theory and practice, the intellectual and the sensory awareness of sound-phenomena; and moreover, that one must arrive at so complete an identification of their mutual perspectives that one would need to give priority to neither the one nor the other. The specifically human, specifically modern work of rationalising the concrete world by concretising reason itself must be continued in the world of music. It is therefore time to return to the question of rationality. However, we have so far used this concept to mean two different things. In a negative sense, it has been a criterion related to the simplest, mechanically-based type of reason, and thus in opposition to the multi-polar, aperiodic conception of music. We never intended to oppose to this a fundamental 'irrationality' – we know what a limited meaning the concept 'irrationality' has in the field of rhythm, or when adapted to the various strata of musical articulation, or when defined negatively as the opposite of a 'first-order' rationality. The narrow type of rationalism has to be opposed by a new, open and

[20] Paul Guillaume, *op. cit.*, p. 22.

dynamic form of reason, the 'super-rationalism' that can adjust itself to qualitative analysis and description, and that appears to make reality of post-Webernian serial theory.

We can now return to the *Exercices de Piano*, and indeed to the preparation of the material, which – at least from the hierarchic point of view – is laid down as the composer's first task. Here, there are six parameter-dimensions. Each group, each structural cell (whose quantitative magnitude, though variable between certain limits, is itself a characterising element), is provided with an index for each dimension. However, this index characterises the group only as a whole. It is left to the work of detailed composition to fix each element in its exact function; at that stage, wherever there are more or less abrupt clashes between the individual parameter-indications, one must always reckon up the importance of each individual indication, and must find the 'correctest' solution, the one best corresponding to the sense of the structure. In general, it may be said that this work can exploit to the utmost any contradiction between the parameters, so as either to confirm the latter reciprocally, or to leave them ambiguous. On the other hand, in working within the structures, guidance can be given by this kind of predetermination, which can be outlined with greater or lesser sharpness.

The six parameters are:

A. *Harmonic fields* (groups of intervals, which fix the entire harmonic articulation of a structure).

B. *Registers* (limits, between which this articulation must take place, and which are defined according to both their average position and through their compass, sometimes with a predominant direction, rising or falling).

C. *Dynamics* (a category dealing with loudness, corresponding to the preceding ones).

D. The types of *morphological behaviour* (of which we have already spoken; these are determined both by the number of available possibilities, and by their position within the entire scale of possibility).

E. *Chronometric density* (defined by the number of elements – notes or chords – , through the number of attacks in a particular duration.)

F. *Polyphonic density* (here there can be various factors; it can be determined both through the number of strata that articulate a structure, and through the number of notes in a chord.)

In *Variations I* these six dimensions were placed all on the same footing, i.e. they were all allotted an equally great possibility of characterisation; this was not so important in this piece, since all the structural elements were already fixed with a view to their structural working-out in each dimension. As is still to be shown, only on a subordinate level do certain parameters alter while others remain unaltered, so that there is complete freedom to combine with each other the possibilities of the various parameters. But even within such narrow limits, different degrees of effectiveness can be recognised. For the ensuing pieces, much more use was made of the possibilities of partial alteration, interchange of parameter functions; on this account, the dimensions could be hierarchically ordered according to their effectiveness, and their differing capabilities of characterisation could be assessed and used. This is the new order in which they came:

1. *Registers* – these are immediately noticed by the ear; they must be unambiguous, since the overlapping of registers opens the way to ambiguity and confusion – obviously one could allow this intentionally, but the effective potential of the parameter would, all the same, be reduced.

2. *Chronometric densities:* their characterising capacity is almost as great as that of registers; however, they can be still more effectively interchanged, owing to their inner articulation.

3. *Loudness* (as an all-embracing characteristic, which is only relegated to third place because of its small degree of variability).

4. The types of *morphological behaviour:* this subtly graded group of characteristics retains a high degree of effectiveness, particularly in the cases where only one single and extreme possibility is in play.

5. *Polyphonic density:* this parameter is effective, above all, when low densities have to be distinguished from neighbouring degrees of density – the distinction between high densities is less clear, except perhaps when it is reinforced by the other parameters; this parameter also depends on the one last discussed, since its indications can be considerably altered by the latter.

6. *Harmonic fields:* the great stylistic homogeneity of multi-polar harmonic structures, at least as regards the form in which they have up to now been handled, makes the various pitch intervals the weakest degrees of characterisation.

We must emphasise that this assessment applies only to the *Exercices de Piano*. The introduction of other elements – e.g. differing timbres in an instrumental group – could alter everything.

There follows a second operation, which is still more particular, since it has to be reconsidered anew for each of the pieces in the cycle: organisation and rationalisation within each individual parameter. This second operation arises directly from the first. Just as it has become necessary to keep a check separately on each of the characteristic qualities of a series of acoustic events, in order to obtain the maximum knowledge of their effects and interactions, it is equally desirable to determine the effect each individual alteration has on our perception. Thus there are two routes by which one arrives at the complete determination of, on the one hand, the 'complex characterising interval,'[21] according to which the relationship of two independent shapes is determined, and, on the other, the multi-dimensional degree of alteration, that regulates successive relationships. The simplest, strongest, most 'inert' formal energies, such as tonal convergence, regular metre and thematic repetition, are now denied their effectiveness. One wonders whether, instead of the criteria mentioned, these overall intervals, degrees of variation – in various realms of composition – will now become the dominant informative criteria of an era (one freed from the fatal forms of 'becoming'). We know of sketches by Paul Klee that allow us to infer something similar.[22] They were intended as preparatory work for the famous 'coloured chess-boards'. The colours for the various squares are given numbers. Perhaps one will see here a useless cerebral game, unrelated to the perceived result, to the wholly concrete and immanent meaning of the picture. Equal mensural

[21] *Trans. Note:* 'Interval' here signifies the overall, 'statistical' difference between two shapes, a difference resulting from the various differences in particular parameters.

[22] Cf. Will Grohmann, *Paul Klee*, Fontana Pocket Library of Great Art, Collins (London), Abrams, in association with Pocket Books, Inc. (New York), 1957.

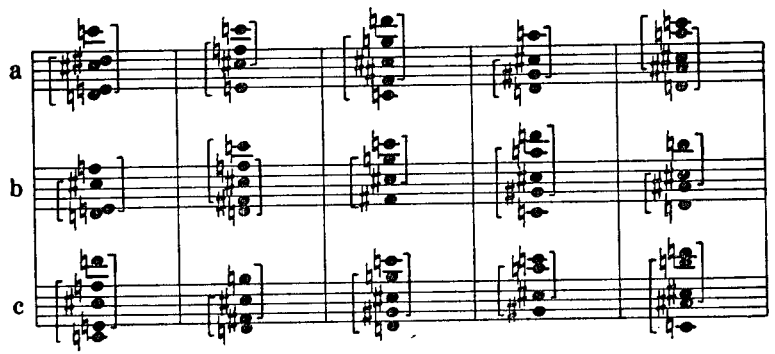
units for perceptible transformation – the latter being the element which can in fact be assessed only by the artist himself – here correspond to equally numbered distinctions. Can one, then, still doubt the effectiveness of the method by which the effective balance of colour distribution has been ensured? Are not results – such as the wonderful pictorial discoveries of Klee – the most convincing justification of this procedure? When one has once grasped the function of the methodical aids used by reason, it is possible, paradoxically, to end by formulating the concept of qualitative gradation; and by then, one is not far from 'information quanta'.

In order to establish a correspondence between the internal hierarchies of the individual parameters, and to be able to combine the latter's data more easily, I introduced a scale of five supra-ordered degrees for each dimension, each degree containing three subordinate possibilities. The relationship between supra-ordered and subordinate indices is not the same for each of the different parameters. Often it was a question of broadening the field, the 'band-scale' surrounding a mean value that was hardly, or not at all, variable (registers and dynamics in *Variations I* and *II*, morphological behaviour, chronometric and polyphonic density in *Variations II*); in other cases it was a question of two indications that were independent of each other – one for the overall articulation of a group, the other for its elements (morphological mode of behaviour, chronometric and polyphonic density in *Variations I*).

The *harmonic material* (A, see p. 67), in the two sets of *Variations* was derived from that of the *Impromptu*, through a further differentiation (it will assuredly also be used in the ensuing pieces). The following table shows the organising rules:

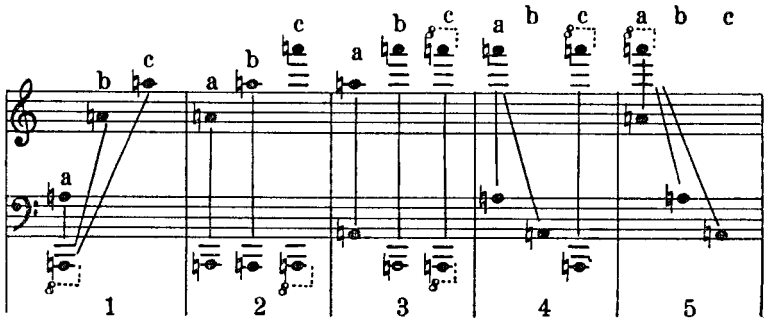
	1	2	3	4	5
Defined by:	(Maj. 6th)	(5th + Maj. 3rd)	(Tritone)	(Fourth + Min. 6th)	(Min. 3rd)
Secondary definitions	(Whole-tone + Maj. 3rd)	(Maj. 6th + Tritone)	(5th + 4th)	(Tritone + Min. 3rd)	(Min. 6th + Min. 7th)

Example 8.



Registers (B) are organised so as to use every possible compass of three, four, five, six and seven octaves (between the various octave-transpositions of the note A).

Example 9.



The customary *dynamic indications* (C) are grouped analogously; here the progression is expressed in average values.

	1	2	3	4	5
a	pp	p	mf	f	ff
b	ppp-pp	pp-p	p-f	f-ff	ff-fff
c	ppp-mf	pp-f	pp-ff	p-ff	mf-fff

Subtler alterations in intensity can, however, occur within each separate 'band', particularly in the places where the dynamic field is defined only by one single possibility.

We have already said, of the *morphological modes of behaviour* (D), that supra-ordered and subordinate indications are active on various levels of articulation. The subordinate indications, each with three possibilities, characterise the time-relationships between a complete group and the neighbouring groups. In the case of possibility (*a*), a group is directly linked with the two neighbouring groups; in (*b*), there is one short rest, of indeterminate length, before or after it (according to one's choice during detailed work); in (*c*), rests are added both before and after the group. If two rests overlap between two groups – one belonging to the preceding, one to the succeeding group – then they are added together; this is bound to make the total rest longer than the longest 'simple' rest in the piece, or at least in the section concerned. Thus the functions of single and double rests are distinguished in a way that accords with our perception.

The supra-ordered indications for (D), on the other hand, apply to the elements *within* the group; this is less of a paradox than it appears – after all, here we are dealing with a characterising element whose degree of effectiveness is higher. Since the overlapping of elements is produced by the subordinate indications for parameter F (number of polyphonic strata), this possibility has to be excluded from parameter D (morphological mode of behaviour), in order to avoid a further multiplication of overlapping elements, such as could not be realised on the piano. For a later piece, I found a

different way to avoid such overlapping: I introduced a scale of modes of morphological behaviour which depended on the number of strata at any particular point; for example, overlapping (as the maximum morphological possibility) is only used when it has not already been produced by another dimension (polyphonic density). This is another example of the dialectic of the parameters. There is no question of levelling down, or confusing the parameter forms – superimposition according to a morphological index produces an overall impression quite different from that of superimposition resulting from the polyphonic structure. Thus we find new possibilities of characterisation. In *Variations I* I retained only the indications governing direct succession or separation of the elements. There were two ways in which such separation was further varied: *staccato* (only the beginning or end of a duration being used for the note, the remainder being filled in by a rest), and *portando* (a note or chord being separated from the succeeding or preceding one by a short rest, usually with a 'comma'; this rest was deducted from the duration). The scale of five morphological modes of behaviour was obtained by combining the three basic forms, *staccato* (st), *portando* (p) and *legato* (l).

1	2	3	4	5
st.st.p.	st.p.p.	st.p.l.	p.p.l.	p.l.l.

Thus there is an average indication that applies to the morphological behaviour in a group. The transition from one type of formation to another is carried out quite gradually; even the two extreme possibilities have an element in common (st.p., – p., l.) It should also be mentioned that the influence of other parameters (chronometric and polyphonic density) can help to characterise the morphological behaviour of structures.

The subordinate factor for *chronometric density* (E) is simply the fixing of a duration for each group: (*a*) quaver, (*b*) crotchet, (*c*) dotted crotchet.[23]

The supra-ordered factor, on the other hand, fixes the number of attacks within a group-duration – a distribution that is settled independently for each polyphonic stratum. Naturally, different numbers correspond to the same index, when the latter is related to a different one of three group-durations; since a group's real density amounts to its speed as actually perceived, it must be made independent of its duration:

	Index 1	2	3	4	5	
Duration a	1	1	2	2	3	Number of elements per stratum
b	1	2	3	4	5	
c	1	3	4	6	7	

Finally, the subordinate factor for *polyphonic density* (F) determines the number of structural strata in a group (1, 2 or 3 strata), while the supra-ordered factor fixes the chordal density of the elements within each stratum. We should recall that the effective density of the elements is again made to depend on the number of strata, in order to achieve a total density that will remain roughly constant when the number of strata varies.

[23] Approximate durations, which in the different sections are subject to differing modes of fluctuation.

Number of Strata	Index 1	2	3	4	5	Average number of notes per element (chord)
1	1	2	3	4	5	
2	1	1-2	2	2-3	3	
3	1	1-1-2	1-2	1-2-2	2	

In the case of polyphonic and chronometric density, the subordinate indication (duration of a group, or number of strata in it) becomes clearer, the more the supra-ordered indication tends toward 1 (a single element per group, or a single note per element). There is no mutual adaptation of the two density-indices. For each of the six dimensions, as has been said, the final distribution of the elements was left free till the final detailed composition, which did in fact come after the organisation of the parameters. We will now discuss this detailed work.

As originally planned, there were to be five short pieces, each of which should receive, for each parameter, only one of the five supra-ordered possibilities. These five pieces were then to be joined together to make one long work, constructed very much like a set of variations – hence the title. However, none of the pieces gave the impression of being the model, the 'theme' for the four others; even though the degree of inner variability was the same for all five sections (independently of their varied character), each ran a quite different course. As will be shown later, the original rigid scheme was made considerably more flexible, through extrapolation of structural fragments from the various sections (pp. 75-80). But since this scheme does none the less exert considerable influence on the overall development of the piece, it will be shown here:

Parameter		A	B	C	D	E	F
Successive Sections	I	4	1	1	5	3	2
	II	3	5	4	4	2	1
	III	5	2	3	1	4	3
	IV	1	3	5	2	5	4
	V	2	4	2	3	1	5

(The various types of bracket in this table are simply to point out the differing degrees of alteration in each parameter from section to section: square brackets point out the greatest degree of change (1-5), round brackets the next greatest (1-4, 2-5), dotted round brackets the next greatest (1-3, 2-4, 3-5)). It will be seen that the various dimensions do not always unfold in parallel, that where there is a sudden jump in one dimension, there may be hardly any alteration in one or more of the others. For instance, at the transition from the first (I) to the second (II) section, there is a genuine change of register (parameter B), the highest register band following the lowest; in their most extended positions ('a', 1 and 5, see Ex. 9), these bands no longer border each other, being separated by an 'empty' octave. The dynamics (C) also alter very strongly. But the other four parameters (harmonic fields, morphological mode of behaviour, chronometric and polyphonic density: A, D, E, F), only alter by one degree; thus they confirm a certain continuity within discontinuity (though the latter is indeed very effective, since

it occurs in the two parameters that we have designated as quite specially pregnant). Similarly, the final section is separated from the preceding ones by the greatest possible decrease in chronometric density (E, 5-1), and an almost equally great decrease in loudness (C, 5-2), but the other parameters change only slightly, particularly register and polyphonic density (B, 3-4; F, 4-5), so that there are links between the last section and the others. The changes between the second and third sections are smaller, but they occur in more of the parameters, and there is practically no compensation in the form of really small degrees of change, which would bridge over the gaps. We shall still have to show how extrapolations have an opposite effect, concealing the breaks as far as possible (pp. 75-80). The most gradual transition is from III to IV; the 'small degrees of alteration' occur in the most effective parameters, while the sudden jump in the harmonic field has only a very secondary effect. In fact, it is the distinctions in morphological behaviour that are felt the most strongly; in III the elements are separated the most widely, while in IV the greatest chronometric density serves to join them up again as 'grace-notes'; the more numerous indices for longer-sustained notes (*portando*) are applied to the notes that are in themselves the longest. Thus long-held chords are bordered by a number of very short ones; they pave the way for the long isolated chords of the last section (cf. also Ex. 11 and p. 76). Here, then, we are dealing with space that unfolds in many dimensions; with a complex and partly divergent development of characters.

If one looks more closely at the development in parameters, D, E, and F, remembering that each of the five sections is characterised by a principal tempo (these tempi are in accordance with the general ordering of the development, since they run absolutely parallel to the dynamics of the piece, and thus in contradiction to the chronometric density – for example, in II and III), then it becomes clear how far multi-dimensional movement has a merely assistant function in this work – the function of obscuring the crude, sloping form produced by a linear and convergent development. For this development has a beginning, a period when its tension rises with increasing rapidity, leading to a regular climax (IV), followed by a much quicker release of tension, which finally brings to an end the overall 'gesture' whose development makes up the piece. However, variation within each section can give enough nuances to the tension as it runs its course, thus justifying the work's overall length.

Each supra-ordered parameter indication for *one* section has three subordinate ones. These already provide, for harmony, registers and loudness, possible ways in which the characters can approach each other, overlap or interpenetrate. The subordinate harmonic index (*b*) and the register- and loudness-indications (*a*) can definitely be regarded as typical 'characterising poles'. But the two other possibilities for harmonic alteration, and those for broadening the field in the other parameters, are related to each other and produce continuity in the transition from one of these poles to the other; i.e. harmonic fields can contain intervals in common, while register-bands and loudness-bands are important zones for dovetailing. In the three remaining parameters, the three subordinate possibilities (three durations, three group forms, three polyphonic densities) are common to the three supra-ordered indices. The subordinate possibilities are distributed as follows: each of the five principal sections is divided into nine structural sequences with varying degrees of variation. The gradation in variability can be seen from the following table:

Sequences (Scalar arrangement, not as arranged in the final structure)

Parameter	I	II	III	IV	V	VI	VII	VIII	IX	
A	1 (a)	2 (ab)	3	1 (b)	2 (bc)	3	1 (c)	2 (ac)	3	Number and character of the subordinate possibilities in each parameter
B	1 (a)	1 (b)	1 (c)	2 (ab)	2 (bc)	2 (ac)	3	3	3	
C	1 (a)	2 (bc)	1 (b)	3	2 (ac)	1 (c)	3	2 (ab)	3	
D	1 (a)	1 (b)	2 (bc)	1 (c)	2 (ac)	3	2 (ab)	3	3	
E	1 (a)	1 (b)	2 (ac)	3	2 (ab)	1 (c)	2 (bc)	3	3	
F	1 (a)	2 (ac)	1 (b)	1 (c)	2 (ab)	3	3	2 (bc)	3	
Sum of the subordinate possibilities for each sequence	6	9	10	11	12	13	14	15	18	

The type of subordinate indication varies from one section to the next, according to these figures. Thus, for example, the first type of sequence, with one value per parameter, uses only the index (*a*); other sections contain several indices for the various parameters. The total of subordinate possibilities of variation for each section (bottom row of the table) shows a growing enlargement of the potential of variation, if not in the form of exactly proportional determination; if one wished to formulate the latter, the relationship of the potential variation between one section and another would be better expressed by multiplying, rather than adding, the individual variation-figures in each vertical column. Even then one would merely have data concerning the possible variability, which does not necessarily correspond to the real variability. In fact not all the possible connections between the individual indices are exploited, for the richness of parameter functions in each section must remain independent of the duration and number of groups, in order to be able to determine more exactly the speed of the various developments. The latter, again, is variable, and not only from one section to another (or, to be more exact, from one set of three sequences to another); more significantly, the average number of groups per sequence is also varied in each of the five principal sections.

	I	II	III	IV	V	
Number of Groups	6	6	5	4	4	
	9	8	7	5	6	← Average number
	12	10	9	6	8	

The variability of the average number of groups per sequence produces an acceleration in the tension-curve of the entire piece. Only the 5th section holds up this development, in accordance with its function of releasing the tension. Moreover, in no section does the arrangement of the degrees of alteration per sequence correspond to the scale of magnitudes given above, because within each section this arrangement is linked with another graduated scale of variability, different in each case. Finally the group-indication for the sequences – with regard to the variably characterising parameters – was handled 'dialectically'. If a parameter indication occurred several times for the same sequence, it was combined as often as possible with the differing indices given the other parameters. An example of this: a sequence is to contain eight groups; each parameter gives two subordinate indications (a type of sequence V); for A and B there

results the single connection ac, for C and D the connection ab, for E and F the connection bc. The final indication for the eight groups looks like this:

Groups (non-structured scalar arrangement)

Parameter	I	II	III	IV	V	VI	VII	VIII
A	c	a	c	a	c	a	c	a
B	c	a	a	c	c	a	a	c
C	b	b	b	b	a	a	a	a
D	b	b	a	a	a	a	b	b
E	b	c	b	c	c	b	c	b
F	b	c	c	b	c	b	b	c

From this arrangement the most varied shapes result. Degrees of variation have thus been used to the maximum effect in the characterisation of this structural sequence. (If there is an odd number of variants in each parameter, and the number of groups is not a multiple of one of the numbers of the parameter variants, then the choice of connections becomes rather more difficult.) As there is freedom of choice in the arrangement of the groups within the sequences, one can join up groups that are related to a greater or lesser degree; one can thus discover the combinations best designed to further the inner unfolding, with a view to the overall development of the sequences. (We must point out that this preparatory organisation leaves enough latitude for the final settling of details during the work of detailed composition; it is itself an act of creation, even though it is always directed toward the final stage in the working-out. In the end, *one* configuration, *one* precise type of distribution for the elements always emerges as the best one possible. Is this not sufficient proof of the concrete effectiveness of a 'preparatory' organisation of the parameters? Seen aright, this will be recognised as a factor in that freedom of choice which is indispensable for the creative process.)

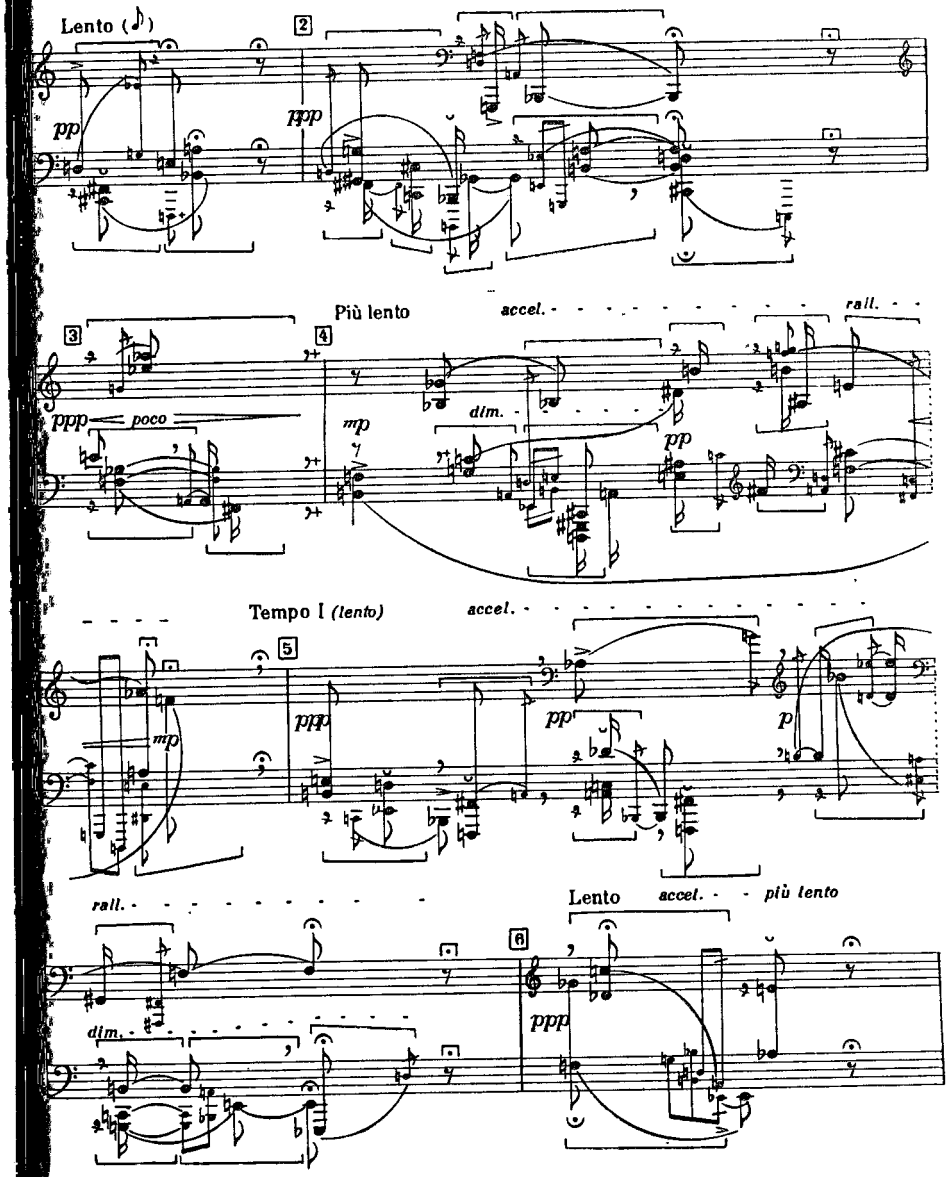
And yet, as so far described, the model for the development of *Variations I* was unsatisfying. If the five structural blocks were lined up, this did not satisfy the desire for an organic and constantly surprising form. The various characters needed to be juxtaposed in an incomparably more subtle way, so that a greater number of varied types of transformation would be made possible. And on the other hand, the piece would gain in cohesion if the informational data could be made to interpenetrate more effectively. The overall organisation had already produced a certain sense of coherence, with a unified development, so there was no reason why this should not be carried as far as possible, even if, as a result, one later had to abandon, where they contradicted the general stylistic awareness, the modes of thought that aimed at development. A new organisation of the overall scheme was produced by a system of extrapolation and interpolation of sequences between one section and another. For this purpose, a varying number of sequences were removed from each section (one sequence from I, three from II, two from III, four from IV, none from V); these isolated sequences were interpolated singly in one of the other sections, in such a way that the number per section again varied, correspondingly inversely to the number of sequences extrapolated (three sequences in I, one in II, two in III, none in IV and four in V). This is the scheme:

I	I	[IV]	I	I	I	[III]	I	I	[II]	I
II	II	[IV]	II	II	II	II				
III	[II]	III	III	III	III	[IV]	III	III		
IV	IV	IV	IV	IV						
V	[IV]	V	V	[III]	V	V	[II]	V	[I]	V V V

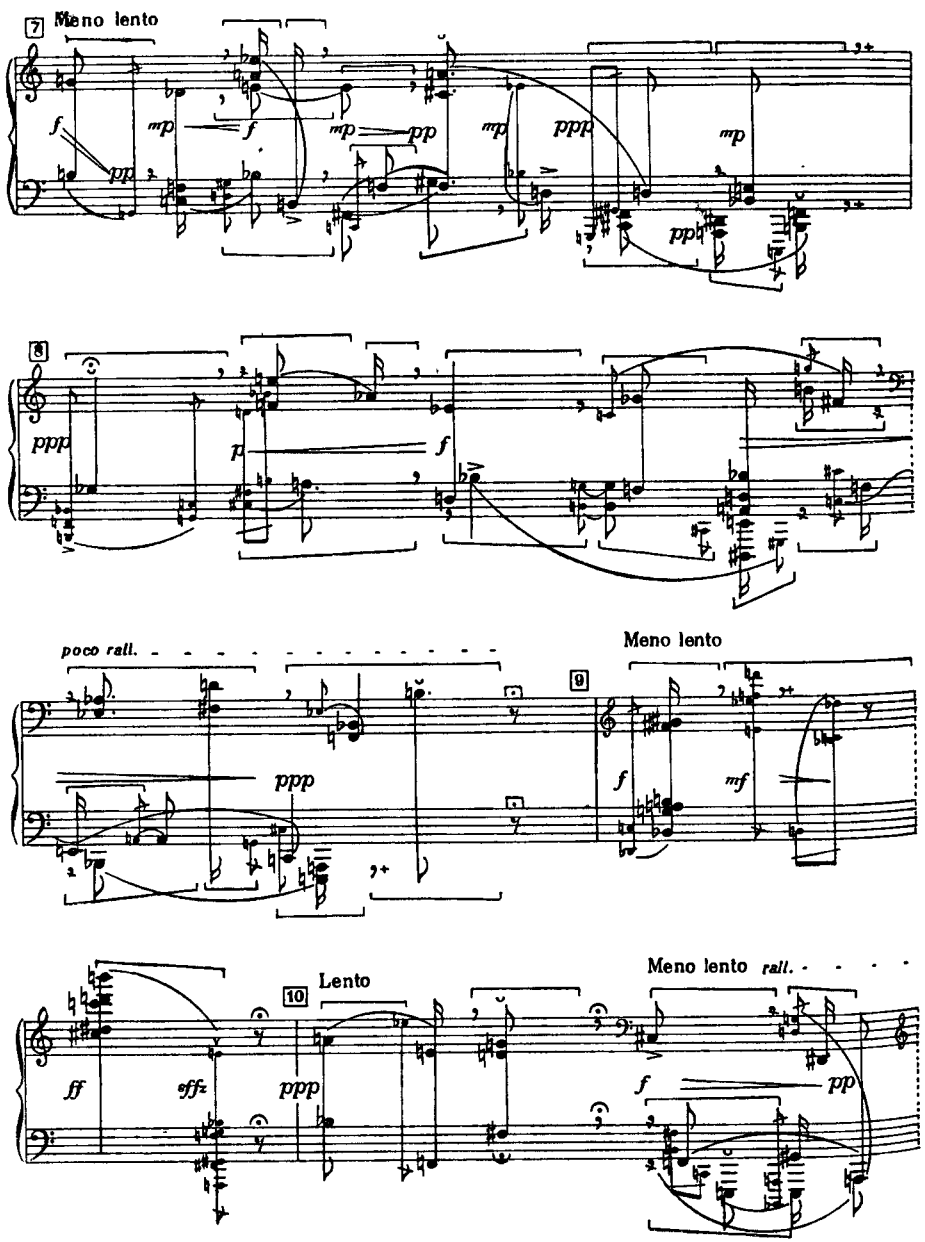
The length of the various sections is thus altered a good deal, and this alteration again confirms the function of each individual section within the overall course of the development. The characteristic type for each section is brought into confrontation at least once with that of all the others. But when the juxtaposition occurs twice – in the direct succession of the sections, and within a 'foreign' section, as the result of interpolation – it proceeds in just the same way as if it happened only once; a sequence interpolated into a foreign section mingles there, above all at the beginning and end, with the neighbouring sequences. The transition between the different sections (I to II, for example, taking place I, II, I, II) consequently has the form of a conflict between opposed characters, a conflict which gradually resolves itself. Such a resolution can take place in different ways. If the first juxtaposition of two characters is still fairly abrupt, then the ensuing alternations reduce the tension, in that the first character is replaced as gradually as possible by the second. This happens, for example, in the first section, at the first introduction of the 'formant' characterising section four (bar 9 of Ex. 10). The reverse is the case between sections IV and V; the first element of type V (the only character that has not so far occurred in the course of the piece) is a long five-note chord, taking up the entire length of a group; it has the effect of a natural continuation of what has gone before – the piling-up of energy through the whole of the third and fourth sections. The chord still has characteristics in common with the fourth section – high density and loudness, and almost all its characteristic intervals. The only really new factor is its extrême length, the greatest to have occurred in the whole course of the piece so far (bar 112, Ex. 11); this characteristic is well suited to the chord's function of interrupting the preceding increase in movement. It has already been prepared by the fact that, toward the end of IV, this movement broadens out considerably, and also by a long rest immediately preceding it. The chord is also followed by a rest, after which it seems, more than once, that the excitement is again on the increase – the dynamics again rise from a low level to *fortissimo*. But another rest, that makes us expect another climax as the 'natural' sequel to this crescendo, is unexpectedly shortened, and the ensuing chord (bar 114) is suddenly struck *pianissimo*, i.e. at a dynamic level that has not been used for a long time. Whereas the first chord slowed up the movement preceding it, but then appeared to lead to its resumption, here the break is finally completed because of the great difference in loudness, and this inevitably affects the development of the form, by liquidating the energies that are opposed to a decrease in tension.

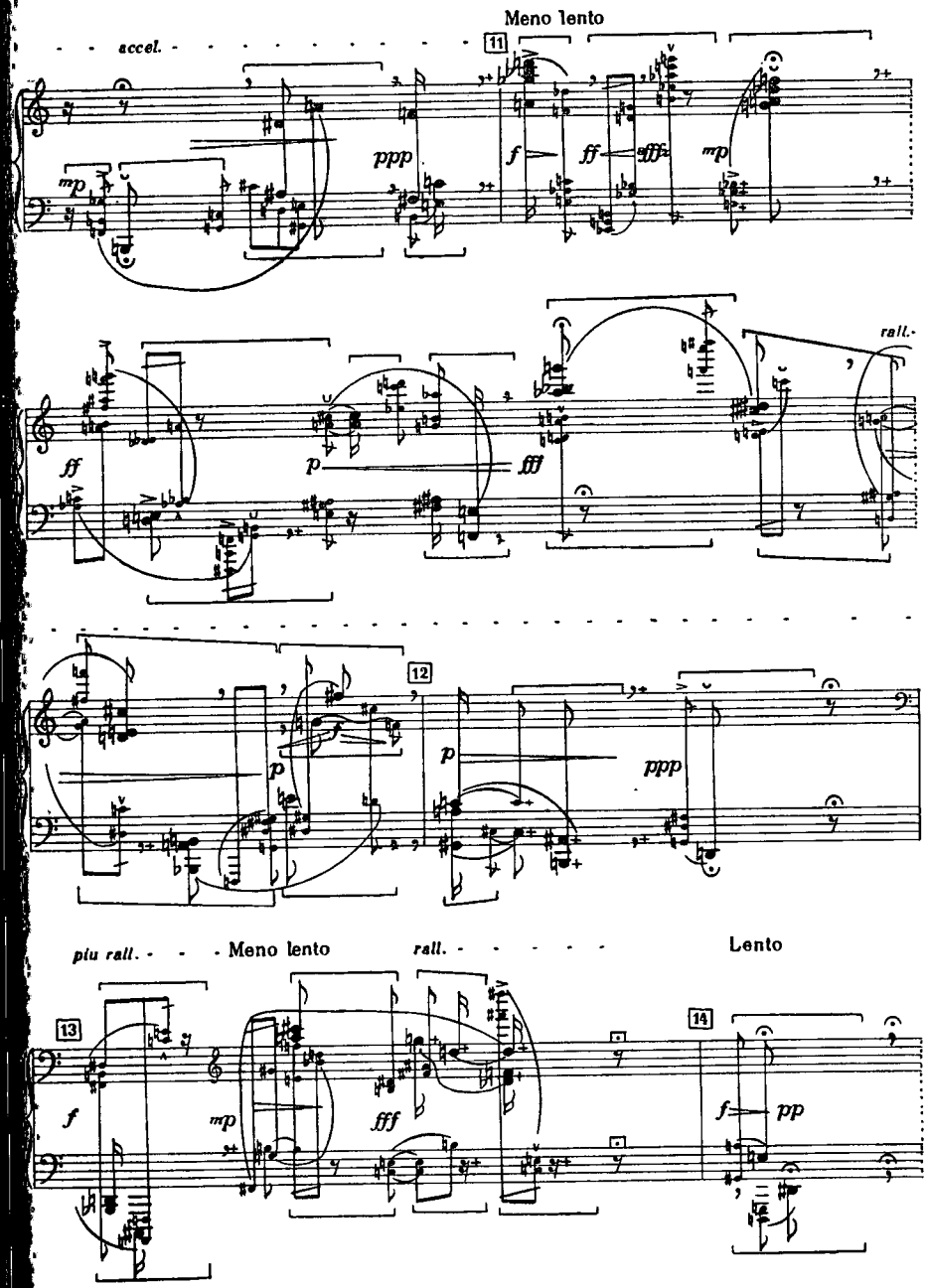
Thus the transition between the two sections is here carried through gradually, and the moments they have in common are the first to appear. The conflict is prolonged for a short time; because the sequences from III and IV have a common function in the outer

VARIATIONS I



Example 10





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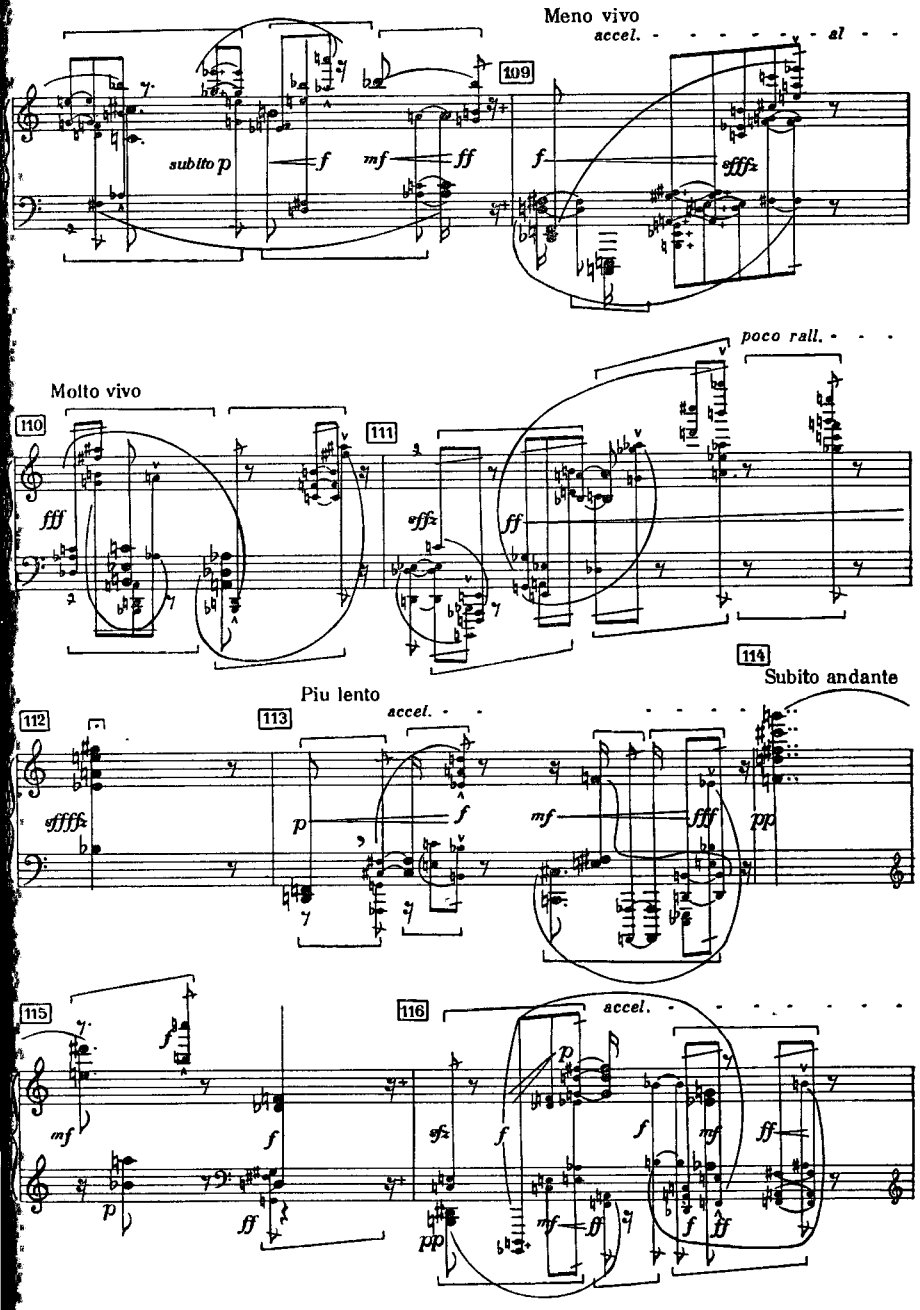
of the climactic central phases, they have taken on a similarity of character that now makes it possible to perceive them unitarily. The type III groups which, in section V, occur temporarily after the liquidation of the type IV structures, are automatically felt to continue the conflict between the elements of dynamic onward movement and those tending to apply the brake; at the same time, they confirm the decrease in tension which seems to be setting in. Since the whole rise and fall of the form in this piece is grasped unitarily, and the middle sections seem to be a broadly laid out development of the first section, the elements from III are remembered directly; it is not a matter of recognition, but of perceiving something always latently present in what is actually happening. In contrast, the interpolated sequences from II and I, which appear toward the end after a brief development of the typical V character, have a quite different memory-quality. The preceding element that they recall has been practically forgotten and wiped out. When, in this fifth section, the interpolated sequences now appear, in quite different surroundings, one can no longer speak of a traditional type of reprise, that would lead to the complete recognition of element-formulae previously stated. What does result, though, is the impression of a return to the beginning.

This must be recognised as to some extent reintroducing into composition modes of thought taken from traditional 'symphonic' form. If this process became at all general, its validity would be called in question. But one may ask whether certain very general lessons in the handling of form could not be of interest even today. Might it not, for example, be possible to free them of their irresistible quality, and to incorporate them in our multi-dimensionality? In fact, the *Variations I* would have an extremely 'strong' and resistant form by the standards of composition where certain 'natural' laws of organisation are in force. It would be as well to split up such second-order centripetal energies (the first-order ones were the genuinely tonal energies, including those of metre and thematism) by making them neutralise each other; one would thus arrive at a musical form that left them as little room as possible. The criterion of the organic quality of a work is unavoidably a criterion of its effectiveness, though only in a limited sense. To make a qualitative criterion out of it, as has been done, was a mistake. The origin of this criterion, and of the concept of form in post-Renaissance music, was an authority which accorded with the most active and elemental musical energies. If the development of present-day musical thought has been fired by the idea of emancipation, by the idea of exploding these energy-relationships; if the deep significance of Webern's mission (which we first found it possible to appreciate in the realm of harmony) lies in the fragmentation of musical shapes, the immanent concretising of everything momentary; then is it not precisely this criterion of organic quality that is called in question? Must we not therefore carry further our research, with an eye to this fragmentation, discontinuity, asymmetry and ever more integral eccentricity? And should we not, therefore, treat spontaneous inspiration sceptically? There is a risk that it would turn out to be irresponsible. Must we not, at least for a time, try to re-establish our faith in spontaneous inspiration, before we let improvisatory ideas have their head? And would not detailed composition then have to be either dynamised through certain chance factors, such as we met in describing the *Quintet*, or practised even more strictly, checked by the intellect, by a theoretical intelligence which would reveal to our fantasy very many paths that were even more unknown and audacious? It was from such questions, hypotheses and suppositions that the plan for the ensuing piece, *Variations II*, arose.



Example 11

5. *Variations II*

In *Variations I*, the primary elements in the process of composition were determined by the musical 'characters', which were completely fixed in all their supra-ordered dimensions. Characterising intervals and degrees of variation were derived directly from the arrangement, line-up and interpenetration of these relatively unalterable 'formants'. Thus the process of composition was in direct control of developments. Yet this control was always in the interests of simplification and co-ordination, since momentary degrees of variation were subordinated to more important, more directed lines of development, and were absorbed by them. Nothing of the sort was to happen in *Variations II*. My efforts had now to be directed principally toward actual degrees of variation and types of development, and the final configuration of the acoustical structures could then become a secondary criterion. Each main index for a parameter had first of all to be combined once with all others, so that varied transformation, excluding all parallelism of the parameter indications, would give rise to genuinely multi-dimensional development. Proceeding from the table in which the degrees of variation for the sequences in *Variations I* were assembled (p. 72), a new table was now worked out, to arrange all fifteen possibilities for each parameter (five supra-ordered indices, each multiplied by three subordinate ones; all fifteen are now treated as of equal value). The resultant distribution of the degrees of variation was to hold good for the work's seven time-sections.

Sections

Parameter	I	II	III	IV	V	VI	VII
A	1	2	5	4	2	4	3
B	2	2	1	3	4	4	5
C	1	2	2	4	5	3	4
D	2	3	1	2	4	4	5
E	1	2	2	3	5	4	4
F	3	2	4	2	1	4	5
Totals	10	13	15	18	21	23	26

Example 12

The figures in the seven columns are values in a scale of parametric richness; naturally they are only an approximation to their effective proportions in the overall structure. They determine the number of indices per parameter within the various time-sections. Horizontal addition of the figures always produces a total of 21. The final term in each group of determinants has formal ties with the one that follows. For Parameter A, the effect is: |1|1 + |1|4 + |1|3 + |1|1 + |1|3 + |1|2 + |1|

Accordingly, six indications held in common by two groups would have to be subtracted from the total of 21, as 'turning points', and this gives a total of fifteen indices in each parameter. The totals of the vertical columns, indeed, give no information about the actual relationship of the degrees of variation, but they do show us the regularity of their increase (10, 13, 15, 18, 21, 23, 26). This succession of seven columns is repeated three times in the course of the piece. The arrangement of the columns, and of the series which are written on top of each other, is different in each of the three repetitions. Lastly, the three groups of columns are related to each other, by each having a member in

common, so that, throughout the piece, the degrees of variation can be constantly controlled.

After the internal structural organisation of the table is settled, the fifteen parameter values are arranged in a particular order, and this happens separately for each parameter. This order, which is different in each of the three major structures, is in fact the decisive idea that settles the characteristic course of the piece. There will be changes in the detailed organisation of degrees of transformation, and of subordinate modalities, but their basic direction will be retained. Here is the table of the fifteen values in each of the six parameters; it applies to the first of the three main structures. Here the fifteen upright columns are again subdivided into seven sections, with the aid of the preceding table:

1. Arrangement of the fifteen indices for the parameters (section 1):

A	5c	2a	4a	1c	3b	1a	2b	3c	4b	5a	4c	5b	2c	3a	1b
B	5c	4b	3a	2b	1c	2c	1a	4c	3b	5a	3c	5b	2a	4a	1b
C	5b	3a	4c	1b	2c	3b	1c	4a	2a	5c	5a	4a	3c	2b	1a
D	5b	2a	4a	1b	3c	1c	2b	3a	4b	5c	4c	5a	2c	3b	1a
E	5a	4b	3c	2b	1a	2c	1b	4c	3a	5b	3b	5c	2a	4a	1c
F	5a	3b	4c	1a	2c	3c	1b	4a	2a	5b	5c	4b	3a	2b	1c

Example 13

2. Structural arrangement of degrees of variation (section 1):

	III	IV	I	VI	V	II	VII
A	5	4	1	4	2	2	3
B	1	3	2	4	4	2	5
C	2	4	1	3	5	2	4
D	1	2	2	4	4	3	5
E	2	3	1	4	5	2	4
F	4	2	3	4	1	2	5

Example 14

Combination of these two tables finally gives a succession of seven groups, in which the number and character of the parameter indications vary from one parameter to another; they exactly determine the dimension-field within which each formal section can develop. As an example, here are only the first two groups:

A	5c 2a 4a 1c 3b	3b 1a 2b 3c
B	5c	5c 4b 3a
C	5b 3a	3a 4c 1b 2c
D	5b	5b 2a
E	5a 4b	4b 3c 2b
F	5a 3b 4c 1a	1a 2c

Example 15

These two groups serve an early phase of the development, which they show in the form of a tabular arrangement of five columns each; here, each parameter is provided with five data, though this sometimes happens through the mere repetition of the same index (5b, 5b . . .); later this is to make it possible both to control the duration of the sections (independently of the parametric richness as given at the outset), and also to produce a larger number of different developmental speeds:

A	5c	2a	4a	1c	3b	3b	3c	1a	2b	3c
B	5c	5c	5c	5c	5c	5c	4b	3a	5c	3a
C	5b	3a	5b	5b	3a	3a	4c	1b	4c	2c
D	5b	5b	5b	5b	5b	5b	5b	2a	5b	2a
E	5a	4b	5a	4b	4b	4b	2b	4b	3c	2b
F	5a	3b	4c	5a	1a	1a	2c	2c	1a	2c

Example 16

The identical columns at the end of the first group of five and the beginning of the second can be seen as a single determining field. Each of the columns of five receives a 'variable number of groups to be realised', and its own developmental speed. In order to get from the first column of a tabular block to the last, twenty-four 'mono-parametric' part-operations must be carried out. These are grouped to form a variable number of complex transformations; they are to be related to 'statistically' characterising intervals. We show three serial types of transformation in their scalar arrangement:

a:	1	1	1	1	2	2	2	2	3	3	3	3
b:	1	2	2	3	3	4	4	5				
c:	3	3	4	4	5	5						

Example 17

These figures show the number of simultaneous part-transformations. There is always at least one transformation, and never more than five. Accordingly, in every complex operation, at least one parameter remains the same; this ensures that the character has a modicum of continuity. The total of the part-operations is always 24, and the last complex operation automatically leads to the appearance of the fifth column of the table, with which a new development begins. Thus, the three types of series (Ex. 17) in fact define different developmental speeds; none the less, the parametric 'richness', to which they are related, will not be without its effect on this speed. Finally, an independent serial process will decide which parameters are to be subjected to effective transformation in a complex operation; and this will be done so that, at the end, each parameter has gone through its four transformations before arriving at the fifth column. Let us further demonstrate this elaboration of the two tabular blocks; the operational plan is determined by these series (the vertical columns show the parameters that are transformed):

A	F	C	D	B	F	D	E	C	D	A	F	C	A	D	F	C	E
B	E	E	E	F	D	E	F	B	C	B		D		E	B		
C	C	A	A	A	B	F	B							F	A		
	B	F	C	C													
		D		E													

Example 18

We now see the way in which one parameter can be transformed several times in succession, while another remains constant. On the other hand, these operational series ensure that the transition from one section to the next will not become a clearly localised boundary. The group succession of the indices, produced by applying to the two tabular blocks the two serial successions just given, looks like this:

A	5c	2a	2a	4a	1c	3b	3b	3c	3c	3c	3c	1a	1a	1a	2b	2b	3c	3c
B	5c	5c	5c	5c	5c	5c	5c	5c	4b	3a	3a	5c	5c	5c	5c	5c	3a	3a
C	5b	5b	3a	5b	5b	3a	3a	3a	3a	4c	1b	1b	1b	4c	4c	4c	4c	2c
D	5b	5b	5b	5b	5b	5b	5b	5b	5b	5b	2a	2a	2a	5b	5b	2a	2a	2a
E	5a	5a	4b	5a	4b	4b	4b	2b	4b	4b	4b	4b	4b	4b	4b	3c	3c	3c
F	5a	5a	3b	4c	4c	5a	1a	1a	2c	2c	2c	2c	2c	2c	2c	1a	2c	2c

Example 19

The degrees of transformation depend in each case on the interference between parametric richness (fixed by the five-column table) and the duration (the number of groups) during whose course the variation-potential must be used up (this duration is determined by the series of complex operations). The quickest transformation is produced when a very 'rich' section of the table is combined with the shortest transformation series. The inner 'flow' of a transformation series can, however, lead to peculiar contradictions; when, for example, the operational plan dictates that the parameter is to be transformed several times running, while the tabular succession of the indices contains only one single unchanging possibility; in this way the flow is, as it were, brought to a standstill. Thus the original arrangement of the transformations is at times violently altered by the arrangement of the individual parameter values.

Each column of the preceding table contains the parameter indications for one structural group. Their succession determines the arrangement of the complex characterising intervals which are actually to be perceived; yet here it is always a question of 'statistical' indications, of the interval structure which is to determine the final harmonic profile of a group, of the acoustic 'region' – according to frequency and dynamics, variable in its average value and in amplitude – in which this interval structure can develop; and of the number, the average morphological behaviour and the average chordal density of the elements. The final distribution of the individual characters is a matter for the final detailed work, and is settled separately. The inner direction of a group, in the combined effect of all the parameters, is a result of the 'interval' (cf.

Footnote 21) that distinguishes it from the groups beside it. Thus one degree of transformation can demand a progressive movement in the direction of the new character index, while another makes just the opposite necessary. Since, at any given point in time, the degrees of transformation are not the same for all the parameters – neither in magnitude nor in direction –, they can converge or diverge or even remain stationary in some parameters. The characterising 'interval' also influences supra-ordered group-indications – and this no longer only in individual parameters but completely; e.g. duration, or the morphological behaviour of groups in contrast to the ones neighbouring them. This or that degree of variation, this or that number of parameters that transform themselves – not in parallel – determine whether the succeeding group is to be short or long, overlapping with the preceding one or separated from it by a rest. In fact, this dependence often varies in its morphological behaviour from one of the seven sections to the next; several groups may overlap, and later they may be more clearly separated. Moreover, the tempo of each group is conditioned by chronometric and polyphonic densities. The following table shows this. The greatest polyphonic density, applied to the greatest chronometric density, demands a slower tempo, if performance is to be possible; the greatest chronometric density, combined with the lowest polyphonic density can, on the other hand, be further reinforced by an extremely quick tempo.

Chronometric Density

Polyphonic Density	1	2	3	4	5
1	1	2	3	4	5
2	4	5	3	1	2
3	2	4	3	1	5
4	2	1	3	5	4
5	5	4	3	2	1

Tempi

1 = *Lento*
2 = *Andante*
3 = *Moderato*
4 = *Allegretto*
5 = *Vivo*

These are 'point' indices. They are subordinate to more important curves of development; the direction of the latter is produced by the constellation of the 'point' indices, by the 'interval', that can produce interruptions, sudden changes, as well as gradual transitions. Alteration of the prescribed tempo has often been replaced by mere alteration of the length of a group, if this was of assistance in maintaining aperiodicity of durations; this makes detailed composition easier and simplifies the appearance of the printed page.

The development of *Variations II* is much less decided, much less linear than that of *Variations I*. The successive characters are constantly renewed; the 'form' of this piece is less rigid, less resistant. One might ask whether in *Variations II* the development pursues an arbitrary course, and whether it would still produce a comprehensible effect, since it lacks an unambiguous direction of development. We have said that every more-or-less autonomous shape is given its function within the whole by a characterising 'interval', that places it in a certain relationship to the neighbouring shapes, and also to the totality of all the shapes in the piece. The concept of multi-polarity has already been introduced in the realm of harmony, and we could now apply it similarly to musical shapes. In this piece there is no development from one point to another (such as there is in *Variations I*) – the significance of each shape results from its 'milieu'. This kind of

form no longer forces the hearer to participate in, and follow, a flow of tension; he remains, rather, outside the tension and takes part more freely in the multiplicity of musical events; he can more readily discover the relational system, the scales, the points of orientation in the work, since he is farther from it. It is certain, however much one may doubt it, that the interpreter has far more freedom to determine the final form of this music. The three major sections of this piece are linked by groups of members in common, and the last group of the third section is identical with the opening group of the first section. This group was not composed twice. Arriving at the end, the interpreter can start again at the beginning, without any interruption. This does not mean unlimited repetition; the player can, rather, begin with any one of the three sections and play out any version he chooses; he can, equally, introduce other pieces from the cycle in between these fragments. A piece as self-contained as *Variations I* could never allow such freedom; this is reserved for the typical 'weak' form of *Variations II*. Such a form is no less valid; it is rather the expression of that general emancipation of which we have already spoken a number of times.

Now we must describe certain modifications of the material of *Variations I*, as used in *Variations II*. General indications for the subordinate parameter indices of morphological behaviour, chronometric density and polyphonic density are replaced by the criteria of inner tension, or of the amplitude of the field within which the elements can be chosen. The subordinate index of chronometric density now determines the field within which the elements can vary in duration; this field is bounded by two extremes – the durations can be identical in length, or as different as possible. Polyphonic density is organised according to the following table:

	1	2	3	4	5
a	1	2	3	4	5
b	12	23	234	34	45
c	123	1234	12345	2345	345

The numbers no longer indicate the average of the indices, but the only possible chord density in a group. Their number varies according to the subordinate index. The morphological parameter is handled analogously; since the number of strata does not vary, elements can again overlap. The table of morphological modes of behaviour is identical with that of polyphonic densities; in this case, the figures have the following meaning: 1 = *staccato*, 2 = *portando*, 3 = *legato*, 4 = overlap with the succeeding element, and 5 = overlap with the *two* succeeding elements. It can happen that the various notes of a chord have different indices taken from among these five. This is necessary because certain groups that had only one chord – minimum chronometric density – had more than one morphological datum. Since the formal principle was now to apply to all groups, no exception could be made for those with only one chord. Yet, as a general remark, it should be said that when the inner variability of a group increases, this group is always less distinct from its neighbours. What one gains in internal tension, one loses in external tension. This could already be a partial solution to the problem of rationalising the relationship between the internal structure and the external, subordinate, function of a shape.

Let us recall again what was said about the influence of the morphological parameter on the general speed; that, for example, at great polyphonic density, as soon as the duration of overlapping elements is prolonged, an impression of slowing down is produced, without its being necessary to alter the distance between the attacks. Let us note, too, that in *Variations II*, the actual chronometric density is also reduced, the number of polyphonic strata remaining constant. In *Variations I*, each stratum of a group contained the number of elements prescribed by the chronometric index. Each stratum had its own chronometric structure; notes in different strata were only occasionally struck simultaneously. Thus, with the increase in the number of strata, the number of perceived attacks also rose in a definite ratio. Finally, in *Variations II*, the element of chance (consisting of the free play of the parameter indications, and of the 'operational series') favoured a low chronometric density (and also high polyphonic density, high registers and predominantly small amplitudes). Consequently, this piece gives the impression of moving slowly; there are only a few moments of increased speed.

It would now be possible to differentiate the individual characters more strongly, by making more effective use, among other things, of the virtuoso possibilities of the piano, introducing greater chronometric densities. This will be done in the next piece, *Caractères*, which consists of four short piano pieces, varied in character. Here the original plan for *Variations I* is taken up again, though the preconditions are wholly different. However, each piece is characterised not merely by *one* possibility per parameter, but by a number that varies between 1 and 4. Apart from this, each piece has a different total of possibilities, and the breadth of the 'dimensional field' for each piece varies independently of the number of indices. As a new possibility, 'formants' can contain two or more different possibilities for a parameter simultaneously, in various groupings, instead of only one. The characters are now, from the outset, predetermined by an interval or even a whole field of characterising intervals, not by isolated characteristics. Thus our work on harmonic fields has been resumed, at a different level. If our method, thus broadened, is applied to the parameters, the relatedness of shapes can be either strengthened or obscured; the variety and effectiveness of structural types is thus considerably increased. So here, too, there results a further partial solution to the problem of the relationships between a shape's structure and its function.

The performer is free to link the short pieces of the *Caractères* with fragments of *Variations II*, giving the whole as much continuity as possible. The structure of the *Caractères* is sufficiently 'open' to permit such an operation. Pieces like *Impromptu* and *Variations I* – strong, wholly self-contained forms – should be clearly marked off from the other pieces when the entire cycle is performed. As conclusion to the first cycle *Exercices de Piano*, there will follow a piece for two pianos,[24] entitled *Fonctions*. In this piece, there will be a synthesis of all the compositional methods described.

[24] Commissioned by the Basel branch of the I.S.C.M. to celebrate the thirtieth anniversary of their foundation.

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YOUNG COMPOSERS

WOLF-EBERHARD VON LEWINSKI

'That's a power of notes, my dear Mozart', said Emperor Joseph the Second to his future court composer after the première of *Die Entführung aus dem Serail* on the 16th of July, 1782. 'Just as many as necessary, Your Majesty' is supposed to have been Mozart's reply (according to Niemetschek, one of his earliest biographers), and we can well believe this, not only because Mozart was one of the very few composers in music's history who did in fact write only the number of notes needed to give intelligible expression to purely musical thought. One could quote many examples that would lend support to Mozart's claim – let us here recall only his G Minor Symphony (K. 550), in whose Finale Mozart works out the first subject in such close stretto, and so tightly interlaced, that there is no longer any question of entertainment, the 'play of notes' – a field of total chromaticism seems to have been created, and one may legitimately regard it as a precursor of dodecaphony. This is also the case in other works by Mozart, because of his extreme condensation of objective musical procedures.

It is in Rossini's music that we find the opposite pole to this Mozartian way of composing – the compromise way, let us say the more entertaining of the possible ways of composing music, not with an eye to the unflawed exposition of musical essentials, but aiming at a mechanically smooth motoric quality that reduces melodic inspiration to the flatness of uniformity, and trusts to ostinato technique and its associations, which are as unmusical as they are empty-headed.

Whereas once Mozart and Rossini were the opposite poles in music, our century sees a much wider gap between entertaining and unentertaining music, for today there are three groups of music – not only the customary wireless categories of Light and Home, light and serious music. In the first place there is the sort of 'light music' that can be summed up by adding a question-mark after 'music'. Secondly there is the wide range of sentimental 'music for pleasure', whose character is more or less clearly that of a Divertimento – throughout classical and romantic music one comes across this. The third, very small group, is that of music which makes no concessions and is not in the least entertaining, from various works by Bach, many by Mozart and the late works of Beethoven, down to those of Debussy, Schönberg or Webern. The works in this group proclaim the fact that music has not the first thing in common with nature, but is a discovery of the human intellect.

A sensation, said Wagner (of all people) is an effect without a cause; but later Karl Kraus added the rider that art is cause without effect. Are we now to witness the spread of music stemming from the brain, not the heart – coldly thought out at their drawing-boards by musical technicians? No. One must take care to avoid the fallacy that intellectual music automatically stems purely from the intellect, and is devoid of all feeling. Here at least one must get back into the way of realising that technical and intellectual postulates are a unity – that inspiration and feeling, soul and intellect are not separate but are working elements in a process that is truly creative. The intellectual

element in a work is always more than the sum or even the potential of reason and 'unreason' – it is the tiny extra quantum that one is always trying to pin down (and also to explain) as 'genius'. One should be just as suspicious of emotion in the raw (possibly coupled with types of philosophy having affinities with musical thought), since this is in fact contrary to the nature of music; as, on the other hand, are those shoddy pieces of musical patchwork that are trotted out for occasional or educational purposes, trimmed and simplified down to the utmost limits. In other words: the private gush of feeling, the so-called 'personal document' in music has become no less suspect than naïve musical photography of nature ('programme-music'), comfortable spinning-out of cheery noises for children, or the much-misunderstood 'musicians' music', whose motive impulse has now been exposed as the empty, mechanical artificiality that it is.

The extreme opposite to this so-called 'musicians' music' (or one might call it the 'perpetual motion' style of composition) would be a musical game with glass beads, a basically infantile pleasure in cleverly devised games with elements and forms; and this would call for equally harsh criticism. If this kind of sublimated nursery game could give rise to something significant (and this never happens through a merely mechanical productive process), only then would one have to pronounce upon it, perhaps in the words already used fifty years ago by Claude Debussy, and long forgotten. His words occur to us when we look at all these various possibilities and impossibilities that have been coupled with the idea 'music', or when we see the way people attempt to dispose of what does not take their fancy by calling it 'constructivist'. Debussy said:

> Music must be a secret science, protected by writings so tiresome and difficult to interpret that they discourage the whole herd of people who would like to make use of music as nonchalantly as if it were a handkerchief. Apart from this, I should in fact propose to found a society for musical esotericism, instead of attempting to carry art to the public: there ought to be a school of neo-musicians, concerned to preserve the wonderful symbols of music in all their purity – a school at last re-establishing respect for art, that is contaminated by so many people . . .

Debussy's words express a wish also cherished by certain young present-day composers, and which graphically illustrates the situation they are in. They are struggling to find a musical language that will meet their inner demands and have intellectual clarity; a survey of recent history would make this fact comprehensible (as a reaction to, and consciousness of, their own tasks and values), and moreover one could regard it as a valuable proof of creative effort – people prefer not to admit this, since all potency involves some uncomfortable results.

The young composer of today cannot bypass Anton von Webern, cannot ignore the way he condensed the material of music. But here the situation starts to get complicated. He does not wish to become a blind follower of Webern, but on the other hand he does want to write 'intellectual' music as Webern did, and thus he is unavoidably tied to the process of selecting notes that are necessary according to the demands of form and the dictates of his communicative powers.

Webern's music is a turning-point; looking one way, it is the end of romantic and also of 'new' music, because it condensed music's material down to very thresholds of perception. ('And also of new music', I said: meaning the 'new music' which can indeed be regarded as a reaction from late romanticism, but which all the same was and is only

one more varied shape the latter took on – not a transformation in essentials, apart from a few exceptions.) Look the other way and one finds the need to take over Webern's insights, to develop a new method of moulding forms, that must not be imitation.

Webern's music can only be taken as a point of departure. It must not be 'continued'; one is soon led into a cul-de-sac if one tries to let 'everything be the main thing' – one reduces these 'main things' so far that musical-acoustical realisation becomes impossible in practice, in fact no longer appears relevant. Many young composers, having followed this path and drawn a few of the conclusions involved, have lapsed into horrifying anachronisms, or have struggled along byways that led them only to compromise.

Meanwhile, the most gifted among today's young composers have seen the error of their ways (though, for many of them, their mistakes may have been necessary ones); they have found a new way that promises a solution for their conflict of conscience – to compose no superfluous notes and yet not to imitate Webern. They have been urged on by the timely 'invention' of electronic music, by which we mean neither the mixture-trautonium nor that playground for acousticians, so-called 'musique concrète'. Webern's intentions have been regarded as completely justifying serial modes of procedure, but now they can be revivified by applying them in a field that is new and spacious, which Webern himself never knew, though he certainly had an inkling of it – the field of electronic musical material. Composition with this material, more than any other, requires very comprehensive laws. So nobody should be surprised that the rule of law was extended to apply to the new material.

It is elsewhere that one finds the surprising feature; these same composers suddenly found a chance to return (with their newly-won insights and experience) to instrumental and vocal music, and to resume composing in this field with new confidence. Musical imagination had at last found a possible way to clothe the acoustic skeleton that is pointillist music (this already looks to us like a compromise between Webern and the present serial methods that have been fertilised by electronic music); composition with the basic elements had been ridden with mathematics, and mere naked structures had resulted, but these could now be tied together, made significant and comprehensible.

Most young musicians are still caught in a dichotomy – they cannot combine their multi-dimensional or serial technique with artistic and stylistic ways of dressing it up. One feels this most clearly when it is a question of form. Traditional concepts of form, like inherited or acquired categories of expression, are a burden for a young composer who wishes to dedicate himself to a new style. Syntheses seem hardly to exist nowadays, or at least they cannot arise from a dichotomy, only as a creative development once all the individual parts have run their logical course.

To think, even so, that synthesising music will do anything but produce a merely synthetic style (and thus an artificial, sterile culture); to believe it will strike the happy medium which is said to have vanished, and which nobody can prove ever existed; to hope that this happy medium can set up standards to help us: all this leads only to mediocrity. Does it not seem, then, that composers are no longer able to write in a supra-personal idiom? And does this bring chaos finally and unavoidably upon us? Certainly, if the mixture of styles during the last fifty years and more were to continue: were there not a few young composers who have not only the vision but also the technique needed to produce music evincing creative fullness and life, genuinely free of

superfluous notes, in a way that is individual but not tied to personality. This is not done by looking back; in Heisenberg's words, 'Man's intellectual development has many dimensions, not only the one in which he has been developing for the last few centuries'.

Certainly it is harder than ever for the public to appreciate multi-dimensional music. With ears led astray by late romanticism, and minds full of threadbare ideas and the hasty prejudices of the 'isms', they have to listen to music that can be approached only by a great effort, since it sets out to raise to a law the elimination of superfluous notes. No longer can listening be made easier by thematic repetitions, cadences or the crutches provided by a key-system. There is, moreover, a further difficulty for the listener – and not only for the listener, as we have seen.

We have already hinted at this difficulty; until now, the 'new' music has not deserved its name. We have got into the way of calling composers 'classics of the new music', and now it turns out that their way of composing is neither 'newer' nor less 'new' than anything in the last two hundred years. Various details of technique changed, but this did not mean a change of style. One cannot take any year earlier than 1950 as marking the opening of a new stylistic epoch, the beginning of multi-dimensional music.

Those who enjoy playing with numbers will be glad to have 1950 as the crucial year, for it marks the end of an epoch that began in 1750. This so-called 'sonata-epoch' was preceded, as from 1550, by the epoch of fugue, which for its part was preceded by the canto-firmo epoch beginning around 1350. So easily detectable is this division of musical history that as early as 1938 it was expounded in detail by a musicologist (Hans Joachim Moser), who dared to express the opinion that in 1950 another 'major epoch' would begin. Just for once a historian was not wrong in his forecasts. The blatant way this epoch has begun will, of course, have been a disappointment to him – but that is another matter. All the major epochs are referred to by names derived from form (such as fugue, sonata) and this is a further proof that no new epoch began in 1900 or 1920, since no new form was discovered then. Only serial music has found the way to create new forms.

If a listener knows little of this new development, he may not only find it difficult to follow but may also get the impression that the new works all sound so alike as to be indistinguishable. This illusion would be no bad argument for our proposition, since it proves that there exists a community, not only of intellectual aspiration but also of musical creation. I recall here the words of Alfred Einstein, that can be applied positively in this case, and negatively to many musicians of the first half of the century: 'Originality is lack of style'.

One must be able to listen more carefully if one is to find that unity evident from a distance does not mean one-sidedness when regarded at close quarters. Then it will be seen that at last, after many decades during which only personal styles appeared or dominated, it is possible to educate pupils so that they are not automatically marked down as mere imitators of a particular personal style. One should bear in mind the mediaeval schools of art, in which individual performance had to be perfected in the context of an ensemble, a more general style: but comparisons are odious (e.g., with the Mannheim school, whose century was so akin to ours), and have in any case never been anything but makeshifts, which are not needed in order to explain new phenomena, the present situation.

LUIGI NONO

UDO UNGER

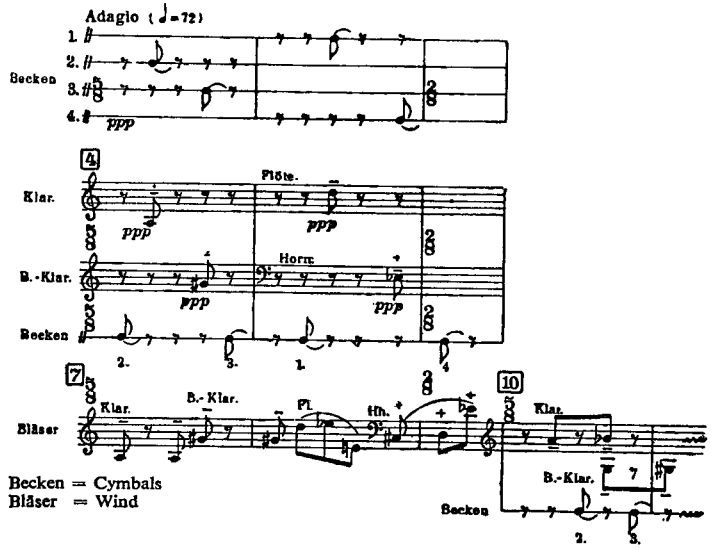
Luigi Nono is numbered among the international *avant-garde* of present-day composers, together with certain other representatives of the third generation of the New Music. He has become known mainly through the concerts of the Darmstadt summer courses. In 1950 his *Canonic Variations* (on a twelve-tone row from Arnold Schönberg's Op. 41) were performed there, in 1951 the cycle *Polifonica-Monodia-Ritmica*, and in 1952 the first part of *Epitaph for Federico Garcia Lorca* – all these were first performances. Other works are *Due Espressioni*, also for orchestra (first performed Donaueschingen 1953), the ballet *The Red Cloak* (Berlin Festival 1954), the cantata *Il Canto Sospeso* (Concert series of the West German Radio 'Musik der Zeit', 1956), and *Music for Violin solo, Strings and Percussion* (Donaueschingen, 1957).

While striving earnestly and relentlessly to come to terms with the legacies that Arnold Schönberg and Anton Webern left to the intellect and to the technique of composition, and while seeking out principles for strict organisation of the musical elements, ways of saying objectively the things it is given only to music to say, Nono has clearly marked out a field of play for his will to creative utterance. This field bears the stamp of a constructive power which employs formal strictness to control a highly developed will to expression and a powerfully passionate nature akin to monomania; and it is characterised by an extremely dramatic style whose fascinating acuity of sound, taut, widely-spun melodic style and differentiated rhythm and dynamics give an exciting urgency to its terseness of formulation. Nono's creative energy has clearly shown itself to be greatest when it is set ablaze by a text – this is seen particularly in the works for choir and orchestra (the three-section *Epitaph for Lorca*, the *Victory of Guernica*, *Love Song*, *The Red Cloak* and *Il Canto Sospeso*). It is therefore a good idea, in inspecting Nono's technique of composition, to investigate not only a purely instrumental work but also one using voices, taking into account the underlying text. The ensuing attempt at an analysis confines itself to sections from *Polifonica-Monodia-Ritmica* and *Il Canto Sospeso*.

Polifonica-Monodia-Ritmica is a three-movement chamber work for flute, B-Flat clarinet, B-Flat bass clarinet, alto saxophone in E-Flat, horn in F, piano, xylophone, four different-sized cymbals, side-drum, tom-tom and two small drums, one with snares and one without. This instrumentation – one player to a part, a group of melodic instruments contrasting with others that are predominantly rhythmic – results necessarily from Nono's idea of laying out a work so that the movements and their separate sections always function as parts of a whole, and their parts make manifest the common elemental substance, in the form of complementary opposites.

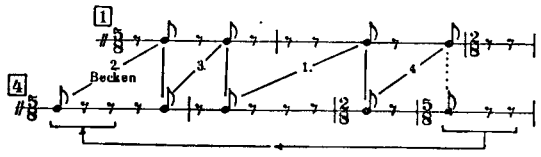
'Polifonica', the first movement of the work, presents the unfolding of an idea conceived *a priori* as to the rhythmic and melodic aspect (and thus at the same time the metric and harmonic aspect); this unfolding is presented as a development which arranges the phenomenal forms of the substances in a gradual intensification of

expressive content. This arrangement is subjective, not governed by the substances concerned. It takes account of a fact in the psychology of hearing – that given a constant energy total for processes in rhythm, melody, metre, harmony, tempo and dynamics, there will be a decrease in experience as time passes. Nono's structural principles, which he employs throughout the work, can be seen even from the first bars of 'Polifonica':



Example 1

In bars 4–6 the wind instruments repeat the cymbal-rhythm of bars 1–3. At the same time, the cymbals introduce a metrical shift, a re-grouping of this rhythmic arrangement, retaining the order in which the cymbals enter (2–3–1–4, 1 being the smallest and 4 the largest).



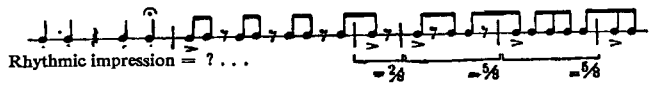
Example 2

Thus in bars 4–7 there are two different phenomenal forms of the rhythmic substance, and these complement each other to form the following rhythmic structure:

Example 3

This rhythmic structure is decisive in shaping the next group of bars ($\frac{5}{8} + \frac{5}{8} + \frac{2}{8}$). First, with another metrical shift, it is presented by the clarinet and bass clarinet. The quaver-rest has thus been given complete distinctness, by means of a note immediately before and after it, so as to make it audibly comprehensible as a fully valid rhythmic component; and the rhythmic structure (a – a and g sharp – g sharp) now appears (with yet another metric shift) in the form of two groups of three quavers on flute and horn. Thus the increase in rhythmic energy is brought about not by adding any substance but by an unfolding that is the product of rational principles (re-grouping, metric shifting, combination). The first group of bars (1–3) contained four quavers, the second group eight, the third ten, so the further developments in rhythm are no more than logical – from bar 22 onward the rhythm of the individual parts adds up to an unbroken succession of quavers; then, as from bar 40, crotchet- and semiquaver values are added (an accelerando begins), until bar 58 completes the transition to the second section of the first movement (Allegro, crotchet = 112): in this section a rhythmic structure, arrived at according to the above-mentioned principles, forms the starting-point of a new unfolding based on these same principles.

The cyclic metre, $\frac{5}{8} + \frac{5}{8} + \frac{2}{8}$, can not be registered by the ear until the beginning of bar 9, since bars 6–7 to 9 are the first in which there are notes and not rests on the strong beats at the beginning of the bar – quavers, which can be accented according to the metre. This does not mean, however, that for the listener the metre now becomes clear in retrospect; the psychology of hearing rules this out so long as the music pursues its onward course, leaving the listener no time to correct impressions already registered by his ear. The impression he registers could be notated metrically in some such way as this:

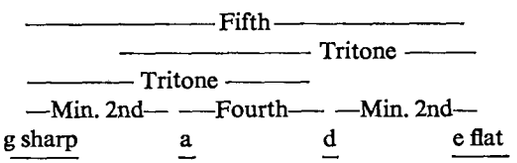


Example 4

if this is indelible and does not accord with Nono's notation (its metre being either taken for $\frac{3}{4} + \frac{6}{8}$, or, at best, felt as indistinct or completely absent), then we must ask whether Nono has chosen a sensible notation. The difference between what is notated and what is heard results, no doubt, from Nono's rational and synthetic mode of composition: rhythm and metre are handled independently from one another, and the complete musical phenomenon is produced only by their synthesis at each moment, in combination with the prevailing factors of melody, harmony (and thus also of timbre), dynamics and agogics. If this complete phenomenon does not make clear the metre, concealing its characteristics with rests, this does not necessarily mean a discrepancy between metre and the other factors – the elemental factors may in fact have been made to accord with each other so as to justify the gradual way in which the metre becomes perceptible, as part of the composer's intentions. In fact at the opening of this movement of 'Polifonica' there is just such a correspondence in the compositional handling of rhythm, metre, melody and harmony; the rhythm of each group of bars is built from that of the preceding one, till there finally arises a network whose rhythmic total represents an unbroken succession of quavers; this means that the metre, too, becomes more audibly comprehensible, that the first four cymbal-notes unfold to become fixed

pitch-values, from which the notes of the melodic series, conceived *a priori*, are derived by changes of perspective (mirroring, cancrizan, diminution, stratification, etc.), and that the harmonic, in fact all the acoustical possibilities of the basic arrangement only gradually take on an audible shape during the course of the events in the piece. After bar 9, the further course of the metre confirms the $\frac{5}{8} + \frac{5}{8} + \frac{2}{8}$ metre, and then leads, in combination with the accelerando, to dynamic changes in the shape of this cyclic metre – these effect the transition to the $\frac{3}{4}$ barring in the second section of the first movement.

As already indicated, the melodic element in the succession of cymbal notes (bars 1–3) – it is not yet definite because of the cymbals' complex sound – appears in bars 4–6 as fixed pitch-values. These contain all the intervals that result from the symmetrical insertion of a fourth into a fifth, plus these intervals' inversions.



The interval-relationships that in bars 4–6 result from this, and from octave-transpositions, take the form of two tritones (e flat – a , g sharp – d) , linked to each other by a major seventh (a – g sharp) and appearing successively as a rising major seventh, tritone (rising) and octave-plus-major-seventh (falling). The possibility of fifths and fourths is for the moment not exploited. At the beginning of the third group of bars this melodic succession begins anew. But this time the e flat (that now appears in the same register as the preceding d) has the e below tacked on to it by a downward leap of a major seventh, so that in these three notes the interval-succession minor second – major seventh (or diminished octave) comes about. This is immediately repeated in a kind of inversion, in the notes c sharp – d – e flat. The succeeding note-steps in the fourth group of bars are produced by reversing the melodic direction of the intervals and condensing the interval-steps to give simultaneous entries; a – b flat is derived, by a change of direction, from a – g sharp (third group of bars), or can also be taken as the inversion of a – g sharp: the diad g – b flat is explained as the minor tenth c – e flat in bar 8 (or is it the result of halving the tritone g sharp – d in bar 8?): if one ignores register, a, b flat and g, plus the ensuing g sharp, produce a chromatic complex covering g to b flat (in bars 8 and 9 there was a chromatic group from c sharp to e); the succeeding intervals d – e and c sharp – e flat are again a kind of inversion of e flat – e and d – e flat from bars 8 and 9. The further course of the melody: the already-mentioned technical principles of composition are used to produce groups of harmonic and melodic formations, which together give a complicated polyphonic network; the individual groups are built up by means of the dialectical methods that result when the composer applies simultaneously the compositional principles already described as affecting the separate elements: these groups are arranged in accordance with this dialectic, due regard being given to economic considerations that regulate the effects of the dialectic in conformity with the composer's subjective overall conception; the arrangement of the groups produces part-sections that vary in quality (and correspond to each other) and movements that vary in quality (complementing each other).

In this arrangement instrumentation is included as a harmonic component, functionally concerned in the process of serial variation and thus in producing the qualities of groups, sections, movements, the whole work. While in the first group of bars the only events are the cymbal notes, and in the second group of bars the events are divided between the wind and the cymbals, in the third they are confined to the wind alone. While until the beginning of the accelerando the wind and cymbals were used, and the accelerando-section was executed by the wind alone, in the succeeding allegro section the wind, piano and drums are heard. One could add: while in the first movement the acoustical manifestation of the *a priori* substance has polyphonic qualities, and in the second is of a specifically monodic character, the third movement accentuates the possible rhythmic ways of realising these substances. During all this, economic viewpoints are respected, to the extent of using only as many and those representative and expressive resources as are at any moment necessary to the events' flow of energy. When any such resource (e.g., the diad in the fourth group of bars) is used for the first time – which means, in terms of the psychology of hearing, that specially powerful energic images are naturally evoked – then other hitherto-employed resources retreat temporarily into the background (the fourth group of bars contains only as many notes as the third, although up till then there have been steadily more in each group of bars). This principle can be seen from the following statistical survey:

Bar-Group	1	2	3	4	5	6	7	8
No. of Notes	4	8	10	10	14	13	16	28
Notes on Cymbals	4	4	—	2	5	3	6	10
Notes on Wind	—	4	10	8	9	10	10	18
Diads	—	—	—	1	6	4	3	6
Diads on Wind	—	—	—	1	2	2	1	1
Diads on Wind and Cymbals	—	—	—	—	4	2	2	4
Diads on Cymbals	—	—	—	—	—	—	—	1
Triads	—	—	—	—	—	—	1	5
Highest number of successive notes without a rest	—	2	7	6	4	11	13	28
Number of note-values in the smallest group	1	2	3	2	2	2 (3)	2 (3)	3 (2)

Nono derives his technique from Anton Webern in the system he applies to the building of detailed form, which occurs through the economical and rational use of the shapes possible for rhythm, metre, melody and harmony (and here the elementary conceptions, or substances, do not really correspond to each other, although they appear to do so). But in Nono's composition one can take as personal characteristics:

(*a*) the dialectic that constructs a musical whole out of the phenomenal forms taken on by the compositional possibilities this system produces;

(*b*) the application of this dialectic as a way, *vice versa*, of confining expressive content within strict forms.

However, in itself his expressive urge, by its nature and because it is bound up with formal principles of a quite generally rational kind, goes back to Arnold Schönberg. The content of his expression is, indeed, of an 'expressive' nature. His dialectic is of an

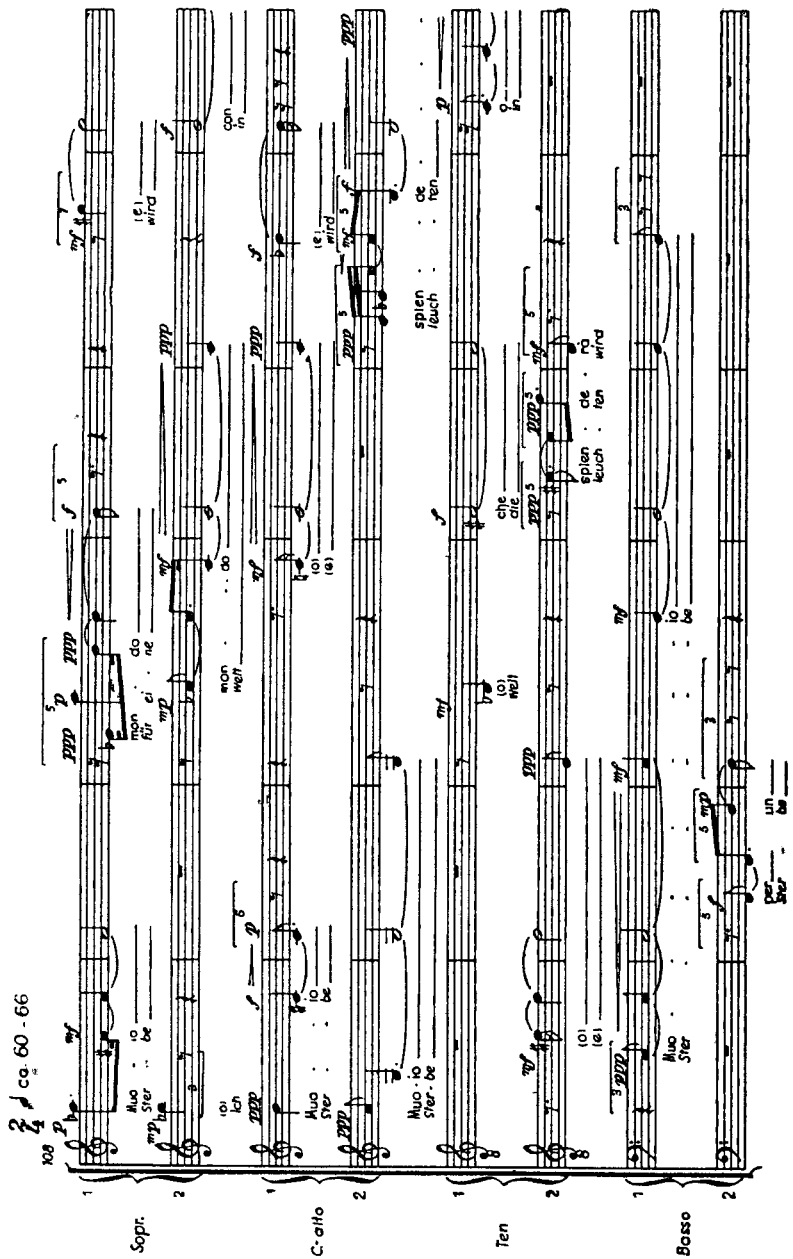
instructive kind, and takes account of aural psychological facts, its economy aims at progressively representing an architecture that is amenable to progressive representation. The remoulding of figures, groups at a time, means that the symmetrical structures, which are an active element in Nono's formal intentions, undergo a process of variation while being presented. Because of this, the same figures never appear more than once, but always others that correspond to each other. Between individual groups these correspondences are in fact felt as correspondences, while in the overall layout of the work they complement each other, and they lie within a subjectively drawn circle of possibilities; they are always variant manifestations of common substances, because the principles used to make the substances manifest do not change. Dynamics, agogics and the use of timbre are closely bound up with the dialectic, since this is used as a way to formulate expressive content, and since its economy aims at progressively representing an architecture that is amenable to progressive representation. The arrangement of timbres, for its part, is also linked with melodic, rhythmic and metric processes.

An objectivising technique, used to serve a subjective striving after expression; Nono's musico-creative Eros is contained in this polar tension between rational and emotional creative thinking, between the need to construct, using individual elements of music, and the need for a personal shaping of expression. Music at a decisive stage has decided in favour of decision itself, of abiding by decision.

If it were possible here to give an analysis of Luigi Nono's chamber cantata for three solo voices, choir and large orchestra, *Il Canto Sospeso*, this would confirm that the compositional-technical characteristics demonstrated in *Polifonica-Monodia-Ritmica* are obligatory for Nono, and would again show that, as composer, Nono's attitude is to live in a state of tension between rational and emotional creative thought. This tension has in fact increased as the composer's aims have broadened. In this work Nono realised a larger project than in *Polifonica-Monodia-Ritmica*, and to do so, feeling himself equal to producing something of deeper significance, he increased the number of movements, used more instruments and made use of a text. Consequently there was an increase in expressive possibilities, and on the other hand his serial technique of composition found greater differentiation possible. Thus the polar forces underlying his creation took on greater precision, and the energic tensions between these forces increased. This degree of tension between Nono's creative energies is matched by the scope of his intellectual and artistic intentions, even when these are not purely musical.

The title *Il Canto Sospeso* is ambiguous. 'Sospeso' means 'floating' and also 'interrupted' (cf. the English 'suspended'). The work is a collection of nine fragments from the last letters of resistance fighters who were sentenced to death, and is deeply moving evidence of humanity's will to freedom. A Bulgarian teacher and journalist, a schoolboy, a student and a hairdresser from Greece, a young Polish farm labourer, an Italian compositor, a girl worker from Germany; all of them young, they staked their lives for liberty and human values, and lost them in the battle against the fury and despotism of power-mania; they were not poets, then, but simply human beings awaiting a violent end, who wrote these brief testaments of faith, distress, farewell, belief in freedom, farewell to life – these lines whose greatness and tragedy Nono wishes us to experience through the medium of his music.[1] "Farewell, mother, your daughter Ljubka must depart,

[1] The complete collection of letters from which Nono selected excerpts, was published in Italy in 1954, and later in German with a foreword by Thomas Mann (Steinberg, Zuerich: 'Und die Flamme soll euch nicht versengen').



Example 5

into the damp earth", wrote the Russian girl: and the young Greek, "Your son must go, he will not hear the bells of freedom". Nono could hardly have found a text better suited to his creative intentions than such simple, piercing sentences. They are in direct line with his musical will to expression. But in music whose whole construction is conceived with a view to unity, and whose elements are rationally organised, words can not escape the influence of the organising principles. Nono therefore uses words, according to their timbre, as one of the elemental components, using group-technique and attuning them to the rest of the acoustical events. Schönberg's *Klangfarbenmelodie*[2] and Webern's interchange of parts may be precedents here, for the words (which have to be sung in Italian because of their timbre) are often distributed syllabically among the various voices. Of course the same also happens to the melodic lines, which result from the melodic basic series; through the technique of rearrangement into groups, the melodic lines, too, can be said to wander syllabically through the vocal and instrumental parts.

Among the most striking features of *Il Canto Sospeso* are the chromatically saturated harmonic formations that result from the superimposition of melodic lines (see Ex. 5, from the beginning of the second movement, first a capella chorus). The melodic series underlying the work, an all-interval series, is here set out in a harmonic arrangement. The series runs:

a	b flat	a	b flat	g	c	f sharp	c	f sharp	d	e	e flat	melodic basic series
* 3	5	2	4	1	9	8	7	6				Mvt. 1
1	2	3	4	5	6	7	8	9	10	11	12	Mvt. 2
1	2	3	4	8	12	15	16 etc.					
5	6	7 etc.										Mvt. 3
9		10	11	13	14 etc.							
1	2	3	4	5	6	7	8	9	10	11	12	Mvt. 4
12	11	10	9	8	7	6	5	4	3	2	1	Mvt. 5
1	2	3	4	10	8	9	12	11	7	6	5	Mvt. 6a
1	2	3	4	5	6	7	8	9	10	11	12	Mvt. 6b
1	3	5	6	4	2	8	10	12	11	9	7	Mvt. 7
1	2	4	3	5	7	6	8	10	9	12	11	Mvt. 8
9	11	12	10	8	7	3	6	5	4	2	1	Mvt. 9
30	40	45	60	240	260	195	96	60	44	30	12	rhythmic series, Mvt. 2

The successions of numbers beneath the notes of the basic series mark the pitch-successions (again regardless of register) with which the single movements of the work begin. They are intended to make clear the degree to which the melodic basic series is binding for the work's harmony and melody. The lowest line of figures represents the rhythmic proportional series, as it is used in Ex. 5. Thus it is to the piling up of a melodic series whose basic set contains two divergent chromatic lines that we must look for the cause of the richly chromatic chord-formations which occur, as in Ex. 5,

[2] In the first consistent application of the concept *Klangfarbenmelodie* (by Schönberg), a whole movement consists, harmonically speaking, of a single chord. Within this chord the instruments alternately introduce its various notes, so that melody is present in all the instruments, but there is no harmonic development.

* Thus the order of the notes is now: g, a flat; a, b, f, c sharp, etc.; in Mvt. 7, for example, the first note is a, the second c, the third b flat, the fourth g, etc.

throughout the work, and whose expressive musical content corresponds exactly to the expressive content of the text. In the first movement the melodic series breaks off after the ninth note and then enters anew. The succession of numbers for the third movement is meant to show that here the melodic series is often used simultaneously, entering in succession to form harmonic stratifications. Though movements 2, 4 and 6b have exactly the same note-order, the other components ensure that they take on completely different phenomenal forms. The reshaping of the melodic basic series with an eye to new symmetry, as in the seventh and eighth movements, may be said to be typical of Nono's technique of composition.

The use of timbre, which is directly linked to melodic, rhythmic, harmonic processes, is, on the other hand, also closely bound up with the arrangement of the movements, and again obeys the laws of musical economy and dialectic such as were demonstrated in discussing *Polifonica-Monodia-Ritmica*. Symmetry, too, is an effective form-building element, as is made clear in the arrangement of the movements. The first two movements correspond to the last two – first and eighth are purely orchestral, second and ninth for a capella chorus. The third and seventh movements also correspond, the third being for soprano, alto, tenor and orchestra, the seventh for soprano solo, women's chorus and orchestra. The fourth, fifth and sixth movements are not symmetrical, they are arranged with a view to the possibilities of a build-up; the fourth movement is set for orchestra, the fifth for tenor and orchestra and the sixth for choir and orchestra. They form the middle section of the whole work. In so far as considerations of symmetry or build-up do not decide the arrangement of the movements, it can aim at effects of contrast. With the aid of compositional economics and musical dialectic, the principles of symmetry, build-up and contrast are used so that they do not exclude each other, but are mutually complementary in shaping the form.

Il Canto Sospeso is convincing proof that Nono's creative energy was set ablaze by the words of those whose struggle for freedom won his sympathy. With the resources of free serial technique, in pointillist style, Nono has expressed his sympathy in *Il Canto Sospeso*, the work that sums up all Nono's previous instrumental and vocal efforts to attain an organic tie-up of word and sound, and to synthesise the total rational organisation of sound-material and the urge to emotional expression: thus it clearly marks out the future path for Nono's development, which will soon surely lead him to opera.

HENRI POUSSEUR

GOTTFRIED MICHAEL KOENIG

A description of his work as a composer would have had to consider the *Three Sacred Songs* (1951), the *Symphonies for Fifteen Soloists* and *Quintet* (in Memory of Anton Webern) (both 1955) and a piano work that has been begun – but for the fact that the first work represents a very early, post-Webernian stage, while the last is at the time of writing (1957) not yet so far advanced that one can make out its overall conception. This confines stylistic exegesis to the two works written in 1955, since these are representative of Pousseur's language and methods, confined only by the standard of the material, which, as articulated, is the motive force for the composer's intention, and of his peculiar critical insight. We shall describe the ways in which this grew in stature even between the *Symphonies* and the *Quintet;* at those elements in the piano work which represent a leap forward beyond the *Quintet*, one can only hint.

As, in recent years, the development of music has striven to resolve Arnold Schönberg's dodecaphonic organisation – via the works of Webern – into integral serial composition, there has arisen the question of coherence within the fragmented material and its organisational forms. *Die Reihe*, as 'information on serial music' is designed to air this question, through analyses and workshop reports, and to be a regular publication attempting to provide an answer by elaborating its subject-matter; this does not prevent the question's constantly re-emerging as the essence of every discussion.

The process of fragmentation does not only affect melody, harmony, rhythm, which as dimensions of the historical transfer had to manifest themselves through formulae – it also primarily affects the experiencing of time. Time as a continuum was partly the compositional result of the mediating agent's fluent and evolutionary articulation of the parameters, partly a reflection of the view that history is continuous and teleological. Time, as well as matter, is quantified, or rather, the medium in which quantified matter can represent only itself is quantified time. The composer's task is to seek out systems of order, whose composition makes the time-matter-discontinuum appear coherent and capable of communicating with our sensory apperception.

As such a system, the composed context of Pousseur's two works to be described here points to a complex of experience and theory, which cannot be ignored by any responsible composer. To the extent that any given work brings this into the light, it will leave criteria of quality behind, however lastingly these may have defied the historical process. The very criteria whose severity results from the historical situation clearly terminate in such connections.

It is the general view that time is the sole dimension for musical communication, just as when one looks at a picture. One can perfectly well compare the way the latter is fixed in two or three spatial dimensions with the way a score is notated, particularly in respect of the analytic patterning of material-constellations and their derivatives. These spatial patterns (which resemble a genealogical tree) can only become audibly manifest with the passing of time, just like the patterns when one looks at a picture. The time-

quanta for the process of information are indeed something for the composer to settle. He lays them out first as the overall outline, which dissolves into sections, part-sections and finally groups (like the frame of a picture which is continued in the distribution of surfaces and the marking-off of structures or coloured planes); then as independent time-intervals, such as those of pitch or intensity. But there is immediately a mutation – the articulation of time-intervals becomes the structure's unfolding through time. The (timeless) space in which music can be conceived consists of a finite number of selected elements and elementary complexes, and their continually mediated relationships.

When irreversible moments of time are thus scattered in a static, quasi-spatial arrangement of inorganic states, composition takes on the character of description, a character that makes it necessary for composition and listening to be acts of definition. Whatever may have been selected and arranged, in a system of elements universally related to each other; however differentiated the manner in which the basic material may have been developed; the mere existence of matter does not legitimize its derivatives, nor do these indicate their origin. Material is always stated as form, and nothing else is present on which to base an explanation of it, so it can correspond only to other material of the same kind. Thus one thing illuminates another, until material correspondence is produced within a system of transformation.

Thus continual correspondence makes all intelligible. This does not happen in a steady climb from lower to higher forms, or in a straight-line unfolding from inside to outside (or *vice versa*); serial proportioning of the elementary nuclear matter penetrates even to the outer surface of the overall form, and in the course of this it penetrates the intervening stages and juxtaposes the most distantly-related formations, just as it forces apart those that are nearest related. This universal linking denotes not only the act of composition but simultaneously (by its methodical character) the informational content.

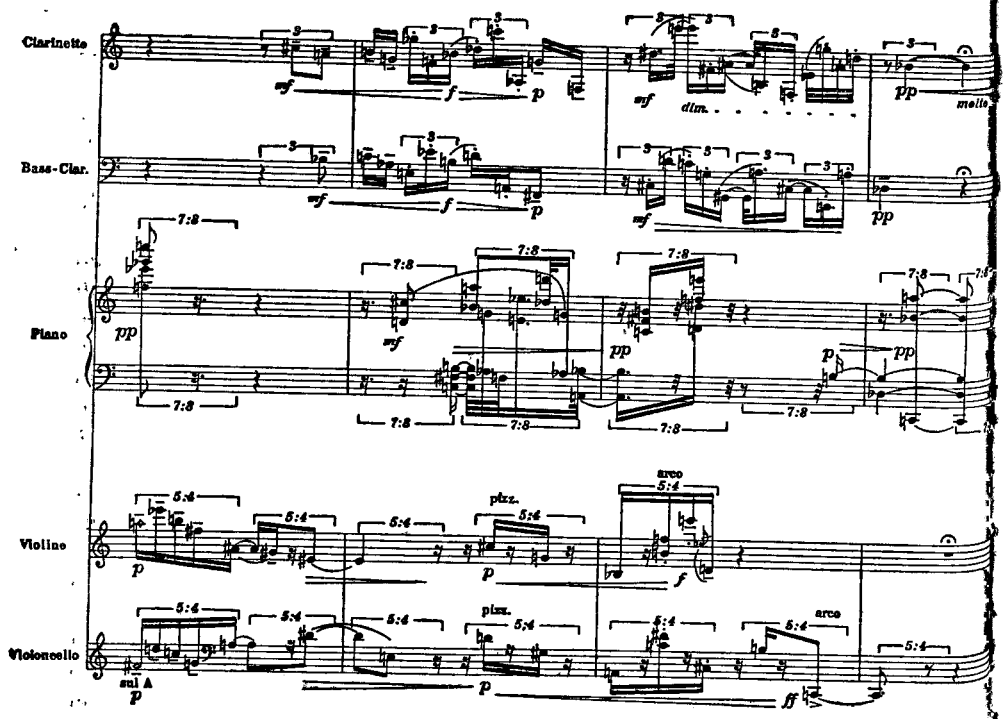
Time, as the vehicle for this universal description of a crystalline structure, stands in direct relation to the importance of what has to be represented, not only economically but informatively. In proportioning material, serial correspondences mean the correspondence of the necessary time-quanta. For music, time is not something pre-existing in order to tickle the appetite once it has been 'filled'– it is a parameter, or the dimension of description. Whereas in pictorial art space is something physically constant, in music it is a function of time, which must first establish itself, and which alters in the process.

This points to the distinction between the function of time in pictorial art and in music. In theory this distinction can be overcome, so long as musical structure is considered to be the spatial arrangement of material, conceived outside the flow of time. But in practice the result is a 'foreign time', which one perceives when listening: music provides not only the material but also the defining dimension. Only through the latter does music begin to exist – it takes shape as the universal description of a universally transmitted coherence of its constituents.

If one analyses scores of serial music, one comes upon various systems of order; these differ in their individual systematising tendencies, in the demands made by composition, above all as regards the oneness of methods and linguistic intentions. We are concerned not with grasping these systems of order statistically, but with their relevance to the particular compositional situation in which they occur. One finds mechanical systems in which the note-constellations' automatic motive-power is expected to make the acoustical flow convincing; permutation insists on its own totality, and at the same time

marks off the limits of the piece. The abstract unity of such works is brought about outside the realm of sensory experience – contradicting it, in fact; text and sensory impressions are not identical. There are systems which withdraw their own demands and which are more the expression of a desire that the material should do justice to the original inspiration. Thus in the end the projected 'development' is woven on the loom of permutation; the material is denied its rights, and right is denied its material. The best solution is for the system to discard dictation from within. The contradiction between a system which has become a fetish and the intended expression is then resolved into a mode of thought unifying language and method; not reducing method to language, nor language to method; neither imputing linguistic quality to mere movement of material, nor defining language as method, but with a syntax and vocabulary that have the same structure as it has itself. Pousseur's work seems to stand somewhere between a parade of permutations and an experiential structure. This will now be demonstrated.

The *Quintet* for Clarinet, Bass Clarinet, Piano, Violin and Cello is split up into four sections of 96 bars each (these are notated throughout in bars of $\frac{2}{4}$[1].) The caesuras marked by pause-signs act as breaks, an effect which is somewhat neutralised by rests within the sections; but the length of the pauses (as opposed to that of the rests) is left



Example 1

[1] The fourth section has only 94 bars, but ends with a very high violin note that gradually dies away. The pause can replace the two missing bars.

to the discretion of the performers, who will try to provide the difficult and nervous course of the piece with breathing-spaces. The four sections have different tempi (crotchet = 56, 48, 64 and again 56)[2]; in the first and fourth sections the metric subdivisions are very unevenly distributed; in the middle two they are more 'directed', with a climax (in the middle) where the most subdivisions coincide. The wind and stringed instruments are mostly combined; in the first and third sections according to register (Clarinet, Violin: Bass Clarinet, Cello), in the second and fourth according to timbre (Clarinets: Strings).

However, these manipulations are not enough to make one perceive the piece as serially quantified, a state where re-stratifications of the material would mutate into new qualities. Apparently it was the composer's job to create a simple, self-multiplying framework whose symmetry was later to be obscured. A remarkable example of such editing of details is found in the sixth of the *Symphonies*. The part we have in mind is divided into 23 sections.

	Length in Quavers	Metronomic Tempo	Duration (Sec.)		Length in Quavers	Metronomic Tempo	Duration (Sec.)
1.	42	108	23·3	13.	2	60	2
2.	10	90	6·7	14.	11	90	7·3
3.	6	72	5	15.	10	72	8·3
4.	24	90	16	16.	22	108	12·2
5.	22	72	18·3	17.	28	72	23·3
6.	8	96	5	18.	4	96	2·5
7.	4	72	3·3	19.	3	72	2·5
8.	3	108	1·7	20.	16	108	8·9
9.	8	96	5	21.	46	72	38·8
10.	3	108	1·7	22.	57	108	31·6
11.	16	72	13·3	23.	18	72	15
12.	3	90	2				

Example 2

Set length-relationships, such as 3:2 or 4:3 thus become equal (2 and 2·5 sec. respectively, see sections 12/13, 18/19): other relationships are reversed (24:22 becoming 16:18, see 4/5) or alter their proportions (8·3: 12·2 instead of 10:22, see 15/16). In these lengths, measured in quavers, there is no more serial order than in the time-lengths that result; according to information given by the composer, the relationships of the lengths in quavers are derived from the pitch-material (time-intervals as multiples of minor seconds), whereas the alterations in tempo are irrational subdivisions of larger structural durations.

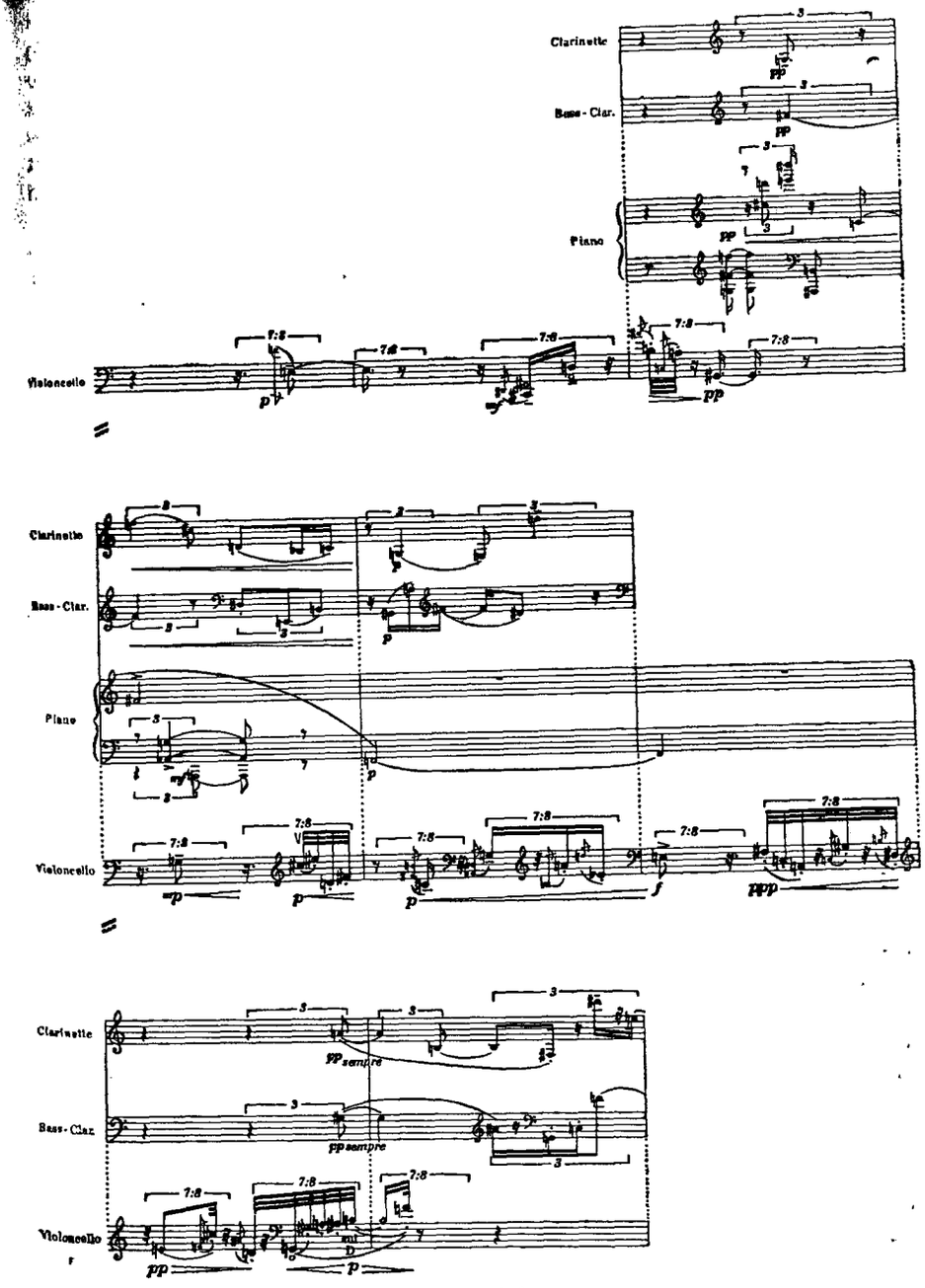
The detailed composition of the *Quintet* was not dissimilar. The 96 bars of each section are divided into 24 four-bar metres, but Pousseur has been at some pains not to let these be perceptible. Either they are not divided, or else they are divided into 2, 3, 4, 5, 6, 7 or 8 equal parts. Thus the harmony is brought into direct quantitative relationship with the flow of time, the horizontal density; each of these subdivided sections of a metre (unless it coincides with a rest) is allotted an interval of the series (that of

[2] There are also occasional small modifications which are not marked metronomically. In order to broaden out as the end approaches. the last seven bars of the piece have the marking crotchet = 40.

Webern's Op. 22) together with the notes that fill it out chromatically (minor second = 1 note, major seventh = 11 notes). Thus the interval-ambit is at the same time responsible for the density of a metre. The maximum density is produced when an eighth of a metre, equalling a crotchet, is linked with a major seventh. Since as a rule this division of the time is entrusted to two instruments (Ex. 1), the virtual total of 'attacks' is reduced by simultaneity of notes. But Pousseur has to some extent deviated from this rule, and has 'horizontalised' these constellations, i.e., given them to a single instrument, reducing the vertical density but still further increasing it horizontally. The quickest sections must thus always be the shortest, but this is remedied by the fact that an eighth of a metre is repeated eight times, a fifth of a metre five times, and so on. The interval is, of course, not repeated – it changes with each part-metre; a metre divided into eight is just as long as one that is not divided at all (if one ignores experiential time), but it is always identical in length with all the others. Furthermore the metre is made still less recognisable – on one hand, the total of notes derived from the appropriate interval is distributed fairly freely within the space of time available (it is broken up into two subgroups of different density); on the other hand, certain intervals appear in the form of rests. Through the system of permutations, these intervals can occur several times running, or can drop out for a stretch; finally there is polyphony between several simultaneous strata (the piano is always on its own, strings and wind are grouped as mentioned above, see also Ex. 1) – i.e., with different metrical subdivisions, and sequences of intervals peculiar to each.

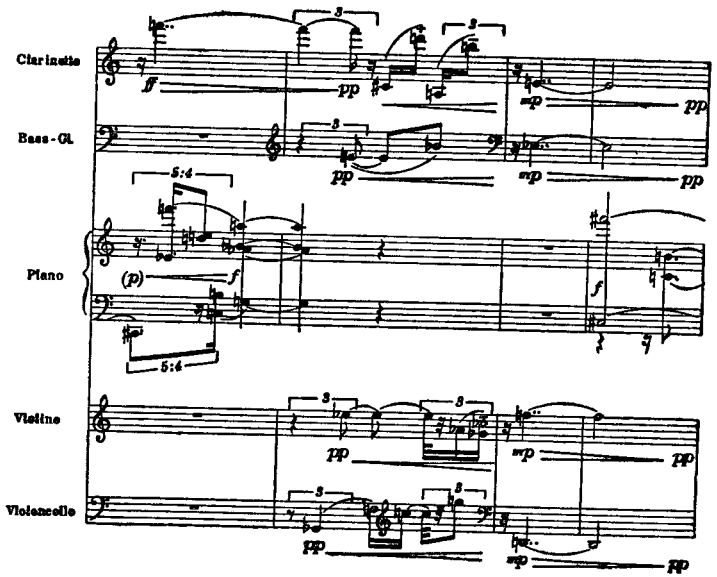
This complex procedure almost completely dissolves the given metre; on the other hand, a certain monotony is inevitable because of the consistent metre and because of its equally consistent process of dissolution. Because of 'experiential time', a constant metre would itself be enough to produce variety, if each metre showed a marked polarisation in its various dimensions – frequency, tone-colour, loudness, density, etc. Pousseur has indeed used a scheme which should guarantee such variety, by varying divisions of the metre, and, independently of this, the use of note-masses that also vary; but his scheme, too, is consistent, and since the simultaneous strata have each their own organisation, they often cancel one another out; the metre is made unrecognisable, but what obscures it is no less monotonous than the metre itself, so that strictly speaking one monotony is simply replaced by another. Moreover the method used to efface the metre serves this one purpose so exclusively that the resources it uses are denied the independence which would enable them to produce serial structures. The last thing Pousseur wants to make us hear is a constant metre; but this is precisely what he uses as the first and basic ingredient. The whole piece grapples with this contradiction. The flow of time could have been articulated as audibly as the other parameters, with the aid of the method used to overcome the handicap of a linguistically controversial metre, if only this method were less exclusively tied to the metre.

We have still to consider the liberties taken in detailed composition; they do indeed give subtle shadings to the flow of time and timbre. Here we should mention another phenomenon that arises as two schemes of order try to heave each other out of the saddle. As already mentioned, the instruments (excluding the piano) are always combined according to register or timbre. This, too, struck the composer as too schematic, and he sought a way out; in places, each register or timbre was represented by one instrument only, and elsewhere the prescribed combinations were supplemented by the



Example 3

remaining instruments in so far as these were not already in use (this was possible in places because of the layout of the rests).[3] This produces 'horizontalisations' (Ex. 3) and 'verticalisations' (Ex. 4), which in a few places interrupt the planned flow of the sound-combinations (radically in the one case, with a braking effect in the other), and which above all make clearer the differentiation of the four sections. But again, the new conditions that set in here are not 'dislocations', interfering with organised material that also organises the flow of the piece, but free decisions, which erupt out of the need for a functional articulation, and thus set the listener a riddle.



Example 4

All the same, surprise is a category that is lacking in the piece. Nowhere are expectations aroused, then to be either satisfied or disappointed. For this could only happen if audible transformations broke off before they had reached their presumptive end – if density or dynamics, the flow of tempo or harmony, were so strongly 'directed'[4] that a premature deviation (or something similar) would create surprise. It is not just that there seems to be complete consistency (in the sense of a permutational system) in the course

[3] Rests are linked to the intervals of the series, in whose place they occur from time to time. Thus they are part of the intervals' permutational system, but are not under the same obligation to move constantly onward. Permutations, too, have their vicissitudes; fermatas have been added to the rests between the first and second, and the third and fourth sections. (Also to the clarinet note between second and third, to intensify the tension, which is then released in the succeeding very quick motion). But there it is also possible to call upon the rests that belong to the process of detailed composition; their values are fixed for each metre, within which their position can vary. From the resulting amalgam of metric subdivision, interval-sequence, layout of rests and combination of instruments we can get an idea what concept of 'texture' inspired Pousseur to begin work; but one is also reminded of the Hollerith process for weaving patterns on looms. I believe, however, that for Pousseur it is 'detailed composition' which is the decisive function, and it is this that clears his music of any suspicion of being mere 'ornamentation'.

[4] The middle sections are in this sense directed (as has already been mentioned). The second section begins with 'horizontalisations' and gradually becomes denser, till at the end there is very rapid overlapping (see Ex. 1); this, as the climax, also marks the beginning of the third part, which toward the end dissolves again into 'horizontalisations'. This evolutionary process is flanked by the corner movements; in the first there are abrupt changes in density, and therefore also the most 'surprise', the most crowded experiential time, while the last section clearly makes way for the end, particularly through the retarding effect of the 'verticalisations'.

both of the metric subdivisions and of the note-masses provided for each; more important, this consistency is hardly audible because of the way such strata constantly overlap. These strata are not to be regarded as genuinely 'polyphonic', but as a means to attain the texture the composer has in mind; the vertical element (as resultant) must then be subject to serial control. Each stratum receives a serial organisation independent of the others'; their resultant, which is important as the index of the whole texture, is thus left to chance, though also to the already-mentioned process of 'detailed work'.

It will be seen that Pousseur conceived his *Quintet* as a self-contained whole. However, in the *Symphonies* he had already tried to solve the problem of large formal articulation. The work's seven pieces are individualised mainly through different instrumental combinations:

I.				Violin 1
				Violin 2
				Viola
				Violoncello
II.	Oboe		Harp 1	Violin
	Clarinet		Harp 2	Viola
	Bassoon		Piano	Violoncello
III.	Oboe		Harp 1	Violin 1
			Harp 2	Violin 2
IV.	Oboe	Horn 1	Harp 1	
	Basoon	Horn 2	Harp 2	
			Piano	
V.	Clarinet	Trombone		Viola
	Bassoon	Horn		Violoncello
VI.	Flute	Trumpet	Harp 1	Violin 1
	Cor Anglais	Horn	Harp 2	Violin 2
	Clarinet	Trombone	Piano	Viola
VII.	Flute	Trumpet	Piano	Violoncello

In the *Quintet*, the articulation of the form was to be achieved by other methods, which contrast with this variability of instrumental timbres and of ways of combining them; first through a very spacious formulation of the successive structures, through 'event-sections' which are chronometrically distributed over the whole time taken by the work; moreover, through more differentiated 'polyphony'. In the *Symphonies* there were also the following schemes:

(1) The time-division affects all simultaneous events – within the part-sections chronometric density remains constant.

(2) The time-division affects all simultaneous events – within the part-sections chronometric density varies serially for each group of instruments.

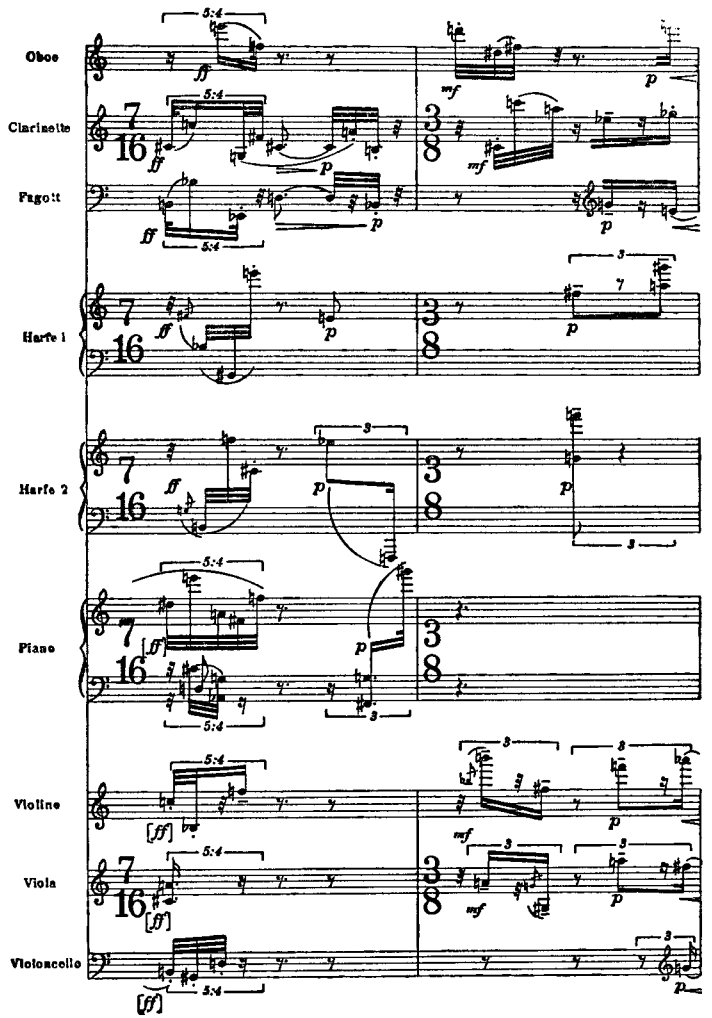
(3) Time-division varies serially for each group of instruments, but the same succession holds good for the chronometric density of each stratum (so that fields of equal density are horizontally displaced in relation to each other).

In the *Quintet* this predominating simultaneous time-articulation and the rational relationship of group-durations (irrational values occurring only as subdivisions) are replaced by independent part-structures, which overlap in a far more supple way, and by variable irrational group-durations. One has to ask whether the change of method has produced a time-structure which is substantially superior to that of the *Symphonies*[5]: a vertical time-division (Ex. 5) has the advantage that it is comprehensible. The fact that fundamental-duration relationships are rational makes little difference, particularly as the fundamental duration is formulated in a number of different ways – through differing chronometric divisions, differing density proportions in the instrumental strata. But the irrational relationships in the *Quintet* are not an advance on the rational ones in the *Symphonies;* on the contrary, they are a regression – they constantly fuse, forming a metre which, being of a higher order, stands as the real fundamental duration, and does not alter during the piece (this is not so in the *Symphonies*). Thus the *Quintet's* differentiated inner chronometric articulation keeps to a single metre, which from the experiential point of view is merely multiplied by whole numbers. The schematically distributed rests introduce an occasional irregularity into the metric flow. The timbre structure results from the changing density-conditions of the vertical sections, and to a lesser degree from superimposing strata of differing pace, which vary in their speed (number of attacks in a fundamental value such as a crotchet) but not in their (metronomic) tempo.

The many changes of bar in the *Symphonies*, particularly the alterations in tempo in the sixth piece (see Ex. 2) are designed to impose a supra-ordered time-structure on the density-indices valid at any particular time for the vertical time-division. In the *Quintet* the time-flow of the density was to be made more flexible by the system (already described) of differing metric subdivisions in the various strata; for this reason Pousseur thought he could afford to do without the difficulties of interpretation that are produced by changes of beat and tempo. The constant $\frac{2}{4}$ barring reflects his conviction that he had formulated a richly-modulated succession of events, within a time-system fixed by its notation and leaving the interpreter no real latitude.

The new piano work uses the customary notation and also a system of signs for the length of sounds and rests, which makes time depend on action ('as short as possible'), or leaves it free, either within measured limiting values (which stand in the relationships 1:2, 2:3 or 3:4), or altogether. The 'indistinct' note-values are subtracted from the notated ones, or are emancipated, i.e., stand outside the system of measured values. This points to a development which is obviously under way throughout these three compositions. In the *Symphonies* higher-order time-units are defined, whose relationship to

[5] One need hardly say that this is not a criticism of Pousseur's works and methods but a presentation of his way of working, his way of thinking, i.e., one out of the many possible ways of composing serially. To discuss the relevance of methods is bound to mean criticising, since methods are nothing but means to an end. Methods and results are certainly not unconnected with each other, but in Pousseur's case one can show how, dissatisfied with methods he had chosen, he proceeded to take liberties in detailed composition, and this doubtless improves the end-product. One can therefore not convict him on the evidence of his basic methods. In this connection it is an open question whether perhaps instead of correcting his method he would not have to replace it with another, or to reverse the whole relationship between method and detailed work, in order to eliminate contradictions that mar the lucidity of the construction. But perhaps it is just this relationship that adds impetus to production; Pousseur gives up his freedom of decision, obeying a system on which he decided at an earlier stage; he creates artistic obstacles, and overcoming them fires his imagination.



Example 5

each other is serial. The individual unit is articulated in various ways. In the *Quintet* the variability of the higher-order time-quanta is already reduced to a unitary metre whose precision is then made less distinct. Then, in the piano piece, time crumbles into a succession of fragments that are defined with varying exactness, indistinct points of time merely adding up to an equally indistinct group; indistinct in its relationship to the neighbouring groups.

Pousseur's technique seeks to make one perceive qualitatively varied degrees, instead of consciously appreciating quantitative values. For him, major sevenths or minor ninths are not interval-relationships (8:15, 15:32) which correspond with others, but

'indistinct octaves'. Indistinctnesses are brought into relationship to each other. Even time-relationships such as 2:3 or 3:4 are important not as constructively recognisable quantitative relationships – predicating a 'pulse' (at least for the fundamental durations), even if a constantly changing one; they are a determinant of the quality 'two values are not equal'. This also explains the $\frac{2}{4}$ barring of the Quintet, which he feels to be of sufficient dimensions for its course to be given motive-power in this way. Exactness of notation becomes unnecessary, in fact pointless, since one is concerned only with defining differences as such. Pousseur faced the question whether one could not find a notation that would communicate significance alone, hit off qualitative definitions, without making a detour via fixed quantities which offer a hurdle to the interpreter. In the piano pieces he does attempt to limit notation to indicating how a relationship is 'meant'. But what are we to think of this as an intention?

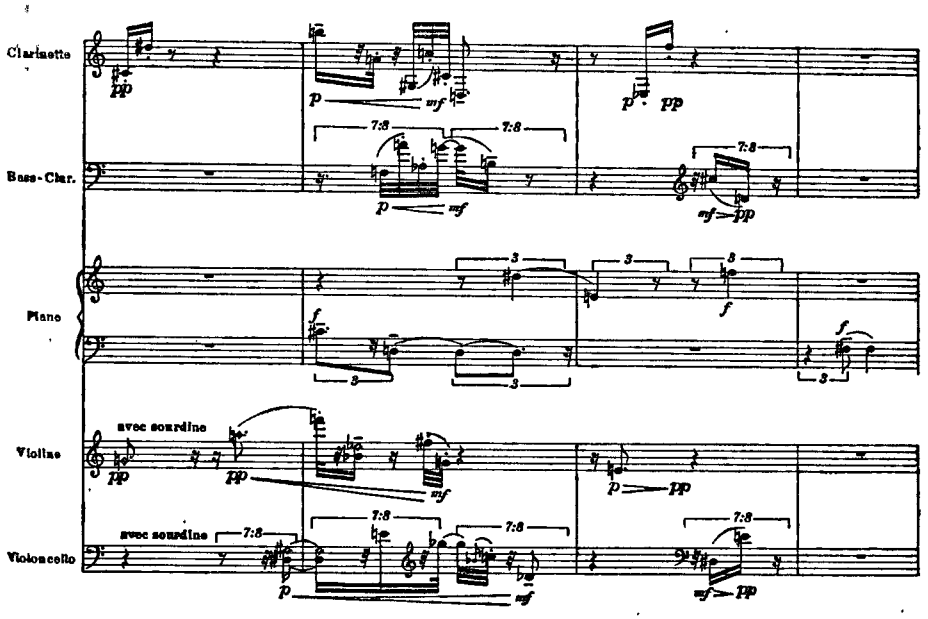
It must be accepted as an axiom that there are no criteria for defining qualities in this way. Differences between values (in whatever parameter) are a precondition not only of serial composition; the latter is in fact concerned rather to define differences quantitatively, if the concept 'composition' is not to go by the board. Only an exactly defined notational system can transmit information; but pointillist quantification surpasses itself in treating statistical fields, which can be 'circumscribed' as correctly as up to now the quantum has been 'described'. What is made 'indistinct' is not the quantum but the field itself, which is defined in its various dimensions. The quality of any perception does not exist beyond its quantitative figuration (a quantitative relationship endures between one field and the next); a relationship such as 3:4 mutates into a quality (takes on an informational significance) when it corresponds to other proportions, to a series of related proportions. It must be conceded that this may be the case in the new piano piece; however, one might remark on the fact that here the composer deliberately refrains from describing his language and statements in quantitative terms, yet does not describe any field that could be 'at the disposal' of action (at least there is no such indication in the score; like all other serial scores published up to now, it amounts to performing indications on pointillist lines).

We have already commented on the fact that in some scores, the flow of sensory perception does not coincide with the vicissitudes of the material. If one looks into these scores analytically one discovers schemes which cannot stand up to the demands of the language. Hence the paradox that the most satisfying-sounding scores are the ones whose material construction is the least audible. The *Quintet* is doubtless among these. What occurs vertically (and also horizontally in vertical sections) is held together by the stylistic powers peculiar to each composer. Pousseur has called an electronic composition *Seismograms*. This title might well be suggested for the *Quintet*, certainly in preference to the dedication to Webern. Except that it uses the twelve-tone series from the latter's Saxophone Quartet, occasionally audible fragments of this series and a similar-sounding instrumentation, the *Quintet* is no more closely related to its Webernian model than are many pieces written at the same period. The *Quintet* was meant to solve a particular harmonic problem that Pousseur has elucidated, both for himself and his readers, in the second volume of *Die Reihe*, discussing Webern's first Bagatelle. In the *Quintet* he evidently rationalises his use of frequency-material from the chromatic scale by employing a series whose intervals provide chromatic 'part-sections'. Since, however, the notes can occur in any order within a part-section, he has recourse to the

dominance of sevenths and ninths, which were already very much typical in the *Symphonies*. This finally jeopardizes the whole point of a selected series; the only use made of its intervals is to produce, in combination with the rational or irrational subdivision of the metres, degrees of density – they are thus left no energy with which to articulate the form horizontally or vertically.

Not only the order of the notes but also the distribution of registers is left free. Intervals other than sevenths or ninths occasionally gain the upper hand, to characterise the structures, but octave registers do not share this opportunity. They are, however, to be rationalised in a later piece.

Pousseur's desire for omnipresent chromaticism provokes one to ask whether the problem of harmony is thus one of chromaticism, or can be solved through chromaticism. The *Quintet's* harmony exists independently of its time-articulation; to be exact, the various intervals of Webern's series each prescribe a particular number of 'attacks', but not an identifiable harmonic configuration, since it is always a section of the chromatic scale that is involved. An element that in Webern's economical time-sound-relationship acted as a kind of joint, linking the arms of an interval with each other melodically and harmonically, becomes in the *Quintet* a trembling, vibrating event, a fluctuating image which transforms a harmonic value into one of colour. The detailed harmonic flow is certainly not articulated, nor are harmonic planes produced; since the twelve chromatic notes are present everywhere, it is hardly possible to differentiate the harmony of the various formal sections. The series is not melodically emancipated, and the small chromatic scales (according to the size of the intervals) do not appear as harmonic blots. Once their material construction has been organized, the



Example 6

methodical artifices again become the material of the composer, who has made his system so narrow that he could feel at home in it and retain his freedom. All the same, his freedom is considerable enough to stand up successfully to the theoretical scheme, which is rigid and particularly rough-hewn as regards form. Apparent monotony (to the eye of the analyst) becomes the unity of events that are genuinely differentiated.

The first metre of the *Quintet* will serve to illustrate the interior arrangement of the piece (Ex. 6). The clarinet is combined with the violin, the bass clarinet with the cello. The piano runs its own course.

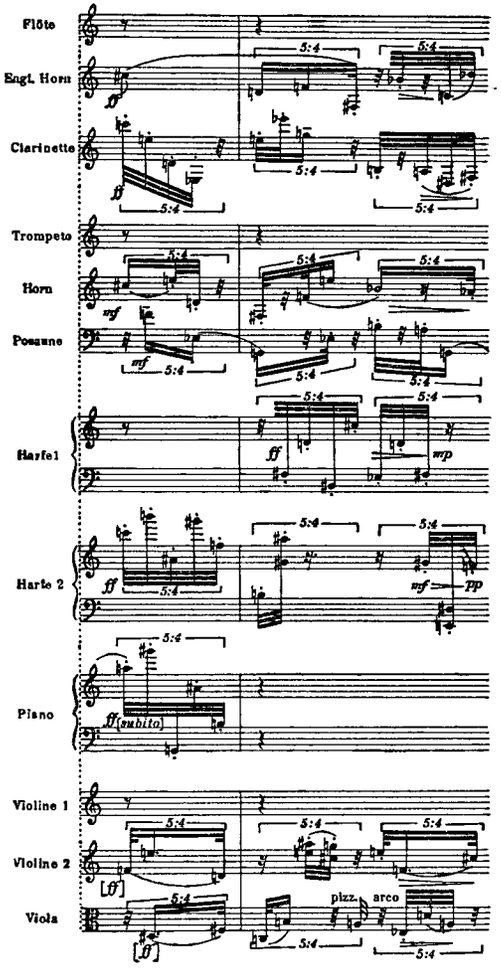
In the upper register the metre is clearly divided into four: four notes in the first bar (major third), ten notes in the second (minor seventh), three notes in the third (minor third), a rest on the fourth quarter of the metre.[6] In the lower register the septuplets suggest a division into seven, but this is inconsistent with the number of notes available. Division into two is more likely.[7] In the piano part the metre seems again to be divided into four. The listener is not supposed to follow this polyphonic organisation – instead, what he hears is actually different, since it does not result simply from this complex flow but makes itself felt in opposition to the system; he hears a flow of density (parallel horizontally and vertically) which starts hesitantly in the first bar, rising rapidly to a climax after a brief caesura (at which the loudest dynamics are also introduced, in the piano, though their self-assertive dominance is paralysed by the low horizontal density of the piano part); it then appears to ebb, particularly with the leap of a seventh, d sharp – e in the piano: however, the level achieved is maintained by a gesture that bridges over the initial caesura between the two metres (plus an additional crotchet rest at the beginning of the second) – this gesture begins with the short figures in bar 3 (Clarinet, Bass Clt./Cello), and continues strongly in the dynamically important seventh-plus-octave of the piano, which starts during the second of these figures. Leaving out the piano, an arc of dynamics (*pp-mf-pp*) has been composed; its descending gradient is also continued after the last *forte* of the piano, introducing a *mf* at the beginning of the second metre, which would be the continuation of Ex. 6. (This descent occurs between *mf* and *pp*. The third metre corresponds in dynamics to the first, only the degrees of loudness are still more strongly polarised; wind and strings play *pp-mp-pp* while in the piano we find the markings *mf-f-ff-mf-f-sffz*. Dynamics, too, seem to be employed in destroying the metre; the second metre is a dynamic transition, but only for three quarters of its length: the arc of the third metre, which corresponds in its dynamic shape to that of the first, begins in the fourth quarter of the second metre, thus extending over five bars.)

The harmonic construction in Ex. 6 is striking. In the upper register (Clt./Vln.) the first bar contains the succession c sharp – d – d sharp – e, and the third bar e – e flat – f: also in bar 3 (in the lower register, Bass Clt./Cello) we again find c sharp – d – d sharp – e

[6] One might also possibly see here a division into eight (i.e., into crotchets); but the succession of intervals would then be minor third, minor second, major sixth, minor second, minor third, three rests, and this makes the idea unlikely. Rhythmically both versions are possible, which is a point against either; only if a real distinction were made between four- and eight-fold subdivision of the metre would there be any point in treating them as different.

[7] To be more precise, the doubled c sharp (bars 2/3) is inexplicable. On the other hand, if one halves the metre, then the first half gives a major seventh (11 notes) and the second a major third (4 notes). The note-repetition could now be explained; eleven chromatic notes are the maximum (major seventh), but the system of interval-permutation may stipulate that the next interval should be the major third c sharp – f.
Throughout the piece the analyst is constantly in doubt about its interpretation, and this appears to justify the assumption that a schematic metre has been schematically destroyed. Neither the harmonic nor the chronometric dimension is unequivocally fixed; this also means that the listener has an odd feeling of being held in suspense, which gives the piece its appeal.

(as above; but whereas there were previously a major seventh and a minor ninth simultaneously – if one imagines that the d sharp in the clarinet is prolonged – and major ninths successively, in bar 3 the simultaneous intervals are seventh-plus-octave and major second, whereas the successive ones are major sevenths or minor ninths: most important of all, the piano has the chromatic scale c sharp – d – d sharp – e – f – f sharp. This, however, is combined so well with the other instruments' quicker movement around it that, despite its dynamic predominance, it is absorbed and does not smudge the harmony. There are also harmonic bridges or struts between the piano and the other two strata, as follows: the piano's initial c sharp is immediately recognisable as the c sharp in the clarinet, with which the piece begins (and whose register is the same). This c sharp is then clearly audible a third time (again in the same register) in the cello (bar 2, dynamically emphasised by the *mf*). The next piano note, d, is repeated (an octave higher) shortly afterwards by the bass clarinet – this is not quite so convincing, but not disturbing. The piano's d sharp, as already mentioned, is clearly part of an interval relationship to the succeeding e, which is prolonged by the same e in the violin, as part of the upper-register group e – e flat – f. The piano's f can be added as a fifth note to the lower-register chromatic total c sharp – d – d sharp – e (rhythmically it comes exactly in the middle of this), and moreover, since it is a repetition of the clarinet f in this bar, it comes as a sudden and violent *crescendo* effect. Finally, the f is linked to the f sharp (as is the d sharp to the e) because of the relationship of a major seventh, whose omnipresence has already been mentioned.



Example 7.

The first four bars have been described in such detail because they are typical of the whole piece. The same sort of thing can be found throughout; everywhere, to varying degrees, Pousseur uses in this way the freedom left open by his scheme. Naturally one

can not consciously follow these subtle relationships during a performance, but as a result of the multiplicity in unity they produce, the apparently dry schematism of its formal and material-constructive layout is seen to be linguistically coherent, full of variety and seismographically sensitive in its details, its refinements of structure.

But the Brownian movements which give vibrancy to the flow of time, the alteration of timbre, are not merely apparent in the general detailed work, the 'editing' of frequency material distributed over the time-divisions according to intervals (and this detailed work can vary from case to case): they also stem from deeper down, from a method of subtle rhythmic differentiation which is already characteristic in the *Symphonies* (Ex. 7). The overall impression produced is that of a 'field' of great horizontal density, quickly decreasing intensity (*ff* – *pp*), and complex timbre. With one exception (2nd Harp and Piano before the bar-line) the quintuplets in each quaver are differently articulated by each instrument. Inexactness of performance then produces the 'indistinctness' which has already been discussed.

HANS WERNER HENZE

RUDOLPH STEPHAN

I do not regard it as out of the question to use consonant chords as well – once it is technically possible either to comply with, or to paralyse, their formal claims.

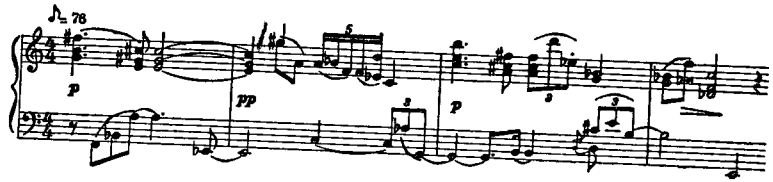
ARNOLD SCHÖNBERG (1925)

One of the characteristic features of the so-called 'new music' is often said to be 'brittleness of sound'. This acoustic asceticism results partly from the complete absence of consonant triads, and partly from unusual instrumentation which is sometimes guided by archaic models. Henze consciously opposes both these tendencies: his music has an exciting sound, is full of rhythmic life and for the most part brilliantly scored. In fact he is a born orchestral composer, and in view of the nature of his talent his preference for stage composition is not surprising.

It is well known that Henze's art has its roots as much in the work of Stravinsky as in that of Schönberg. He is related to the latter in that he uses the method of 'composition with twelve notes related only one to another', and to Stravinsky by a preference for 'natural' note-relationships, as well as various metric-rhythmic peculiarities and a weakness for parody. Thus his relationship to both masters is thoroughly ambivalent – the positive meaning of this is simply that he is no mere imitator. Henze has also been impressed and even influenced by other composers, for example Alban Berg and Anton Webern, and on the other hand Wolfgang Fortner and Boris Blacher. Fortner's influence is evident mainly in the early works (about 1946), which are of no great import, and there are occasional traces of Blacher's 'variable metres'[1] (e.g., in the String Quartet, 1952, see below). Of course one can scarcely regard chamber music as Henze's strong point, and this perhaps explains the fact that in these works he is particularly amenable to outside influences. Probably Henze needed to combine the instruments freely in order to achieve the lyric and dramatic expressiveness for which his works are rightly so esteemed. Such an ensemble does not necessarily have to be large, as we see from some of his best works, such as *Apollo and Hyazinthus* (1948) and the *Five Neapolitan Songs* (1956).

If we look at Henze's relationship to Schönberg, we are struck by his wholly un-Schönbergian use of twelve-tone technique. Henze is certainly not alone in this; one only has to think of so important a master as Frank Martin. In fact Henze, too, was moved to take up this technique by a work of Alban Berg, the Violin Concerto, and his earliest important works, such as his *Violin Concerto* (1947) and the *Chorus of Captive Trojans* (1947–8) show the pervading influence of Berg on their musical language, which is milder than that of Schönberg. Even one of his works most akin to Schönberg in expression, the *Piano Variations* (1948) shows the technical cleavage between him and Schönberg.

[1] Cf. Blacher's own remarks in Joseph Rufer's *Composition with Twelve Tones* (Williams and Norgate, London). Adequate criticism of these remarks would take us too far afield.



Example 1

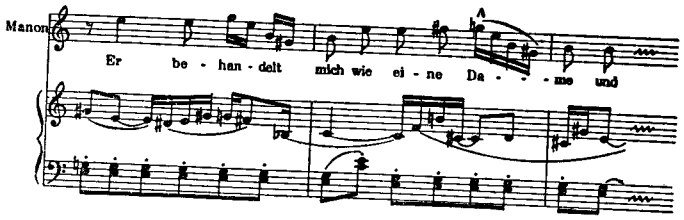
The most important thing that strikes us on perusal of the bars of music in Ex. 1 (opening bars of the seventh variation) is an appreciation of its note-relationships. The antecedent (Bars 1 and 2) is characterised by the fall of a fifth (g–c), the shortened consequent (bar 3) by the falling fourth c–g. The consequent is prolonged by an added bar (4), which gives a different turn to the tonality of the whole phrase, without quite leaving the region of C. One could go into further detail, such as the significance of the third-relationship, which appears so clearly at the beginning of the motive, and appears to be almost more important than the fifth-relationship. Although our example lies within the bounds of twelve-tone music, the fact is of little relevance to the musical reality.

Since we have still not given the expected twelve-tone analysis of this example, here it is. This is the series underlying the whole set of variations:

F sharp — c sharp — d — g sharp — b — d sharp — e — f — c — a — b flat — g

The series contains two consonant triads, g sharp minor and f major, an isolated fifth (fourth) f sharp–c sharp, and a minor third (major sixth) b flat – g. Such a series is basically akin to Berg's serial formations, such as those of the *Lyric Suite* and *Violin Concerto*, for it allows the composer to produce traditional harmonic relationships (in detail).[2] In our example the series appears in the complex upper part (r.h.), first transposed to the fourth (beginning on b), and in bar 3 transposed to the seventh (beginning on e). The last sound of Ex. 1 derives from the start of a new transposition beginning on f. The lower part, finally, is based on the inversion of the series beginning on f.

Thus third- and fifth-relationships are the favourites (moreover major and minor thirds with the same root are usually treated as equivalent, a tendency already noticeable in Berg); recognising this, we discover relics of tonality. In this respect Henze has attempted to combine the peculiarities of Berg and Stravinsky. Various passages from

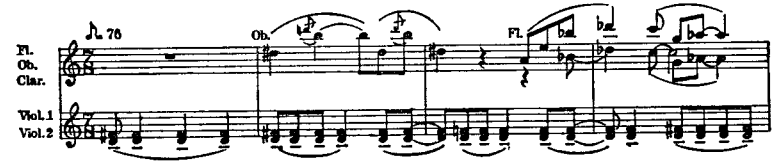


Example 2

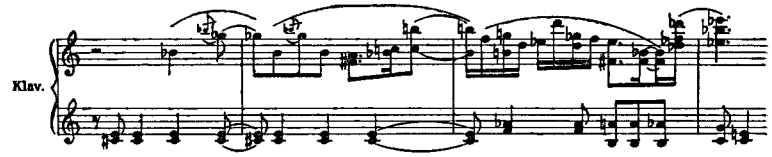
[2] For discussion of these problems cf. E. Krenek, 'Über neue Musik', 1937. p. 61 *et seq.* R. Leibowitz, 'Introduction à la musique de douze sons', 1949, pp. 279 *et seq.*, and G. Perle, 'The harmonic problem in twelve-tone music', *The Music Review*, 15, 1954, pp. 257 *et seq.*

Boulevard Solitude (1951) are eloquent testimony to this; Ex. 2 is an excerpt from Manon's aria (No. 8 in the vocal score, p. 31).

No comment is needed. Naturally the note-relationships are not always so clearly evident as here, but very often they are; and a study of the whole opera shows beyond doubt that, purely as sound, it presents few obstacles to comprehension. Of course this does not mean that its harmonic construction is equally unambiguous. I believe rather that Henze sets less store by this kind of construction and lets himself be guided wholly by his acoustical fantasy, which willingly *plays* with traditional sounds, but does not force them to organise the harmony. To show this I quote from the second movement, 'Pas de Deux', of the *Piano Concerto* (1950), bars 1–4 and 11–14.



Example 3a Score, P. 16

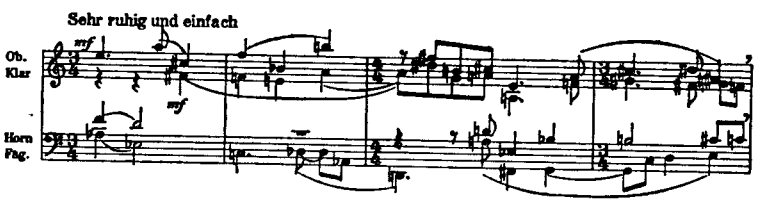


Example 3b Score, P. 17 et seq.

In the first of these two quotations one clearly sees the ambivalence of the (major and minor) third, and the constructive force of the fifth-relationship, which ties up the whole phrase (a kind of half-paragraph). The second phrase, the beginning of the piano solo, makes all this still clearer. The accompaniment 'disturbs' the 'harmonic' clarity with its chromatic subsidiary-notes that add 'spice' to the sound. But precisely by comparing these two quotations – thematically almost identical, the second being, so to speak, in the dominant – one sees that Henze is in fact *not* aiming at harmonic construction; whereas the complex upper part from the first has been transposed to the fifth (diatonically), the lower part has been transposed to the seventh. This combination borders on bitonality, even though as a whole the passage definitely stays in the region of the dominant. Stravinsky's discoveries are constantly being used, very understandably, since the work is pervaded by the spirit of the ballet. So we see that Henze has been influenced by Stravinsky (or his followers) not only in the field of rhythm and metre, but also in that of tonality (or, better, of sound). This technique with sound is most obviously manifest in frequent parallel thirds, of which there are many examples in the early works, too. Here I mention only the *Ode to the West Wind* (1953, p. 25 of the study score) and the *Quattro Poemi* (1955, pp. 27 *et seq.* of the study score), but should like to emphasise that these parallels are never made up of exclusively major or minor thirds, since that would be a simple case of 'mixture', as defined by Erpf,[3] or of simple bitonality.

[3] H. Erpf, 'Studien zur Harmonie- und Klangtechnik der neueren Musik' 1927 ,pp. 78 *et seq.*, 175 *et seq.*

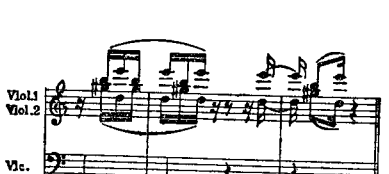
Finally, I would add here a characteristic example from the chamber music, the beginning of the theme from the first movement of the Wind Quintet (1952), bars 37–40.



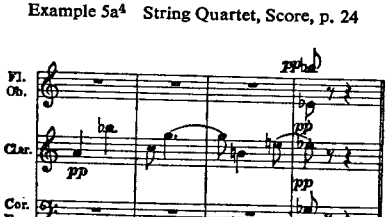
Example 4

I do not think that this example still needs elaborate interpretation, since it merely confirms everything said so far.

Henze's attitude to note-relationships could be called 'natural', or perhaps better 'reasonable', in so far as he treats fifth- and third-relationships as a reality, without immediately falling back (like many others) into the major-minor system as a result. The most important point is this – for all his twelve-tone manipulations, Henze recognises the hierarchy of note-relationships. Fifth and fourth make up the constructive framework, third and sixth fill out the sound and thus produce the characteristic euphony, second and seventh add 'spice'. Not that this involves merely the traditional way of using traditional resources! Henze does not use the latter in the old constructive way but, as it were, 'plays with them'; now he reveals them openly, now he obscures them with subsidiary notes (bi- and polytonality are the most convenient sources of



Example 5a[4] String Quartet, Score, p. 24



Example 5b Wind Quintet, Score, p. 24

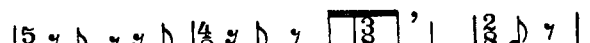
[4] In the last bar but two, the g in the second violin must obviously be sharp, but in the score the sharp is missing. The printed editions of Henze's works are often afflicted by inaccurate setting of the accidentals. I think Schönberg's method of giving each note an accidental is very useful, since it not only simplifies things for the person reading the score, but also helps to avoid mistakes. Let me quote at least one typical example. In the last bar but four of the *Quattro Poemi*, the second violins begin to hold a b flat and d, which are to last till the end, but at the same time the first violins have a b natural (without an accidental!), if only for a moment. At the end of this bar the violas begin to hold a b (without accidental!) which is to last till the end, and in the last bar but three the celli enter on a b (*with* a natural-sign!) Now: is the viola note flat or natural? Both are possible – b flat seems to me to make better sense.

these), or he often hides them by metric displacement. Ex. 5 shows two characteristic examples, the close of the *String Quartet* (1952) and of the *Wind Quintet* (1952).

In the *String Quartet* one can clearly hear a normal cadence, which is hardly veiled. In the Quintet the closing chord (triad of e flat minor) produces a surprising effect, since after d minor and b minor one expects and does not get f sharp minor. Henze is fond of such surprises, and they help to make his music attractive to a wider public. They mostly arise because he constructs only the details, leaving the broader coherence to his 'feeling'. There are works, not yet completely understood harmonically, that strive after tonal roundedness (those of Schönberg or even Hindemith), but this is quite foreign to Henze because of his particular way of constructing form. When, as in *Boulevard Solitude*, he makes a paraphrase of traditional formal types, he admittedly follows the methods of the classicists in principle, but prefers a looser organisation, and most of his works in fact have a quite free formal outline, e.g., *Apollo and Hyazinthus* (1948), the *Ode to the West Wind* (1953) or the *Symphonic Studies* (1955). However, the last-named work, and the third movement of the *Quattro Poemi* (1955), which is only twenty bars long, one might take to be modelled on the orchestral pieces of Schönberg (and his school), only with the difference that Henze never has any taste for 'counterpoint', and his musical contents are simpler altogether.

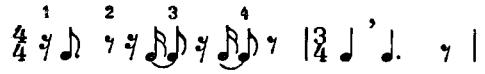
If for example one looks at the first letter-aria of Manon from *Boulevard Solitude* (No. 8), from which our Ex. 2 is taken, one realises that its form stems from the three-section aria form particularly favoured in the 18th century. The first section (bars 6–21, 'Geliebter Armand . . . über mein Wohlergehen') returns, as far as the vocal part is concerned, in the third section (bars 45–66) 'Wie schade, geliebter Armand . . . gezogen wird'), altered only to the small extent demanded by the new text. Here of course we ignore the coloratura at the end of each section. But comparably simple formal relationships are also found in the instrumental works, e.g., in the fourth of the *Quattro Poemi*.

Since this volume is concerned with serial music, the reader has a right to at least some hints about Henze's attitude to 'serial' music. After all that has come to light, he will indeed not be very surprised that Henze maintains no very intimate relationship with this constructional tendency. On the other hand, it is less than amazing that Henze has also come to grips with this tendency, and at least once tried to do something similar. Just as so-called 'pointillist' music has also lately been a stimulus for Henze – I have already mentioned the *Symphonic Studies* and the 'Elegia' from *Quattro Poemi* – he has toyed with various modes of procedure and techniques, particularly in his String Quartet (1952).[5] For example he has applied Boris Blacher's 'variable metres' – from which even such an important composer as K. A. Hartmann has not held aloof; but the question arises, whether constant bar-changes, according to arithmetical principles, are matched by any metrical reality. To my mind, this is so only in a very few places. This can be speedily shown. Let us look, for example, at the second movement, bars 60–63 (Score, p. 13).



[5] The *1952 String Quartet* is not his first, though the only one so far published. In April 1947, in Heidelberg, the Freund Quartet performed an early work in this medium, and it was well received. If I may trust the notes I took at the time, the work was still strongly influenced by classicist tendencies.

This purely chordal passage could surely be barred more reasonably, more in line with its musical content, though this is not to advocate simply forcing it into a conventional scheme of barring. But one could just as well choose two $\frac{7}{8}$ bars, or one $\frac{8}{8}$ (= two $\frac{4}{8}$s) and a $\frac{6}{8}$ bar. A change from $\frac{4}{4}$ to $\frac{3}{4}$ gives the following sensible rhythmic picture:



In examining the metre it is of little interest to be told (by the score, not by one's ear) that here we have a cancrizan form of bars 25–29 (Score, p. 11), which were also barred arbitrarily.

The sceond and third movements of the Quartet are written wholly in 'variable metre'. The first movement, on the other hand, in simple $\frac{4}{4}$, is striking for its complicated rhythm. Here Henze works with many subdivisions of normal note-values (such as $\frac{3}{16}, \frac{5}{16}, \frac{6}{16}, \frac{7}{16}, \frac{4}{32}, \frac{5}{32}, \frac{10}{64}$), frequently intermingling them with 'normal' subdivisions. Since these rhythmic formations are introduced with interruptions, syncopations and ties, the rhythmic effect is fairly amorphous. In analysing this movement one can see at once that certain things correspond to each other, and it is very probable that there is a scheme or a 'formula' at the back of it. All of this composition shows signs of a lot of thought, but one doubts whether its construction corresponds to a musical reality, i.e., whether there was any interior compulsion to use these constructional principles.

Henze has analysed[6] the 'second subject' from the second movement of his Quartet, and thus showed how this section is constructed. The reader of the present article would be well advised to look up this analysis for himself, and to drive home the piece's musical construction by examining the score. This theme again uses variable bars, and is notated in $\frac{2}{8}$, $\frac{3}{8}$, $\frac{4}{8}$ and $\frac{5}{8}$. Twelve-tone technique is so applied that all four parts are derived from one form of the series, but each part forms constantly new twelve-tone successions. Naturally these secondary 'series' bear no relation to the basic series, so they have no constructional significance, unless one adheres to the view that serial technique exists primarily to delay note-repetition as long as possible. But nowadays this view, once very prevalent, is already obsolete.

In his *String Quartet* Henze has come to grips, in a somewhat forced way, with techniques that are inwardly foreign to him. It is surely no accident that this occurred in a chamber work, in fact in a String Quartet; this, after all, is the musical medium in which Haydn, Mozart, Beethoven and Schönberg wrote their masterpieces, so that it has special prestige, demanding constructive density more than any other. Hardly any composer who is to be taken seriously has been so naïve as to shake off all this load of tradition, not even Debussy or Ravel – perhaps only Stravinsky, in his *Concertino:* so one will not wish to reprove Henze for trying to achieve tightly-knit construction by the methods described. It is for others to decide whether he achieved his object. To me it seems certain that all these technical procedures suppressed a large proportion of his best qualities. But perhaps this is cancelled out by other, positive characteristics that I have yet to see (and above all to hear).[7]

[6] In J. Rufer, *Op. Cit.*

[7] In the recent *Concerto per il Marigny* (1956, dedicated to Pierre Boulez), Henze, according to the experts, has again come to grips with the techniques of 'pointillist' music.

Since writing this Quartet, Henze has proceeded along his own path, never putting a foot wrong, and his most recent work, the *Five Neapolitan Songs*, which I have had a chance to hear several times, shows that it is the right path. (Sept. 1956).

PIERRE BOULEZ

GYÖRGY LIGETI

DECISION AND AUTOMATISM IN STRUCTURE Ia

If one is to demonstrate the way constructional principles were used in the early stages of serial music, Structure Ia[1] is a particularly suitable example. Since this composition is very perspicuously worked out, its anatomy is revealed of its own accord, so it can be analysed as a 'textbook example'. Alongside the very ramified complexity of the *Marteau*, it stands in crystal-clear sobriety.

At this level of serial technique the compositional process can be reduced to three working stages: *Decision I – Automatism – Decision II.*

Decision I

A. Selection of elements.
B. Choice of an arrangement for these elements.
C. Choice of the further operations to be carried out with these arrangements ('arrangements of arrangements') and mutual relationships of the individual arrangements to each other.

Automatism

Elements and operations, once selected, are, as it were, fed into a machine, to be woven into structures automatically, on the basis of the relationships chosen.

Decision II

The automatically derived structure is to some extent crude, and one must work on it further, taking decisions in dimensions that are not employed mechanically. If, for example, the parameter 'dynamics' or 'register' has not been passed into the machine, then one can work over the crude structure by directing these left-over parameters. This can be done aleatorically, or with definite formal aims, such as to form or avoid particular connections within the given crude structure.

But the above-mentioned division into three results only if, in analysing, one is inclined to simplify. It could easily tempt one to regard the serial mode of working as a dialectic between freedom and mechanical compulsion. That would be wrong, for in this case decision is not to be confused with freedom, nor automatism with compulsion. You stand before a row of automata, and are free to choose which one to throw into; but at the same time you are compelled to choose one of them; you build your own prison as you please, and once safely inside you are again free to do as you please. Not wholly free, then, but also not totally compelled. Thus automatism does not function as the

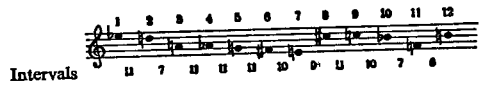
[1] Musical examples can for the most part be dispensed with here, since a printed edition of the *Structures* is available. Figures in the text refer to bar-numbers in the UE edition, 12267.

counterpole to decision; choice and mechanism are united in the process of choosing one's mechanism.[2]

Let us investigate how the process of composition, as outlined, is realised in this piece by Boulez.

Selection and arrangement of note-qualities[3]

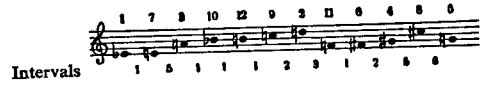
Tied down by the given, fixed temperament of the instruments chosen, and also by the traditional twelve-tone method, Boulez employs all twelve available note-qualities. In homage to his teacher he arranges these notes to form the same series as Division 1 of the note-succession from Messiaen's *Mode de valeurs et d'intensités.*



Example 1
Intervals measured in rising minor seconds

The marked homogeneity of this series is striking – the frequent occurrence of the interval 11 (five times), and the lack of 8 and all intervals below 6. The intervals present, apart from 11, are fairly evenly represented: 10 and 7 twice each, 9 and 6 once each. Very characteristically, 6 is used as the final interval of the series (this will later be intensively exploited in the piece); and the symmetrical position of the two 7s (second and penultimate intervals) is also characteristic.

This apparent poverty of the series becomes an advantage, however, since the inversion of the series



Example 2

consists only of intervals *below* 7, and thus, apart from 6, has no intervals in common with the basic form; this makes it easier to draw a clear distinction between the individual series, which function like threads in a web. Through this arrangement, the tritone 6 (common to the two series) becomes the axis of the basic series and inversions, while the regions of the remaining intervals function separately, in the one case as intervals above 6 (basic series and inverted cancrizan), in the other below 6 (inversion and cancrizan of the basic series). This separation is made all the more clearly manifest because the two triple successions of the same interval (11 and 1 respectively) act as characteristic vectors and thus produce a very marked contrast between the prevailing movement of the two different serial regions. 11 and 1 also produce a pronounced chromatic connection within the series; however, in the network of variously-combined serial threads these connections and prevailing movements are to a greater or lesser degree destroyed, because between the intervals of one series there are inserted notes from other series, which distract our attention from the connections mentioned, making us concentrate on other relationships. Thus as the overall structure

[2] For further discussion of this question the reader is referred to Herbert Eimert's article 'The Composer's Freedom of Choice', *Die Reihe III*, Universal Edition (London) and Theodore Presser Company, 1959.

[3] In our case it is more exact to talk of twelve note-qualities per octave, rather than pitches (which, after all, signify wholly exact frequencies), since the individual notes of the series can be transposed to different octave registers.

unfolds, there is continually a dialectic – chosen conditions within the series, versus the tendencies (moving in a different direction) of automatic serial combination.

Boulez uses the chosen note-quality series and its inversion, cancrizan and cancrizan inversion[4] in all twelve transpositions. In arranging the individual transpositions he refers to the following tables.[5]

S

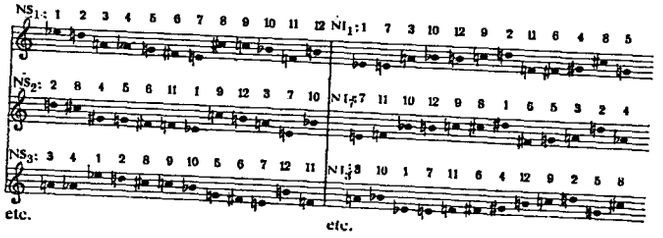
1	2	3	4	5	6	7	8	9	10	11	12
2	8	4	5	6	11	1	9	12	3	7	10
3	4	1	2	8	9	10	5	6	7	12	11
4	5	2	8	9	12	3	6	11	1	10	7
5	6	8	9	12	10	4	11	7	2	3	1
6	11	9	12	10	3	5	7	1	8	4	2
7	1	10	3	4	5	11	2	8	12	6	9
8	9	5	6	11	7	2	12	10	4	1	3
9	12	6	11	7	1	8	10	3	5	2	4
10	3	7	1	2	8	12	4	5	11	9	6
11	7	12	10	3	4	6	1	2	9	5	8
12	10	11	7	1	2	9	3	4	6	8	5

I

1	7	3	10	12	9	2	11	6	4	8	5
7	11	10	12	9	8	1	6	5	3	2	4
3	10	1	7	11	6	4	12	9	2	5	8
10	12	7	11	6	5	3	9	8	1	4	2
12	9	11	6	5	4	10	8	2	7	3	1
9	8	6	5	4	3	12	2	1	11	10	7
2	1	4	3	10	12	8	7	11	5	9	6
11	6	12	9	8	2	7	5	4	10	1	3
6	5	9	8	2	1	11	4	3	12	7	10
4	3	2	1	7	11	5	10	12	8	6	9
8	2	5	4	3	10	9	1	7	6	12	11
5	4	8	2	1	7	6	3	10	9	11	12

Example 3

These tables result from lining up the original series and inversions according to the note-order of NS_1 and NI_1, thus:



Example 4

No further tables are necessary for cancrizan and cancrizan inversion, since these result without more ado if we read the series of numbers from right to left: e.g., NI_4 becomes 7, 10, 1 . . . 4, or NIC_{10} 2, 4, 1, . . . 10.

[4] To distinguish between the note-quality series and duration series we use the following abbreviations
NS Original forms of the note-quality series.
NI Inversions " " " "
NC Cancrizans " " " "
NIC Inverted cancrizans " " " "
DS Original forms of the duration series"
DI Inversions " " " "
DC Cancrizans " " " "
DIC Inverted cancrizans " " " "

[5] Cf. Feldman, Boulez, Cage, Wolff: '4 Musicians at work', *Trans/formation*, 1/3, New York 1952, p.169.

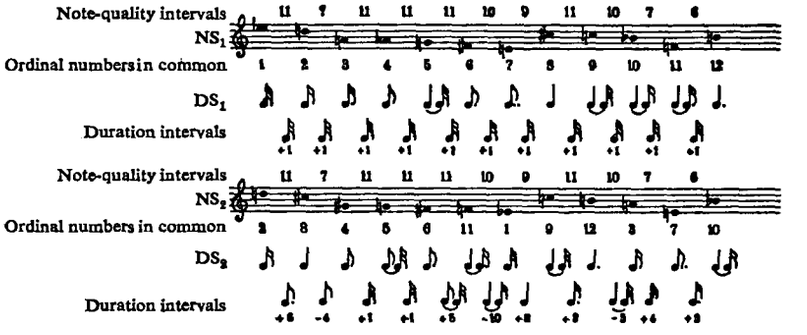
Selection and arrangement of the (relative) time-durations

The chosen basic unit (demisemiquaver) is multiplied by from 1 to 12, and arranged in an increasing arithmetical series (again as in the above-mentioned piano piece by Messiaen).

Example 5

Whereas the twelve elements of the note-quality series are predetermined by the customary temperament, the choice of durations, though in itself logical (as an arithmetical series), is all the same arbitrary. The number of duration elements (12) is meant to equal the number of note-qualities present, but the duration series, because of its additive structure, behaves heterogeneously as compared with the note-quality series, whose organisation is proportioned.[6]

It would, however, be unjust to pass a negative judgment on this dimensional difference, since such disagreements, artistically used, can lead to exciting combinations. It is not such a bad idea of Boulez', to link a linear scale (as duration series) to a note-quality series that is formed quite differently and is not (or only partly) scalar. One might object more to the unorganic way the durations are permutated. Boulez proceeds as follows: since a duration series DS_1: 1, 2, . . . 12 corresponds to the note-quality series NS_1: 1, 2 . . . 12, a permutation DS_2: 2, 8, 4, 5 . . . 10, for instance, must correspond to the transposition NS_2: 2, 8, 4, 5 . . . 10. Let us compare the resulting duration intervals with the note-quality intervals:



Example 6

Since in a series the decisive thing is the relationship between each element and the next, the contrast between the two procedures is obvious; whereas with the (organic) transposition of the note-quality series, the individual note-qualities are permutated but the interval-relationships always remain the same, the permutations of durations (which are in fact not transpositions at all) occur mechanically, according to tables, and have constantly different internal proportions. It is therefore by no means clear why just *these* permutations have been chosen out of all the possible ones. What is unorganic is this pointless transplantation of a system; note-qualities labelled with numbers, the

[6] Stockhausen has discussed this in detail in '. . . how time passes . . .' *Die Reihe III.*

dematerialised numbers organised into tables, and the tables finally used like a fetish, as a measure for duration-quantities; thus what were originally mere indications of *arrangement* are now used as indications of *value*.

Selection and Arrangement of the (relative) intensities

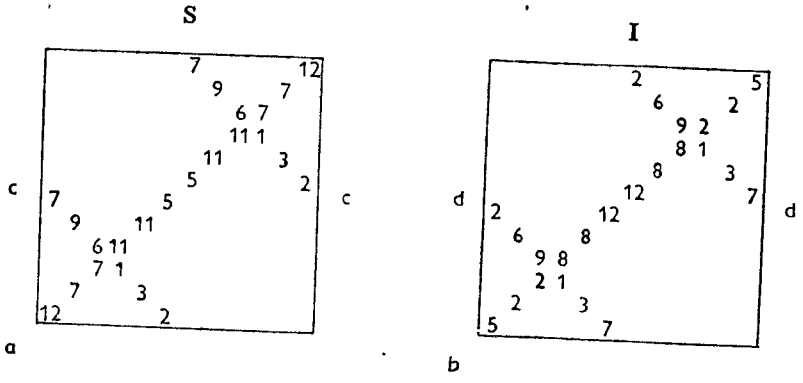
A scalar series is chosen with twelve values from very soft to very-loud:

1	2	3	4	5	6	7	8	9	10	11	12
pppp	ppp	pp	p	quasi p	mp	mf	quasi f	f	ff	fff	ffff

Whereas the predetermined pitches can be exactly realised on the piano, and the durations, after sufficient practice, relatively exactly, a consistent performance of these intensity-values is hardly possible. For pitches are ready-made on the piano; durations can be exactly measured (the basic unit can be counted throughout, since Boulez does not use too quick tempi), but dynamics can only be approximately estimated by the performer – this is not necessarily a fault, since listeners, too, experience music according to proportions that are subjective rather than calculated. However, it is problematic to differentiate dynamics so subtly as this; the regions of the individual intensity-values overlap, and one can certainly not be sure, for example, that a *p* at one point in the work will not be louder than a *quasi p* or even a *mp* at another point. Thus intensity-values spread out from points to become indistinctly bounded fields, and can only be estimated in relation to the loudness of their environment (the loudness of notes that are simultaneous or have recently ceased). Thus one can discern, among the various elemental regions so far discussed, further serial arrangements, according to their degree of performable exactness:

1. *Wholly unambiguous* pitches,
2. *Measured* durations, which, however, in the course of the piece are subject to certain *variations* in tempo,
3. Unmeasured, only *estimated* dynamics.

But the serial arrangement of intensities is still more inadequate than that of time-durations. Boulez has in fact taken out his chessboard for the purpose, and has proceeded diagonally like a bishop:



Example 7 (cf. Ex. 3)

He has thus obtained four arrangements for dynamics:

a:	12	7	7	11	11	5	5	11	11	7	7	12
	fff	mf	mf	fff	fff	quasi p	quasi p	fff	fff*	mf	mf	ffff
b:	5	2	2	8	8	12	12	8	8	2	2	5
	quasi p	ppp	ppp	quasi f	quasi f	ffff*	ffff*	quasi f	quasi f	ppp	ppp	quasi p
c:	2	3	1	6	9	7	7	9	6	1	3	2
	ppp	pp	pppp	mp	f	mf	mf	f	mp	pppp	pp	ppp
d:	7	3	1	9	6	2	2	6	9	1	3	7
	mf	pp	pppp	f	mf	ppp	ppp	mp	f	pppp	pp	mf

(if we search the piece for these arrangements, we shall find deviations at the points marked *; *ff* instead of *fff*, and *fff* instead of *ffff*. These are subsequent alterations of the dynamic proportions; in the section 'Lent' – bars 32–39 – the 2nd piano should be marked *ffff*, according to the higher-order determinations to be discussed later. But this would be too loud in relation to the remaining intensities, and the *quasi p* in Piano 1 would be obscured. Therefore Boulez reduced the *ffff* to *fff*. As a result, he had in the next section – bars 40–47 – to prescribe the intensity *ff* instead of *fff*, so that the decrease of one degree in loudness should be retained. Thus in view of the previous exchange of *fff* for *ffff*, the proportion *fff-ff* replaces the original proportion *ffff-fff*. Such alterations are wholly permissible, in view of the indistinctness of intensity-values.)

The selection of dynamic proportions according to this diagonal process is interesting as a game, but is even less functional than the duration-permutation described; it is not derived from the musical material, but from a numerical abstraction.

Using the diagonals, one automatically obtains symmetrical successions of values. The number of times the various elements appear throughout the piece therefore shows a symmetrical-statistical distribution; two elements (intensity-values 2 and 7) occur eight times, eight elements (1, 3, 5, 6, 8, 9, 11 and 12) four times, and two elements (4, 10) not at all.[7] The effect of this distribution is that the most differentiated dynamic indications are used – *pppp*, *ppp*, *pp*, *quasi p*, *mp*; the simple *p*, however, never occurs – the only reason being that the selected diagonal paths in the tables never touch the figure 4.

Choice of timbre: selection and arrangement of modes of attack

Boulez behaves very ascetically in this work; the structure proceeds logically from the selected elements, and he wants to leave it pure, to let it 'be itself', so to speak. The structure is to emerge as pure shape; for this purpose two pianos are particularly well suited to realise a monochrome network spreading out plastically and translucently in time. (The use of *two* pianos is determined by the inner construction of the music, since the individual serial threads are woven into two 'bundles' that pursue their course simultaneously.) The sound of the piano is made still more suitable for this kind of

[7] Because of the subsequent alterations, this distribution is altered to the extent that the element 12 occurs only twice instead of four times, while 11 occurs five times instead of four; moreover the element 10 (ff), which theoretically did not occur at all, does in the end occur once.

structure because after each attack there is a characteristic decrease in amplitude; a fact which points to the way this music, for all its polyphonic stratification of series, is formed from discrete elements of pitch and duration: because of the piano's characteristic attack, the acoustic events are concentrated into points that are well defined as to frequency and time. The horizontal threads are not indeed unrecognisable, since in the course of the piece they are unmistakably characterised by a constant dynamic and mode of attack for twelve pitches and durations each; but, all the same, the total of events consists more of a structured conglomeration of points. These points are not 'geometrical', that is to say not simple place-indications in the frequency-duration continuum – their varying dynamics and modes of attack give them varying weight, lucidity or nuance within the constant tone-colour.

In this piece Boulez makes use of ten modes of attack. It was hard enough to differentiate twelve degrees of intensity, but the distinctions between individual modes of attack are infinitely subtler, since piano touch (unlike string instruments' very differentiated modes of attack which each produce a quite different formant-spectrum) results from duration- and intensity- proportions that are always the typical ones. I.e., touch is not an independent parameter.

It is obvious that durations functioning as components of the mode of attack are not a part of the composition's serial organisation of duration-values. Durations (predetermined by the series, of course) are filled out by notes and rests, whose time-proportion is specific for each mode of attack. Thus with the limiting value *legato*, the entire duration is filled out by the note, and the rest thus equals 0; with the opposite limiting value *staccatissimo* the duration of the note tends toward 0 while the rest tends toward the maximum, i.e., toward the serially predetermined total duration; with the remaining modes of attack, the proportion of note to rest lies between those of the two limiting values, without one's being able to fix them definitely (this is to a great extent left to the performer).

Apart from this, some modes of attack have a degree of intensity (such as > or *sfz*) which still further reinforces the prescribed intensity. This peculiarity of the modes of attack creates difficulties when attack-series are coupled with intensity-series. The serial loom works badly when first intensity values and then modes of attack (with their own intensity values) are thrown into the process independently of each other and in such a way that at first any one can combine with any other. This leads to a number of contradictory combinations. For example in Piano 2, bars 48–56, we find *ppp poco* $\overset{sfz}{\wedge}$, and in bars 73–81 *pppp* $\overset{>}{\cdot}$. Such combinations are most uncertain, and can only be very vaguely interpreted by the performer. But the places with a weak primary degree of intensity are the most problematic – the louder intensities are influenced relatively less, since their additional intensity (decided by the mode of attack) is unimportant in comparison with their basic intensity.

This 'counterpoint' between the original intensities and those implicit in the modes of attack creates fields of inexactness, which do not follow from the overall conception of the work.

It was still possible to form a series from intensities, according to a loudness scale. But such a scale can not be made distinct for modes of attack, since between the two firmly established limits *legato* and *staccatissimo* one can not build any succession that will have a clear direction. This is because of the double significance of modes of attack

(duration + intensity). Boulez therefore had to choose an arrangement of the performing indications as he pleased. He arranged the modes of attack as follows:

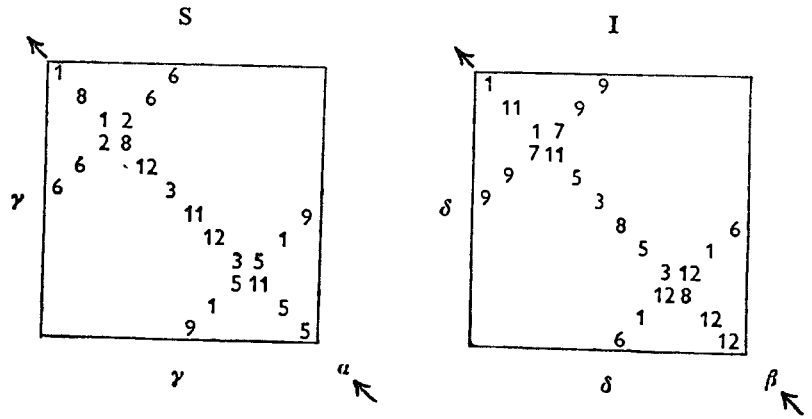
1	2	3	5	6	7	8	9	11	12
>	$\overset{>}{\cdot}$	·	normal	⌒	▾	$\overset{sfz}{\wedge}$	$\overset{>}{\blacktriangledown}$	$\overset{-}{\cdot}$	⌒

As we see, the ten modes of attack are numbered from 1 to 12, leaving out 4 and 10. This is a result of the arrangement of these elements used in the course of the piece. Correlating with the ordering of dynamics, Boulez uses not the above attack-series as such, but the successions obtained from it by manipulating the diagonals.

To find in the serial table the ordinal numbers for individual modes of attack, one has to look for correspondences of certain recurring modes of attack in the piece, and then look for corresponding number successions in the tabular diagonals. Thus for example in Piano 1, bars 40–46, we find the indication $\overset{-}{\cdot}$, in bars 48–56 > and $\overset{-}{\cdot}$, in 57–64 again >; bars 65–72, ⌒, > and ⌒, bars 73–81 ⌒, bars 82–89 > and ⌒; in Piano 2, bars 40–47 $\overset{sfz}{\wedge}$, bars 48–56 in two parts > and in one $\overset{sfz}{\wedge}$, bars 90–97 $\overset{>}{\blacktriangledown}$ and >, bars 98–105 'normal', bars 106–115 'normal', > and $\overset{>}{\blacktriangledown}$. Starting from the frequently recurring >, it is possible to make out groups of modes of attack, two of which are periodic: $\overset{-}{\cdot}$ > $\overset{-}{\cdot}$ > in Piano 1 and correspondingly $\overset{sfz}{\wedge}$ > $\overset{sfz}{\wedge}$ > in Piano 2; two other groups, however, are symmetrical: ⌒ > ⌒ ¦ ⌒ > ⌒ in Piano 1 and $\overset{>}{\blacktriangledown}$ > normal ¦ normal > $\overset{>}{\blacktriangledown}$ in Piano 2. In the tables one can find certain periodic or symmetrical number arrangements which correspond to these successions of modes of attack, e.g., 11.1.11.1; 8.1.8.1; 6.1.12.12.1.6 and 9.1.5.5.1.9 (see Ex. 8). So it is quite certain that the ordinal number 1 marks the mode of attack >. Through a similar procedure one can also identify all the remaining modes of attack. The final result shows four successions:

	5	5	11	3	12	11	3	12	8	1	8	1
α =	normal	normal	$\overset{-}{\cdot}$	·	⌒	$\overset{-}{\cdot}$	·	⌒	$\overset{sfz}{\wedge}$	>	$\overset{sfz}{\wedge}$	>
β =	12	12	8	3	5	8	3	5	11	1	11	1
	⌒	⌒	$\overset{sfz}{\wedge}$	·	normal	$\overset{sfz}{\wedge}$	·	normal	$\overset{-}{\cdot}$	>	$\overset{-}{\cdot}$	>
γ =	6	6	2	2	6	6	9	1	5	5	1	9
	⌒	⌒	$\overset{>}{\cdot}$	$\overset{>}{\cdot}$	⌒	⌒	$\overset{>}{\blacktriangledown}$	>	normal	normal	>	$\overset{>}{\blacktriangledown}$
δ =	6	1	12	12	1	6	9	9	7	7	9	9
	⌒	>	⌒	⌒	>	⌒	$\overset{>}{\blacktriangledown}$	$\overset{>}{\blacktriangledown}$	▾	▾	$\overset{>}{\blacktriangledown}$	$\overset{>}{\blacktriangledown}$

These can be found as follows in the tables:



Example 8

Since in this selection of diagonals two figures are again missing, one sees why Boulez also works with ten modes of attack. Whereas the intensity series could be made up to 12 by adding *p* and *ff*, a similar interpolation into the attack-series is pointless – what could one insert between · and 'normal', or ≷ and —? The enigma of the succession of attacks is further complicated by the fact that two modes of attack are interchanged; the succession 11 and 3, which occurs twice in the diagonal α, is reversed when it occurs for the second time in the piece[8]: in the section 'Lent' (bars 32–39) Piano 2, lowest part (e, F, etc.), there has to be · instead of —, and in the middle part — instead of · (because of the higher order relationships which we shall discuss later).

Since the automatically produced arrangement is no longer symmetrical (a deviation from the succession of intensities), the statistics of the element-distribution are also asymmetrical (but always go by even numbers); one element (1) occurs eight times, four elements (5, 6, 9, 12) six times, three (3, 8, 11) four times, two (2, 7) twice, and finally the two imaginary ones (4, 10) no times.

Choice of the arrangement of arrangements

The entire piece is woven from serial threads. Each individual thread consists of one transposition of the note-quality series (wholly strictly, without note-repetitions), in conjunction with one of the permutations of the duration-series. All the transpositions of the note-quality series are used in basic form, inversion, cancrizan and inverted cancrizan, as are all the permutations of the duration-series (derived by similar methods from the tables); and each individual form is used only once. This produces a total of 48 doubly-determined threads.

In any particular thread pitches and durations constantly alter, as serially determined; but each thread is homogeneous in its dynamics and modes of attack. These latter parameters vary from thread to thread.

The individual threads are united to form bundles, so that each bundle contains one, two or three threads beginning simultaneously (and also ending simultaneously, since

[8] This place is marked * in the succession α.

every duration series is the same length: 1 + 2 + 3 . . . + 12 = 78 demisemiquavers).[9]

Pianos 1 and 2 each have a bundle running simultaneously, but there are two places where one piano is silent (bars 24–31 and 57–64) so the vertical thread-density of the piece oscillates between 1 and 6. These double bundles, resulting from the communal work of the two pianos, are so lined up that there is no time-overlap at the 'seams'. Thus the composition is quite rigidly articulated into sections – the place for artistry is in the balance or contrast of the sections, since within them practically everything happens automatically. As there are fourteen such sections the total length of the piece amounts to 14 × 78 = 1092 demisemiquavers.

The higher-order serial arrangement is formed so that the whole composition is divided by a horizontal and a vertical axis. The vertical (time-)axis divides it into two. In part A the note-quality series is used in original form and inversion – the duration series, according to the tabular figures, in cancrizan and inverted cancrizan; *vice versa*, part B contains the cancrizan and cancrizan inversion of the note-quality series, and the duration series according to the numerical successions in the original-form- and inversion-tables.

The horizontal axis further articulates these two chronometric sections by distributing the serial forms (S, I, C, IC) between the two spatially separated instruments. Thus four sectors result. We mark them according to their formal part and instrument; sector A 1 means part A, piano 1, etc.

The note-quality series are so laid out that in Sector A 1 the transpositions of the original form occur, and in A 2 those of the inversion, in B 1 the inverted cancrizan transpositions and in B 2 the cancrizan transpositions. The duration series, on the other hand, run in such a way that A 1 contains the inverted cancrizan permutations, A 2 the cancrizan permutations, B 1 the inversion permutations and B 2 the permutations of the basic series. Thus the note-quality and duration series are 'counterpointed': in A, the basic note series and its inversion are linked to cancrizan forms of the duration series, and *vice versa* in B. But this 'series counterpoint' is purely external, since, as we saw, the duration permutations have not the same validity as the organic transpositions of the note-quality series.

Thanks to their internal structure, the note-quality series could be distributed with special plasticity. We have seen that NS and NI, or NC and NIC have only one interval in common (the tritone), yet the intervals of NS and NIC, or NI and NC are the same, only the succession of the intervals being reversed, so that the entire serial region falls into two families. Boulez exploits this in the architecture of the piece: in Piano 1 first NS, then NIC take their course – i.e., only intervals above 6; in Piano 2, NI comes first then NC, i.e., only intervals below 6. This 'motivic' separation ensures that although the two simultaneous bundles mix as sound, they are to some extent self-sufficient, since they have no intervals in common except the tritone. (All the same this separation, like that resulting from the spatial separation of the two instruments, is not enough to differentiate the two bundles for the purposes of perception; dynamics and modes of attack have an additional separative effect, as well as their effectiveness within the

[9] Each element in the series consists of an attack and a remainder which is wholly or partly filled out by a note; thus each bundle begins with a simultaneous attack in all the threads, whereas the attacks of the last element in each series are not synchronous.

bundles, since they split these up into individual serial threads. Thus there arises a continuous dialectical play between separation and mingling of the individual threads and bundles; in fact this is one of the stimulating features of the work.)

The tritone (common to all forms of the series), which occurs either at the end (in NS and NI) or at the beginning (in NC and NIC) of the series, serves as an adhesive in the realm of intervals. Boulez exploits this: since in part A NS- and NI-forms are present, each section ends with tritones in the individual threads (this adhesive effect is less powerful if there are more threads simultaneously, because the latter's superimposition interpolates notes from other threads between those of the tritones, thus obscuring them). In part B, where NIC- and NC-forms take their course, each section begins with tritones. Thus the tritones illuminate, more or less distinctly, first the ends of the sections, then their beginnings, so that they help to organise the overall build-up of the piece. The accumulations of tritones are produced automatically, yet they result from choice – choice of the tritone as the series' peripheral interval, choice of the series' simultaneity within the sections. Clearly the automatism of the serial loom can be artistically exploited, if elements and operations are well chosen.

Within the four sectors the arrangement of the serial threads is again determined by series or tables. In sector A 1, the individual threads are arranged so that the first notes of the 12 NS series produce the higher-order series NI_1; in sector A 2 the total of the 12 NI series is arranged according to the series NS_1, in B 1 the first notes of the NIC series are determined by NIC_1 and finally in B 2 the first notes of NC are determined by NC_1. Thus one can sum up and survey the process:

	PART A	PART B
Piano 1	Total of all NS series arranged according to NI_1	Total of all NIC series arranged according to NIC_1
Piano 2	Total of all NI series arranged according to NS_1	Total of all NC series arranged according to NC_1

These principal arrangements run through the individual sectors without regard for simultaneity or successiveness of threads. This clearly illustrates serial music's general tendency to dissolve the barriers between horizontal and vertical.

As we have already seen, the successive sectors (A 1 – B 1 and A 2 – B 2) were linked by typical serial forms with common interval relationships. In the higher-order arrangements, however, these relationships run crosswise; the related nature of NS and NIC links sectors A 2 and B 1, that of NI and NC links A 1 and B 2. This division is in accordance with Boulez' technique of mingling right-angles with diagonals in order to produce an 'X-polyphony'.

Since there are no connections between the individual duration series such as exist between note-quality series linked by common intervals, Boulez had to unify the duration-arrangements (to some extent) by choosing the same higher-order series twice in each sector (DIC_1 in A 1 and B 2, DC_1 in A 2 and B 1); by now it will go without saying, that this occurs in 'X' form.

The first element of each duration series is again decided by a higher-order series:

	PART A	PART B
Piano 1	Total of all DIC series arranged according to DIC_1	Total of all DI series arranged according to DC_1
Piano 2	Total of all DC series arranged according to DC_1	Total of all DS series arranged according to DIC_1

Yet a flaw has crept into the arrangement – though it can only be regarded as a flaw from the point of view of tabular consistency. The IC_1 series runs: 5, 8, 4, 6, 11, 2, **9, 12,** 10, 3, 7, 1; but the DIC series built into sector A 1 as a higher-order succession is: 5, 8, 4, 6, 11, 2, **12, 3,** 10, 3, 7, 1. This is a more radical interference with serial order than the alteration in dynamic succession or the interchange of modes of attack, which have already been mentioned. Here a whole series is missing (DIC_9), while another (DIC_3) occurs twice. It is impossible to tell whether this state of affairs is to be regarded simply as a lapse on the composer's part, or as an intentional introduction of 'unpredictability' into the construction – a 'gratuitous action', as a minor revolt against automatism. Deliberate or unconscious, it is certainly a tiny structural flaw, but it does not disturb the pattern too much – still less since the flaw is embedded in a tangle of six different threads. It is remarkable, though, that in the same section, the first 'Lent' (bars 32–39), the already-mentioned interchange of modes of attack occurs, apparently to restore the balance; the first 'flaw' occurs in Piano 1, the second in Piano 2, where one of the two loudness-alterations also occurs. Did Boulez perhaps have an off day when he wrote this section?

In this pile-up of deviations from strict serial order, hardly anything will be perceptible to the listener, so the disturbance of the mechanism can hardly be taken as deliberate. In strictly regulated composition, 'gratuitous actions' are conceivable, even desirable; by introducing the unpredicted into the predetermined, extraordinary artistic effects could be produced. But an inaudible act of arbitrariness will shock nobody – except maybe the analyst. And it would be trouble for nothing to build a subtlety into the work simply to make a reader rack his brains for an hour or two.

An exaggeration of serial thought would here establish a series of degrees of error:

1. faultless;
2. quite small deviation (the dynamic alterations);
3. rather more radical deviation (interchange of modes of attack);
4. very radical deviation (disturbance of the course of the durations).

But such 'error-series' could only be functionally evaluated if they were built into the overall architecture in a truly organic way – which is not the case here.

As we saw, the arrangement of dynamics and modes of attack is not composed within the single threads but only as a higher-order element. Thus in A 1, dynamics are ordered according to the succession a (see p. 41), in A 2 according to b, in B 1 according to c, and in B 2 according to d (but in a and b there are alterations, as discussed).

The arrangement of the modes of attack in A 1 is determined by the succession β (see p. 43), in A 2 according to α, in B 1 to δ and in B 2 to γ (with the exchange already mentioned).

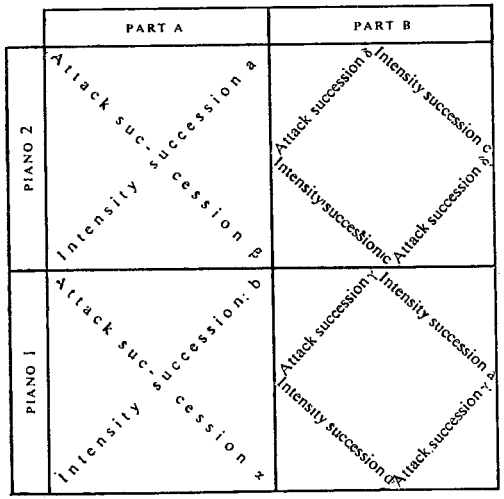
Thus one can summarise the entire plan of the arrangements for the whole structure:

	PART A	PART B
Piano 1	Total of NS acc. to NI_1 Total of DIC acc. to DIC_1 Dynamics acc. to a Attacks acc. to β	Total of NIC acc. to NIC_1 Total of DI acc. to DC_1 Dynamics acc. to c Attacks acc. to δ
Piano 2	Total of NI acc. to NS_1 Total of DC acc. to DC_1 Dynamics acc. to b Attacks acc. to α	Total of NC acc. to NC_1 Total of DS acc. to DIC_1 Dynamics acc. to d Attacks acc. to γ

This gives a general view of the tabular relationships; the individual threads of the composition are arranged, as to the proportioning of their note-qualities and durations, according to the horizontal lines of the tables; the individual sectors are ordered as to higher-order note-quality- and duration-proportions horizontally, but, as to dynamics and mode of attack, according to the diagonals of the tables; the whole work, however, is laid out, as regards note-quality- and duration-proportions, according to a 'diagonal' X-concept.

It is remarkable that the diagonals for dynamics and modes of attack in the individual sectors again cross. Since the intensity- and attack-arrangement of each individual sector is derived from two different tables (when dynamics are from table S, attacks are from table I, and *vice versa*), one must imagine the two tables written on top of each other, if one is to see the relationship between the diagonals of intensity and mode of attack.

The planning of dynamics and modes of attack in the sectors can be sketched as follows:



Example 9 (cf. Ex. 7 & 8)

But the construction, as so far explained, still tells us nothing about the proportions between the individual sections, nor about those within the sections. As we saw, the piece is articulated into 14 sections by the succession of double bundles. The individual sections are made much more recognisable by the alternation of different tempi (as duration-regulators of a higher order than the duration-series), and by pauses of varying length. But this happens in such a way that the second, third and fourth sections, and the sixth and seventh, are grouped into two major sections by common tempi and the absence of caesuras. This reduces the number of sections to 11 (this corresponds in a way to the 11-interval series). In the succeeding analysis, to make it easier to follow the overall form, we number the 14 sections I to XI, differentiating the major section II into IIa, IIb and IIc, and the major section IV into IVa and IVb. Thus the piece is articulated as follows:

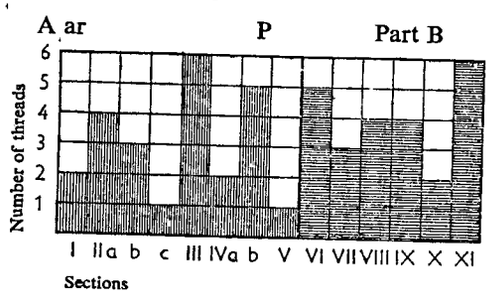
Part A:	first section	I	Bars 1–7
	second „	IIa	8–15
	third „	IIb	16–23
	fourth „	IIc	24–31
	fifth „	III	32–39
	sixth „	IVa	40–47
	seventh „	IVb	48–56
	eighth „	V	57–64
Part B:	ninth „	VI	65–72
	tenth „	VII	73–81
	eleventh „	VIII	82–89
	twelfth „	IX	90–97
	thirteenth „	X	98–105
	fourteenth „	XI	106–115

Thus the distribution of the sections between parts A and B is unsymmetrical – a welcome deviation from the otherwise rigid regularity of the construction; parts A and B are as 8:6 in their number of sections, but as 5:6 if one counts sections and major-sections.

Statistically speaking, the horizontal distribution of the vertical thread-density is fairly even, between the limiting density-values 1 and 6: the number of threads present in each section is:

	PART A								PART B					
Section	I	IIa	IIb	IIc	III	IVa	IVb	V	VI	VII	VIII	IX	X	XI
Number of threads	2	4	3	1	6	2	5	1	5	3	4	4	2	6

Thus densities 2 and 4 happen three times each, and 1, 3, 5, 6 twice each. The distribution is still easier to see from a diagram:



Example 10

In B the average vertical thread-density is visibly greater than in A; this goes with the smaller number of sections, since the total of threads in A and in B has to be the same. The varying horizontal distribution of vertical densities in the two parts is particularly well formed; A begins with low density, rises somewhere about the middle to a maximum, and falls at the end to minimum density; the maximum in the middle is emphasised very plastically by minima directly before and after it. This sudden condensation in section III and the great decrease in density at V have a high degree of surprise.

In the denser part B, just as the flow of note-qualities and durations is the negative of that in part A, so the horizontal course of the vertical thread-densities contrasts with that in the first part. Thus in B the density first decreases from a higher degree to a lower one, and ends with a steep ascent to the maximum.

The proportioning of densities is also different in each part. In A we find an unsymmetrical, strongly oscillating density-flow (e.g. the leap from 1 to 6 and then back again to 2); in B there is a balance of densities: at the beginning a decrease from 5 to 3, at the end a reversed and greater proportional change from 2 to 6. The middle value of both these proportions 5:3 and 2:6 would be 4, and in fact we do find density 4 twice running, as a level plateau at the chronometric centre of B.[10] This produces a correlation between the shaping of density and of the time-flow.

Since the 14 sections can be run together to form 11, we can also investigate the distribution of the threads in the light of this organising pattern. In such an investigation the distinction between horizontal and vertical vanishes in sections IIa, b, c and IVa, b, for whereas in all the other sections the threads run simultaneously, in these two major-sections they run both simultaneously and successively. The distribution of threads in this case is:

	PART A					PART B					
Sections and major sections	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Number of threads ..	2	8	6	7	1	5	3	4	4	2	6

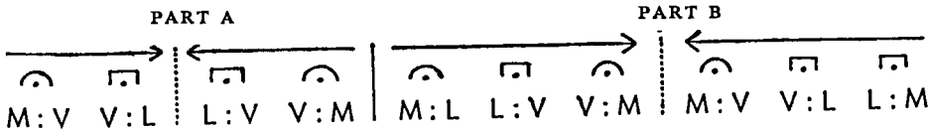
[10] This direct succession of two equal densities does not lead to monotony, since the modes of attack in sections VIII and IX differ widely; in the first, longer attacks mainly occur, in the second, shorter ones.

The distribution of the total of threads from sections I to VIII is serial (marked by the bracket). The remaining sections IX, X, XI contain threads as indicated by the even numbers in the preceding series, namely 2, 4, 6.

Alterations of tempo are similarly balanced; of the 14 sections, three are 'Lent', four are 'Très modéré' and seven 'Modéré, presque vif'. Obviously it is the super-sections IIa, b, c and IVa, b that are marked 'Modéré, presque vif'; thus their flow of time is brought into proportion with the two 'Très modéré' and the one 'Lent' in part A. In part B the alterations of tempo are more frequent; it changes with each section. This results logically; whereas in A the entry of a new tempo is itself endowed with a high enough degree of surprise, in B the degree of suprise must be maintained by more frequent changes of tempo, since one has already experienced all the tempi. (One can also see this from the behaviour of the quickest of the three tempi – 'Modéré, presque vif'; it first joins together three sections (IIa, b, c) to form a group, then only two (IVa, b), and later this tempo occurs only in isolation, in VII and IX).

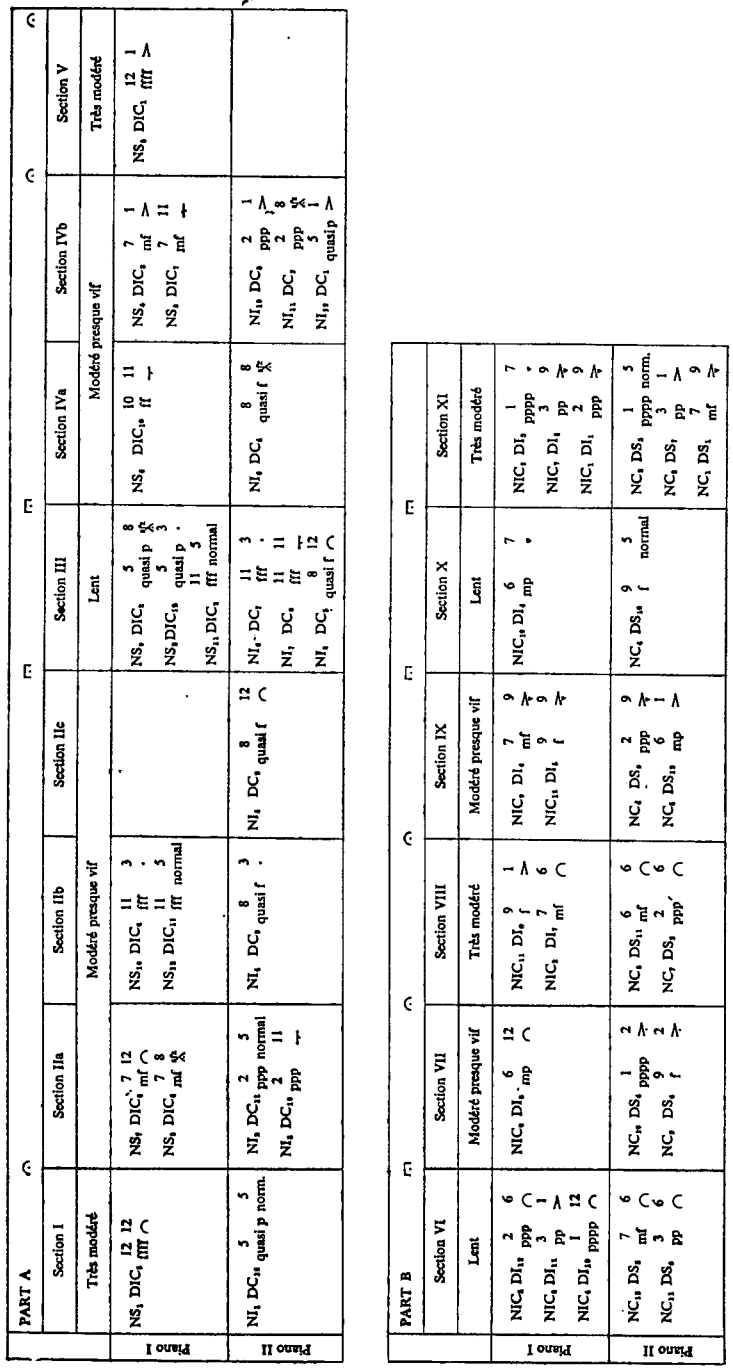
The distribution of tempi between the various thread-densities also has a particular balance. Sections with the same tempo differ, if possible, in density; 'Lent' is combined with density 6, 5, 2, 'Très modéré' with 2, 1, 4, 6; only in 'Modéré, presque vif' do two densities each occur twice (3, 4), and only because this tempo is used relatively more often – the succession of densities for 'Modéré, presque vif' is thus: 4, 3, 1, 2, 5, 3, 4. In any case, the equal densities in this succession are kept as far apart as possible, and the composer makes sure that they come in a different order, first 4, 3, then 3, 4.

Boulez has found a very artful way of proportioning the alterations of tempo. To see this better, we use abbreviations for the tempi: L = 'Lent', M = 'Très modéré', and V = 'Modéré, presque vif'. Thus we find these two different symmetrical proportional arrangements:



Between the sections or major sections the fermatas are so distributed that out of the 10 caesuras 5 are longer (𝄐) and 5 shorter (𝄓). With the maximum difference in tempo (V:L, L:V), the caesura is short (𝄓); between the quicker tempi (V:M, M:V) it is long (𝄐); between medium and slow tempi, however, it varies according to the order, so that long fermatas are used when the faster tempo comes first (M: L) and short fermatas when the reverse holds good (L:M). This is a wholly functional use of fermatas, since when the difference in tempo is greater the separation of the sections is in any case ensured, and the new tempo's degree of surprise is higher, so long as it enters without great delay; on the other hand, smaller tempo alterations do not mark the borders of the sections so clearly, so that longer caesuras have to emphasise the separation (though this is only true in this special case, where the whole architecture of the piece is designed so that the individual sections are to be as easily distinguishable as possible).

Thus we have taken a brief general look at the predetermined construction. The full-page table (p. 52) sketches the build-up of Structure Ia; here the individual threads, in their 'four-dimensional' determination, are distributed among the individual sections I-XI.



Automatism

Once arranged, the elements are woven, in the predetermined way, into a network in which the detailed results can not be foreseen. Since the sections are separated from each other, the mechanism manifests itself only in their internal structure.

The simultaneous threads appear as if photographed over one another; this automatically regulates the succession of note-qualities. The realm of notes can only be grasped statistically, and one can say no more than that in any section each of the twelve given note-qualities occurs as many times as there are threads. Thus the note-succession is to some extent indifferent, and almost every remnant of 'melody' is dissolved (more radically than in Webern, where remnants of 'expressive melody', if only fragments, are left hanging from the skeleton of the structures.)

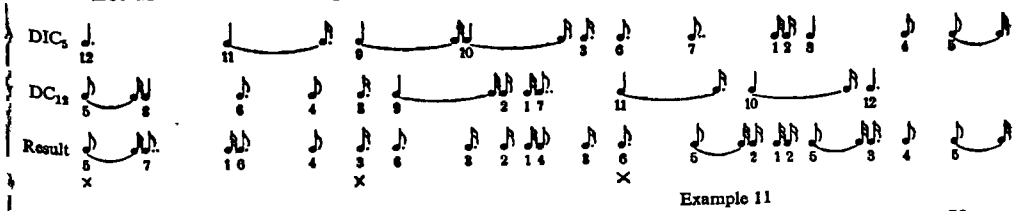
The vertical relationships are equally unpredictable. There is no question of 'chords'; pseudo-chordal phenomena do result when several attacks coincide at the same point in time, but as their components are wholly indifferent these simultaneities have no chordal function – they count only as interference-maxima of the threads, with the sole function of greater or lesser vertical density. Thus every beginning of a section is marked by a simultaneity of attacks that has the maximum density specific to that section, and this gives a typical physiognomy to the density flow of the entire composition.

This uncontrollability of the horizontal and vertical dimensions, resulting from predetermination, has its roots in traditional twelve-tone technique. In the latter, there were already to some extent relations of uncertainty between the dimensions; one could either arrange vertically, in which case one lost control of the horizontal; or one composed with linear series, in which case the vertical simultaneities were very difficult to manage; or else one tried to find a common way to direct both lines and simultaneities, but had to make concessions both ways. The art of dodecaphonic writing lay precisely in managing the dimensions' balancing-act in the confined space of the relationship mentioned.

In our example from the early stages of serial composition the situation gets considerably worse; there is no longer even the narrow field of play left by relation of uncertainty – in fact neither dimension is really available any more. But there is nothing terrifying in this, it only means that the possibilities for composition have moved into new territory (one previously had not an inkling of the dimensions opened up for composition in more recent serial works). So the 'poor old serialist' is no more a captive than the tonal composer chained to his cadences; now as ever, the vital thing is how far, and in what way, one can tug at one's chains.

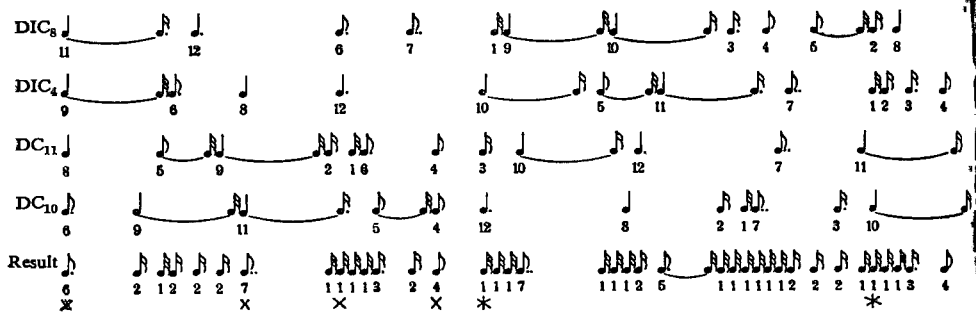
The duration-proportions produced by the superimposition of threads are not to be influenced any more than are the successions of note-qualities. Variations in horizontal density (frequency of attack) – horizontal alteration of the vertical attack-density: both are now taken out of the composer's hands.

Let us take a few examples. First the superimposition of two threads in section I:



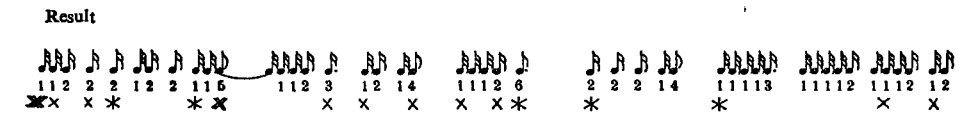
Example 11

In section IVa, four threads are simultaneous:



Example 12

For a still more complicated case, take section III. For simplicity's sake only the sum-total of the six superimposed threads is quoted:



Example 13

Thus the adding together of regular processes gives a wholly irregular result, of very elegant flexibility. The fewer the threads working together, the more richly varied is the flow, since no duration value occurs much more often than any other (in this case, however, there is still not too much damage to the original layout – all duration values once each, maximum degree of variation, as seen in the single-thread sections IIc and V). But when the number of threads increases, the number of smallest phases (demisemiquavers) increases very rapidly, and the frequency of semiquaver values also increases, if less, still fairly rapidly. Both multiply at the expense of longer values, which slowly disappear. This can be seen from the comparison on opposite page.

It is not by chance that the highest thread density in the piece is 6. If the threads were to pile up any further, the demisemiquaver would devour the longer values so completely as to produce a boring, almost periodic pulsation, which would rather harm the aesthetic value of the piece. This is why the already-mentioned 'flaw' in the flow of durations (in fact it occurs in the dense section III) has not the slightest disturbing effect on the overall picture, since demisemiquaver values are so frequent.

The horizontal variation in vertical attack-density is still more irregular.[11] As we saw, this density, determined by the nature of the construction, reaches its maximum at the beginning of the sections. Elsewhere, the density obviously rises as the number of threads increases, but where and how many attacks coincide is left to chance: an intersection of *separately* determined processes, which from a statistical point of view does not happen all that often.

The extent to which the individual threads in the web are distinguishable could also be regarded as a mechanical end-product. Here three factors are determinant: dynamics,

[11] See Ex. 11, 12 and 13; × means two, ✳ three, ✖ four, ✖ six simultaneous attacks.

Value	Number of values per section		
	I (two threads)	IIa (four threads)	III (six threads)
𝅘𝅥𝅯𝅘𝅥𝅯	3	21	25
𝅘𝅥𝅯	3	9	14
𝅘𝅥𝅯.	4	2	2
♪	3	2	2
♪‿𝅘𝅥𝅯	4	1	1
♪.	3	1	1
♪..	1	2	0

mode of attack and the number of threads present. Maximum clarity is obviously attained by the single-thread structure in section IIc and V. But the first section, too, can be very clearly 'heard through': two threads with a very great difference in dynamics (*ffff* and *quasi p*). In section X the two threads are rather less plastic; although the distinction in mode of attack is greater, the dynamic distinctions are much less vivid than in I. Of the three-thread structures, section VII can be clearly heard through; two threads which in fact have the same mode of attack (>) are composed with a very great difference in intensity (*f-pppp*), and the third (*mp*) is very plastic because of its mode of attack (*legato*). A minimum of separate existence for the individual threads is found in the six-part final section (XI); all short attacks (one single line played *normal* but none *legato*), also fairly homogeneous dynamics (two threads each *pppp* and *pp*, one each *ppp* and *mf*). Among the two-thread structures, too, there is one that is fairly welded together: section IVa, played *ff* – and *quasi f* sfz. The structures of the other sections are plastic or indistinct to varying degrees, as stages between the extremes mentioned.

Decisions within the products of automatism

These occur, as discussed, through choices in some parameter not yet exploited; in this case, register-distribution of the notes, and, in conjunction with it, the direction of their movement.

Note-qualities only become pitches when their register has been determined; this changes an abstract 'quality' into a note that can sound.

We have seen that intervals, both built up vertically and lined up horizontally, are fairly indifferent in this work. But there is one exception: the serial structure is hypersensitive to octaves. One is familiar with this from traditional twelve-tone procedure.[12] There is something vague about the octave as an interval; it is not a genuine note-

[12] Cf. H. Jelinek, *Anleitung zur Zwoelftonkomposition*, Vienna 1952 (Universal Edition), Chapter 6. Die Oktave in der Dodekaphonik.

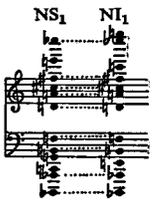
repetition, yet it mingles too much with the original frequency to be perceived as genuinely different.

In choosing registers Boulez to a great extent follows this principle of avoiding octaves. This leads to serial degrees of freedom of choice; in the monodic sections, the register-distribution is free; the more simultaneous threads are present, the more likely are octaves to occur, and the choice of registers becomes increasingly fixed, to ensure that they are avoided as far as possible.

This is a particularly good example of the way decisions hang together; the original choice of vertical thread-density for each section affects the free choice of registers, because of the principle of avoiding octaves. Thus one choice inevitably imposes limits on all the decisions that follow from it.

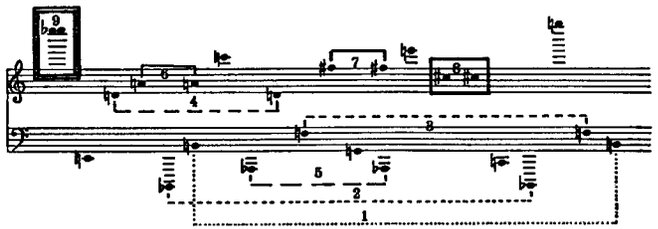
The avoidance of octaves means the piling-up of note-repetitions – these occur because the chosen threads are woven in fixed registers. These note-repetitions again produce very plastic connections within the structures, so that further patterns are built into the irregularity of the network; this dialectic between the apparently regular and the seemingly accidental is in fact one of the most attractive characteristics of the piece.

Let us examine a few sections from the standpoint of register-distribution. For clarity's sake we run all the notes of each thread together, ignoring the time-dimension; section I then shows the following distribution, which is almost even:



Example 14

We see that nine note-qualities – i.e., the great majority – are in registers common to both series; only three (c, e, g) differ in position. This means a greater degree of fixing than would have been necessary to avoid octaves.[13] This leads to frequent note-repetitions, which attract our attention when we hear the piece. The resulting connections have the effect of knots in the structural network. These knots are all the tighter as fewer attacks are inserted between a note and its repetition. (These repetitions in the same register are thus chosen with relative freedom; but their degree of separation is automatically predetermined by the nature of the serial weave).



Example 15

[13] This is not so in every section; for example, in section IVa, which is also two-part, only five pitches are common to the two threads.

We can list a series of degrees of connection, which emerges clearly from the structure. For this purpose we sketch the course of Section I, without indicating the rhythm.

The degrees of connection, arranged in a scale, are as follows:

Degree of connection 0* : c''' – C ; E – e'''; G – g''''
Smallest actual degree of connection (1): B – B (14 other pitches between)
Degree of connection 2: low B Flat – B Flat (12 other pitches between)
" " " 3 : f-f (9 other pitches between)
" " " 4 : d' – d' (5 other pitches between)
" " " 5 : low A Flat-A flat (4 other pitches)
" " " 6** : a' – a' (one foreign attack between)
" " " 7** : f'' sharp – f'' sharp (one foreign attack between)
" " " 8 : c'' sharp – c'' sharp (direct succession)
" " " 9*** : e'''' flat – e'''' flat (simultaneous)

* This marking means that these pairs are far apart not only in register but in time, to that no trace of a connection is present.

** One can only determine the degree of connection between these pairs if one takes into account how near in time the note is to its repetition. Thus the interval of entry of the f sharps is a quaver, that of the a-s is a crotchet plus semiquaver, so the first pair has a somewhat higher degree of connection.

*** In fact the maximum degree of connection is not a connection at all (maximum quantitative alteration is transformed into something qualitatively different), because an element is absent – recollection of a pitch that has already sounded; so there results not a 'connection' but complete welding together. In any case note 1 of NS_1 swallows the first note of NI_1 since it is struck *ffff* as against the *quasi p* of the other, and also lasts longer.

If we arrange the individual connections chronologically, taking the points where the connection is perceived, i.e., the second note of each pair, the succession of degrees of connection is as follows:

$$9,\ 6,\ 4,\ \tfrac{7}{5}^{*},\ 8,\ 2,\ 3,\ 1$$

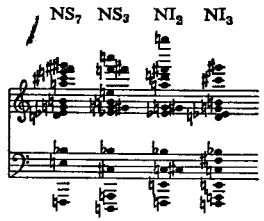
(7 and 5 struck simultaneously, but 7 more prominent than 5).

It is no accident that the lower-degree connections are left till near the end of the section. As time passes, it becomes more likely that these looser connections will occur, since they take more time than the higher-degree ones (thus most of the latter are shifted forward toward the beginning).

This series of 'knot-strengths' shows that at the beginning the threads are woven together particularly firmly; the web then loosens for a time, only to tighten again in the sixth bar of this seven-bar section (our attention is especially caught by the repeated c sharps). Then the web quite suddenly loses all its tension, since the note-repetitions at the end of the section lie so far away from the first appearance of these pitches that they are hardly to be perceived as repetitions.

Since there is a great dynamic difference between the two threads, the note-repetitions act at one point as a note with an echo (*ffff – quasi p*), at another as a 'pre-echo' of a note that actually enters later (*quasi p – ffff*). This enriches the structure through stereometric effects of nearness and distance.

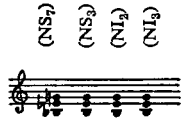
The fixed register-relationships are more complex in section IIa, where four threads are interlaced.



Example 16

Here repetitions occur not merely once but two and three times. These multiple note-repetitions are particularly stimulating because this section is highly differentiated in its dynamics and performing indications.

Notes repeated three times (i.e. sounding four times) are:

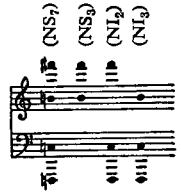


Example 17

The note b flat first appears in the section's first bar (bar 8), *ppp* — in NI_3, then (already almost forgotten because of the interpolated repetition of the note g) it returns in NS_7, *mf legato* (bar 10), and immediately after (a semiquaver later) as an immediate echo in NI_2 (*ppp*, *normal*). A dotted minim plus semiquaver after this, it is suddenly struck as a sharp *mf* sfz (NS3, bar 13).

The note g behaves similarly. However, a more interesting and conspicuous repetition is that of e flat, since by the automatic workings of 'chance' the four e flats come very close together. In the first bar of the section (bar 8) we first hear e flat *ppp* (in NI_2), and in the same bar, a dotted semiquaver later, it reappears louder in NS_7 (*mf*, *legato*), as if the initially thin thread had suddenly thickened; in the next bar (dotted quaver later) the process is reinforced still further: e flats occur simultaneously in both NS_3 and NI_3, and the one in NS_3, struck *sfz*, rounds off this succession of repetitions very pointedly. Thus the note e flat becomes especially conspicuous, emphasised by the recollection of the e flat three octaves higher at the beginning of the first section. But one may not regard this note as a 'tonic' or central note – nothing of the kind can exist in this kind of music (since to compose 'serially' means the abolition of any hierarchy of the musical elements); the pile-up of this note, being a purely accidental result, has no harmonic function.

The three threefold repetitions are placed close together in the middle register, whereas the four twofold ones lie wide apart in the frequency-space:



Example 18

Of these notes, the pitch f sharp is particularly emphasised, being almost of equal importance with the repeated e flats – moreover its appearance corresponds practically symmetrically to the latter, coming almost at the end of the section (bar 15). Thus section IIa is held firm as if with a nail at either end.

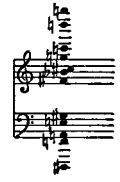
These f sharp repetitions occur as follows: first *ppp* in NI_2, and immediately after (a demisemiquaver later) *mf* in NS_7 and NS_3 simultaneously, reinforced by the combination of sfz and *legato*.

The other double repetitions are less important than this, but still noticeable. The low F toward the middle of the section (bars 11–12–13), and the b and c toward the end (bars 14–15) produce, together with the f sharps, a whole web of note-repetitions. Of the single repetitions, c sharp is very pregnant (in NI_2 and NS_3, bar 11), because the two identical pitches follow each other very closely (phase-difference of a quaver). The second c sharp (NS_3), because of its intensity, and especially because of its mode of attack (*sfz*), emerges specially audibly from the three-note simultaneity, since the other two notes (E from NI_2 and f sharp from NI_3) are to be played *ppp*.

The remaining single repetitions have less effect than those mentioned.

These and similar connections occur in all sections, and each section has it network of knots, denser or less so. We saw that, in order to avoid octaves, the fixing of registers intensifies as the number of simultaneous threads rises. This increases the number of connections, and the sections with greater thread-density are also denser from the point of view of note-repetitions. Thus the density of the connections is at its maximum in the six-part section III, in which all registers are fixed:

common to NS_2 NS_9 NS_{11} NI_6 NI_7 NI_8



Example 19

All the connections produced are six-fold, so that they produce a wholly static result, and they have a particular charm, nuanced as they are by intensities and modes of attack.

Since there is a relation of uncertainty between the choice of connections and that of the parts' interval directions, the complete fixing of registers means that the composer can no longer influence the course of the individual threads, which is wholly automatic.

The conditions in section XI are similar to those in III, with one exception; there are only 11 six-fold connections – one note-quality (B) changes register. Thus one can draw up a scale of degrees of connection, from the maximum connection in section III to connection nil in the two monodic sections (IIc and V); this scale is a series of a higher order than the connection-series within the sections.

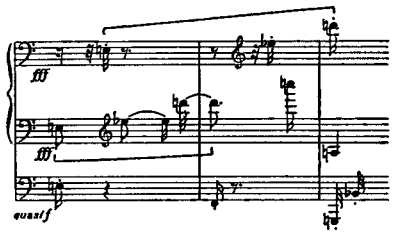
But within the multi-thread sections relationships of other kinds can be heard; particular formations of a motivic kind, which (as we have already indicated) are no longer really motives but something like the shadow of the remains of motives. Such formations occur where particular intervals are repeated. The occasion for this is usually one

of a number of relationships between the individual note-quality series. These relationships are partly predetermined by automatism, but can be emphasised with varying clarity by the (limited) choice of register.

One opportunity is provided by the tritones, which have been mentioned as the 'end-intervals' of the series. We said that forms NS and NI, NC and NIC have no other intervals in common, because of the way the series is constructed. There are all the more intervals common to the various transpositions of the same basic form. Obviously the structure could not exploit all the possibilities offered by the combination of series. And Boulez clearly did not strain himself to pile up these relationships, since if there are too many ghosts of motives they materialise and become real motives; this coagulation could disturb the glassy transparency of the network.

To permit such relationships, the registers of the intervals must remain the same, and the return of the interval may not be delayed beyond the time within which recognition is possible.

In Section IIa, for example, apart from the tritones mentioned, four other interval-repetitions would be possible: a – a flat and d – c sharp in NS_3 and NS_7; a – b flat and e – f in NI_2 and NI_3. But only the latter is exploited, with marked effectiveness in the bass; E and low F, both times *ppp*, first with a short attack (_.), then normally (bars 10–11 and 11–12). Plasticity is increased by the return of low F *mf* in bar 13 (see the low-F connection mentioned). A still more striking passage, which stands out of the structure almost as a normal motive-imitation, can be found in section IIb: the coinciding series NS_{10} and NS_{12} have a three-note succession in common (e – e flat – d). This complex is reinforced by the identical registers of each pair of repeated notes (bars 17–18):



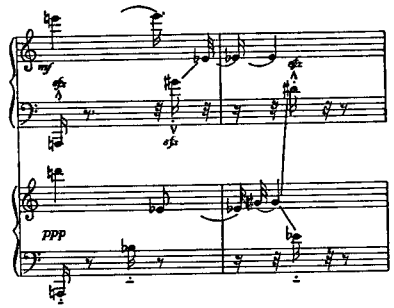
Example 20*

* In bar 2 of the top part a semiquaver rest is missing after the e flat.

This comes close to being a traditional 'augmented imitation in stretto', yet this passage has a quite different effect from a similar one in earlier music. In the latter, high degrees of surprise are usually associated with the appearance of elements not previously used; but in serial music of the kind investigated here, one result of the total exploitation of note-qualities is that the sudden literal repetition of a several-note figure in fact gives the impression of something wholly unexpected, and thus has a specially high degree of surprise.

It is interesting to observe how in very dense webs, e.g., in section III, motivic relationships are obscured even though their notes share the same registers. For the multiple note-repetitions attract our attention, preventing us from perceiving the rest of

the interval-relationships. For example, the interval f sharp – F (bars 33–34, NS_9 and NS_2) is also imitated in stretto, and the two F-s even follow each other with a phase-difference of a mere demisemiquaver; but this process is strangled by the labyrinthine network, and is also obscured by *fff*-attacks. It is of no avail that the same interval f sharp – F has already been heard at the beginning of the section (bar 32, indeed not in the same thread, but as the first note of NI_6 and the second of NI_7). Such motivic relationships, which do not result from a serial relationship but draw their notes from several simultaneous series, often occur when the constellation of the threads is favourable. A particularly pregnant example of this kind is found immediately after the beginning of section IIa (bars 8–9). We have mentioned that in this passage the pitch e flat stands out. But if we also examine the passage from the point of view of interval-imitation (one does not even have to look – one hears it the very first time), we find a very surprising example of the way motives are built from all four series (g sharp – e flat imitated):



Example 21

* * * * *

So when we hear this composition a complex network unfolds – of coarser or finer weave, variable aural perspicuity; consisting of a significantly ordered flock of sounding 'points': these are organised to form threads of varied thickness, which now stand out plastically, now become less distinct. The threads, for their part, are woven together with greater or lesser density. For the listener, knots, relationships, connections of many kinds emerge; the result is an organism as ramified as it is elastic. We have seen that this organism is the result as much of decisions on the composer's part as of automatic mechanisms; and that these decisions and automatisms are not opposed principles but two aspects of the same principle. Interacting decisions lead unavoidably to automatism, determination creates the unpredictable; and, *vice versa*, neither the automatic nor the accidental can be created without decision and determining.

Seen at close quarters, it is the factor of determinism, regularity, that stands out; but seen from a distance, the structure, being the result of many separate regularities, is seen to be something highly variable and chancy, comparable to the way the network of neon lights flashes on and off in a main street; the individual lamps are indeed exactly controlled by a mechanism, but as the separate lights flash on and off, they combine to form a statistical complex.

Seen from a greater distance, these light-complexes merge to form a higher unit, which is also significant in its own way; so, too, does the structure of this music when heard often. Our perception, which at first only noted the accidental details, then penetrates gradually to deeper levels, till it discovers the overall coherence and proportions. It is just these latter that give the piece its artistic value, which can hardly be grasped by listening in a traditional way. The 'beauty' of a piece like this lies in quite new qualities. Webern's interval-objects, as we said, still contained a trace of the (discreetly) 'expressive', and although the satisfaction derived from his music is the result of quite different qualities, the traces of 'expression' present at times do provide crutches for the struggling listener. All this has vanished in our example from Boulez' 'Structures'; they expose to view something that in Webern already formed the nucleus: beauty in the erection of pure structures.

Since in music this can only be achieved through time, composition at the serial level has become work with time. Thus composition ceases to be essentially 'art-work'; to compose now takes on an additional character of research into the newly-discovered relationships of material. This attitude may strike people as negative, 'inartistic' – but there is no other way for the composer of today, if he wants to get any further. For Boulez, basic experimentation of this kind produced Structure Ia. In Ib, dry severity is relaxed a little (relatively free splitting-up of the determined duration-elements), in Ic it is again more rigid.

This ascetic attitude, akin to compulsion neurosis, is self-limitation from choice – as if the composer were taking himself for a walk on the end of a lead; yet Boulez had to break away from it, in order to throw himself into something completely opposed (but internally related). And so he created the sensual feline world of the 'Marteau'.

JUST WHO IS GROWING OLD?

HEINZ-KLAUS METZGER

> I hear that in a new book on counterpoint he refers to the decline of the art of composition and asserts that nobody can compose any more; this is little more than an invalid whining about the 'good old days'. Indeed one need not be content with one's own days; not because they have ceased to be the good, vanished, old ones, but because they are not yet the better, future, new ones. Such unproven attacks do not even oblige us to defend our art against them.
>
> (Arnold Schönberg on Heinrich Schenker, in *Harmonielehre*)

Theodor W. Adorno's book *Philosophy of Modern Music*[1] is the first comprehensive philosophical project that attempts to face the problem of 'extending dialectical treatment to the state of composition itself, which is always the decisive factor for music'.[2] Even as an intention this is an epoch-making turning point in the rather unedifying story of how philosophy has been applied to music. Hegel, for instance, realised that art could be philosophically grasped only from the point of view of production, but he hardly thought music worthy of more detailed treatment than its mere inclusion (which he found a difficult task) in a system for the arts that was itself arbitrary. It is hardly necessary to stress Marx' and Engels' lack of interest in art of any kind. However, a fair start is made by Ernst Bloch's early fragment of a 'Philosophy of Music'[3] which includes Mahler and even touches on Schönberg; but instead of considering technical configurations he forces music to serve an aesthetic of 'content',[4] so that in a sense the book, for all its good intentions, is not really about music at all.

Those who have promised a complete sociological explanation of music have never produced anything more than dilettante confections such as the pamphlet by one H. E. Wind on 'The final crisis of bourgeois music and the role of Schönberg'.[5] Bearing in mind such efforts, which hardly even touch on the subject they are supposed to deal with, one can not sufficiently emphasise that Adorno, the first truly educated musician among philosophers, orientated his method from the outset on the condition that 'technical analysis can always be taken for granted, and is often given in detail'.[6]

The book's central theses are familiar. The basic idea is that of an objective historical tendency in musical material. This

'contradicts the traditional conception of musical material. The latter has been

[1] *Philosophie der Neuen Musik*, Tübingen, 1949. Not yet published in English.

[2] *Op. cit.*, Preface, p. iii.

[3] In *Geist der Utopie* (The Spirit of Utopia), Berlin 1918.

[4] This tendency, unmistakably influenced by the official art-politics prevailing in East Germany, is made absolute in Bloch's book *Subject-Object, Explanations of Hegel*, Berlin 1951 (German). (See chapter XV, especially pp. 259 *et seq.*). In a new, fundamentally important essay with the untranslatable title *Ueberschreitung und intensitaetsreichste Menschenwelt in der Musik* (in *Sense and Form, contributions to literature*, Year 8, 1956, Vols. 5 and 6, pp. 730 *et seq.*), Bloch appears to have gained a very exact insight into the way expression and technique coincide and hang together. His sociological exposition of twelve-tone technique and atonality, though applying exclusively to Schoenberg, is proved in genuine propositions; the utopian definition of all musical significance is the true one and has here been reattained, this time through technical reflection. There is, of course, no reference to the current state of music, nor even to Webern.

[5] Vienna 1935.

[6] *Op. cit.*, p. 16.

defined physically, or at least in terms of the psychology of hearing, as the total of sounds available to composers at any particular time. However, the composer's material differs from this as much as does a language from the potential of its sounds. It not only narrows and broadens in the course of history; all its specific traits are tokens of the historical process . . . Music knows no natural law – this is why all musical psychology is so problematic, since the latter's efforts to achieve a standard "understanding" of music from all periods imply that the musical subject remains constant. This assumption depends more heavily on constancy of music's natural material than psychological differentiation would like to admit. The element that is here so insufficiently and unreliably described must be looked for in the recognition of material's own laws of movement. These mean that not everything is possible at all times . . . The requirements imposed by material on subjectivity arise far more from the fact that material is itself sedimented intellect, something pre-formed sociologically, through human consciousness . . . what seems like mere self-willedness of material has in fact the same origin as the social process, and runs its course, constantly penetrated by the latter's traces, in the same direction as society itself, even when music and society are no longer aware of one another and stand in opposition. Because of this, the composer's conflict with his material will be that with society, to just the extent that the latter has invaded his work, instead of merely co-existing with it as something external – a consumer or an opponent.'[7]

It can scarcely be denied that at least this 'recognition of material's own laws of movement'– something of the 'fury of disappearance' – has been absorbed into the awareness of history which nowadays cannot be avoided by any young composer who takes notice at all of the historical situation; even though acoustics and psychology, meaning the most exact knowledge of auditive conditions, have meanwhile become more important for composition than Adorno could have suspected at the time. However, he later supposed, and said more than once, that his thesis had been misunderstood by just these young composers; they had ignored that the 'historical tendency of musical resources' only takes on reality through composition. In fact there could be no question of any such misunderstanding. The concept of material 'as different from the available sounds as a language is from the store of its sounds' wholly rules out the idea of material that at the same time exists 'in itself', independent of any composition, self-willed and onward-moving; as if any idiom could undergo historical development divorced from the language of those who use it.

The book describes and interprets musical progress, as with the progress of Schönberg's work it became caught in deadly antinomies; and musical counter-revolution, which in Stravinsky finally became discernible as a betrayal of humanism, without gaining for music any of the reliability aimed at. Here it might be doubted whether the juxtaposition of Schönberg and Stravinsky was the best possible experimental arrangement for the philosophical treatment of modern music. It is indeed unchallengeable that for the last fifty years the musical situation could only be grasped from the extremes,[8] but only at a very early stage were these Schönberg and Stravinsky. It is striking that in *Philosophy of Modern Music*, Webern is simply included among

[7] *Op. cit.*, pp. 21 *et seq.*
[8] *Op. cit.*, p. 1.

Schönberg's disciples (if not in so many words, at least in the book's layout), though this means not merely misunderstanding him, particularly his later works, but making such misunderstanding a formal requirement; on the other hand, Varèse is expressly placed among the followers of Stravinsky.[9] But at the time there was no way of knowing that this already betrayed a withdrawal of philosophical initiative, its fixation at a particular historical stage.

Early in 1954, however, on the occasion of the Stuttgart Week of New Music, Adorno gave a lecture 'Modern music is growing old', which shocked those who are still in the least concerned with the dialectic of enlightenment, but which gave rise to general rejoicing among the reactionary journals. First one must dispose of the words of self-defence contained in this text, which claims to be a critical evaluation of present-day musical production.

> We need not fear the objection that such criticism stops arbitrarily short at Schönberg, without going beyond him, Berg and Webern, and that it could in the end be of use to reactionary opponents. In 'new musical' circles, too, the expression of insights is sabotaged because they might be useful to some opponent or other; such arguments are secretly related to the thought-control practised in totalitarian societies. The real danger lies not in insights that might be exploited by enemies, but in blind partisanship that bolsters up what is shaky and thus really admits that its opponents are in the right (*p. 119, see below*).

The answer to this is a sentence from *Philosophy of Modern Music:*

> No criticism of progress is legitimate, unless possibly to point out the reactionary element in progress, the part it plays in the prevailing lack of freedom – this kind of criticism uncompromisingly rules out any possibility that it will be misused to serve the establishment.[10]

It is still up to Adorno to prove that his lecture fulfils these conditions. However, we here mention its effect, not in order to avoid discussing the article by reviving the resultant journalistic squabbles, but because he can not simply ignore its effects. Adorno is the last person one should have to tell that if his text should prove a reference library for those who have always said what 'even Adorno' now admits, this is no mere external accident. Practically the same day as Adorno's lecture, a respectable Stuttgart critic took the intransigent protagonist of modern music as his highly unexpected authority for advancing the claims of Egk's *Zaubergeige* to be just the sort of music that is needed at the moment; no doubt Adorno intended nothing of the sort, and his article gives no grounds for such claims. But they should have made him think.[11] Instead, he repeated his lecture elsewhere, published it in a periodical with a wide circulation[12] and finally included an amplified version of it, which if possible intensified the damage, in his collection of essays *Dissonances: Music in the totalitarian world.*[13]

[9] *Op. cit.*, p. 100.
[10] *Op. cit.*, Preface, p. iv.
[11] Walter Benjamin was less heedless of the effect of what he wrote. In the foreword to his treatise 'Art in the age of technical reproduction' he said, 'The new concepts here introduced into the theory of art differ from those in current use because they cannot be used for fascist purposes. On the other hand, they can be used to formulate revolutionary demands in artistic politics'. (From his collected writings, published by T. W. Adorno and Gretl Adorno, in collaboration with Friedrich Podszus, Frankfurt-am-Main, 1955; Vol. I, p. 367.)
[12] *Der Monat*, May 1955.
[13] The book also contains an essay 'On the fetishistic character in music and the regression of hearing' (written in 1938 and published at the time in the *Zeitschrift für Sozialforschung*); the purpose of this essay was 'to demonstrate the internal alterations undergone by musical phenomena through their inclusion in commercialised mass pro-

There could be no greater mistake than to find fault with the central motive of the essay merely because it is not well worked-out:

> Reactionaries observe spitefully that scholasticism has found its way into modern music and is spreading while nobody notices: this objection can only be met by critical self-consciousness, which is already an essential element in the phenomenon of modern music. The latter is by nature irreconcilable with 'affirmation', the confirmation of what is established, even if what is established should be existence itself. Only when music really lost its faith in the establishment did it take on new life. In its heroic days, as at the Viennese first performance of Berg's Altenberg Songs, or that of the 'Rite of Spring' in Paris, this music had an impact due not merely to its unusual and disconcerting quality (as good-natured apologists would like to believe), but to something in it that was both distracting and distracted. Anyone who disputes that this element exists, insisting that modern art is in fact just as beautiful as anything previous, is doing it no service; he is praising an element that modern music despises, so long as it lets itself be carried along by its own momentum.
>
> To say 'modern music is growing old' means simply that this momentum is exhausted. (p. 102.)

This motive, that progress must be self-critical, became, in *The Dialectic of Enlightenment*,[14] the most decisive historico-philosophical impetus of our epoch, even if the idea of the epoch has to be applied rather differently to the actual course of things in our time. It would be foolish to deny that the 'danger of being innocuous', which is in any case a constant menace in the broader field of musical production, also lies in wait in the innermost being of that different music with which we are concerned here. But the idea of 'critical self-awareness such as already lies in the sense of the phenomenon' is contradicted when this is dragged in from outside, without even examining the phenomenon. Adorno's article can not claim that 'technical analysis can always be taken for granted and is often given in detail'. Numerous mistakes, which underly even his basic attitude to the most recent music, and finally eat away the consistency of the whole text, lead one to suppose that Adorno simply omitted to consult the available primary sources, and also the important secondary ones. I am certainly of one mind with Adorno in believing that thought must maintain its sovereignty in face of the facts, if it is not to descend to the level of mere conformist recognition of what actually exists. But when it takes upon itself to aim at concrete alterations, then, of all times, it should be careful that this does not mean 'so much the worse for the facts'. One might hope that in the end this very sovereignty in treating a subject would take as a necessary condition an exact knowledge of the subject.

duction, and at the same time to show how certain anthropological displacements in standardised society extend right into the structure of musical hearing' (Preface to *Philosophy of Modern Music*, p. iii). This essay, together with the fragment 'Culture as an industry, enlightenment as betrayal of the masses', written by Adorno in collaboration with Horkheimer and contained in their *Dialectic of Enlightenment* (see footnote 14), is prescribed reading as an analysis of the entertainment industry. An essay published for the first time in *Dissonances* is a lecture given in 1956 for the South German Radio, 'On note-spinners', unquestionably the most thorough, incorruptible and brilliant article yet written about the movements for 'school music' and 'youth music'. 'Muzzled Music', already published in *Der Monat* in 1953, deals with the musical politics practised in the eastern hemisphere. Page numbers from 'Modern music is growing old' refer to the German page-numbers of the final form of the article in *Dissonances*. (*Trans. note: Dissonances* has not been published in English. 'Modern music is growing old' is the title given to the English version of Adorno's essay published by *The Score* in December 1956. This version is extremely readable, but appears to be based on a French translation of the article in its original short form. The extracts from Adorno quoted here have been newly translated.)

[14] Max Horkhoimer and Theodor W. Adorno, *Dialektik der Aufklaerung, Philosophische Fragmente*, Amsterdam, 1947.

Here is the first sentence that makes one pause for thought.

> Nobody is likely to maintain that what is being produced in the middle of the twentieth century is in any way better than *Pierrot Lunaire*, *Erwartung*, *Wozzeck*, Webern's lyrical works or the stormy early works of Stravinsky and Bartok. (p. 103.)

Adorno has just said that the legitimate works of the present day despise any acceptable quality, any market value, and that they are not supposed to be 'just as beautiful' as those of fifty years before; and now he suggests a sort of competition over the decades, which implies precisely the 'constancy of the musical subject' he has himself exposed as a glib assumption. So this sentence is informative less for its prejudice against present-day music than for the way it makes clear the sacrifice of a conception of musical material attained in *Philosophy of Modern Music*.

Nobody would deny that nowadays a great deal of nonsense is being written – probably much more than in earlier historical situations, though, as far as I can see, most of the music ever written has been pretty poverty-stricken. Adorno runs through the various 'movements'.

> To point to the impotence of neo-classicism is already to flog a dead horse; young composers of talent are obviously repelled by the weakness, insipidity and monotony of recent works in that idiom. But this makes it all the more pressing to see what is going on in the camp that draws the discontented ones, the rebels against the establishment; i.e., twelve-tone technique. Schönberg's own doubts protect one from being misunderstood if one is only as pleased about the popularity of this technique (which is today as historically necessary as ever) as about, say, the popularity of Kafka. This method is justified only if it can give expression to complex musical content; otherwise it degenerates into a delusional system. One should ponder deeply the fact that modern music, particularly the achievements of Schönberg, has been generally labelled as 'twelve-tone' and thus too easily pigeon-holed – whereas a very great proportion of such music, perhaps the decisive portion as far as quality is concerned, originated before this technique, or independently of it. (pp. 106 *et seq.*)

Here, indeed, a great deal of present-day production by music students, or the new type of 'festival music' as a whole, is pinned down with deadly accuracy. But it is not those who are now attracted by classical twelve-tone technique who should be called the 'discontented ones, the rebels against the establishment'. Nowadays the methods which are 'justified if they give expression to complex musical content' go far beyond this technique, which they have broken down into more complex connections of a far more comprehensive kind. By comparison, twelve-tone technique is as 'historically necessary' as tonality according to Alois Melichar or Furtwängler: in fact, all progress simultaneously discloses possible specific ways of lagging behind – quasi-negative forms of historical necessity itself; but their contours rapidly dissolve. At a recent summer school of music there was a several-day general exercise 'ways toward twelve-tone music in schools'; this means there has been a change, not in the youth and school music movement but in twelve-tone music. Nowadays the difference between a tonal piece and one that is 'twelve-tone' shrinks to a mere nuance, and the particular qualities of the pieces

do not affect the question. The same could be said of apologetics on behalf of this mode of composition.[15]

> Countless recent twelve-tone pieces stand condemned by the fact that serial technique was quite unnecessary to create the relatively simple musical coherence formed by the relatively simple musical occurrences within them. Here serial technique is a mistake equivalent to what is referred to in mathematics as 'over-agreement of an equation'. (p. 108.)

This is true wherever the needful is provided by, for instance, thematic-melodic relationships, hierarchic relationships between melody and accompaniment, and all the other things that come from the repertoire of tonal formulation. Here Adorno's criticisms strike back, implicitly but objectively, at Schönberg, not only at the composers of various other generations who have settled down to write their pieces in the shadow of the master's formal regression. For it is a case of regression. Not only did the historical promise contained, for example, in Schönberg's Orchestral Pieces of 1909 shoot far beyond what he was later able to achieve, but one's breath is completely taken away when one sees what he was then able to bring into being, as he could not do in his later 'maturity', except perhaps by quoting himself. There were many features in these early works that should have set a standard: in the 'break-through', in the intoxication of new perspectives, flung open to give a view of a harmony no longer bound to tonality, this harmony was functionally conceived together with a revolution in timbre combination: thematic-motivic work, as a method less of composition than of literal 'decomposition', was applied to a specific historical task; even the despotic rigidity of tonal music's metrical framework appeared to have been given new freshness (within a certain graded system of course). After this there should have been no retreat. One may go further; the Songs Op. 6 and the First Quartet have long since proved more 'modern' than the Violin Concerto. Here one can append the following passage from Adorno's text.

> But the extremists, who would like if possible to be even more radical than Schönberg, combine sectarianism and academicism in a very remarkable way. It is easy enough to discover traditional features in the great exponents of modern music, even in Schönberg. Above all, features of a musical kind, those of expression and the internal organisation of music, as opposed to its material, which has been completely remoulded . . . Thematic formation, exposition, bridge passage, continuation, fields of tension and relaxation, and everything else that comes into such categories; even in the boldest works of Schönberg these hardly differ from those in earlier works, even in Brahms. Now, one can hardly conceive of true composition as anything but a process of articulating various related musical devices in a way that will be significant right down to the smallest detail. But the devices available up to now all developed in a tonal context. If they are now to be applied to non-tonal material, certain inconsistencies result, a kind of clash between musical material and musical formulation. Schönberg, being a supreme composer, could still cope with this clash. But there is no denying the antagonisms which he discovered, and which trouble the younger composers. All the features to which he held fast with such superb naïvety – such as certain figures from the early tonal Chamber Symphony, reproduced in the dodecaphonic Fourth Quartet – have a function which precludes their simple transplantation from the soil where they grew. For instance, the idea of a bridge passage presupposes a plan of modulation from one harmonic plane to another; unless a bridge passage fulfils such a harmonic purpose, it all too easily degenerates into mere formal reminiscence. Even the central category – the theme – is difficult to retain when the twelve-tone process stipulates that all notes are to be equal; in twelve-tone composition themes are often like crude survivals from an earlier stage. On the other hand, it is only these and related categories which in Schönberg's works ensure the survival of musical significance, true composition, in so far as this is more than mere arrangement. In this respect his conservatism is not lack of consistency, but is in fact to be attributed to his concern lest composition should fall prey to the pre-forming of resources. His most recent successors are causing a short circuit by their way of gaily setting out to resolve the antinomies which Schönberg rightly regarded as a price that had to be paid. They purposely forget about musical significance and its articulation, which Schönberg managed to preserve, and they believe that to arrange notes is the same thing as to compose, as soon as one has omitted from the arrangement everything that could make it into composition. They get no farther than negative abstraction, and set out gaily on a fruitless journey, during which their scores become as complicated as human ingenuity can make them, but nothing in fact happens any more; thus they can also write one work after another, never stopping to think. (pp. 108 *et seq.*)

Here we quote almost verbatim, so that at any rate we shall not be guilty of belittling, by cuts and interruptions, a passage that marks the extreme limit of Adorno's insight into Schönberg's historical dilemma and the historical context of the most recent school of composition. Of course, to see the inner contradiction in Schönberg's later works defined as the result of, on one side, 'musico-linguistic elements' hardly different from those in Brahms, and, on the other, 'completely remoulded musical material' is confirmation of something that stands out throughout the essay – the extraordinary regression from Adorno's own conception of material, his demonstration that the latter is not 'working material' *au Hindemith*,[16] but is the current state of the language. Thus the division into 'musical form and musical matter' seems to have been thought out very schematically, as if material, which is in fact anything but 'matter', had in fact developed separately from composition. What Adorno fails to see, in the constellation of Schönberg's later music, are precisely the 'tokens of the historical process'. He notes the inadequacies that govern relations between the dimensions (while completely eliding musical time-processes, the truly unique dimension of music), but does not notice that from such inadequacies, which have constantly reappeared throughout the history of music, one can tell at any moment whether they appear because one dimension has been developed beyond the others during the historical process, or because one dimension has lagged behind the others. 'Material' did not finally reach a realm beyond Schönberg's ability to follow it as a composer; in the course of his composition, material underwent a historical development, which he later cancelled as to some of its parameters, so that contradictions emerged which required, in his neo-tonal works, a complete

[15] In fact one is struck by the astonishing way Adorno now lumps together *Pierrot Lunaire*, *Erwartung*, *Wozzeck*, Webern's lyrical works and the stormy early works of Stravinsky and Bartok, whereas in *Philosophy of Modern Music* he finds many distinctions and even contrasts between them; 'Those who praise *Wozzeck* as one of the first lasting results of modern music do not realise how their praise compromises a piece that is marred by excessive poise'. *Op. cit.*, p. 20.

[16] Paul Hindemith, *Craft of Musical Composition*, Vol. I.

withdrawal if they were to be 'resolved' (and here we ignore these works' character of utterly contradictory anachronisms). The only person who stood out in favour of the younger Schönberg's boldness was Webern, and today the only people are composers such as Boulez, Stockhausen and Pousseur, who have taken up the contradictions here treated, and absorbed them into their consciousness as something to be solved in a progressive way. But Adorno has thus in fact implicitly misjudged the young Schönberg, who knew (if in a rudimentary way) of devices quite other than those 'developed in a tonal context' – which according to Adorno represent everything 'available up to now'. But the devices really 'available now' might well give Adorno cause to think. Musical significance is not confined to first and second subjects, and there is compelling musical coherence, too, beyond all thematic-motivic relationships (which Adorno sees as the only elements in 'musical language'). Has he not heard of Stockhausen's concept of groups?

> In his later works Webern aimed at so completely adapting music's linguistic devices to its new material (twelve-tone series) that he came very near to giving up music's linguistic devices altogether; music became simply processes within material, vicissitudes of series; yet he did not completely sacrifice musical significance. These perspectives have recently been reopened by a group of composers, led by Pierre Boulez. A pupil of Messiaen and Leibowitz, he is doubtless a highly educated and extremely talented musician who has reached a very high formal level and a power which can be felt even though he rejects any idea of subjectivity. He and his associates hope, in ridding composition of the remnants of traditional musical idiom, to ban all freedom as 'arbitrary'; in fact initiative on the part of the subject means initiative on the part of musical language. Thus the main attempt has been to include rhythm within the strict order of the twelve-tone process, and finally to replace composition by an objectively calculated arrangement of intervals, pitches, long and short durations, degrees of loudness; an integral rationalisation of music such as has never before occurred to anyone. But this rule of law is arbitrary, a mere illusion of objectivity in a dogmatic system, as is evident from the fact that its rules are not suited to structural relationships within the musical flow – and these it has not been able to do away with. Whatever is merely thought out is never sufficiently thought about. (pp. 109 *et seq.*)

Now of course traditional scores, too, tend to show arrangements of intervals, pitches, long and short durations, degrees of loudness; not as a substitute for composition, but as what is composed. And one could never manage without calculation. It is only among the producers of 'objectively calculated arrangement' that we find cases in which traditional counting is replaced either by assessment or by time-regulation orientated on the limits of technical possibility, and where the intonation of traditional intervals and pitches is free to deviate within a defined field: in short, where freedom is introduced into regions that up till now were rigidly fixed by numbers. Adorno obviously has not come across the new means of notation that express this kind of thing. Indeed in 1952 Boulez wrote, 'It is ironic that the *avant-garde* glorifies the liberty of a discipline that is consented to, while the conservatives favour liberty that is anarchical';[17] but one must know that here the author's apostrophe to the *avant-garde* is meant to poke fun at the dodecaphonists. But Adorno seems firmly mounted on the hobby-horse that the pre-

[17] *Eventuellement* . . . in 'L'Oeuvre du XXe. siècle' ,special number of *La Revue Musicale*, April 1952, No. 212, p. 119.

determination of music, which was to a certain degree inherent in twelve-tone technique, must meanwhile have proceeded ever further. It is this, above all, that he must be referring to when he writes of 'banning all freedom as arbitrary'. He hardly seems aware that composers such as Boulez, Stockhausen, Cage and others who today have some historical significance have long since aimed at the greatest possible *unpredictability* of the overall form, though without sacrificing the unity of the whole. 'Again, the unexpected: there is creation only when the unforeseeable becomes necessity'[18]– Boulez formulated this dialectic all of five years ago, so there is nothing new about the arguments (found particularly in countless minor polemics against Schönberg) according to which the most advanced music of any time is 'caculated', the composer a 'prisoner' to his merely 'thought-out' system. Adorno is better informed, at least about the revolution before last, and one would have expected him of all people to refrain from taking over such stories. Messiaen's *Mode de Valeurs et d'Intensités* does indeed show a 'decreed system' whose rules not only seem unsuited to the structural relationships of the musical flow, but finally prevent any such relationships; all the same it is true that this was the first piece to be illuminated by the possibility of regarding even an isolated note as the contrapuntal relation of its parameters, here taken to be pitch, duration and mode of attack. The elements can be arranged senselessly, but this does not prevent a sensible arrangement of them from counting as composition. The objection would no longer be legitimate as applied to even the first *Structure* by Boulez, a work which is relevant at exactly this point; the piece is already decidedly on the right road, and if an observer is not more vividly struck by its manifestation of the tendency of history than by its egg-shell thin remnants of Messiaen's model, then that observer is not particularly sensitive to the 'tokens of the historical process'. But nobody who has looked at the score even once would admit the validity of such arguments as applied to the succeeding pieces in the cycle, or to Stockhausen's Piano Pieces; Adorno take his arguments from an archaic arsenal that has had no new addition for fifty years. One is, however, shocked by the crude way he asserts that 'these rules are not suited to structural relationships within the musical flow' (incidentally none of the composers considered here have formulated any 'rules') – in order to dispose summarily of a whole compositional movement (even if it can hardly be called one), ignoring the noticeable variations within each individual composer's development, and the divergences between the various composers that amount to diametrical opposition. It is significant that he does not quote a single work which could prove his propositions by concrete technical details. He may indeed have been thinking in pure abstractions, but even if he had no very clear idea what he was talking about, it must have occurred to him that so specific a judgment could hardly be expected to fit very accurately so diversified a field of phenomena. When carelessness is erected into a method, discussion becomes impossible, and one has to search for a more polite term if one wishes to avoid describing the process as 'rabble-rousing'.

But Adorno does risk some more precise technical details.

> The basis of it all is a static conception of music; all the correspondences and equivalences demanded by total rationalisation are based on the assumption that in music the return of identical material has an identical effect – as is, for example, the case in a schematic spatial layout. The fixed 'picture' in the score is

[18] *Loc. cit.*, p. 141.

confused with the actual occurrences it symbolises. But so long as music has time as its medium. it is so dynamic that identical repetition loses its identical quality, because of the passage of time; just as, *vice versa*, an identical effect can result from what is not in fact identical (as in a shortened recapitulation). In traditional music, what one calls 'architecture' is based on just this, not on mere geometrical relations of symmetry. Beethoven's most powerful formal effects depend on the fact that a theme, which was once simply there, can later come as the climax of a development and thus take on a quite new significance. Often such reappearance clarifies in retrospect the significance of what has gone before. At the beginning of the recapitulation one has the feeling of enormous things that have been happening, even if one can not give chapter and verse as to just where. The pointillist constructivists not only deprive themselves of this sort of form-building possibility but fail to see that, for all their efforts, time-relationships do in fact assert themselves and give a completely different value, derived from its position, to what looks identical on paper. They have worked out a sure balance on paper; and it does not work out. They need security so badly that they in fact destroy it; because the static balance of the musical elements is all too exact, it clashes with the music's own dynamic quality. The only thing that needs to be secure, artistically speaking, is the course of the music; and this is robbed of its security. (pp. 110 *et seq.*)

The concept of 'pointillism' only has an exact technical meaning (and thus a rightful place) when linked with that of its opposite pole, the 'statistical'; but it is constantly cropping up nowadays in reviews, degraded to the level of a catchphrase. When Herbert Eimert first used it in a lecture at Darmstadt in 1953, it was exactly defined, but Adorno seems to have learnt it from the journalists. In any case, it is in the work of the composers he refers to as 'pointillists' that the pair of concepts mentioned would have to prove themselves. There is, of course, truth enough in Adorno's remarks about musical time, and it is splendid that although previously, in discussing questions of composition, he has so often failed to grasp the rhythmic dimension, here he has realised its importance in his treatment of the time-factor in overall form. But (for instance) Stockhausen, to whom we are more or less indebted for our present knowledge of musical time, is not quite the person to lecture about this sort of detail . . . In fact Stockhausen, starting from the viewpoint that all acoustical events, even frequencies themselves, are time-processes, has made it possible to dissolve the traditional dimensions of music, both theoretically and in the practice of composition, to form the superior category 'articulation of time'. If 'harmony' and 'melody', as previously understood, can thus be conceived in terms of time-organisation, the concepts of tonality and atonality, *vice versa*, could also be applied to rhythmic organisation. As a result, the divergence of the musical dimensions was for the first time really done away with, by considering 'experiential time', which up till then had hardly been seriously regarded by musical theory.[19] This, and not 'objectively calculated arrangement' is the way to truly integral composition, which in Schönberg is merely envisaged. But this means a verdict on all present-day music that lags behind. 'Opposition to the idea of complete rational organisation of a work, to the mutual "indifference" of the material

[19] *Cf.* Karlheinz Stockhausen, 'Structure and Experiential Time', *Die Reihe* II, Theodore Presser Co. and Universal Edition (London), 1958.

dimensions in a work; this is what shows Stravinsky's and Hindemith's methods to be reactionary. Technically reactionary, in fact, to ignore for the moment the sociological environment. "Note-spinning" is clever play with a divided realm of material, instead of the constructive consistency that subjects all material strata to the same laws. This sort of cleverness, in its obstinate naïvety, has today become regressive.'[20] That is what Adorno wrote in 1940-41, the same Adorno who today praises as 'superb naïvety' Schönberg's adherence to tonal figurations within the twelve-tone technique, and who maligns 'complete rational organisation'. If he were to bring up to date what he wrote then, he would have to write off the later Schönberg as a note-spinner. But when Adorno, who can hardly be very familiar with Stockhausen's works, establishes without more ado that young composers do not know how time-relationships 'give a completely different value, derived from its position, to what looks identical on paper', the only explanation is that he has fallen into an attitude that, together with Horkheimer, he once summed up (in the thesis 'Against knowing better'[21]) as 'after all, I ought to know what I'm talking about', and castigated 'as the stupidity of being too clever'. In any case, remarks about 'paper music' belong to the stock of perennial clichés used for the last fifty years by polemical reactionaries, while Kolisch has aptly pointed out that there is only paper-music – a remark not to be contradicted even in the light of electronic works.[22] Thus the composers concerned do not handle musical time in the way Adorno assumes, and if he were to look, for example at the work on which Boulez is currently working – it is for solo flute, but at the end ten other instruments suddenly have to enter – this might tell him something about 'the sure balance they have worked out on paper'. The same also applies to other composers. There are indeed cases in present-day production in which a 'schematic spatial presentation' takes on an unusual value, for example, certain piano pieces by Earl Brown, such as 'Four Systems', or 'For David Tudor, Dec. 1952', which take for granted a multidimensional space-time-continuum, described in spatial terms by the notation. Here the fundamental idea does not differ much from that cultivated by Schönberg as 'musical space',[23] which he found confirmed by the description of Swedenborg's Heaven in Balzac's 'Seraphita'; only the idea has been taken to its logical extreme. One has only to try to play or practice such a piano piece (there are no longer printed notes, the page looks like a constructivist picture, not unlike certain designs by Mondriaan from the year 1917); when one translates its optical relationships into time-relationships, one becomes aware of the way significance has gravitated, realises that this transposition is guided, that there is a true adaptation to the medium of time, and that this adaptation corresponds more exactly

[20] *Philosophy of Modern Music*, p. 35.

[21] *Dialectic of Enlightenment*, p. 247.

[22] 'One result of music's maturity is a suspicion of all actual sound. In the same way, now "subcutaneous" qualities can be made tangible the end of musical interpretation is in sight. Imaginative silent reading of music could make playing aloud just as superfluous as reading has made the speaking of a text; this practice could at the same time free music from the senseless damage done to it by practically every performance nowadays' (Arnold Schönberg, in *Prisms; Cultural Criticism and Society*, Frankfurt 1955, pp. 210 *et seq.*). These thoughts reveal Adorno as an advocate of paper music. But this tendency has remained only one element, and developments have rather tended to polarise; whereas Boulez, Stockhausen, Pousseur and others have become ever more interested in the realisation and perception of sound, Cage and his school sometimes divorce music completely from its realisation, so that it can even leave the sound out completely. This polarisation also makes a marked division within the American school. It is related to the gradually emerging polarisation of the most recent music – some can only be adequately realised by playing from memory, some incorporates reading and its transformation into action as an essential element in its correct realisation. This happened earlier in the history of interpretation; the Kolisch Quartet made a principle of playing from memory, Webern made a principle of conducting from a score.

[23] 'Composition with Twelve Tones', in *Style and Idea*, London and New York, 1950.

to its model the more precisely one takes into account the deviation of experiential time from mere spatial proportions; one cannot but learn that the visual assessment of lengths is in fact convertible into subtler sensitivity to time-relationships than is the usual method of counting in figures, which is directly temporal but whose scheme is more spatial. Whatever the technical relationship with time may be in particular cases, all composers who are at all advanced tend in fact to reject the 'symmetrical relationships' of which Adorno accuses them; this has already percolated through to the newspapers, who are not always very happy about it. It was this, after all, that once made Schönberg's music, too, so 'hard to understand'.

By comparison, the following observation has to be taken a great deal more seriously.

> This loss of tension is not a mere symptom of growing old, but can be traced back to the very beginnings of modern music; today's happenings cast their shadow backwards over the heroic days . . . Music wanted at last to live up to Kant's phrase to the effect that the sublime is intangible, and as commercial factors tended to reduce it to the level of childish play, it strove all the more emphatically after the intellectual quality that would make it mature. But there was a price to be paid – Valéry suspected that this was so for all modern art. Now the bill has to be settled – and modern music is growing old. If musical material was to be emancipated from given formal categories and structures, one thing had to be taken for granted – rather like one aspect of expressionist painting; the latter could intellectualise its methods on the assumption that all colour values, material elements, have some intrinsic meaning. When multi-layer sounds were conceived, of a complexity never before imagined, it was as means of expression. And this they were, but indirectly, not immediately. Their individual values depended partly on their relation to traditional sounds (reinforcing one's recollection of these by the way they contrasted with them), and partly on their place in the total structure of composition, which at the same time they caused to change. But at first it was thought that these sounds had expressive qualities even in isolation, because the expression was of such a new kind. This gave rise to the superstition about intrinsically meaningful basic elements; in fact these are the result of history, with a historical meaning. The radical view of art has so far been unable to free itself of this superstition, and has thus all too easily mutated into its opposite, pure 'art for art's sake' . . . But what is happening today in the name of pointillist music and integral rationalisation is only too closely related to key-colour music and all the rest of it; obsession with material and disregard for what becomes of it, as a result of the fiction that material can speak of its own accord – a rather crude symbolism. Indeed material can speak, but only through the constellations in which art arranges it. Schönberg's greatness rested from the very outset on his ability to do this, not in his mere discovery of isolated sounds. (pp. 111 *et seq.*)

The last sentence is a platitude; nobody ever assumed that material can 'speak' on its own, divorced from the constellations in which art arranges it. Nor could one really show that any of the leading present-day composers 'disregards what becomes of his material'. But there is a certain amount of limited justice in the remark about 'obsession with material', and this has been so ever since Kandinsky found the arrangement of colours on his palette more beautiful than in any picture:

> I was thirteen or fourteen at the time. I had saved up for years, and bought myself a box of oils. The feeling, or rather the experience, is still with me – how the colours came out of the tube. A little pressure, and out they came, these extraordinary beings we call colours – joyful, solemn, thoughtful, dreamy, lost in themselves, deeply serious, bubbling with mischief, sighing with relief at gaining their freedom, with a deep note of mourning, full of rebellious energy and resistance, softly and compliantly, with obstinate self-control, precariously poised: they had life of their own, and all the qualities needed to stay alive on their own; ready at any moment to combine in new ways, to mix with each other and create infinite series of new worlds . . . the palette made up of those elements is itself a 'work of art', and often more beautiful than any other; let us praise it, for it gives great joy.[24]

Schönberg must have sat at the piano, similarly fascinated by his raw material, silently depressing the keys that would produce the harmonics in Op. 11, No. 1; Cage probably listens in just this questioning way to a new prepared-piano sound, and the experience will be familiar to any composer who works in an electronic studio. It is felt as something dangerous – one may be led to choose as if from an assortment in a jeweller's window, and this would indeed be regression to the sphere of the 'pre-musical, pre-artistic tone' (cf. p. 118). Now, the question is whether art can be produced even if its material has no innate affective cathexis; and whether the important thing is not, rather, how one resists the danger mentioned. The more important younger composers have a very strongly prevailing sense of history, which is an essential determinant in their work and deals a deadly blow to any 'superstition about intrinsically meaningful basic elements, which are in fact historical, with a historical meaning'; this throws light on the historical nature of material, at a time when the historical situation is in fact likely to encourage the superstition mentioned. Stockhausen once included in a lecture a warning against 'blind wonder at the sight of apparatus', and thus took sides, within the dialectical method, with Adorno; on the other hand, occasional conversations with composers of the young American school have left the impression that over there, for all their study of musical history, the historical dimension, as one dimension of consciousness, seems so cut off that Adorno's criticism could be justly applied; a certain element in their musical thought is indeed a 'reactionary element in progress, the part it plays in the prevailing lack of freedom'. But this, the only passage in his criticism of present-day production that could in fact be applied to actual phenomena, concerns not the element that he calls 'no mere symptom of growing old', but one that rather 'casts its shadow back over the heroic days'; so his argument has no specific applicability to the theme he has set out to investigate; it does set up a fruitful and thoroughly dialectical opposition to the overall thesis of his essay, but unfortunately this dialectic is not developed any further. He soon reverts to the theme of growing old:

> But at the same time the material of music has expanded to the utmost. There was always a belief not only that material is itself eloquent, but that one could find uncommitted layers, where absolute directness was possible – like new snow, still unmarked by the imprint of subjectivity or the expressive conventions which show that someone has been there already. We can ignore the bichromatic subdivisions of the tonal system, which were never really absorbed into the aural

[24] Wassily Kandinsky, *Rückblick*, Baden-Baden 1955, pp. 23 *et seq.*

world of even the most sensitive composers; now they just sound like chromaticism further split up, and this means that they clash with modern music's tendency to make the secondary degrees of the scale independent; so we have virtually exhausted the possibilities of new sounds within the realm of the twelve tempered semitones . . . When in his later works Wagner added the minor ninth to the diminished seventh chord, or when Schönberg used the 'forbidden' last inversion of the major ninth, these chords contained hints of what Webern called a sea of unheard-of sounds; and it was not long before 'Erwartung' was well and truly launched on this sea. Nowadays there is no sound that could so justly claim to be 'unheard-of'. (pp. 113 *et seq.*)

Perhaps Adorno would revise this opinion once he had taken a look at electronic productions such as Stockhausen's *Song of the Youths*, Koenig's *Klangfiguren II* or even a piece of *musique concrète* such as Brown's *Octet I for 8 Loudspeakers*. I do not know what paradigm of electronic music led him to the conclusion that it all sounds like 'Webern played on a Wurlitzer organ' (p. 119). Maybe his experience and mine simply do not coincide here. Certainly no sound can nowadays 'so justly claim to be unheard-of', but, despite this difficulty, recent efforts in composition, always based on acoustic fantasy and the technical considerations affecting production, have driven on the expansion of material with absolutely explosive force, covering more ground than in the last thousand years (though not 'within the realm of the twelve tempered semitones'). Not only are all imaginable scales now possible; one can also compose the internal dimensions of the single note (or noise; for Schönberg's words on the dissolution of the difference between consonance and dissonance are applicable here, too[25]) – which need no longer be accepted as the obstinately given quality of some particular instrument, its 'character'. The direction of sound has taken on the status of a variable parameter; Stockhausen, Koenig and Brown have variously composed for spatially-distributed groups of loudspeakers, thus opening up a dimension for the articulation of musical form which may have been hinted at in a rudimentary way in Berlioz and Mahler, but whose theory was not formulated until Varèse. There is no foreseeable end to this expansion, as long as technological advances continue. One might, however, be suspicious of a combination between expansion of musical material, and the search for 'uncommitted layers . . . like new snow, still unmarked by the imprint of subjectivity and the expressive conventions which show that someone has been there already'. This combination could correspond only too closely to commercial expansion and the search for untouched, geographically new markets, so that the expansion of musical material, as 'society invading art', might reproduce in music the illusory usefulness of unlimited technological progress; compare the activities of present-day commerce, 'the part it plays in the prevailing lack of freedom'. No sphere of production can automatically assume that it is exempt from the compulsion of objective social tendencies, however independent it may intend to be. But so long as 'the composer's conflict with his material is that with society', composition can always give notice of its uneasy pact with the present state of the world, even though it is tied to historical conditions. Adorno has in fact devoted too little attention to the composer's subjective role in worthwhile current production; this would have meant thorough technical analysis, although here and there he might have been convinced by the mere overall impression of a work which

[25] *Harmonielehre*, 3rd edition, Vienna 1922, pp. 14 *et seq.*

he had doubtless never heard; and those who can follow the subtle workings of Adorno's mind will perhaps be unable even to rule out the suspicion that Adorno, in ruling out the idea that the composer now has any subjective role, is not making quite the point he intended. The objective content of a text may differ from what the author had in mind when he wrote it; this unfortunate essay has already given rise to many conclusions overlooked by its author.

Still, it might at least seem difficult for music to 'claim to be unheard-of' if it still uses traditional instruments.

> An insatiable composer who went looking for this would soon have a feeling of paralysis, as is usual when one has to make an arbitrary selection from a display of goods (in this case new stimuli), instead of enlarging one's stock (of material) from inner compulsion. Present-day musical radicalism is so untrustworthy, its boldness is so merely slick, because we appear to have reached the absolute limits within which Western music is historically possible; every conceivable sound seems to have been worked out (as we had foreseen), whereas there is to date no strong impulse to explode the set limits – nor is it even likely that spontaneous hearing would be possible outside them. (pp. 113-4)

There are probably no 'absolute limits within which Western music is historically possible', no entropy of the material possibilities that are historically feasible. But it is true that instrumental music still remains very much in bondage to the twelve notes which instruments were originally designed to play. The bi-chromatic subdivisions of the scale by Haba and Wischnegradzky, being merely 'chromaticism further split up', offer no escape from this bondage. When used significantly by composers, as in part of Boulez' giant choral work *Le Visage Nuptial* (whose other sections use only the chromatic scale), they function not, of course, as 'new stimuli' but constructively; the series can be used in diminution, within a tritone instead of an octave, and thus 'chromatically' transformed in various ways. Cage and his school have developed various piano-preparations, plus pizzicati and 'archi' (with the finger or the hand on the strings of the instrument), plus percussion of the strings with a drumstick, use of the piano-lid, note-clusters and the similar things involved in the movement toward a 'total piano'; all this does alter the piano's 'sound-landscape', but does not make it wider than what can be produced by an orchestra (including that of Varèse's 'Ionisation'). Even Stockhausen has been able to add to piano technique only a few, though fundamentally important, new possibilities, mainly of attack and pedalling, plus a few effects with harmonics. It must be freely admitted that instrumental combinations such as the ensemble used in *Le Marteau sans Maître* can produce an elegant and distinguished sound, but nothing basically new – the xylorimba is not really the beginning of a new world. The specifically new thing about present-day instrumental music is that its traditional task – to realise the printed text exactly – has been taken over by electronic music. Instrumental music must pull itself together and for the first time allow the interpreter what is his by rights; composers need the interpreter for their new types of time-conception, since these can only be realised through interpretative freedom (as defined for the work concerned). This has become evident in certain works by Cage, Brown, Feldman, Pousseur and particularly Stockhausen – the latter, after his Piano Pieces, was able to apply very ingeniously to ensemble playing certain ways of regulating time, which had previously been possible only in solo works (the piece referred to is *Zeitmasse* for five woodwind

instruments). Bo Nilsson seems on the whole to share this tendency, as for example in his *Schlagfiguren*, despite a notation that shows an almost diametrically opposed approach. But with this totally new experience of time, 'unheard-of' sounds can again be created, in so far as time and sound can not fail to interact. Against this, the fact that composition is still 'with twelve notes' seems merely accidental, or at least of no 'material' relevance. It is to be doubted whether one can very happily philosophise about the current musical situation without a knowledge of all this. The 'absolute limits within which Western music is historically possible', and which according to Adorno have been reached, recall a certain conversation between Brahms and Mahler on a bridge over the Danube; even if this is only a story, Leibowitz' exegesis of it[26] is very apt. But Adorno has a lot more to say about young composers.

> But something in these tendencies toward total rationalisation seems to appeal strongly to the younger generation. This hangs together with the currently widespread allergy to any kind of expression, common to the iconoclastic exponents of 'pointillist' music and their counter-revolutionary opposite numbers, such as the historical interpreters of Bach or the collectivist adherents of the (musical) youth movement. (p. 114.)

One's initial reaction is innocent amusement that this should come from Adorno, who once saw 'note-spinning' as the very 'opposite of the idea of complete rational organisation of a work', whereas he now equates the two; next, one must remark that Koenig's instrumentation of the *Art of Fugue*, on which he is working at present, is rather a continuation of what Webern began in his orchestral analysis of the *Ricercata* from the Musical Offering. And in fact not a single one of these composers shows much trace of 'allergy to expression of any kind'. Boulez did indeed launch his second Piano Sonata with the note 'What are usually called "expressive nuances" must be absolutely avoided, especially in slow tempi' but the immediately preceding sentence is 'It is left to the intelligence of the interpreter to give shape to the architecture of the music, both through varying dynamic relationships and by allowing the tempo to fluctuate to a certain extent'; this should make it clear to anyone who has not already noticed the inverted commas and, if he can read music, looked at the printed page, that Boulez was simply trying to protect his music from the kind of snivelling interpreter who, when playing, compensates for his technical inability to make the music expressive by pulling expressive faces, which are soon reflected in his whole performance. Certainly this traditional 'espressivo', usually bound up with a particular kind of vibrato, is a thing of the past. For instance Stockhausen's works are more than full of expression, but it is bound up with such processes as the abrupt alternation of intensities, leaps to distant registers, alterations of speed and tempo. In contrast to exclamatory, interjectional expression of the kind still found in Webern's later works, this new kind could best be called 'formulated' expression. Mature music no longer needs a catch in the voice – it has technique enough to say what is the matter. This, perhaps for the first time, makes it truly into a 'language'.

If one really considers the matter in hand, this problem of expression is the key to all Adorno's misguided pages about music's similarity to language, about the domination of art by technology and science, about so-called fetishism. His thoughts are logical enough, but have no bearing on the music under discussion; his suppositions can only

[26] René Leibowitz, 'The Evolution of Music from Bach to Schoenberg,' French edition, Paris 1951, pp. 177 *et seq.*

be the result of ignorance. If any existing music resembled what he so consistently describes, then doubtless I, too, should reject it. Thus the question to ask is not so much whether his processes of thought are consistent; it is a less pleasant one – what musical sources did he draw on for this essay? There are certain clear indications in the text.

> What is meaningless can also take on meaning, when it contrasts with what is meaningful, just as in music inexpressiveness is one form of expression. But the most recent efforts have nothing to do with this. They simply take lack of meaning as their programme, which is at times obscured by dogmas from existentialist philosophy; instead of subjective intentions, existence itself is to become audible. (p. 115.)

If I remember rightly, in 1951 the young Karel Goeyvaerts used this sort of argument when he brought his 'Opus 1' for two pianos to Adorno's composition class at Darmstadt (International Summer Course, Kranichstein). Adorno then insisted that Goeyvaerts was an existentialist, something the latter violently denied. And:

> One can not reproach the critic with not understanding these recent products of rampant rationalism, since according to their own programme they are not to be understood but only to be demonstrated. Ask what is the function of some phenomenon within a work's total context of meaning, and the answer is a further exposition of the system. (p. 119.)

Again (and this I do recollect very clearly), Goeyvaerts used such 'exposition' in reply to Adorno's questions as to what his 'Opus I' was 'about'. If it had ever occurred to Adorno to ask a composer like Boulez or Stockhausen about the 'function of some phenomenon within a work's total context of meaning' he would have been rudely awakened by a very different reply. Instead, he merely substituted the name Boulez for Goeyvaerts. It is clear from the essay that one of its principal sources is this discussion with the young man from Antwerp, who is an artist of exemplary moral bearing and subjective attitude, but who seems, as regards the main point at issue, to have lost himself in deviation just as Hauer did in his time. This discussion, apart from being wholly inadequate as a sole documentation, is not even representative of today's *avant-garde*.[27]

Now, if Adorno felt so sure of his case that he imagined himself free from the obligation to check his assertions against actual scores (and this one would have thought the minimum demanded by scientific method), there must be, and doubtless there is, some deep reason for this. It is not enough to point out to him that his so-called 'insights' and intuitions (which we are said to want to 'sabotage' by the 'totalitarian' argument that they might be useful to some opponent or other) are not insights at all, but rather the opposite, since they are wholly irrelevant to the matter in

[27] At the time, Stockhausen was without a doubt extraordinarily interested in Goeyvaerts' activities as a composer. At a time when most of the young men at Darmstadt were still stuck at Hindemith, here at least was someone who set himself to compose in a truly integral way. Stockhausen himself has often emphasised, particularly with regard to Webern's later works, that pieces which open the widest methodic perspectives are often not the most successful compositions. This speculation might suggest that in composition, the aesthetic innervation and the historical had so far diverged as to reveal their incompatibility; this would reflect the way that in social practice, too, what is necessary and what is meaningful are alternatives. This is a moot point. Adorno, however, first paraphrases as 'cold comfort' the hope that 'as once in the seventeenth century, future composers may perhaps be able to give meaning of this kind to the new musical resources they have to master'; then later he feels unable to reject it as 'out of the question *a priori*' (p. 119 *et seq.*); so one should say that this hope was justified even before he began to cherish it. The story of the new resources, which spans only a few years, could in fact be defined as the way they graduated from fetishism to composition. This holds good not only for particular compositional 'discoveries' but also in a sense for electronic composition as a whole, measured against its primitive beginnings only a short while ago. Although the technological aspect of this development suggests a certain onward progress, its various stages are linked by relationships of negation. All the same, these very composers are to be hailed as the 'men of the future'.

hand. Probably this carelessness and nonchalance, so amazing in an author of Adorno's stature, are deeply bound up with the abandonment of certain central ideas in the *Philosophy of Modern Music*. One may say that modern music is growing old, if one is referring, as is legitimate, to the music of Schönberg's successors – the newest music has reacted more decisively against this than 'modern music' did against the tonal era. But in Adorno's text the symptoms of this indubitable ageing, which can be demonstrated in detail, both technically and aesthetically,[28] are not so much named as absorbed into the essay itself and into the ideas in it. Although the essay's treatment of unobjectionable conservative phenomena is still fairly safe, even here Adorno lacks the deadly certainty which once characterised all his attacks on reaction. Thus his text is not too severe, it is too conciliatory. Just as Bloch, for instance, realised that Heidegger's cosmic night-philosophy simply reflects the dead-end situation of the class it champions, so one could say of 'Modern music is growing old' that its internal structure reflects the ageing of the very music championed by its author. This is what we mean when we ask, 'Just who is getting old?'

[28] Perhaps this is what Webern was reacting to when (as Max Deutsch tells me) a pupil's work used to irritate him into saying 'Oh, this accursed modern music'.

INTERMEZZO II

The following juxtaposed excerpts bring to light a hitherto-unnoticed state of affairs in musical criticism. It is very significant that this should occur in connection with essays about young composers, for these are the people of whom it is widely alleged, in the course of criticism based on apparently absolute standards, that they are no longer composers at all. This would also mean that they are no longer a fit subject for criticism – something that has obviously escaped the eagle eye of our critics. Since criticism has to exist, if only for its own sake, and its representatives could not make their presence felt simply by keeping silent, criticism has come perilously close to trickery – as when one of the younger composers is recognised as 'a highly educated and extremely talented musician' (see p. 70 of this volume), and directly afterwards 'he and his hangers-on' are presented with a list of their sins that seems to introduce a new species – the musical criminal.

The following quotations are taken from two critical articles about the situation of young composers: Theodor W. Adorno's essay 'Modern Music is Growing Old' (cf. previous article, and especially footnote 13, pp. 65-66), and remarks in a similar vein by one Hellmut Kotschenreuther (in the collection 'Musikstadt Berlin', *Bote & Bock*, Berlin). Kotschenreuther's words and demands are unambiguous: condemnation of Schönberg and all twelve-tone music, as the concentrated symbols of a world that is 'ideologically violated and shrunken': back to nature, in fact to Blood and Earth. Adorno carefully insures himself by giving the reader to understand that he speaks in the name of modern music (and anyone who contradicts him is employing the 'thought-control practised in totalitarian societies'). He says that he hardly needs to guard against the misuse of his remarks for reactionary purposes; that no element in dialectical thought is secure against such misuse. In fact there is such misuse, when one of Adorno's arguments, in itself well grounded (it is given here: cf. page 67) is taken from its context andtwisted for reactionary purposes. However, what we have to say here is unconnected with dialectic, for we are not concerned with arguments that are twisted and misused but with the astonishing similarity of these two writers' language, arguments and phraseology, which finally confirms that today it is all one whether young composers are judged and condemned from the standpoint of 'Rosenkavalier' or of 'Pierrot Lunaire'.

One should compare each quotation from Adorno with the corresponding one from Kotschenreuther. One can also read differently – and this is often still more informative – not juxtaposing but regarding the quotations from Kotschenreuther as continuations of the ones from Adorno, as if they came from the pen of the same author.

ADORNO	KOTSCHENREUTHER
. . . this music in its heroic days The main attempt has been to include rhythm within the strict order of the twelve-tone process, and finally to replace composition by an objectively calculated arrangement of intervals, pitches, long and short durations, degrees of loudness.	The great, 'heroic' days of modern music. The angry young man is annoyed by everything that is alive, organic and unregimented, so now he is trying to rationalise rhythm, duration of sound and loudness.
The confections of serial engineers	Technical processes are made into ideological idols.
The cult of consistency ends in the worshipping of idols.	Procrustes, the ancestor of all ideologists and violators, has become the model for the angry young man.
One blindly takes a work of man for a primeval phenomenon, and bows down before it.	No wonder the angry young man regards as sacred any technique that might help him over the emergency.
In the very first bar the listener realises that he must resign himself to being handed over to an infernal machine, which mercilessly runs its course.	. . . the twelve-tone order thus instituted is fundamentally foreign to material and music, in fact in many ways it is inimical to music.
	This system, according to Adorno, is justified only if it can give expression to complex musical content, which could otherwise not be reduced to order. Otherwise, it degenerates into a delusional system. Twelve-tone music, which is thus acknowledged to be ideological, would in fact be a most suitable musical representation of an ideologically violated and shrunken world.
The symptoms of the way modern music is growing old are, sociologically, those of the shrinking of freedom, the decay of the individual.	
The brutal measures taken in totalitarian states, both right- and left-wing, where music is muzzled . . . are only an outright manifestation of something that is also happening in non-totalitarian countries.	In the age of the ideologically muzzled masses, no questions are asked; one trots blindly behind leaders who are themselves blind.

ADORNO	KOTSCHENREUTHER
The concept of progress loses its justification when power is seized by a violent and basically foreign extremism, not at all unlike political totalitarianism.	Thus there is a political counterpart to the angry young man's willingness to submit to his own private rules of order . . .
In this music, nothing is composed any more. It regresses to the sphere of the pre-musical, pre-artistic tone. Many of its devotees, logically enough . . . are also trying their hand at producing sound electronically.	This torture has long since finished music as a language, and the angry young man finally robs it even of its voice – he replaces with electronic sinus-oscillations the sounds made by men on instruments made by men.
These young composers purposely forget about musical significance and its articulation . . . and believe that to arrange notes is the same thing as to compose, as soon as one has omitted from the arrangement everything that could make it into composition.	The angry young man, being a paltry sort of fellow, pretends that meanness is a virtue; he has nothing to give music but arid intellectualism, so his instinct of self-preservation tells him he must proclaim that the only salvation lies in being intellectual.
Schönberg's own doubts protect one from being misunderstood if one is only as pleased about the popularity of this technique . . . as about, say, the popularity of Kafka.	If dodecaphony had not been invented by Schönberg and Hauer, then it would have had to be invented by Kafka, or to be more exact, by his disciples.
They have worked out a sure balance on paper; and it does not work out. They need security so badly that they in fact destroy it.	Their need for security is just like that of the overfed bourgeois, and keeps them on the look-out for techniques of composition that will shelter them.
. . . submit to the dominant principle, or . . . set themselves up at the head of wildly infectious clans and sects.	. . . this is why they cling together in groups where they can hold each other's hands.
Youth no longer dares to be young. Anxiety and suffering have grown to extremes.	The angry young man makes a noise, not because he is strong but because he is weak, empty, afraid.
The desperate hope, that in a world of disillusion art can save itself by posing as a form of science, spells its destruction.	When all along the line there is such a nonsensical mixture of artistic and scientific ideas, this must be attributed to the activities of ideological critics.

ADORNO

Nor are music critics much help. For once, critics and composers meet on the same level.

The critics, even more than the musicians, are incapable of evaluating one of the more taxing new scores. Instead, they usually come up with surrogates such as fortuitous likes and dislikes, or information of a journalistic type.

For fear of missing the birth of a new genius, they indiscriminately praise anything that might possibly have some sort of meaning.

But at the same time the material of music has expanded to the utmost . . . the boundaries have been traced, and no new sound that can be added will change the total acoustic landscape.

Thirty years ago, music was set an enormous assignment, which has never been completed.

All this should be remorselessly emphasised, for the sake of the better things that could be.

KOTSCHENREUTHER

It is no wonder that the angry young man does not know what he is about; the only surprising thing is that most of the critics obviously do not know either.

Instead of thinking things out from first principles, the critics are content with vague journalism; instead of doing their duty, namely to weigh things up, to warn and where necessary to call a halt, they stand aside, making O.K. remarks as music goes its Way of the Cross.

These critics are eaten up by the fear of exposing themselves as *démodé*, counter-revolutionary or even reactionary.

Stravinsky, Bartok, Hindemith and Schönberg have pushed the boundary line back to the borders of the absurd; any further, and one is in the ghostly realm of unreality.

But this side of the line (from Stravinsky to Schönberg) lie broad stretches of land which have still to be built on, which can be cultivated and settled.

The conclusion to be drawn from all this is that truly modern music is quite different from what is developing in the grey matter of the angry young men. Our task is now to fight for the recognition of this truth.

(translated by permission)

BO NILSSON

GOTTFRIED MICHAEL KOENIG

This Swedish composer, who was born in 1936, has become known through a number of short compositions, most of them chiefly for percussion instruments. Some time ago he sent his first electronic composition *Audiogramme* to the studio at the West German Radio. I took over their realisation, and use this opportunity to give a report on the techniques involved in work with electronic resources.

If a composer makes use of the existing corpus of instruments, he will be familiar with instrumental technique; he has studied scores, not infrequently plays several instruments himself, and if possible he will have acquired practical experience as an orchestral musician or conductor. During all this, he may well have been struck by the way composition and interpretation hang together, may have become aware that written music is a symbolic notation, an autonomous graphic transvestition, for which one then has to find appropriate action. This latter – 'performing practice' – a field partly for musicology, partly for analysis in terms of the particular historical moment (i.e., in terms of the most radical position) – has up to now provided the performer with the means of transformation, justification for his own 'way of interpreting'. The composer, nowadays rarely his own interpreter, is answerable for his score – the arrangement of codified signs, the flow of musical significance that can be read in them – but not for what an interpreter makes of it. Although notation has become ever more precise, leaving the player ever less 'latitude', the composer continued to believe in the musician's right to 'interpret' – and he was right, so long as he wrote bearing in mind the specific conditions that prevail when a group of people make music together, right so long as one substitutes a right of nature, as it were, for the traditional type of interpretation. So if a composer tends to accept the division of labour rather than to abolish it, one should not be surprised if his approach to composition with electronic resources is based on the same premises.

This was the way Bo Nilsson approached the matter, and one welcomes his initiative, even while finding it possible to upbraid him for a certain gullibility (this also in respect of the musical language): if his *Audiogramme* lie heavy on anyone, it will not be on him, but on composers who would like to follow his example. The fact that he chose the above-mentioned approach can not be explained simply as a result of the great distance between Northern Sweden and Cologne. By the time he first heard one of his pieces, he had written more than ten, and while his *Audiogramme* were still in production he had already composed a further electronic piece and planned a third. By examining a page of his printed score we shall soon see the results.

Is there such a thing as an abstract work of art, a composed interconnection of numerical relationships with no indication of any optical or acoustical realisation – an artistic algebra comparable to symbolic logic? This is possible. Could one regard *Audiogramme* as such a work? Impossible. The composer could indeed draw only on broadcasts and one score (Stockhausen's *Studie II*) as sources for acoustic imagination

and nomenclature, but his score shows beyond doubt that he was aiming at exactly that music which is already on the market as 'electronic'. I would not go so far as to assert that he has chosen sinus-tones because they have in the meantime become available; however, it strikes me that to know this is all he seems to need in order to act as producer by remote control. This has emerged in the course of correspondence arising out of a number of questions left open by his foreword. If particular manipulations should be impossible or inconvenient, I am to carry on according to my own judgment. Instead of information I had asked for, he sent the following formula for aleatoric modulation:

$$(a + b)^n dx = \frac{(a + bx)^{n+1}}{(n+1)\,b} + C; n \infty -1$$

There is no objection to a composer's formulating sound-structures in terms of mathematics. Unlike notation for familiar instruments, which demands rehearsed or imagined action, this definition, though extremely precise, has no technical equivalent. One can adjust the generator to particular frequencies, regulate dynamics with a potentiometer, feed into an echo-chamber the sound-process thus produced. When we now explain our illustration the reader will see what kind of information we in fact need in order to carry out studio work.

In the upper half of the illustration, frequencies between 55 and 4186 cycles are entered. The basis is the familiar temperament $12\sqrt{2}$. A gap between the two lines corresponds to a minor second. Separate lines indicate pure sinus-tones, shaded fields tone-mixtures of all the sinus-tones present within the limits shown (using the chromaticism mentioned), dotted lines mean reverberation. The figures in the middle show the length of tape in centimetres at a speed of 76·2 cm./sec. (30″ per sec.). In the lower half, finally, dynamics are shown, from 0 dB to –40 dB: a gap between two lines thus indicates 1 dB.

The technical procedure is as follows.

1. To produce a tone-mixture, one tone is first recorded on tape, immediately copied onto another tape, and (during the latter process) mixed with a second. The result is again copied, together with a third tone from the generator, and so on, until all the frequencies are combined. In the first tone-mixture of the illustration there are nine frequencies; this means that the tone first recorded has to be copied eight times, the second seven times, the third six times, etc. Each copying leads to deterioration (tape-hiss, etc.) that can be restrained to a certain extent by splitting up the tone-mixture into smaller groups which are then put together in the way described. The number of copying processes remains roughly the same, but the deterioration is more evenly distributed over the entire spectrum.

2. From what results, a length of tape of the prescribed length is cut out and put aside for further working-over.

3. It is more difficult to produce those sounds whose individual tones differ in length. These have to be recorded separately for the length required, and then so put together that their beginnings (or ends) lie exactly over one another. We call this procedure 'synchronisation'. Often many attempts are necessary before the stipulated results are obtained.

4. Our example shows that the components of the sounds described in 3 are not only of different length but of different intensity. The longest time-value of the last spectrum

reproduced (illustration, approximately in the middle of the frequency diagram) has a frequency of 587 cycles (e flat′′), and thus lies in the best auditory region. At the same time it is the loudest. On the other hand, the shortest, and also the softest, is the lowest, 73 cycles (D). There are tables for the sensitivity of the ear at various pitches (the Fletcher-Munson curve, for example, or the son-scale), and these show that one must give a good deal more energy to very low frequencies in order to reach the same level of perceived loudness. This means that 587c. and 73c. will in any case be very markedly different in volume, if they are both produced at 0 dB; but the prescribed decrease of 44 dB means that the low note – though not absolutely inaudible – can not be heard if it occurs at the same time as the higher one. This 'masking effect' is indeed nothing new to the musician; he knows from experience how loud one has to pluck a harp if it is to be audible when a trumpet is playing fortissimo, but he must go through it all again if he wants to work with sinus-tones. Here, I believe, there emerges very clearly the distinction between a symbolic instrumental score and working instructions for electronic music. In our example it is not merely stated that the lower tone must sound softer than the higher one; the composer has given exact figures. The 'interpreter's responsibility' has returned to the composer: perhaps one could define the difference between composers of electronic music (or even between composers in general) as the degree to which they have taken note of this fact.

5. Certain sounds are to be reverberated. Whether one uses an electrical or mechanical system here is irrelevant – in either case the results are determined by the forces at work in the system, not those in the score, if the two do not coincide.[1] One can demand of an echo-chamber a preference for particular frequency-ranges, or a maximum reverberation-time, but not things that are beyond it by definition (e.g., the production of a multiply-reflected muted vibration). For the last spectrum of our page of score (as for the first), every sinus-tone has to be reverberated. The echo of the lowest tone is to be 11·1 cm. long (ca. $\frac{1}{7}$ sec.), the second lowest 8·5 cm. The second echo is to end 4·5 cm. (ca. 0·059 sec.) later than the first, all this at almost –50 dB, whereas the loudest frequency in the best auditory region is at a level around –5 dB. Lay readers may not be much impressed by these figures; if composers had not always made excessive demands on the instruments available in their time we should probably still be making music on hurdy-gurdies. But in this case the composer is not overrating his equipment, he is envisaging a mode of composition unrelated to the concrete communication of what has been composed.

6. After the sound-material thus produced has been given the right duration, its dynamics are formed. Each sound receives its own 'envelope' (intensity-curve) in the course of a further copying.

7. Lastly, the final results are put together, 'synchronised'. In our example, one could stick together a continuous tape of the first two tone-mixtures (reverberated and unreverberated) and the succeeding long spectrum (the one whose partial tones end one after another) – first one had to synchronise the two tone-mixtures with each other. The same could be done with the first spectrum (whose separate echoes correspond by mirror symmetry to the original frequencies, including the 8·4 cm. rest), and the second

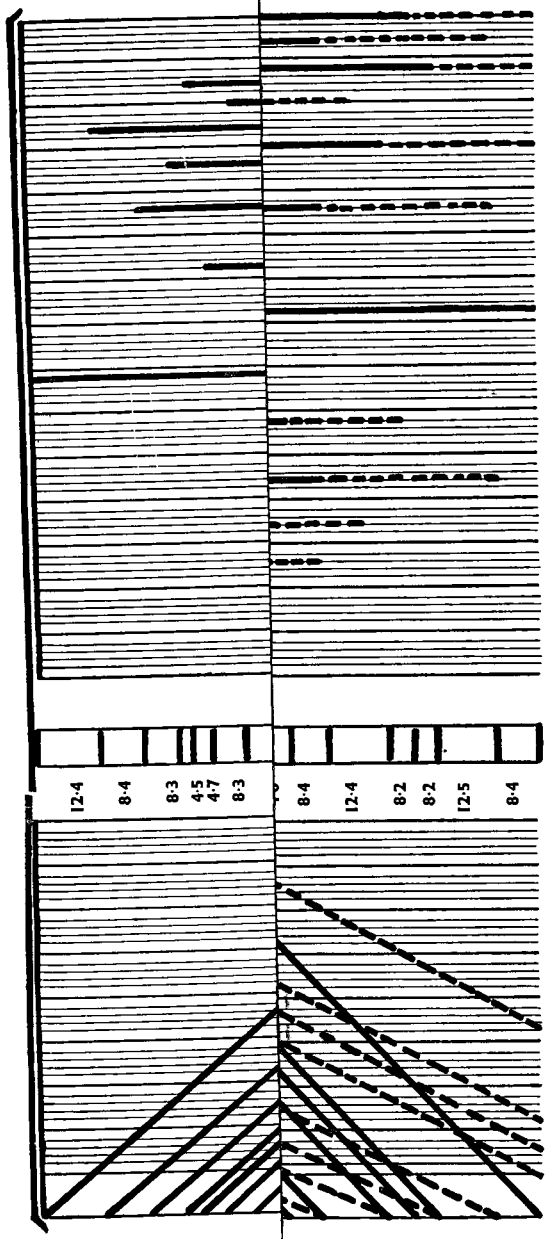
[1] This is true not only of the echo-chamber. We do not let our machines dictate to us, but often perceptive powers and mechanical limitations coincide (cf. instrumental music, where if successions of tones are so rapid that the instrument can no longer 'speak' quickly enough, one also has difficulty in being sure that they are successive), as do a process and our perception of it(or our definition: a backward reverberation is by definition no longer a reverberation at all).

group of four tone-mixtures, which again had first all to be synchronised. One thus produced two 'strata', which could be put together in the way already described, observing the correct 'entry delay'.* These manipulations again necessitated copying a few more times.

Let us forget about the composer who writes even when he only knows music from hearsay. We can see beyond him in the light of experience acquired in dealing with his work. One can come to know the limits beyond which performance is physically impossible or beyond which our sense-organs can no longer analyse, without, however, confusing these with the idiom itself. A consciousness for which 'more artificial' is the comparative of 'art' may lose patience with what is un-composed, with the gifts of mother nature – it will want to progress beyond sound, to speech. It wants to carry the process into the nucleus, into the musical atom. This 'making' of even the smallest element can not be made a job for the technician, or indeed for anybody but the composer. The moment composition concerns itself with the smallest element, this becomes the whole. Electronic music can not afford to ignore this. Our example again provides an illustration. The individual tones of the long middle spectrum stop successively, at intervals that vary from 12·4 cm. to 12·7 cm. This is more or less equivalent to a mean time-fluctuation in the ratio 127:126, which is absolutely inaudible, the more so because the already-mentioned masking-effect makes the individual endings almost impossible to hear. The result is, indeed, that the tone-colour 'falls away' toward the lower register (over about 1·6 sec.), and this may be intentional; but where do the exact figures come from, which are obviously to be as binding as the frequency-values? In so short a study it is impossible to counter the objection that this is a special case selected deliberately. In the twelve pages of the score there are countless pointers to secret mechanisms, which are supposed to leap from the surface of the score into the consciousness of the person charged with its realisation. Everyone, indeed, makes mistakes. Those composers who, before working in a studio, spent from four weeks to eighteen months experimenting, have perhaps not constantly produced better works, but they have corrected their preconceptions and then known what they were doing.

All the same, one should emphasise the work's stylistic purity, so far as this emerges from the score. The score is indeed not based on experiment, i.e., on constant checking by the ear, but on the model of the already-mentioned *Studie II*. One can not quite quell the suspicion that the composer of *Audiogramme* trusted to an 'established style' whose limits, while not defining it, may offer a false security. This is shown by the liberties the composer authorised me to take. Here we already find a hint of the problem of interpretation, which is to be considered separately in a future volume of *Die Reihe*. It seems that here the concepts with which we began coincide. The graphic scores of electronic music have the appearance of documentation for the course of music, and also production notes for a technique already possessing its own 'performing practice'. I believe that the intention behind the building of a studio must keep building; it does not provide the basic plan, or even the building material; it is inclined to fathom the very principles of architecture (to keep to the metaphor), since it sees before it a Utopian vision of the completed house.

* This term is equivalent to the 'interval of entry' used in earlier volumes of Die Reihe, but seems preferable as it avoids any confusion with melodic 'intervals'.



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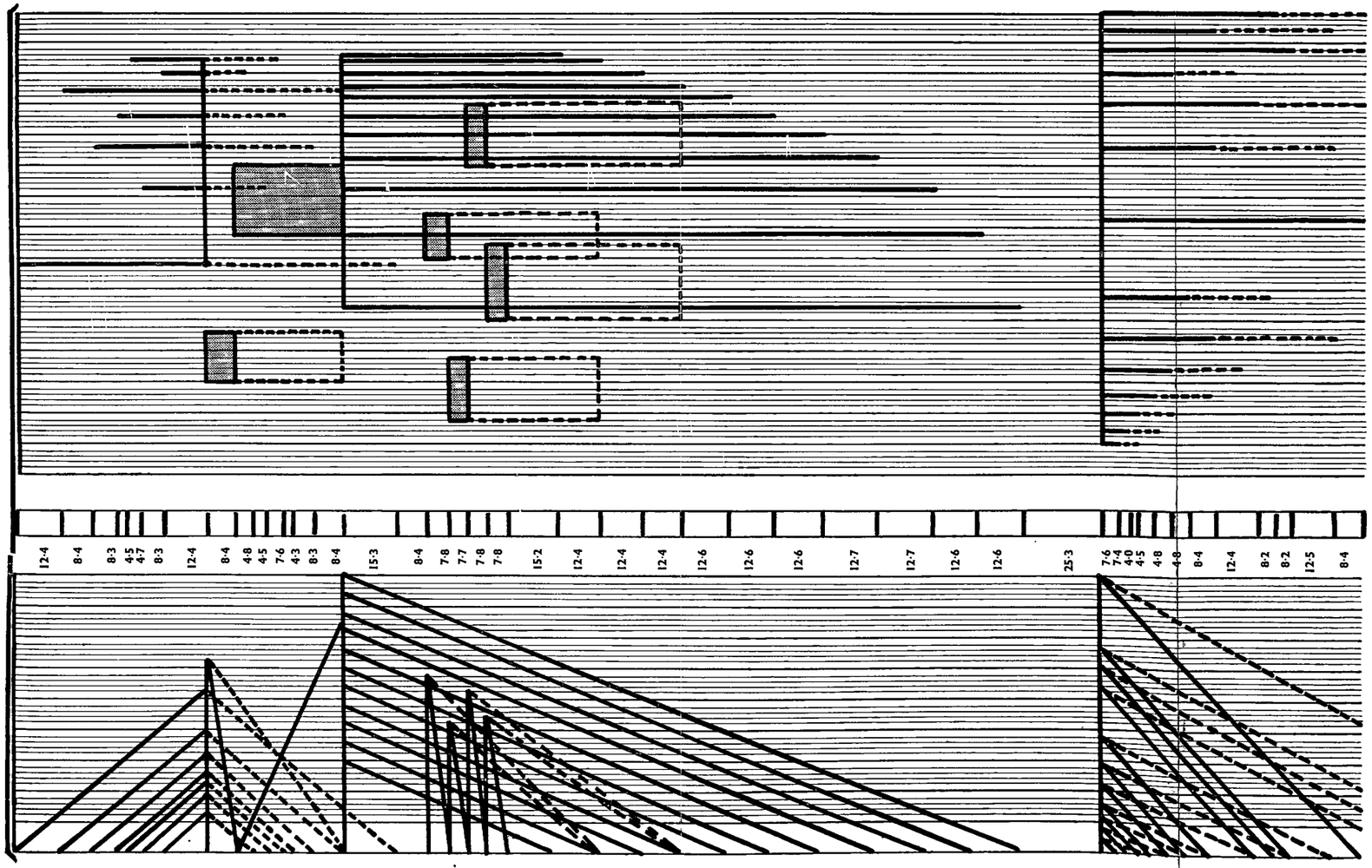


GISELHER KLEBE

WOLF-EBERHARD VON LEWINSKI

Nowadays there is something symptomatic about every composition by a really gifted and genuinely young musician (and talent may well be easier to discern and demonstrate than youth, which is not to be reckoned numerically). Such composers' work is symptomatic for the simple reason that they no longer write any 'minor works', meant purely as entertainment, unconcerned with severe artistic standards. In other words, if I here select from the output of Giselher Klebe[1] a few pieces that seem characteristic of him, I shall also be selecting pieces that are characteristic of his generation, of the attempt to develop a generally valid, suprapersonal style. There is a general application for the questions which crop up during analysis of his works (or, rather, perforce of one work only). The questions thus brought to light do not necessarily have to be answered here. There are problems whose solution does not take the form of guiding principles that can be proclaimed as dogma; art has nothing to do with formulæ, nor should it have. Nowadays, I feel, a much more important thing is that certain questions should get asked at all, so that they come to the notice of the only people entitled to give an answer – creative musicians.

What interests me in Klebe's music is its formal problems, and also its expressive language (the two are closely linked). I shall investigate the form of two works, and see what relation it bears to the audible musical communication encountered by the listener. Let it be made clear at once that this 'communication' has nothing to do with the 'content' of music as generally misunderstood. Music – or rather music that is good, demonstrably good – has no content. At the most one could use the term 'musical substance' to mean what 'comes over' audibly, i.e., musical material set in motion in particular ways. One may also regard constructive will and manifestation in sound as two 'exponents', but then the former must mean more than mere intellectual manipulation without 'ideas', and in the latter one must attend not only to the surface effect but to the way the will to construct is put into practice by direct methods, and at times, perhaps, by more devious ones also.

I select Klebe's *String Quartet* Op. 9, written in 1950, and his *Elegia Appassionata*, a piano trio from the year 1955, his Op. 22.

In the *String Quartet* Klebe set out from a purely musical idea. What one may call his 'inspiration' was that in planning the formal layout he wished to link together six movements each of individual character, through a common twelve-tone series and a number of basic rhythmic shapes. The individual character of the various movements is not determined by extra-musical ideas; it results gradually from the material set out in the first movement, which in the other movements is varied or combined, so as to be seen in new ways.

[1] Born in Mannheim in 1925, educated in Berlin with Boris Blacher and Josef Rufer, now teaches at the Nordwestdeutsche Musikakademie in Detmold.

The work's material:

I. (*a*) A series, whose basic shape appears in the main theme (Bars 1–5): f sharp\e\ c sharp/d/f\a/b flat\a flat/c\g\d sharp/b (the strokes from top left to bottom right, top right to bottom left show downward and upward movement respectively).

(*b*) Intervals that are important for the further shaping of the material – minor and major third, fourth, minor and major 7th (bars 1, 2, 24, 25): a succession of three chromatic notes that appears as a motive (bar 32).

II. Basic rhythmic and dynamic elements.

(*a*) A group of six quavers; quavers occurring off the beat; alternation of $\frac{3}{4}$ and $\frac{2}{4}$ (bars 1–5). Dynamics: *f*

(*b*) Metric alteration: quaver triplets plus two crotchets becoming $\frac{3}{8}$ and $\frac{2}{8}$ bars (bars 24–27): dynamics *p* – *pp*.

(*c*) Semiquaver figure punctuated by rests (bars 32–35). Dynamics: *ff*.

The first movement (*Allegro*) establishes the work's material in its original form, presenting it in the light of varying instrumentation and dynamics, but not as yet contrapuntally dovetailed. The movement represents an exposition.

The second movement (*Vivace*) introduces a plastic ostinato-theme consisting of ten notes. Rhythmically the theme is not altered enough to obscure the contrast of the three themes, which are combined in a free fugal form with the ostinato theme. The first theme is built from the chromatic succession (1b above) and from minor and major thirds. Subject (bars 6–9, 1st Vln.) and answer (bars 9–11, 2nd Vln.) between them contain the series. The second theme is determined by the fourth and seventh (bars 20–22, Cello). The third theme combines the chromatic succession, as enlarged in the first theme, and the rhythmic conclusion (syncopated quaver figure) of the second theme (bars 37–42, Cello). The movement reminds one of passacaglia-form. Dynamics here are continuously *ff* without exception.

The third movement (*Allegretto scherzando*) splits up the material into minimum rhythmic groups, which are obtained by combining various motives. The intervals develop greater independence. Dynamics, modes of attack and phrasing provide much contrast and thus further both the intended character of the piece and its fragmentation in a purely material sense: material fragmentation produces the character intended.

Fourth movement (*Adagio*). The series is investigated with an eye to its cantabile possibilities: this results in three melodic arches which dominate the movement. Characteristically, the serial order of the notes is altered, e.g., in the first melodic arch, which anticipates the two final notes of the basic series. The three arches (Bars 1–9, 10–17, 18 to the end) are complemented by a number of the basic motives, such as chromatic succession, triplet figure and syncopation.

In the fifth movement (*Presto*) the contrapuntal working-out is intensified. Fragmentation of the material is continued and at the same time concluded. The series is distributed between the various instruments, thus extending the acoustic scope of the piece. Melodic entries are built out and finally brought together in a triplet-movement which is challenged by all the instruments. The concentration is intensified, not only rhythmically; at the same time the violoncello introduces an independent variation of the series, the viola an extended version of the chromatic linear motive. The two violins join in with the cancrizan of these first two series, whereupon a combination of the two complexes closes the movement. In the last two bars this 'summing-up' is accented

by a trick of composition: each instrument comes to rest on a note split up into triplets, *ff*, with a further crescendo. The register of the four notes in these bars (b, c, c sharp, d) continues the process of drawing everything together.

The sixth movement (*Molto Lento – Larghetto – Moderato – Allegro Vivo*) attempts to bring together the material in another of the ways it makes possible. Whereas in the fifth movement the object was to weld the material together, here all that is intended is to add it together, still leaving the separate components and elements their own individual life, and presenting the themes and motives from each movement in all their basic forms and variants. Here the individual lines have more independence than anywhere else. The first section of the movement recalls the series in its longest, medium and shortest note-values (bars 1–5, 6–13 and 15 respectively), the second quotes mainly rhythmic motives and others that are determined by intervals, the third is a transition (using widely spaced intervals) from the retrospective atmosphere of the first two sections to the final one, which ends by quoting the opening theme and a group of motives from the first movement.

In this quartet we find a severe and concentrated process of formal building, in a contrapuntal idiom that rules out any inessential, merely rhetorical or ornamental notes. Principles from sonata and suite form are combined to give a higher-order complex linked together by the series (which plays the role of a theme). Throughout, the harmonic constellation and the use of dynamics, phrasing and counterpoint can be easily understood, since they are striking while never revolutionary or unusual. The process of composition is used to create movements that have individuality of expression. This makes the work amenable to wholly classical criteria, less perhaps in its ductus than in its diction – at any rate, in its will to form and its mode of expression.

The piano trio *Elegia Appassionata*, Op. 22, owes its existence to an extra-musical stimulus – this does not mean it has any specific 'subject' or programme. Klebe wanted to write a work for an ensemble with divergent sound-elements: piano and strings (violin, violoncello). The work's layout is basically affected by the acoustical and technical factors involved in using string instruments, to which the piano would have to be subordinate, 'melting-in' as far as possible. The individual constructional elements, too, took on their characteristics with an eye to the idea of 'melting-in':

1. A ceaselessly flowing tempo.
2. A latent twelve-tone, all-interval series.
3. Melody, harmony and rhythm were to interact and be one complex.

The individual elements are related in a logarithmic series which is most clearly expressed in the note-values – in the other elements, its geometric form is transformed into arithmetical values.

I. THE MUSICAL POINT OF DEPARTURE IS FIXED IN THE FIRST FIVE BARS (*dolce*), by:

(*a*) the notes e flat, a, a, b, a, a, e, b flat, e.

These form the melodic germ-cell and their origin is the name of the composer's daughter – all letters were used that can stand as the names of notes: **Sonja Katharina Klebe**. The note-repetitions (the e flat also appearing twice) articulate the acoustic space by octave-transpositions.

It should be noted here that although an all-interval, twelve-tone series is used in the work, it appears only once in its basic form, and then immediately afterwards in inversion, shortly before the close of the piece (bars 295–306). The series, which is also the basic series of the opera *The Robbers* is: c\b flat\b/f sharp/g\e flat\f\a flat\d\a\c sharp/e.

The quoted name, Sonja Katharina Klebe, is repeated at the end of the work, after the above-mentioned occurrence of the basic series (basic set plus inversion), in order to establish more definitely that the work is at an end – but the order of the letters is now reversed. The (free) f that begins the piece is played at the end by the cello. The piano is silent in the last two bars; thus the dominance of the strings is again emphasised. Apart from this it should be noted that the ending, with its quotation from the opening, does not use the surname Klebe (or the letters from it: e, b flat, e); only the Christian names remain, as if to demonstrate that someday a girl may lose her maiden name.

(*b*) The notes of the melodic cell played on the violin and cello are 'mirrored' by the piano, and thereby complemented to form a twelve-tone series, though this series does not have one definitely fixed shape. The piano is subordinate to the other two instruments in dynamics and through its extremely short note-values (compared with those of the strings).

(*c*) Note-values are not yet organised, and the rhythm, too, is still amorphous. The only striking real values are the semi-quavers in the piano and on the cello (as an upbeat), and the quaver-triplets at the end of these first five bars (strings). Dynamically there is a crescendo from *pp* to *mf* and back, then *p-f-p*, and a sudden *f* (at the transition to the next structure). This first structure acts as an introduction.

II. EXPOSITION OF THE NOTE-VALUE SERIES (bars 6–15, *energico*). The series, and an example of its transposition into note-values:

Series	$\sqrt{12}$	$\sqrt{11}$	$\sqrt{10}$	$\sqrt{9}$	$\sqrt{8}$	$\sqrt{7}$	$\sqrt{6}$	$\sqrt{5}$	$\sqrt{4}$	$\sqrt{3}$	$\sqrt{2}$	$\sqrt{1}$
Values	3·5	3·3	3·2	3·0	2·8	2·6	2·4	2·3 (2·23)	2·0	1·7	1·4	1·0*
Time												

(Values × 10 semiquaver units.) * To nearest decimal place.

Obviously in the course of the piece there are other multiplications (e.g., by 7, 5, 3, etc., and mainly by prime numbers, also permutations of the serial values, e.g., the abrupt alternation between long and short, etc.).

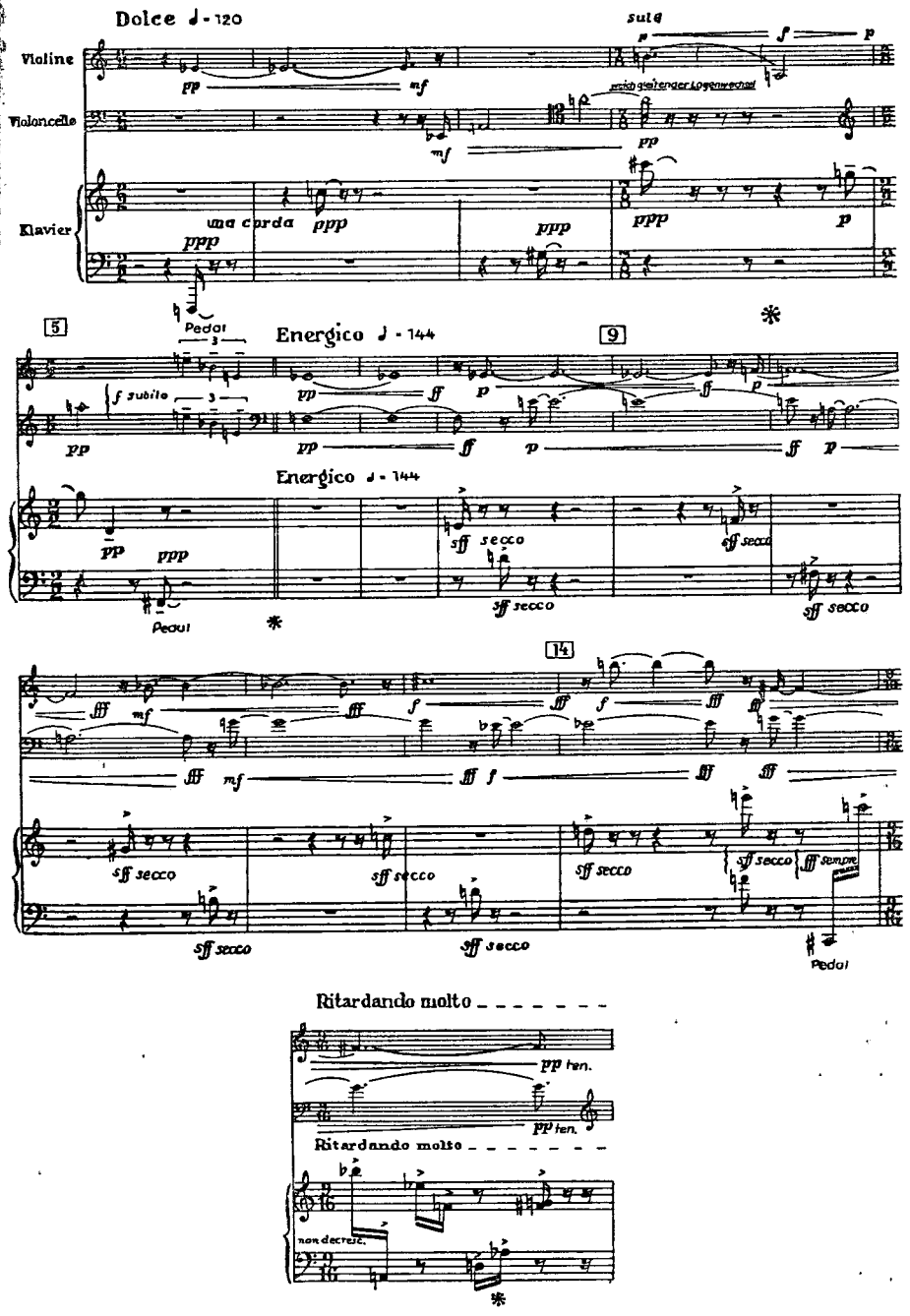
A practical example of this: bars 6–15 (bar 15 is a transitional ritardando bar) contain the following exposition:

(*a*) in the violin, values taken from the odd-numbered roots, decreasing from $\sqrt{11}$ to $\sqrt{1}$, i.e., from 33 semiquavers (two semibreves plus a semiquaver) to 10 semiquavers (minim plus quaver).

(*b*) in the cello, values taken from the even-numbered roots, decreasing from $\sqrt{12}$ to $\sqrt{2}$, i.e., 35 semiquavers to 14.

(*c*) the piano indicates the borders between the note-values, playing the last semiquaver of each (which in the two string parts is notated as a rest). The acoustic space of this structure is deliberately kept as narrow as possible, although all twelve notes appear. The dynamics of this second structure, in contrast to those of the first, show a build-up, without the ensuing decrescendo that occurs each time in the first structure: 1. *pp-ff*, 2. *pp-fff*, 3. *mf-fff*, 4. *f-fff* (strings).

Opening of the Piano Trio *Elegia Appassionata*, Op. 22.



This build-up is closely linked each time to the series of note-values (see IIa, b). In the piano the marking is *sff secco* (on each of the 'boundary' semiquavers mentioned). The second half of bar 14 and all of bar 15 mark a decrescendo from *fff* to *pp*, and thus a transition to the next structural period. As in the transition from the first to the second structure, dynamics introduce an element that is relatively surprising, because it contradicts the tendency at work immediately before.

The logarithmic series organising note-values has three functions:

(1) To keep the tempo fluid (transitions from fast to slow and *vice versa*, as in bars 23–57).
(2) to induce sharp contrasts of short and long, without interrupting the perception of time (as in bars 73–112).
(3) So that in sections where measured rhythmic values were so short as to necessitate freer transposition of the logarithmic series, there could still be an overall organisation of the form.

III. FORMAL ORGANISATION

Structures 1 and 2 are first varied separately (1a, bars 16–22: 1b, 53–57: 2a, 23–52: 2b, 58–72).

Then they are varied together (73–112).

These seven structures make up the major section I.

There follow two more, similarly constructed, sections, as total variations of I and its sub-varied structures (Klebe would like to see the term 'similarity-transformation' used here).

II has three structures linked by overlapping (113–129).

III is built out of two structures linked by 'melting-in' to each other completely (220–end).

The three-section overall form is built so that as from structure 3 each new structure is a variation of one of the first two, but from structure 7 onward the distinction between structure 1 and structure 2 is obscured first by overlapping and then by welding together. This fact makes it reasonable to draw a comparison with the three sections in classical sonata form:

I *Exposition*, with an extended unfolding of the material and its combinational possibilities, including an introduction.

II A kind of *Development* of the two structures.

III A return to the beginning, and at the same time a recapitulation.

In analysing these two works (and here, to ensure maximum authenticity, I have also often had recourse to information given by the composer), parallels of formal or expressive handling are easy to recognise. However, the two works are separated by a caesura which shows us the essence of our problems: contact with serial technique, which in the last few years has had ever more to be regarded as the decisive, in fact exclusive, point of attack for a music that can more justly be regarded as 'new' (or even as proving the existence of a new stylistic epoch) than can any music in our century (with a few exceptions).

One might think that for Klebe, too, this caesura had effects that are clearly manifest in his scores. But this appears not to be so. Klebe's musical thinking was always

mathematically orientated. His earlier works appeared almost to be preliminary stages in what one calls 'serial'. But at the very moment when Klebe could have written serially, with more than mere technical consistency, he seems to have declined to do so – at least not with the exclusiveness and in the all-embracing way that one might expect. This decision is worth examining.

Klebe's mode of working altered between the two pieces quoted. In the first he is still the musician, thinking purely in terms of counterpoint and its mathematics: in the second he has become a thinker, composing along elemental mathematical lines. His compositions are conceived and realised with the aid of ideas based on mathematics. We shall return to this later. But if one looks at the score and hears how it sounds, the difference between the two works is difficult to appreciate. This fact could be explained as follows: we have shown that even in his earlier works Klebe used a principle that employed mathematical 'Leitmotives' freely distributed. Thus the whole of his music inclined toward the elements of serialism. After the latter had been born (elsewhere than where Klebe was), he could have used it without difficulty. But at this moment there was suddenly revealed a dichotomy, in which not only Klebe but two generations of composers in our century have had, and still have to live. Once, conception could be transformed smoothly into realisation, without contradictions' creeping in. Klebe, however, now decided not to give up his accustomed way of shaping forms, but to reconcile it with the new technique. The result was that he could not adhere uncompromisingly to serial technique, making no concessions (however slight) to technical 'laxity' such as might well become possible, but only later. Klebe seems to have chosen this way, although it must have been clear to him that in adopting serial technique as his mode of working it would be impossible to avoid its deeply effective intellectual and stylistic consequences.

Klebe had to leave himself enough free space to accommodate the expression he intended, the shapes he desired. And here in fact, in comparing the two works, one sees that Klebe has made no basic alteration in his melodic ductus and his dynamic conception. Melody and dynamics are vital to his communication, which does not result of its own accord from given or determined movement of the elements, but attempts to fill out serial technique. To put it differently, the space left free in his process of shaping resembles the arbitrarily added material meant to give a 'taste' to a medicine whose formula is, chemically speaking, already complete.

The printed page reveals the presence of various factors which Klebe subordinates to the process of compositional shaping; these may remind some listeners of a musical language whose style clashes with the artistic intentions of serial music, whereas they may prove useful, just because of their associative possibilities, to another listener who would otherwise be unable to follow the work at all. These factors are:

(1) The way the tempo alters (obscuring divisions between structures, ensuring coherence; a conscious function of tension);
(2) Break-up of the texture into parts that are markedly melodic ('singable'); this makes it easier to hear and follow the form.
(3) Use of dynamics to attain specific, intentional effects.
(4) Expression marks cast in deliberately conventional mould (*dolce*, *energico*, etc.).
(5) Instrumentation: the compositional lines are made to melt into a sound-picture that is as self-contained as possible.

(6) Overall formal planning: forms arise which are not absolutely new, but which approximate to traditional ideas.

The expressive content communicated by Klebe is honest, unlike much 'expression' in the works of many of his generation – additional and yet fitting, not a separately constructed supplement, forcing on the work attributes that are foreign to its nature.

Our list of six points (which does not claim to be complete) may look like a recipe for 'the synthesis possible today'. But it is impossible to give a strong enough warning against using any such 'formula'. The will to synthesis, as in Klebe's case, must be a *creative* development from within the composer; anyone who tries to develop it in retrospect ends up in non-committal mediocrity, since his efforts toward a golden mean are based on postulates that are wrong – constructed, not organic. There are three reasons why a composer should feel the desire to communicate a genuine expression consciously and clearly, aiming to blend it so completely with the very substance of music as to preclude subsequent dissection into component parts:

(1) A concrete musical urge to communicate.

(2) National ties which will not tolerate an absolutely abstract conception.

(3) Bondage to obsolete ideas of what is to be communicated as 'music'.

The first point holds good in Klebe's case. In the Piano Trio he wished "to make the constructive idea (in the form of magnetic lines in a field of energy) guide a strong and passionate expressive urge, which is to be distinctly felt at a first hearing".

Thus one recognises that in dealing with music, too, there are two sorts of mathematics. On one hand there is reliance on the guiding principle, which is an obligatory basis for shaping form, and is at the same time the way the elements are composed, a guiding principle with whose help it is by no means impossible to determine all the elements in a musically viable way. On the other hand, there is the attitude that music needs certain ordering principles, less as starting-points than as limits which are imposed on, and therefore not really derived from, music itself. Klebe inclines to the latter view, and defines his relation to mathematics as follows: "Mathematics, for me, is a stimulus to formal and time-relationships in a composition. My concern with mathematical problems is not an end in itself, but is always bound up with basic questions of musical articulation, either as direct transformations (as in the case of permutations or arithmetical series) or as functions of similarity in logical developments of some problem, in a sense as a trial of strength between the freely soaring fantasy and logical calculation". This would also be his own interpretation of the *Elegia Appassionata* and there is nothing immediate for us to add, as either supplement or contradiction. Unless one were to adorn the problem by quoting the words of a key witness, whom it is strange to find here, since he is a romantic. Novalis said in his *Monologue:*

> 'One can only wonder at people's laughable folly in imagining that language is concerned with what is talked about. What is unique about language is just its concern only with itself; and this nobody realises . . . If one could only make people understand that it is the same with language as with mathematical formulas – they constitute a world of their own, they play only with themselves, express nothing but their wonderful nature, and it is just this that makes them eloquent.'

Substitute 'music' for 'language' and you have a valid formulation of the relationship between mathematics and music, on the one hand, and, on the other, that between composition and expression.

To sum up; we were faced by the problem, whether traditional formal ideas could be linked to a new artistic and intellectual attitude so as to lead to any kind of supra-personally valid solution; and whether the result was not bound to be a discrepancy that could only be temporarily hidden from the listener by a strong, direct appeal to him on the part of clever fakers, or, more positively (as with Klebe) by creative musical talents. Mozart wrote fugues: he could do so because he had studied Bach. But it was not his fugues that made Mozart what he is; they were not the form appropriate to his period. He blended them with sonata form. Again, Mozart succeeded in combining tendencies from C.P.E. and J. C. Bach, despite the clear differences of their expressive imagery, in such a way that the result was Mozart (this is known to have happened in the Piano Rondo K. 485). So if today one feels the lack of a new, technically and intellectually adequate form, or consciously neglects to search for such a form, should one refer again to sonata form and apply serial technique to it? Does not the new technique make essential the automatic rejection of expressive categories that it can no longer find genuine? A little logical thought will quickly provide the answer. But one should not forget that we are all weighed down by our transitional situation, between two periods. There are three possible ways to escape from the dichotomy that dominates us:

(1) The negative one – the way back.

(2) The positive one, the radical way ahead, destroying all bridges behind one and building anew in an unknown country with no inherited burdens.

(3) The way of synthesis, that can only be valid and positive by way of exception.

Klebe clearly chose the third way, whether or not he was aware of doing so. One must wait and see whether, in the long run, he will be able to bear the inner contradiction between his intellectual components so as to ensure equilibrium. It will be most instructive to see how Klebe continues his efforts (which up to now have been very significant) toward a synthesis, despite the looming dangers which tempt him both to right and to left of his steep, lonely knife-edge; how he can achieve, in his own way, an ever new balance between musical fantasy and mathematical principles, so that none of the elements are sacrificed. Klebe's activity, which in the present situation is so strikingly like that of Alban Berg alongside Anton Webern, can be seen, from the point of view indicated here, as a very remarkable omen, and to watch it, in the near future, should be extraordinarily rewarding, and also important for the further development not only of his own music.

LUCIANO BERIO

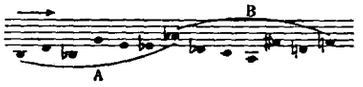
PIERO SANTI

There has already been a good deal of amazement, especially outside Italy, at the way Italian music has recently developed. People wonder how the land of the sun, of bel canto, of melodrama, can give rise to music so complicated and controlled. Furthermore, how is one to explain why none the less it retains the spontaneity, the natural quality, even the 'lyrical' character long acknowledged to be typical of our music? People would be less amazed if they were free of a prejudice – the prejudice that this music's intellectual inspiration and technique come from a cultural world that is not Italian but primarily German, and whose nature is held to be the antithesis of ours.

Here something has been overlooked. This very survival, in the newest Italian music, of the 'lyrical' element could be the key to a realisation that there is no question of merely assimilating foreign influences and passively absorbing particular working methods. The fact that ideas and experiences have been industriously exchanged (recently in particular) in no way diminishes the diversity of their origins and of the conditions under which they matured. They are indeed stimulated by a general necessity – this, however, does not originate in one single culture but is the counterpart of conditions which, though general, affect differing cultural worlds. Everyone's aim is authentic organisation of the world of sound, which is finally to be freed from foreign superstructures and external compulsion; accordingly it is generally recognised that one must constantly exercise strict analytical control over both material and language. But from then on, once conversion into deeds is under way, the ground can vary a hundred per cent, and the stimulus lies each time in quite particular conditions and differing original impulses. Thus, in the years after the second world war, new Italian music, too, had a path marked out for it. Naturally it profited from study of hitherto unavailable works, and from insights that had been gained elsewhere; but the natural reaction was against our own most recent musical past. To put it more bluntly: there was a reaction against 'expression at all costs', against rhetoric (veiled to a greater or lesser degree), against sentimentality which no longer dared to express itself melodramatically, unreservedly, and which even at its best only disguised itself in the provincial uniform of a cosmopolitan style. On the other hand their inner independence allowed the new composers to protect the truly traditional Italian characteristics. These are the ones usually taken for the characteristics typical of the artist, or even of the Italian: a happy nature and a lyrical temperament. These characteristics are features of an artistic civilisation, which passes down the years mainly as a clear feeling for form, and which is a constant reminder of formal synthesis. The craftsmanship of the young composers under discussion preserves the attitude of our classical composers: that the life of musical forms is to be presented clearly, that one must go straight to the heart of the work – in their view the work must tend to disclose its structures as a comprehensible and harmonically balanced end-product. I.e., a capacity for synthesis – guided by analysis, since this

allots to each element its function in the work's formal balance. Similarly, in old Venetian architecture, irregularity of individual proportions and asymmetry of the architectonic elements strive to achieve a synthesis which, in complete contrast to the details, gives the impression of perfect balance and undisturbed grace.

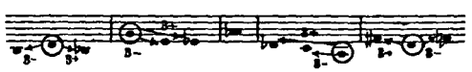
Similar characteristics underly the impression of balance given by the music of Luciano Berio. An interesting work from this point of view is *Nones*[1] for Orchestra, whose symphonic course is marked by a series of tensions and releases of tension. These are produced by thinning out or condensing the sound material between two poles, the 'empty octave' and the chromatic total. This first acoustic idea already tends to determine the details of the work, since it concretely derives these from a unifying concept. The composer's idea served as a basis, since the two sound-poles can in fact be heard as two clearly perceptible extremes, between which a relationship must be produced. Nobody who knows *Nones* will have overlooked the fact that its climax at the central point of the score is a saturation of the orchestral register (inspired by the spectrum of 'white noise'), and that the empty octaves toward the end have a quite chilling shock effect which polarises our attention between these two points, so that the contrast between the elements can be felt with particular clarity. All this arises from the choice of material. Work proceeds from a series of 13 notes, which for its part consists of two groups (A, B) with one note (a-flat) in common. B is a mirrored cancrizan of A.



As there are 13 notes, one (d) must occur twice, and this doubling also means that the interval of an octave must be used more often in the course of composition – it is set up in opposition to the vertical use of the chromatic total.[2] The scheme for durations,[3] too, retains its technical consistency, but is given light and shade by augmentation or diminution of its proportions. The essential thing is that a compositional idea must be grasped as it has developed in the author's mind in accordance with his lyrical feeling.[4] Apart from this, the overall form is shaped by dynamic superstructures, which arise

[1] The work was inspired by Auden's poem *Nones* (The Ninth Hour).

[2] As can be seen, the series contains the four basic forms. It is designed to emphasise, above all, the relationships of minor and major third; from this point of view it can fairly be regarded as a sequence, which is permutated in the interval functions of major and minor thirds. The presence of the central member, a-flat, producing the relationship of a perfect fourth with the preceding and succeeding notes, ensures that the sequence has an open character:



[3] Values for duration, intensity and mode of attack are summated to a mean. In this way the composer ensures a balance of expenditure among these musical dimensions.

[4] *Nones* can be divided up into five sections, all built on the same basic elements. The given scheme is permutated, and the durations are progressively altered and mutated. Each section is characterised by a moment of greatest tension, reached through vertical condensation and by shortening the note-values, especially in the piano part. In general, the moments of greatest speed are matched by a maximum vertical condensation, except in the fifth section, where a gradual increase in metronomic speed is linked with a minimum number of sounds.

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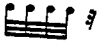
from the basic scheme. The overall dynamic course is in accordance with the superstructuring of modes of attack, timbres and register-distribution.[5]

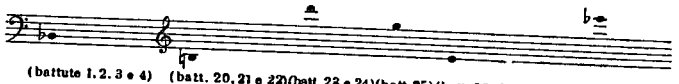
In short, in *Nones* the formal justification for all the sound-dimensions and their articulation is a higher-order formal flow which the listener can summarise after it has mediated in varying degrees between the two poles of the original formal idea.

In the *String Quartet* there is less inner dependence between material and the scheme of construction, on one side, and, on the other, the way they are carried through in music. The Quartet is built up wholly on permutations of pitch-series, which recur in each sequence, and on sequence-permutations which recur in each structure, because of the use of six different durations and a particular intensity for each sequence.[6] Thus it is a matter of six different 'readings' of the same material. But Berio makes the rigid skeleton of the structures produce stimuli and ideas, and also a certain coherence within his material. Here he moves with unrestricted freedom; he may leave out notes and durations or add some, he divides up durations into periodically beaten rhythms, chooses registers with complete freedom, and in all this he adheres by and large to the prescribed dynamics, within the limits of his own taste, exploiting effects of timbre and instrumentation very delicately. It would be interesting to follow from bar to bar the onward course and the melting-down of the elements, while keeping the basic scheme before one. It is typical of Berio that he lingers a short time over each of the individual elements, till these take on a figurative shape within the resulting overall picture – they do this less as pointillistic formations than as a collective agglomerate. There is no old-fashioned dialectical play among these elements; they produce particular episodic phenomena according to a statistical criterion of distribution. And yet even in this form it is clear that certain articulations are bound very deeply to a schematic basic layout. Rhythmic articulations, above all; it may suffice to observe the way the cell '4 + rest + 1'



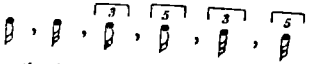
(Ex. 5), which forms the first sequence of the work, returns in different forms at the beginning of each structure, and how it gives rise to characteristic articulations; how the

[5] E.g., a dynamic superstructure results from the maximum dynamic accentuation of the first six notes of the series which are polarised according to the following arrangement:



(battute = beats)

[6] Each structure consists of six series of six sequences each. All the durations in these six series of six sequences, i.e., 36 durations, are multiples of one of six basic values:



Thus for example in the first structure the durations in each of the six series of sequences are multiples of 1, 3, 5, 7, 9 or 11. This means that each duration in the first sequence-series is one of the six fundamental values, while in the second sequence-series each duration corresponds to one of the fundamental values multiplied by three: in the third series the fundamental value is multiplied by five, in the fourth by seven, etc. Sequences, sequence-series and structures follow each other exactly according to the scheme, in order then to achieve a synthesis in the free articulation of the quartet-texture.

group of two (etc.) gives a shape to the entire introductory section, or the way the equally important group '3 + rest + 1' runs in varying forms through the entire Quartet.

The *Variations for Chamber Orchestra*, written in 1953, before *Nones*, are also 'chamber-music', and this is perhaps what made possible their clear articulation; though the work was inspired by a classical model. In this sense the methods used in the Variations are more closely related to those of the Quartet than to those of *Nones*. The *Variations* tend to build up characteristic shapes rather than to aim directly at a massed effect. It is self-evident that the shapes, for their part, tend to build 'masses', and that their quality depends on their statistically distributed quantity. Within just this fluid flow of sound-time and sound-space the inner time-duration of music attains order. The whole of the first variation is determined for the most part by two superimposed sound-planes; one is a prolonged background given by the continuous passage of the pitch-series from one instrument to another, while the other is a proliferation of small cells, which are derived from the very scheme of the *Variations*, and which alternately approach each other and separate. Similarly the third variation consists in essence of a continuous plane, varied in colour, illuminated momentarily by almost brutal elements which are entrusted mainly to the brass.

Obviously the episodic characterisations perceptible in the Variations still result from the traditional idea of a variation. This means that in listening, one can hear clearly the underlying sound-ideas that form the basis of the individual variations and episodic sections. After all, even before the *Variations* Berio had not been afraid of forcing his work to obey rules of a formal or poetic nature. This is shown, for example, by the *Five Variations for Piano* (completed in 1953), and *Chamber Music*, written the same year (in this work Joyce's text must obviously be taken into account). Nor does Berio later hesitate to adapt his music to the practical demands of the theatre, as at all those moments in the *Mimusique No.2* when the mimetic action has to be given a clear musical lead.

But in *Nones* all trace of a model or of a formal skeleton has disappeared, and the work's form results from its choice of sounds that will make audibly distinct the possibilities contained in the schematic outline. Never during the entire creative process does Berio forget what is to be its end-product. Here is the basis of his artistic freedom and his excellence as a craftsman. These are still more clearly manifest in the *Quartet*, since the connections tying them to the basic scheme, though less directly visible than in *Nones*, are clear within the musical coherence of the whole work, as that unity of all details that I have already mentioned. In his most recent work Berio again shows, more

clearly than before, that he relies not on the formal guarantee provided by an abstract, cerebral scheme, but on his own creative energy. Berio's fantasy does indeed always create a plan, but this is in order to play within its limits, to vary it without invalidating it, to enrich it without obscuring it beneath a mass of dovetailings and superstructures. His fantasy loves clear form, of the kind demanded by the artistic tradition to which Berio himself belongs.

Thus the Latin or Italian traits in Berio's work come not from a vaguely sentimental disposition, conventional 'lyricism', but from a professional – Berio would say, a 'craftsman's' – attitude, the result of a practical mentality typical of our art. This also explains how the new Italian music is capable of autonomy and originality, which Berio typifies more than most. Here one is reminded of the comparison which Wölfflin made in his 'Kunstgeschichtliche Grundbegriffen', to distinguish the character of Italian art from that of German. He says, with reference to the Baroque: 'In the Baroque, too, the Italian nation never went as far as did the Germans in depriving the parts of their autonomy. One could draw a musical comparison to illustrate the contrast between the two kinds of fantasy: Italian church bells always keep to definite note-figurations; when our bells ring, there is a sheer mixture of harmonious sounds'.

BERND ALOIS ZIMMERMANN

REINHOLD SCHUBERT

Report on 'Perspectives'

Bernd Alois Zimmermann's *Perspectives*, subtitled *Music for an imaginary ballet, for two pianos*, were written in the years 1955 and 1956. They were preceded by two other works for the ballet, both orchestral, *Alagoana*, Brazilian Capriccios, from the year 1950, and *Contrasts*, 1953, which is again described as 'for an imaginary ballet'. To set these in context, let us list some other leading works of Zimmermann: *Sonata for Viola Solo* (1955), *Cello Concerto* (1953), *Oboe Concerto* (1952), *Symphony in One Movement* (1951, new version 1953) and *Violin Concerto* (1950).

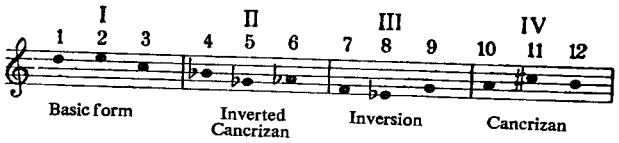
Here we shall be concerned with the music of *Perspectives* as music, not with how far it is ballet music, nor with how far the intended ballet claims or can claim to be 'imaginary'. For the sake of information, let us add that the composer has in mind a

> '*Gesamtkunstwerk* of a structural kind, in which the function of points, straight lines, planes, figurines, puppets, mobiles, and finally also of dancers is conceived as proportional from all angles, in a sense as an "emanation" from the music'. '"Ballet" is taken as a collective term covering the presentation and combination of utterly varied kinetic elements, which can be rhythmic, spatial or bodily. One could regard music as the geometric location on which all this is orientated' (Zimmermann).

This music marks a distinct caesura in Zimmermann's development, and, in his output so far, doubtless a point of particular concentration, not to say a climax. We say a 'caesura', since the composer, who has gone through the typical German post-war course of 'catching-up', taking in Hindemith, Stravinsky, (Bartok) and Schönberg, for a long time showed very varied lines of development, which often appeared to diverge or genuinely did so; these seem finally to have been integrated in the name of Anton Webern. We say 'concentration' since what has called forth and made relevant Zimmermann's own language is a creative effort toward the current stage of musical consciousness fixed in the work of Anton Webern.

Zimmermann's *Perspectives* are divided into two major sections, each divided into several subsections, though the transitions between these are gradual. We limit our analysis to the first 'movement' – so far as the term can still fairly be used here (since the section's form is not developed as one unit). As far as material is concerned, the basis is a twelve-tone formation (Ex. 1); it would be pointless to call this a series, as understood in orthodox (i.e., Schönbergian) dodecaphony. The composer speaks of a 'group-aggregate', meaning that four three-note groups, arranged according to particular interval-relationships, have been linked to form a twelve-tone field. What Schönberg did to the twelve-tone series as a whole – using it in the process of composition, contrapuntally varied by inversion, cancrizan and inverted cancrizan – has now become a constructive principle affecting the structure of the series itself; Group II is a cancrizan inversion of the basic form Group I (major second rising plus major third falling), Group III the latter's inversion and Group IV its cancrizan. III and IV together produce

both cancrizan and inversion of I + II. The link intervals between the individual groups also share the latter's interval-relationships; twice (notes 3–4, 9–10) the major second appears, twice (6–7, 12–1) a third, although it diminishes from major to minor. Thus the entire series is built out of a pervasive alternation of seconds and thirds. Two more structural relationships should be demonstrated at once; between the three-note groups I and II, as between III and IV, there is a latent regular tritone-relationship, which, though ineffective while the original note-order 1–12 is retained, can immediately become evident when the note-order is altered or when chords are built up. (Tritone between 1–6, 2–4, 3–5, 7–12, 8–10, 9–11). These tritone relationships also mean that the first half of the entire twelve-tone complex (Groups I & II) gives a whole-tone scale, which is complemented to form the chromatic total by the whole-tone scale of III and IV.



Example I

Thus even the interval material has been pre-formed so as to radiate a mass of relationships, crying out for constant transformation. This material, firmly ordered as it is, tends toward a kind of chain-reaction of 'processes of decay', which at once rise again in the form of new arrangements. Naturally Zimmermann is not the discoverer or inventor of this method of series construction; it is an intellectual 'heirloom' from Webern and is part of the technical freehold of the most recent music. Here there are some basic points to consider. From the point of view of historical development, the twelve-tone series is a product of expressionism at its height. Its technical character, purged and made purely objective by the recent *avant-garde*, or indeed by Webern, had a highly subjective origin – the radical expressive urge of free atonality. In Schönberg's middle-period works, such as the Orchestral Pieces Op. 16, one can see the way particular note-groupings, marked out as explosive expressive gestures (motives, in old-fashioned language), become solidly established and force an originally disordered chromaticism to condense into 'basic shapes'. Even here they become more objective, as elements of constructive linking, which determine the musical coherence. When Schönberg's twelve-tone technique rationalised composition with 'basic shapes', the latter, together with their structural function, continued nevertheless to be carriers of expression, only (to draw a mathematical analogy) with the 'sign' reversed. This they remained so long as the twelve-tone series was handled and related as a whole, 'thematically', so long as it was used in composition as a principle of total development. Schönberg never quitted this position, but merely realised its severest implications – the ultimate implications of the formal principles of 'thematic development' dating from Haydn and Beethoven. This angle of vision shows that in his dodecaphonic period (the 'free atonal' works must be regarded differently) he was the 'radical conservative', who once more made eloquent the linguistic resources of the great tradition, by exploiting their intrinsic severity to eliminate the elements in them that had become traditional in the wrong sense. His truth arises, as it were, out of constant contradiction of what is not

true; and if the technical source of Schönberg's way of writing – the 'canon of the forbidden' – is reflected in the sphere of expression as a hardened protest against existing falsehood, this speaks only for the identity of the musical whole.

In Zimmermann's development, which people have fairly regarded as containing certain neo-expressionistic elements (in the *Symphony* and also the *Violin Concerto*), the series initially had such a thematic motivic character; moreover, at first it was manipulated in a very free way. Some day someone should write a summary of the way Schönberg's innovations, and then Webern's, have been absorbed into post-war German music. It would be a story of repeated and often very fruitful misunderstandings, caused by defective knowledge of the scores that had been forbidden for twelve years – only very gradually did we gain a more concrete idea of them. At first, oddly enough, the incentive to compose with twelve-tone series often lay not in their polyphonic nature but in their pure sound – there was temptation in sounds that hovered, free of tonality, differentiated, as if split up into spectra, complementing each other in the form of 'complementary chords' that added up to the chromatic total. Another attraction was the expressive richness of the twelve-tone melos, and it is no accident that many scores from the first years after the war show a streak of sensitivity, tenderly atmospheric, a new kind of 'sensibility', or one could even say 'romanticism'. This early dodecaphonic stage, which most of the younger composers reached after wrestling with the problem of neo-classicism, is typified in Hans Werner Henze's remark about his *Violin Concerto* (1947): in conceiving the work he

'imagined . . . widely-ranging, tender cantilenas and carefully fostered sounds',

and after he had made various prolonged experiments he decided

'to work with twelve-tone series, for better or worse.'

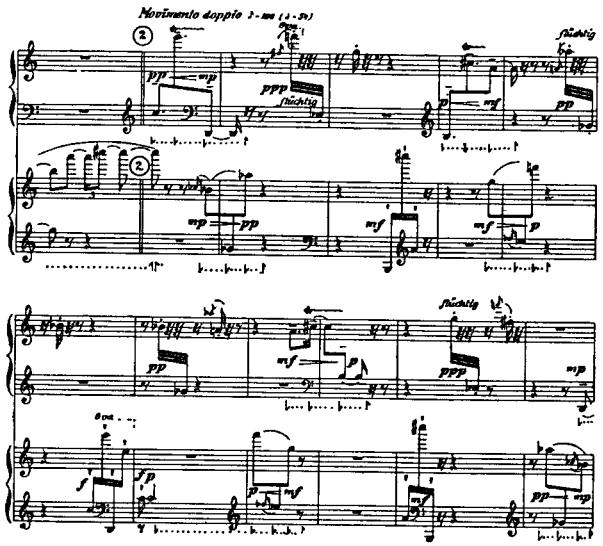
Zimmermann, too, went through this post-war stage of German 'special dodecaphony', whose morphological significance has so far been little observed or described, and where, technically speaking, the form is usually to divide the serial material into two components, one 'thematic' and one 'accompanying', and then at times to treat these part-groups without serialism, like a 'mode'. (There are countless examples, especially in Fortner's works.)

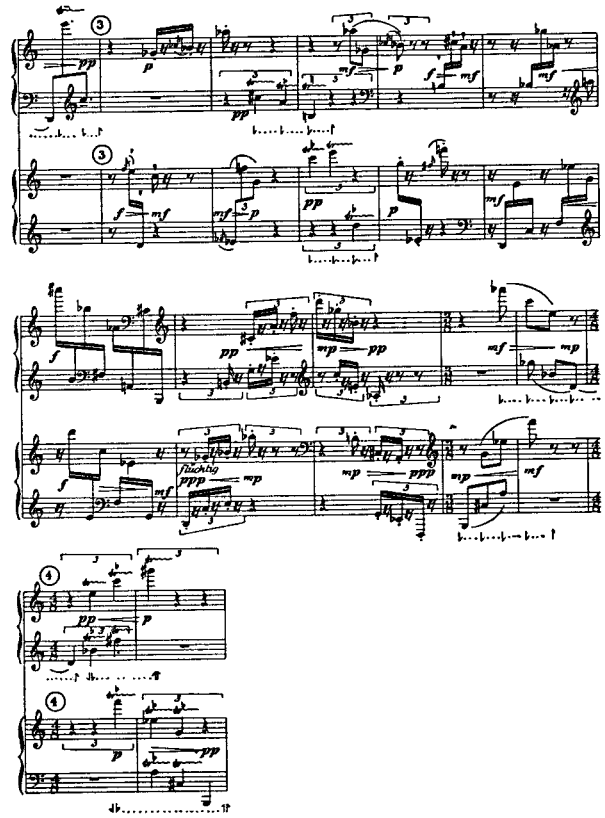
It is in the Cello Concerto that Zimmermann for the first time advances beyond Schönbergian technique and approaches Webern – more, for the moment, through a kind of 'gesture' than in any effective structural way. The 'post-Webern style' (if we may for once help out with what is really a useless concept) is assimilated as a specific expressive factor, drawn upon to form a very individual atmospheric force; this is quite in order, since it gives the piece a thoroughly individual quality. Even in the *Perspectives*, whose structure takes the aftermath of Webern seriously, Zimmermann still maintains a kind of espressivo-relationship to serialism. An emotional correlate is indicated even by the fact that the conception of this work, with its concrete musical processes (which are in fact serial in all dimensions), includes the optical materialization as a 'ballet'; that the 'perspectives' of the compositional web are matched by similar perspectives of visual perception. But if the ultimate 'idea' is in fact extra-musical (and it is a moot point whether the purely 'intra-musical' can have any significance at all), this protects the acoustical process from being mere self-representation. It is communication, and an instrument (no matter how rational and technical) for regulating expression.

The first section ('movement') of *Perspectives* begins with a slow introduction (*Grave*, quaver = 54) in which the series or its four three-note groups are set out rather as pure sound, in pure harmonic proportion. From bar 2 onward, the notes of the series are successively given out, dynamically graded from *ppp – mf*, emerging from two initial six-note chords that summate to form a twelve-note one (first and second halves of the series); the notes link up to form a sound-field whose density varies but is at times saturated to give the chromatic total. This process runs its course twice in the bass, the two six-note chords being repeated in the topmost register to provide a clear caesura. Owing to the even arrangement of entry-delays from note to note, mainly with constant values ($\frac{3}{16}$ or $\frac{1}{8}$), the rhythm is reduced to the mere articulation of a flow of time. All our aural attention is drawn to the tonal, intervallic and chordal events. At the same time, a factor of collected relaxation is brought into being, so that this formal section not only has a markedly 'preparatory' character, but can later function as a point where the form comes to rest, stops, and turns. The section is again repeated (with this function) in the second part of *Perspectives*, though much varied; thus it is altogether useful as a linking-element in the form.

A short, five-bar transition, in which the register rises to middle and high, leads to the first principal-complex. In this transition the three-note groups of the series, previously 'submerged' in a continuous band of chords, are now motivically isolated and set against each other in canon and counterpoint. Thus at this point both the harmonic (intervallic, chordal) and motivic structure of the series are presented. There is then a direct motivic join ensuring a seamless transition from the introduction to the first major formal complex (*Movimento doppio:* quaver = 108). The first 24 bars of this section (Ex. 2, figure 2 onward) will now be examined more closely.

Example 2



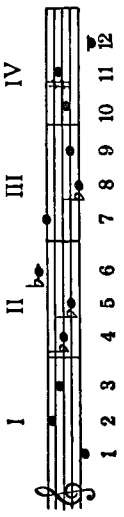


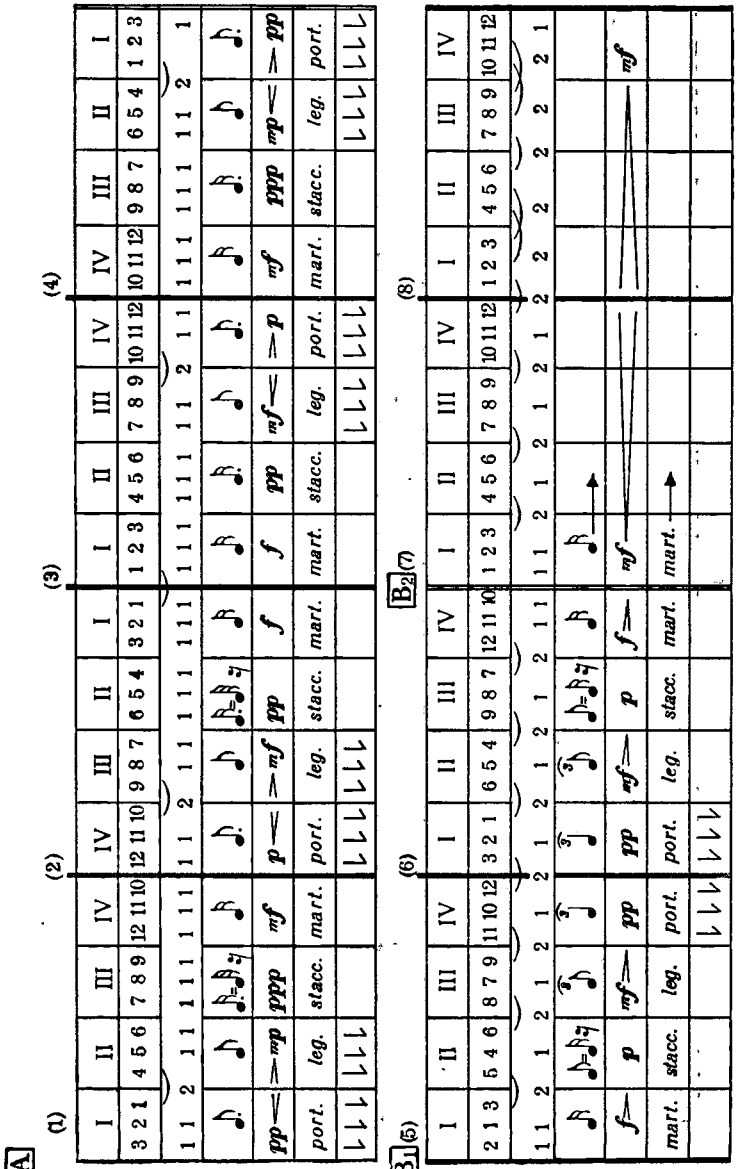
One quickly recognises that the passage is articulated into two sections of equal length: A (bars 1–12), B (12–24). The second section is again built out of two sections, four plus eight bars: B^1 (13–16), B^2 (17–24). Closer formal observation shows that in the complete section A and the part-section B^1 cancrizan structures are built up, whose turning points are in bars 6 (last semiquaver) and 15 (first crotchet triplet) respectively. The subsection B^2, on the other hand, presents a progressively developing form in which an arch-shaped figure is used four times, spread each time over two bars. Whereas B^1's relationship to A is that of a confirmatory, concentrated repetition, B^2 clearly has the character of a 'codetta' with a ritardando written into it. What follows, as might almost be expected, is not unlike a development section – even though all these ideas from classical sonata form should be referred to only as broad approximations, and in inverted commas. Structural analysis (see Ex. 3) will show in detail that the formal superficies is consolidated from within, through every dimension used in the composition – or, more correctly, that it represents a projection of all the interior musical processes.

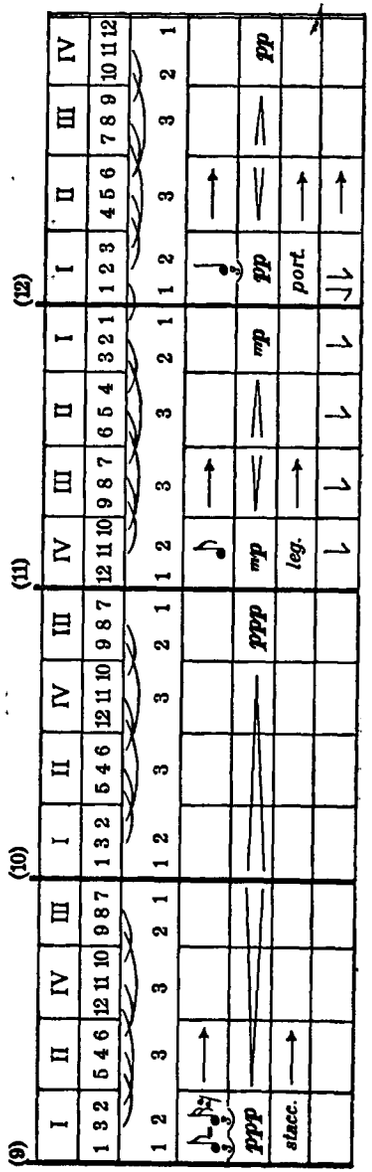
1. The 24 bars under consideration manifest total organisation of sound, i.e., of the succession of notes (and groups), registers, note-values, dynamics, timbre and note-density. We recognised as a formal principle the intensification of a cancrizan by concentrated repetition, and, at the close, 'resolution' of the mirror-form into one that develops. This principle is found again in the serial ordering, where the structural movements either follow the course of the major form, carry it, or else – on a different compositional plane – cross and overlap with it. Thus the group-succession in Section A completes a cancrizan twice, i.e., twice as fast as the total form. (Within the groups the succession of notes is also subject to serial regularity, but to analyse this exactly would lead one into limitless detail. We have also ignored the grace-notes and trills: these are free from serialism and 'colour' the timbre; however, the quality they give to the principal notes *is* included in the serial structural movement.) One might perhaps think that the double mirroring of the group-aggregate, of the twelve-tone series, will hardly be very noticeable, since the series itself contains several mirror-forms; its basic shape and its cancrizan are indeed completely identical as to intervals, except for the change of direction between notes 6 and 7. And yet the way the form runs forward and then reverses does become clear, most essentially through connections of register. Section A is predominantly monodic, apart from the characteristic overlappings between groups 1 and 2; the three-note groups are clearly separated by rests, and moreover opposed in dynamics and modes of attack. Since within the groups ('motives') the predominant intervals are again large, stretching over a wide sound-space, the ear has little trouble in hearing the notes individually and remembering them. In the reverse half (bars 4–6, 10–12) individual notes or whole groups are repeated at the original pitch, thus emphasising their mirrored relationship. One note in the same register is enough to provide an aural bridge at the turning-point of the cancrizan, whereas the groups more widely separated are recapitulated in full. The total-cancrizan that starts just before bar 7 (we recall that section A is built as a strict mirror-form) further reinforces the correspondences of register (see Ex. 2). In Section B^1 the succession of groups is 'linear' (I, II, III, IV, twice), and thus seems to cut loose from the cancrizan flow of this section, already anticipating the progressive formal scheme of B^2. The second phrase of B^2, which corresponds to twelve-tone periods 9 and 10 (see Ex. 3), introduces mirrorings of the two halves of the group-aggregate, whereas the third and fourth phrases again form a complete cancrizan. Measured against the form as a whole, this again demonstrates a 'contrary motion' between serial ordering and formal events, reversible versus progressive, as already in B^1.

2. These features of the constellation of groups and group-aggregates interlock with the serial processes in the remaining compositional dimensions. Note-values are subjected to progressive shortening or lengthening. The original rhythmic series, whose terms coincide respectively with the four groups in the twelve-tone series, constitutes an accelerando from dotted quavers through quavers and dotted semiquavers to semiquavers. It exactly follows the cancrizan process in A, i.e., it runs its course 'forwards' twice, then (from twelve-tone period 3, just before bar 7) twice backwards, i.e., in cancrizan, as a slowing-down. Here the note-value series not only regulates the duration of the notes, the changing rhythmic structure of the three-note groups, it also determines the entry-delay between the latter. With one constant exception, each group is

Example 3





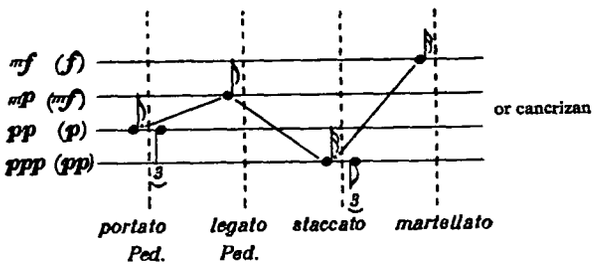


isolated from the succeeding one by a rest of the same length as its note-unit. One could scarcely still call this insertion of silence between sounds a 'rest' of the usual kind. It does have an articulatory function, but is neither an organic physiological caesura (a 'pause for breath') nor a sign of psychological tension or relaxation, nor an architectonic element concerned with completing each appearance of a prescribed metre. The fact is rather that silence, just like sound, is appropriate to a completely organised time-continuum (as the negative form of sound, perhaps). Rhythmically, the motivic unit in the three-note group consists not really of three but of four note-values; three positive (sounding) plus one negative (silent). Because of this prolongation of the acoustical phenomenon till it reaches zero, one can also understand a time-interval as a unity of note and 'rest', as in group 3 of the first twelve-tone period (bars 2/3) and at the corresponding places where it is repeated. Here the note-value 'dotted semiquaver' is assembled from a demisemiquaver and two demi-semiquaver rests, the latter being in no sense a 'caesura'.

In B^1, which, as regards form, has already been seen to be an intensification, the rhythmic progression is also intensified, using slightly shorter values – quavers and crotchet triplets. Thus the note-values are shortened and movement increases. Calculating against the prevailing $\frac{4}{8}$ metre, in A the four note-values from largest to smallest (dotted quaver to semiquaver) produced the following accelerating series(maximum number of note-values within a unit bar): $2\frac{2}{3}$, 4, $5\frac{1}{3}$, 8. As against this, the accelerating series from crotchet-triplets through quavers and quaver triplets to semiquavers, is now: 3, 4, 6, 8. (In the cancrizan half one would have to speak of a deceleration series. The development of the rhythmic series here, in contrast to A, is in fact from slow to fast and back. The aim is the 'structural variation' of formally similar sections, in this case two cancrizan forms, just as it was with the alteration of the group-succession (v. s.).) The figures in the above series demonstrate something

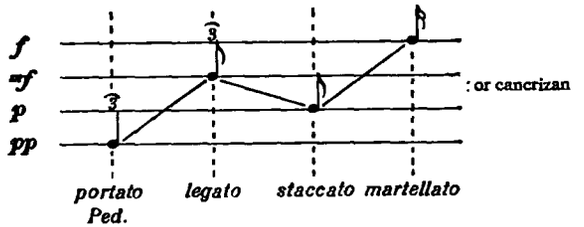
else; whereas in A the metre was often overlapped and crossed by the actual rhythm (the fractions show this), the time-durations in B^1 slip neatly into the bar scheme. The movement is metrically ironed out at the same time its tempo increases (very slightly, just as all these structural alterations are a matter of very small differences). This already prepares for the closing section B^2, in which each note-value is used exclusively for two bars, which coincide with the twelve-tone periods; the rhythmic series in its decelerando form thus carries the written-out 'ritardando' that has already been mentioned. One can hardly imagine a closer tie-up between the various formal elements, a more complete derivation of the large from the small.

3. The factors of *intensity* and *mode of attack* are closely dependent on the note-value series; the use of the pedal also becomes a function of mode of attack (timbre). (Linear alteration in intensity, i.e., *cresc.* and *decr.*, is prominent in Ex. 3. It constantly reinforces the dynamics of the form). The following scheme results:



Example 4

This correspondence between the series of note-values, dynamics and modes of attack (pedalling) is absent in only one passage – within the 'intensifying' section B^1, which is varied in so many of its dimensions. Along with the interchange of note-values, degrees of intensity are also permutated, while the succession of modes of attack remains constant. The scheme in B^1 is as follows:



Example 5

It is clear that dynamics and timbre, precisely because of their regular tie-up with note-values, constitute a very essential factor in the articulation of the form. The linking of registers (and positions) means that over and above the direct link-up from note to note there is spread a network of relationships – and this can be made more effective through the resources of dynamics and tone colour. This sort of organisation is indeed a closed

book for those used only to listening in melodic-harmonic terms that can not do it justice. One has rather to hear sound-proportions as the 'perspectives' of a compositional structure, whose elements are subject to a constant strictly ordered serial process of alteration. This also explains the title of the work; it signifies the multiplicity of what is alike, the non-identity of what is identical, portrayed in the kaleidoscopic 'perspective' of all the compositional dimensions.

4. A final investigation of this passage deals with *note-density*, i.e., the distribution of single notes and chords. This also shows a serial progression, whose relationship to the other variations of structure is calculated exactly. The entry-delays have already shown us that in A, groups regularly (four times) overlap, so that diads occur at formally characteristic points, which are, moreover, emphasised dynamically. But in this section the diads are still exceptions, which give accent to the form. The listener is mainly concerned to perceive a structure which, though monodic, is highly complex, and variously 'contrapuntal' in its several dimensions. Note-density then increases in the 'intensifying' section B^1, which is a concentrated repetition of the formal pattern of A (cancrizan). Single notes and diads alternate: the groups run into each other at the beginning and end, and are linked in canon. Maximum formal intensity, the climax of the entire 24 bars, is reached in this section but finds the listener well prepared and informed about the form, because of section A; the first factor accounts for the increase in note-density, the second makes it possible. The final section B^2 leads, as we have seen, to a formal relaxation. The degree of alteration in note-values, intensities and modes of attack decreases rapidly (all parameters remain constant for two bars at a time), apart from a *cresc.-decr.* which seems immanent in the arching movements found here; but the note-density increases further to the coefficient 3. Thus the decreasing 'aural interest' is given an upward impetus. Stretti between the groups, and the resulting diads or triads, counteract the decrease in intensity, by transferring the 'density' to another dimension. This constant interchange is another essential feature of Zimmermann's 'Perspectives', as of post-Webernian music in general.

* * * * *

Some people may ask what happens to the composer's creative freedom, when musical organisation is so complete. Was he ever free, or only relatively so? Is not his freedom preserved by the very fact that he is himself the creator of the ordering organisation – penetrating to regions previously unilluminated, structurally ungoverned and therefore blindly self-willed? (It goes without saying that this is in no way an aesthetic value-judgement. We are concerned with states of historical consciousness.) Nor should anyone believe this kind of composition to be merely the working of a pre-set automatism. What is realised is one possibility, selected from countless ideal ones; almost any of its features could be different – with different results. But as it stands it is a completely self-contained reality; this is because of its severity and consistency, the compelling force of objectified individuality.

Further analysis of this composition would have to show the way formal sections of the 'strictness' described above alternate with those in which certain structural dimensions (never that of intervals) are left more or less free; further, the way multifarious

relationships are produced between these formal sections, articulating the whole extended work. It is in fact characteristic of Zimmermann's 'handwriting' that he is at times directly expressionistic, interpolating a kind of structural improvisation; that the structure's 'organisational breadth' oscillates (by intention, not by accident). This is so in the 16 bars immediately after the passage analysed – these we have already mentioned as approximating to a 'development', and they complete the first complex of the first 'movement'. (Two further major complexes follow.) There is no comparison between such varying formal organisation and, say, alternation between strict dodecaphony and free atonality, as also found in Zimmermann's work at an earlier period; for everything that is heard keeps the one common denominator, the proportioned ordering of note-material, the interval-constellation of the twelve-tone group-aggregate. In fact, only through objectifying the series, overcoming its conditioned and conditioning thematic function, 'reducing' intervals to phenomenal objects, could intervals again be given a specific expressiveness, according to their 'motivation'. This zone opened up by Webern, on the far side of Schönberg, is reached by Zimmermann in his *Perspectives*, and his individuality is settling down there. It is easy, if one wishes, to find a personal stylistic line running back to earlier scores by this composer. To cross the Rubicon cuts one off irrevocably from the past; but nobody does it without taking some of his past among his luggage.

BRUNO MADERNA

GIACOMO MANZONI

It does not take very long to get a bird's-eye-view of the present state of progressive music. In recent years a musical language has developed which is a more or less visible link between all young progressive composers, with specific demands and common principles; a language whose ideal requirements may to a great extent be regarded as generally valid. But if one looks more closely, one finds within this general 'linguistic' unity a deep multiplicity and variety of musical phenomena.

At first it was objected that this language constitutes cosmopolitanism, which can tell us nothing further about composers as individuals and as beings who are tied to their time and their country; and, to be quite honest, until very recently this objection was to some extent justified. Lately, however, the situation has altered; it has taken on a sharper profile, and whereas even a few years ago reservations could well have been made, today they seem gradually to disappear before the growing differentiation which is steadily penetrating everywhere. This process of differentiation is in itself not conscious, but is rather spontaneously noticed – one might say that it grows out of the matter in hand. For man, whether he be craftsman, technician or artist, is unthinkable outside his own immediate experience, which is to say that of his land and his culture.

In present-day music, too, this development is a direct result of the composer's individual experiences. This makes itself most clearly evident in Germany and France. From Debussy to Boulez on one hand, and from Schönberg and Webern to Stockhausen on the other, this process can be unmistakably followed.

But a glance at the situation in Italy reveals a quite different picture. We can not look back to a modern instrumental tradition, as in Germany and France. In the middle of the 18th century the continuity of Italian instrumental music was rudely interrupted in favour of opera, which from then on dominated Italian music unchallenged. In the 19th century the Italian public were hardly aware that string quartets or purely instrumental music existed at all. It was not till the beginning of our century that responsible musicians noticed these lacunæ in Italian musical culture; this was the time of Casella, Malipiero and Pizzetti. These composers made an important contribution, setting out to restore instrumental music to Italy. But Fascism soon suppressed this progressive attitude, and for twenty years Italy lived its musical life beyond the pale, away from essential musical phenomena. What remained was merely a colourless reflection of the achievements of the new instrumental music, and only with the return of freedom after the war did Italy awake to the current musical situation. Since then our young composers, free from prejudice, have kept in contact with the present state of music, and are now quite aware that the path of our national music leads through the great European music of the last decades. A start was made fifteen years ago by composers such as Dallapiccola and Petrassi, and today this is being carried further by our younger composers.

If in this context we now examine more closely the personality of Bruno Maderna, we must say above all that as a composer he strives to comply with the musical requirements of the listener and of hearing. This does not hamper the process of constant and progressive rationalisation of sound-material; musical language has certain universal effects, and awareness of this serves above all to guide the process of composition so that it is not to be regarded as an end in itself but is constantly directed at the listener's powers of perception. This at first appears to be a contradiction. If in handling his sound-material the composer complies wholly with the demands of his rational method, his music is unlikely to be amenable to straightforward listening – with an open mind, as it were. This would in fact be the case, if the composer were to ignore the process of listening. But his musical 'feeling' is constantly active, more than anything else, and in some cases it opposes the rational layout of the whole. This does not, however, mean that the methods used in composition lose any validity. They remain, and such deviation from the original plan can be taken as one of the possible aleatoric phenomena in composition. Thus the layout itself is not renounced – deviations are absorbed so that in fact they help to enrich the scheme. Here we will devote our attention to Maderna's *Serenade for 11 Instruments* (1954, revised 1957) and then particularly to the *String Quartet in two Tempi* (1955). Although both works were written within a phase of development lasting only two years, they give a complete picture of Maderna's way of composing.

The Serenata still shows signs of an attitude bound to tradition. From a purely formal point of view the composition is divided up so as to remind one immediately of the classical A-B-A′ form. A's main function is to prepare the listener for the second section, which introduces a rhythmic movement typical of a serenade. With its frequent note-repetitions this rhythm recalls Schönberg's Serenade, but also, and above all, the spirit of the Italian 'Serenata', where so important a role is played by figures that are somehow typical of the mandoline. This reference to the mandoline, to some extent as an acoustical category, dominates the whole piece, if only as a non-committal and almost objectified allusion. Although the Serenata is still tied to an ideal model, many of its details are evidence of those elements most characteristic of the composer of the String Quartet. The first section, in particular, almost anticipates the atmosphere of the first movement of the Quartet. But as far as the composer's development is concerned, the decisive feature of the Quartet is that these elements, already present in the Serenata, are no longer exploited in a 'preparatory' way, as a mere beginning, but as a self-sufficient means of composition, free of all ties with tradition. One could therefore say that in the Quartet a conscious means of expression has developed out of what in the Serenade is only sensed indefinitely.

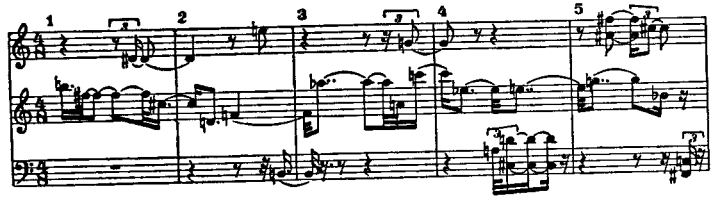
The String Quartet consists of two movements, of which the second mirrors the first. The first movement, with its unusual differentiations of sound and timbre, is clearly a departure from the usual way of composing for quartet. Only the first six bars still recall a 'classical' quartet, with a kind of Webernian texture; they serve to emphasise still more clearly the structural otherness of what follows. For, in the region here disclosed, no particular significance any longer attaches to notes as such – defined by their pitch and intervals. The peculiar quality typical of the piece is revealed only by the extreme differentiation of modes of attack, i.e., of tone-production (*vibrato*, *al tallone*, *etc.*). On the other hand the second movement, whose expressive character is quite different, has a much more lively rhythmic stamp, mainly because long note-values from the first move-

ment are often 'interpreted' by means of new instrumental colours and rhythmic distributions (for instance the c and d in bars 22-23, *et seq.*, which correspond to the c and d of the second violin in bars 163-162 of the first movement; or the c of the second violin, bar 48 *et seq.*, which corresponds to that in bar 144 *et seq.*; the marking '*battuto con le dita sul coperchio*' (drummed with the fingers on the casing) in bar 73 *et seq.*, which is merely an 'interpretation' of the a in bar 123 *et seq.* of the 1st movement, breaking this note down into its physical components – vibrations, etc.).

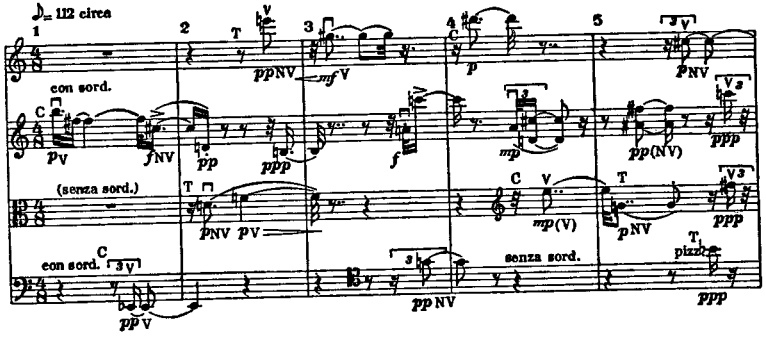
After the reserve of material in the first movement has been totally exhausted, the second gives an impression of looking at the same object from another point of view. Here the composer retraces his steps back to the beginning, now devoting his attention only to certain objects and ignoring others. He emphasises some and lets others fade into the background, but this does not mean that they no longer exist. To put it differently; here we are dealing with a process closely related to the Freudian 'automatism of the unconscious'. Thus one can easily see that the beginning of the second movement of the Quartet is a mirroring of the first, but the dynamics, pitches and timbres are quite different. The high g *pppp dim.* in the first violin at bar 190 of the first movement is matched by the g *ff* in the first bar of the second; the d sharp *ppp non vibrato* in bars 190-199 by the d sharp *fff al tallone* in the first violin, four times accented *sff* by the second violin; the b, c sharp, a *pppp* in bar 190 are matched by a return of the same notes in bar 1, but at different pitch and with *ff* dynamics. Further analysis of the course of the second movement soon shows that one is indeed dealing with a 'literal' mirror of the first, but that at the same time the result is a wholly new compositional picture. In accordance with the principle of free repetition notes are often omitted from the second movement when they could disturb or hinder the flow of the movement – they are simply replaced by rests. Thus, for example, in bar 3 of the second movement, which corresponds to bars 187-6 of the first, the notes d, f, e flat, g flat, e flat and b flat are missing, and in bar 4 g: one can follow this process throughout the movement. Apart from this, the second movement is two quavers longer than the first, although the composer consistently replaces omitted notes by rests. Such displacement occurs in the second movement mainly in the groups of bars 12-16, 146-7 and 190-9, where the succession of note-values is ignored. Thus here the composer allows his 'feeling' to come into play, and in the first and third cases (12-16, 190-9) it adds a long rest, though with only a slight deviation from the values of the first movement. But obviously the second movement, too, is strictly governed by the structural logic and layout of the whole piece – as has been said, it is only a free interpretation of the first. By its nature this layout allows certain deviations within its limits, without damage to itself. This is what we have referred to above as an aleatoric possibility. The quartet is not affected as a whole by possible deviations from rational procedure in its compositional structure; this demonstrates particularly well the reliability of the method.

But we should like to point out something else. Analysis shows that in sketches for the String Quartet the preliminary groups are not essentially different from the final result contained in the score. Dynamics and registers have been distributed freely, that is all; note-values and rests remain the same as in the preliminary groups. We can recognise in this another essential trait in Maderna's compositional procedure. Here is an example, from which one can observe the free distribution of dynamics and registers as compared with the way the preliminary group is laid out.

Preliminary groups



Score (final version)



C = String (normale). T = On the finger-board. V = Vibrato. NV = Non Vibrato.

After the overall course of the piece has been settled, the composer carries out no further essential alterations. For example, he will have none of a process beloved of other composers, the mutual permutation of different structures. The rhythmic working-out of the piece is based on distribution of the material in groups of triplets, quintuplets and septuplets (in addition to the normal binary divisions of note-values). But this is not only for the sake of the requisite ordering of the material; it is (mainly) to further the composer's expressive aims. If we look at bar 90 of the second movement, where three different note-values are superimposed, or other similar bars where note-values are very various, the impression we have, as listeners, is of something indistinct, the independent movement of autonomous time-strata, and finally a feeling of instability which reflects the layout of the whole work. This is also part of the composer's 'aesthetic' intentions. If, when listening, we were to perceive in all these juxtapositions of different values their 'rational' basis and not a synthesis, an expression of the whole, it would be a hindrance rather than an aid to correct understanding of the piece.

In the whole of Bruno Maderna's creative output there is a discernible logical development. From the Concerto for Two Pianos, written 12 years ago; the Studies for Kafka's 'Trial' (1949), their formally indistinct and diffuse sound still obviously under the influence of the expressionistic experience; the Flute Concerto (1954), which still shows a strong Schönbergian influence, to the Serenata and Quartet, one can follow a line of development which characterises the composer's present situation. The new way of handling tonal material is first hinted at by certain features of the Serenata. Now, in the Quartet, we find the result of total structural organisation. One critic has made the

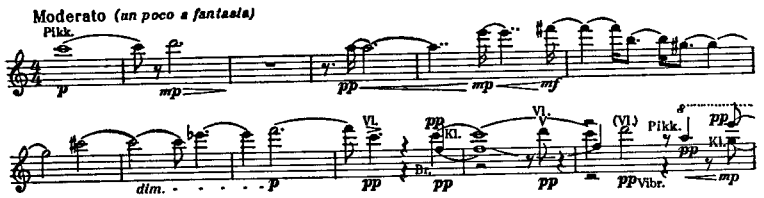
cheap criticism that the Quartet is a 'mere compendium of every unusual string effect'. If there is ground for objection, it does not lie in such superficial features – to point out these, after all, tells us nothing about the composition's deeper nature. It seems to us that the composer is after something much more deep-seated, that he is attempting to present music quasi- 'spatially' in the first movement, while the second movement's compelling, plastic figures partially eradicate this spatial quality from the work's experiential time. The differentiation of timbre in the first movement serves only to enliven and shade all parts of the picture. The composer draws from a rich store of dynamically differentiated colours, as a painter from his palette. Now a *fortissimo* throws a sudden, unexpected light on some peculiarity of rhythmic movement, now a melodic germ gradually fades away in the undifferentiation of a *ppp* (we refer for instance to the figures in bars 150 *et seq.*, 172 *et seq.* and the bar sequences 83-6, 174-77 respectively).

To show this in more detail, observation of the groups from bars 7 to 64, 81 to 98, 108 to 128 is particularly informative. Here virtually nothing 'happens' in the accepted sense, and such passages must be appreciated quasi-spatially in order to justify the whole way the first movement is written. It could be objected that this static conception of music, which relies mainly on juxtaposition of individual spatial moments, ignores or at least relegates to the background one essential element of music as an art-form developing through time: recognisable allusion to what has already happened; in other words it sacrifices the dimensions of similarity, in fact of memory. If the first movement is characterised by its spatial and almost 'pictorial' layout, the second shows a revaluation of the elements. Not only is there strong rhythmic life here (one need think only of the frequent note-repetitions in equal note-values, which unify this movement in an almost traditional way), but the last section, from bar 141 to the end, is also a direct reference to the element in the first movement that we have called 'spatial'. If the first movement made us speak of a 'sacrifice of memory', here this dimension of recollection comes into play again in an unexpected way. The arch formed by the whole piece is thus completed with absolute logic. One must regard the Quartet's two movements not as if they were two self-contained monads, but as an inseparable unity, welded in form and expression.

One should not forget that Maderna is one of the few composers who has concerned himself with electronic music. In the last few years he has been able to realise a number of pieces with electronic resources at the Studio di Fonologia of the Italian Radio in Milan. Neither the composer's technical resources nor his working procedure can be described here. He has gone beyond mere theoretical speculation, and uses electronic resources to look into the possibility of opening up a real and self-contained world of sound. Maderna's pieces are characterised – for example the 'Sequenze e Strutture' – by a specific pleasure in sound, or – as in 'Notturno', Maderna's last electronic composition but one – by lyrical tendencies which seem to go beyond the 'pure' electronic medium as such. But the world organised in the composer's electronic compositions must be regarded as different from that of his instrumental music. He does not aim to replace instrumental music by electronic, he is concerned with exploring the new 'instrumental' electronic form, to find what it can do and to arrive at a language appropriate to it. Maderna's work in this field is severely methodical; it aims only at music, and also refrains from absorbing non-electronic resources, This tendency is clearest in his latest electronic composition 'Syntaxis'; here the composer appears to

have laid the foundations of a genuinely electronic way of building form, and one may well expect that in the next few years this line of development will produce important and decisive results in the field of electronic music.

Lastly, let us inquire what is specifically Italian about Maderna's music. Is it Italian or cosmopolitan? Today, without a doubt, musical cosmopolitanism, in the disparaging sense of the word, still exists. Nobody who has been at Darmstadt will be able to deny it. The people concerned believe that they have finally found a formula for 'making music'. They write music as they would approach a mathematical problem or a geometrical design; they use other people's discoveries so that they may think themselves composers. Clearly 'cosmopolitanism' (as we understand it) is rife among these young note-spinners. But they should not be confused with the composers who are genuinely devoted to working out an individual musical language with a conscious attitude. Thus Maderna, being an Italian, is anxious that his compositions, too, shall be accepted as representative of Italian culture and musical sensibility. This element can often be discovered in the compositions discussed. Take, for example, the beginning of the Serenata, with its almost 'cantabile' line, of a kind hardly to be found in the work of young composers from other countries.



Or take the differentiation of instrumental colour which stands out particularly in the Quartet; this is used neither impressionistically nor psychologically, but always with a view to a directly expressive quality inherent in the music. Characteristically, in the Quartet the composer has left himself free to use timbre according to his musical intuition, not as a structural element. Even the structuring of material is not a repudiation of the whole work's lyrical layout; it is not hypostatised as such. Thus the final aim is a synthesis of expression and content, which can be regarded as a typically Italian hallmark. Not a genre-picture, not an explosive 'outcry', but a tendency to unite all the elements in a flow that is compelling and at the same time self-contained.

If Maderna's music still contains no hint of the epic, of big, 'breathing' form, one may hope that in the near future his very material and his treatment of it will give rise to this, revivifying it by a thorough overhaul. Maderna's works already show that he aims at a generally intelligible musical language, which will finally renounce the 'ivory tower', to be 'music' in the universal and fullest sense of the word. We are approaching the time when our music will free itself from the conventional formulae of bogus 'nationalism', to become a conscious and true expression of Italian feeling.

* * * * *

(The above essay was written in 1957 for the German edition of *Die Reihe* IV. Since then Maderna has composed the following works:

An electronic piece *Continuum* (1958) in which, as in his previous pieces of the kind, he employs purely electronic resources with no attempt at 'psychologising'. This piece may be said to be one of the best so far designed for the electronic medium.

Musica su due dimensioni (1958) in which a flute is freely combined with a supporting electronic tape. This idea, as we know, has since been taken up by other composers and has led to thoroughly convincing results.

Finally the *Piano Concerto* in one movement, which had its first performance in Darmstadt in August 1959, conducted by the composer. This is probably the climax of Maderna's output so far. Written for David Tudor, who gave the first performance, it uses certain resources first introduced into piano music by John Cage; the piano is regarded partly as a source of noise, but Maderna's procedure differs in substance from that of Cage, since Maderna does not use 'noise' as an end in itself but builds it into a work conceived strictly musically. Thus in this concerto noise is in fact used as a 'musical' resource (it particularly calls to mind certain works by Varèse), and thus for the first time justified by an approach which does not try to deny the heritage of the European tradition.

Here it is out of the question to discuss the work's particular qualities, since this would mean opening a new chapter about Bruno Maderna. Suffice it to say that in view of the way this work raises anew, in the music of the younger generation, the problem of the solo instrument and of the dialectic between the individual and the orchestra, it must be regarded as a landmark in recent music, opening up new possibilities of development.)

KARLHEINZ STOCKHAUSEN

DIETER SCHNEBEL

Time

I

A composer's stature becomes apparent in his ability to define the historical situation – which is to say that by getting to grips with it he destroys illusions about it. For the truth about it lies in negating everything that is obsolete. This used to happen through a break-out from historical continuity – the presentation of works as if divorced from any historical context: but nowadays organic history has long since disappeared, so history is de-masked in other ways than by demonstrating its discontinuity. One has to formulate the moments in which alone history does still manifest itself. But this makes all simple development meaningless; categories such as tradition, style, 'life-work' – in fact all the things representable by apparently logical processes – have capitulated to mediocrity, and the latter makes easier than ever the task of recognising at once where history has failed to make its meaning clear by localising it.

But the decay of historical continuity has a further corollary. Events are no longer simply equivalent to their genesis, the gradient from past to present – they appear disconnectedly, as moments containing not only the past but also the future. Future events pervade the present, the future is pervaded by what is in a real sense past, and time shoots abruptly together when the intentions of form bring past and future to fulfilment.

II

In examining Stockhausen's works one becomes vividly aware of this conception of the historical situation, and its extension to take in musical time (in fact time in general). In view of what was said above, this is itself enough to tell us everything about these works' stature. The conception mentioned is the explanation of Stockhausen's output; it is deduced from it, and explains the remarkable discontinuity of his work. Each complex of works, each work, in fact each part of a work and each event therein is the fixing of a moment. Thus not only the *Kontra-Punkte* but all his other works, too, are 'Op. 1'. With each of these works it is as if Stockhausen had only then begun to compose. Each work is a new effort to formulate the historical moment. Consequently, to try to understand a particular work one is not in the least obliged to know its predecessors. Listening to the Piano Pieces, one forgets all about the *Kontra-Punkte*; similarly when listening to the *Zeitmasse* one forgets the Piano Pieces. And some of these works – e.g., the first or fifth piano piece – begin as if they were opening an epoch, in the face of which all existing composition seems over and done with.

III

The method of composition used in these works is what distinguishes them so powerfully from all others that one is forced to concentrate on them. Each group of works and

each work has a quite special method, because for each work there is a specific, suitable selection of elements and a specific, suitable course for them to follow. The method of composition is determined, then, by construction, i.e., by the way the moment takes shape, for Stockhausen always starts by imagining a particular and unique whole whose structure affects the details as much as the all-embracing unity. Composition thus becomes disposition. But a part of this is to mark out the 'region' within which the process of composition takes place. The true process of composition, the course of the various element-configurations, then makes its appearance within the region thus limited and articulated. The individual works' regions, within which they play, are something like this:

KONTRA-PUNKTE

Limitation and articulation of the time-space:

Micro-region: fundamental phases of the tempered scale within the compass of the piano.
Macro-region: approximately tempered scale of durations from (quaver = 120) semiquaver to dotted long.
Six intensities from *ppp* — *f* (*sfz*), with transitions.

Limitation and articulation of the time-flow:

Micro-region: six different sound-rhythms; Flute-Bassoon, Clarinet-Bass Clarinet, Trumpet-Trombone, Piano, Harp, Violin-Cello.

Macro-region: $\frac{3}{8}$-pulsation in seven different tempi (quaver 120, 126, 136, 152, 168, 184, 200).

(These seven tempi, which in fact represent frequencies, correspond roughly to the seven frequencies with which the piece begins. Transposed so as all to come within one octave these would be: c sharp 274, d 290, e flat 307, e 325·9, f sharp 365·8, g 387·5, a 435.)

PIANO PIECES I-IV

Time-space

Micro-region: fundamental phases on the piano. (Selection varies from piece to piece.)
Macro-region: few fundamental phases, which manifest themselves as bars. Apart from this a multiplicity of individual values (like overtones), from to 𝅝. (harmonic and sub-harmonic time-scales). Here again the selection varies with each piece.
Eight intensities from *fff* — *ppp*, also a different selection in each piece (I: *fff–pp;* II: *ff–ppp, ppp* only once at the end; III: *p–ff*, no *mp*, and *ff* only once at the end; IV: *pp–fff*, no *mp*.)

Time-flow

Micro-region: only one sound-rhythm, that of the piano.
Macro-region: a succession of sound-rhythm complexes differentiated in many ways. A tempo determined by action (condition: smallest note-value to be played as fast as possible), and related to the fundamental phases of the macro-region, joining these together – thus no consistent pulsation.

PIANO PIECES V *et seq.*

Time-space

Micro-region: fundamental phases of the tempered scale.
Macro-region: a large number of values in the normal time-duration scale from demisemiquaver to long (register decided by the tempo). Also action-durations; short in V, VI, VIII, longer in VII.
Ten intensities from *ppp–fff*, highly differentiated by *cresc.* and *decr.* signs and indications of touch. (Here too the selection varies from piece to piece.)

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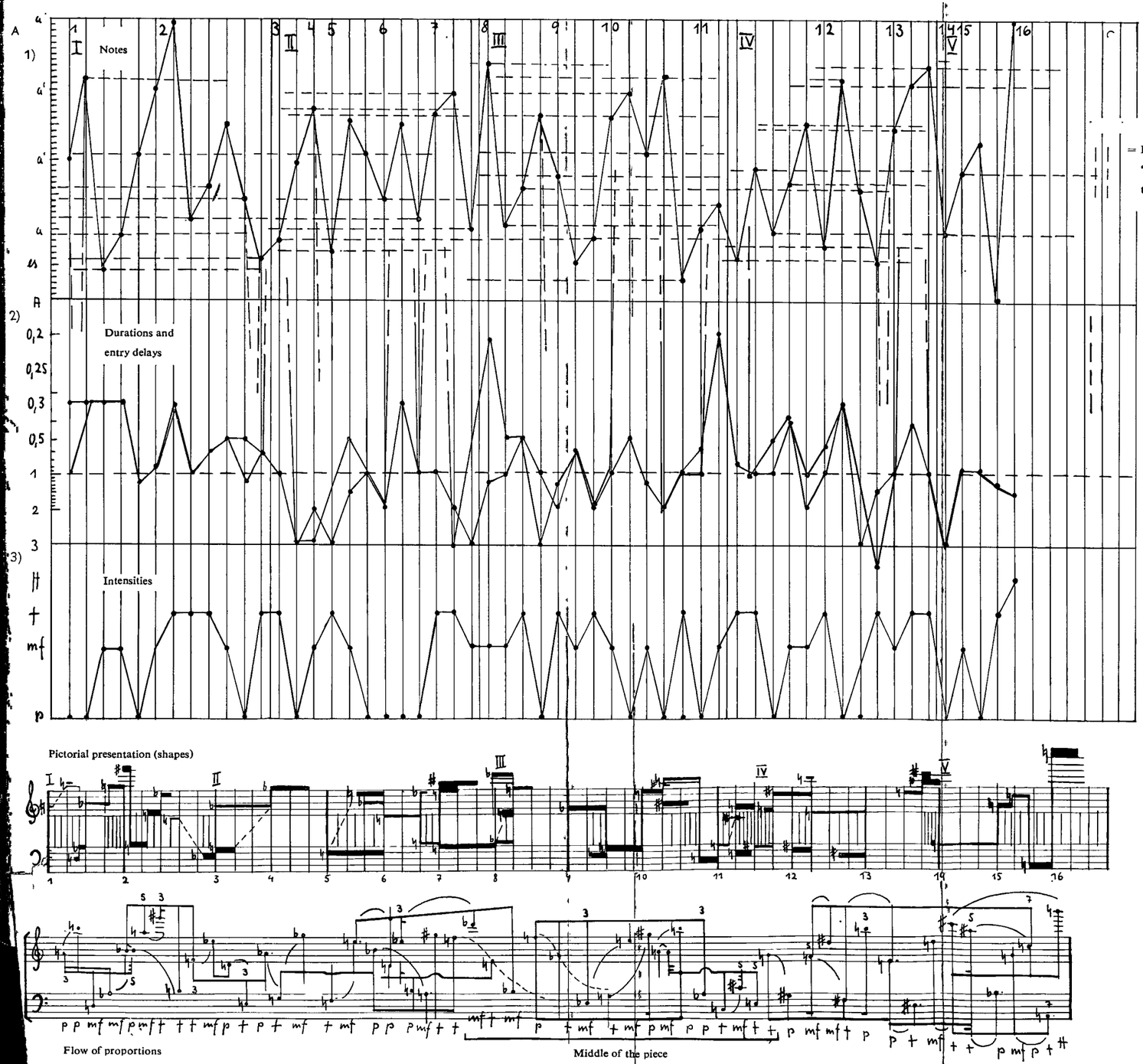


Time-flow

Micro-region: differentiated sound-rhythms of the piano (fading in or out of overtones through special modes of attack and pedal indications).

Macro-region: unarticulated pulsations determined by fixed, variable or dialectically altering tempi (VI). Into this pulsation, time-fields are introduced – time-structures with indistinct borders and determined by actions.

ZEITMASSE

Time-space

Micro-region: fundamental phases of the tempered scale from the lowest notes of the bassoon to the highest of the flute.

Macro-region: many simple fundamental phases (bars or articulation-units), many single values derived from the normal scale of durations by various subdivisions (chromatic, harmonic and sub-harmonic time-scales). Also a considerable number of action-durations. (All the types of time-duration developed so far by Stockhausen are used.)

Intensities: continuous scale from *ff–pppp*.

Time-flow

Micro-region: sound rhythms of five different instruments (flute, oboe, cor anglais, clarinet, bassoon), either in succession, merging into one another or overlapping (indication that the instrumentalists are to play certain notes 'to' each other).

Macro-region: articulated and unarticulated pulsations in fixed, alterable or action-determined tempi, successive or overlapping.

These ready-made 'regions', within which the pieces take shape, owe their existence to the fact that the available material is also ready-made – instruments that offer only a particular number of notes and timbres, or performers whose technical abilities have limits. In electronic music such restrictions are removed, and it therefore lacks this 'prepared' background, whose gradations largely determine construction at the outset. Except for a few restrictions, electronic music has unlimited material at its disposal. To construct is to make a selection from this, at the same time settling how what is selected is to hang together. But then what is selected amounts to the 'region' of the work.

In *Study I* Stockhausen selects a number of sinus-tones with their parameters, within which the proportions of a many-note sound are portrayed in constantly new ways. The selection of these elements is simultaneously the temperament of the piece and – its time-space. Its time-flow is, however, fixed by the work-idea (see below). Much the same is true of *Study II*, only here the choice of elements produces note-mixtures; the course of the piece is different, in accordance with its different time-relationships. The *Song of the Youths* uses eleven different elements (this time not only sinus-tones) – and their parameters – a specific store of durations, pitches, intensities. The possibilities open to the time-flow are correspondingly varied, particularly as here it finds the spatial dimension opened up for it.

In electronic music the selected elements and their course are not picked from any articulated background, whether one already given (e.g., a store of instrumental notes), or one that has first to be produced (metres and tempi). This background, the region of the work, is produced only through the configuration of the elements. 'The work's structure and the material's structure are one.' Thus not only the work but its material is unique: selection and determination of material produces one work, and no more.

It is different with instrumental music. Its material is limited and also structured in advance. So is the course of this material. Regions are given or worked-out. But within

them the possibilities are unlimited; there is 'no foreseeable end' to developments. The realms opened by the *Kontra-Punkte* or the first piano piece permit many different constructions. This explains the need for series of works – they are not intended to exploit all these possibilities, but to circumscribe them. The *Piano Pieces* are examples of possibilities realised. The epochal quality of some of the pieces is manifest not only in the terseness of their construction but in just this fact, that such random samples of development encompass more evolution than a whole late work even in the days of Webern.

Stockhausen's electronic music engages in an effort to make material that is limitless yield the limited, terse unity of a work. His instrumental music seeks to explode predetermined limits. In each case the result is a unique construction, the configuration of the moment.

IV

The region of an instrumental work makes clear what was historically possible at the moment of its composition, what the composer expected of instruments and performers, the degree of emancipation he prescribed for performers – and instruments. But in electronic music, since here the composer is in a sense alone with himself, one sees what he was able to imagine at the time he wrote the work. Still, the individual examples of both sorts of music show what the historical moment actually produced. From the total of works one can then construe a development, within which the tendency of history is apparent, however many twists and turns it may have.

So what became possible in each of these works? What development is there, even in the shaping of their regions? In *Kontra-Punkte* the individual parameters have a chromatic, scalar structure that permits them to be moulded equally independently. The fundamental phases in micro-, as in macro-region, intensities, timbres, speeds of pulsation – each of these can be formed on its own. This implies that it is possible for one and the same process to be depicted within the limits of each of these areas. *Piano Pieces I-IV* open up possibilities of contrast between the micro-region sound-rhythms, which are still fixed and constant (the single tone-colour of the piano), and macro-region sound-rhythms that are highly differentiated. There is a similar dialectic between predetermined fundamental phases in the micro-region and indistinct ones (determined by the tempo of actions) in the macro-region. In short; monochrome, fixed micro-region and fluctuating, 'polychrome' macro-region are played off against each other. The succeeding piano pieces (*V-VIII*) make it possible to realise this dialectic in succession, not (as in *I-IV*) merely in static simultaneity. The fundamental phases of the macro-region can be fixed either by a settled speed of transportation (fixed durations), by a degree of variation in such speeds (approximately fixed durations) or through action-tempi (fluctuating durations fixed within a particular region). Whereas in piano pieces I-IV the entire macro-region flickered evenly, their successors make it possible to alternate distinct and more or less blurred 'time-pictures'. To extend in this way the macro-region of fundamental phases means a first weakening of the distinction between the latter and the phases of 'partial tones'; where there are so many phases it is meaningless to divide them into fundamental phases and phases of sound-rhythm. A graduated scale of varied sound-rhythm, from 'note' to 'coloured noise', replaces the

previous abrupt juxtaposition of few fundamental phases and richly varied sound-rhythms (as if a few notes constantly took on new colour). This differentiation is continued in the micro-region, the sound-rhythm being more vividly reticulated by means of indications for touch and pedalling. In *Zeitmasse* this development continues. The transition between highly varied sound-rhythms, which occurred successively in the *Piano Pieces V-VIII*, now becomes polyphonic. There is frequent overlapping between the various flows of sound-rhythm in the macro-region. This is also effective in the micro-region; the sound-rhythms of the individual instruments come in quick succession or are superimposed. But since the pitch changes, only the proportions of the sound-rhythms remain constant, not their phases, so that many different combinations are possible.

The development from *Kontra-Punkte* to *Zeitmasse* shows an extension of the macro-time region. In *Kontra-Punkte* all regions were still 'shaded' similarly. In the succeeding works, the macro-region is ever more subtly structured, but what is achieved always reverts at once to the micro-region. This poses a problem – the consistency of time. For if duration becomes phase, and metre becomes pulsation – i.e., if the temporal events of the macro-region appear as a combination of vibration-processes – then what principle is to govern the succession of these enormously swollen 'notes'? If one uses existing methods – direct succession of 'notes', or the regulation of their flow through a higher-order metre – one merely produces yet another vibration-process. Stockhausen has found his principle in *action-time*, which has pervaded his instrumental music more and more since the piano pieces. Here is time, literally, at one's fingers' ends. The performer has to be wide awake; he has to grasp the time appropriate at the moment of action. Here a wide, unexplored territory is opened. Stockhausen has been moving toward it ever since in piano pieces I-IV he simply juxtaposed heterogeneous groups and thus slashed the flow of time; since in the succeeding piano pieces he again dissolved temporal continuity (which had been re-established) by fading-in time-fields; and since in *Zeitmasse* he communicated the consistency of time, at least in part, through actions (those of the performers). In electronic music the situation was different *a priori*. It lacked the mechanical time-flow implying that time is a stream. Here the passage of time can be determined only statistically – time as the effect of juxtaposed quanta. Dissociated time is a precondition, whereas instrumental music is only just beginning to approach it. Time is a summation of intrinsically existent parts – but it has no gaps. (In the present context these could not be closed by any time that was spontaneously grasped.) Thus the vital thing is that real time is produced by the shooting together of the effect of quanta, their density, their direction and the speed that becomes evident in them. The elements are then 'raised from their insignificance to receive a specific musical meaning'.

This latter, however, is transmitted by overall coherence, the 'work-idea', construction. Construction gives meaning to the statistical structures of electronic music, as to the irrational actions of instrumental music. But in terms of time, construction, as the work-idea that infiltrates the macro- and micro-structures throughout the work, is the present; it is ever-present time. Such a work-idea draws every event into the present, and makes the present into concentrated time. 'Constant presence of nuclear proportions' (which in this case corresponds to the work-idea) 'means: every moment needs the inspiration that produces shapes. Concentration is necessary, in order to keep at the

centre of the proportioning nucleus, and not to fall out'. But time, thus compressed into the present, is the moment.

V

Now: what, in concrete terms, is a work-idea, construction? It is a regulator, regulating the flow of the elements and at the same time determining their selection – their shape. Thus in a sense it exists before, behind and within every piece. Stockhausen has described the proposition: 'Different shapes in the same all-penetrating light.' The presence of the work-idea is such a light.

We shall take the third piano piece as an example of this infiltration of a piece by the work-idea, and of the identity between the two. In this case, the work-idea might be described in some such way: in the course of the piece, which uses five different, closely-related time-structures, intended symmetry is to become apparent. Thus, on one hand, the piece is grouped around a centre, on the other it will evince a directed flow. Such dialectic presupposes that the formal course be ambiguous, and in order to achieve this, without deviating from close relationships in the time-structure, the piece receives a homogeneous structural course. Since the latter has only a small degree of variation, brevity is essential. The store of material selected comes from a fairly narrow region of the parameters – medium and medium-high values:

Notes, A – b ′ ′ ′; Durations, 0·2 quavers – 3 quavers; Intensities, *p* – *ff*. Thus in each case the region is four octaves wide.

The five different time-structures first show themselves indistinctly in a succession of various degrees of density.

I Bars 1–2[1] (1st group-aggregate): 12 notes lasting 9 quavers, density 1·3.
II Bars 3–7 (2nd group-aggregate): 12 notes lasting 15 quavers, density 0·8.
III Bars 8–11, 2nd quaver (3rd group aggregate): 16 notes lasting 14 quavers, density 1·14.
IV Bars 11 (3rd quaver)–13 (4th group-aggregate): 10 notes lasting 10 quavers, density 1·0
V Bars 14–17 (5th group-aggregate): 5 notes lasting 9 quavers, density 0·5.

In this succession of degrees of density – 1·3, 0·8, 1·14, 1·0, 0·5 – the extreme values are at the beginning and end. The straightforward progression from highest to lowest value is interrupted in the middle by a symmetrical formation. Thus here the desired symmetry already prevails. The regions of the various parameters are structured according to variants of this succession. (In reading what follows, diagrams A and B should be consulted. The limits of the group-aggregates are ambiguous because of overlapping.)

Group-Aggregate	Notes		Durations[2]		Intensities	
	Selection	Distribution	Selection	Distribution	Sel.	Distr.
I	Notes within a region of 3·5 octaves	Fairly even distribution of the notes – density decreases toward the top (elucidation).	Durations within a region from the 'middle' upwards.	Mainly high durations, a few low 'vertices'	*4f* *4mf* *4 p*	contrasts of *p–mf* *f–mf* rising to *f*
II	2·25 octaves	Notes arranged in three register-bands – at the borders and in the middle. Elucidation toward the bottom.	Durations within the whole available region.	Mainly durations in the middle lower region. Few high vertices.	*4f* *3mf* *5p*	Three complexes: *mf* *mf→p→mf* *f*
III	3·1 octaves	Notes distributed fairly evenly, grouped in high and low complexes, high density.	Durations within a middle region.	Mainly medium durations	*6f* *6mf* *4 p*	constant alteration and mingling
IV	2·75 octaves	Notes arranged in four register-bands. Elucidation toward the top.	Durations within the entire available region.	Mainly durations within the middle and upper region. Few low vertices.	*4f* *3mf* *3p*	complexes *p–mf* *p–f* *mf–f*
V	4·1 octaves	Average even distribution of notes. Elucidation toward the bottom. Low density.	Durations within a low region.	Medium durations, one low vertex.	*1ff* *1mf* *2p*	*f* Contrast of *mf–p* and *f–ff* (rising to *ff*)

[1] This marking-off is made indistinct by much overlapping.

[2] The low durations are used less than the high ones, since they are not only phases but mostly also form-quanta.

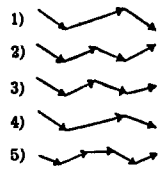
Thus in the structured regions the following successions appear:

1. First five different degrees of density – in a sense 5 frequencies –
2. five different widths for the region of notes – five note-flocks of varying width –
3. five inner structures for these note-flocks, which have the effect of a higher-order density structuring (the three register-bands in II, or the four in IV, at the same time connote a higher-order density-structure of the note-space). Quasi five degrees of lucidity in these note flocks –
4. five different concentrations of values in the region of durations – as it were, five different concentrations of height in note-flocks that remain the same width –
5. five different combinations of intensities – five 'space-sounds'.

In all parameters there are clear correspondences between I and V, and II and IV (see the diagrams). Symmetry is emphasised.

At the same time the 5 different structures are proportioned. But this gives them direction, indeed development. The proportion-succession is now specific for each of the parameters mentioned above; moreover their directions overlap. The proportional fields of the parameters still correspond to each other, since compass and articulation of

each overall region correspond. But within, the articulating units are linked in various ways. Thus it is a matter of diverse internal structures of analogously articulated regions.



However, such articulations and proportions remain approximate. Definite values result only from the specific shaping of the groups. The five group-aggregates in the piece contain groups of 2 notes (I), 3 (II), 4 (III), 5 (IV) and 1 (V). The last group shows five 1-note groups. Thus the tendency of the piece is to reach a group of 5 notes as its formal unit; at the same time there is symmetry, even if it is rather eccentric.

Intervals	14 (33)	6 (14)	11 (11)	33 (6)	10 (13)	10
Directions	↗ ↘	↗ ↗	↗ ↗	↘ ↗	↗ ↘	↘
Duration proportion	1:1 (1:1)	1:1 (2:5)	3:2	1:3 (15:4)	4:3 (2:3)	3:4 (1:1)
Intensities	p p	mf mf pf		f f	f mf p f	
Lengths	1,3	0,6	2	1,3	1,16	2,5
Shape						

II

10 (25) ↘13 (3)	6 (1) 17	11 (5) 3	3 20	8 (11) 13 6	10 (7) 11 4
↓↗ ↘	↗↘ ↘	↘ ↗	↕	↘↗ ↘	↘↗ ↗
1:2:3	6:3:2	6:3:1	1:2:3	1:3:3:7	2:3:6:6
mf p f	f mf p	p p p	f f mf	mf mf f p	f mf f mf
6	3	3	3	4 (2)	5

III

IV

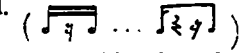
3 10 20 (9)	6 4 5	8 10 9 2 (3)	3 (29) 8 10 13
↕↘ ↗	↘↑	↗↘↗↘	↘↗ ↘
2:4:5:8	3:10:12:15	5:9:15:15:30	6:10:10:15:30
p p mf f	p:mf f f	p mf mf f p	p f mf f f
3	2	2	7

V

11		5	27		50	
↗	↗		↘	↗		
4	:	4	: 6	· 7	:	14
p	mf		p	f		ff

Characteristics of these group-aggregates:

I. Monodic

Note-intervals derived from 1, 2, 3, 6, mainly emphasised by a double upward direction. Symmetry produced by a fall at the end, however. Simple *duration* intervals ('as far as the 4th partial'), developing from simple to more complex. Symmetry emphasised by correspondence at beginning and end. 

Intensities: at first, groups of two equal intensities, then of two different ones. Rising to *f* and subsiding.

Thus symmetry. I.e., a structure that pulls forward and yet is self-sufficient.

II. One to three parts

Notes: mainly interval 1, linked with 1, 3, 6, direction rising and falling regularly.

Shapes: development from simultaneous entry of two notes to that of three notes. Group I – two notes entering at once, one linked to the note that is dying away. Group 2 – three notes at once, but entering successively. Group 3 – two simultaneously entering notes linked to the note that is dying away. Group 4 – three notes struck simultaneously. Shapes that narrow until the 3rd group, then broaden. Within the shapes, the 'central' note comes to lie nearer the extreme registers.

Durations: development of complicated intervals (as far as the '6th partial' in the third group). Symmetry through correspondence of 1st and 4th groups.

Intensities: at first all intensities evenly (1st, 2nd groups): 3rd group, region of *p*; 4th group, *f*-region emphasised ('eccentric symmetry').

Directed, but self-contained time structure.

III. One to three parts

Notes: mainly interval 3 linked with 1, 2, 4. 1st group: upward direction emphasised, 3rd group downward direction. 2nd and 4th, 'balance' of directions.

Shapes: new combinations of the formations ⌜⌞ ⌟⌜ ⌝⌜ ⌜⌜ developed in II (contracted symmetrical succession: a′ b′ a″ b′ b″ a′ b″ a″.
Internal shapes of the groups:
1, Even note-distribution. 2, Condensation toward the bottom. 3, Condensation toward the top. 4, Even note-distribution.
Compass:
1, 2, approximately equal compass, high-low contrast. 3, greatest compass, displaced downward as compared to the total compass of 1 and 2. 4, smallest compass, localised within the lower region of group 3.
Clear symmetry in the shaping of the notes (middle of the piece), movement toward the lower region.

Durations: growing complication of intervals (to '15th partial'). Groups 1 and 4 grouped around quaver value, 2 and 3 around crotchet value.

Intensities: Gr. 1, 4, average *mf*; Gr. 2, *f* emphasised; Gr. 3, *p* emphasised.

Symmetrical time-structure, whose note-flow is, however, strongly directed.

IV. One to three parts

Notes: interval 4 dominates; apart from this, intervals 1, 2, 3, 5, 6. Upward direction emphasised.

Shapes: combinations of the figure ⌟⌜ or ⌟⌜ developed in III. Strongly directed succession, since no shapes are reversed. Compass of Gr. 2 extended upward and downward compared with that of Gr. 1. Gr. 1, condensation downward, Gr. 2, condensation upward.

Durations: further complication of the intervals. In the outer sections again grouped around quavers, in the inner sections around crotchets or dotted crotchets.

Intensities: Gr. 1, *p* emphasised. Gr. 2, *f* emphasised, tending toward *f*.

Time-structure not very symmetrical, strongly directed.

V. Monodic

Notes: Mean interval 5, also 1, 2, 3. Upward direction emphasised.

Durations: symmetrical layout, less complex intervals than before.

Intensities rising to *ff*.

Strongly directed time-structure, pulling onward to Group 5.

The piece thus shows five different time-structures, each of which has its own characteristics – a particular number of notes per group (1–5), the emergence of particular note-intervals (1–5), different degrees of complication in duration-intervals, particular combinations of intensities. Thus the organisation of durations emphasises symmetry, that of notes and intensities emphasises direction – in every group-aggregate notes and intensities are directed. The 'target' is achieved in the extreme registers of the last two notes and in the intensity-maximum of the last note; the piece is at an end.

But this overall time-structure regulates the work's material, not only its organisation. Thus a succession of 5 proportions runs subcutaneously through the whole piece. This series is set out in the first five notes of the piece. It consists of four notes in chromatic succession and another note a minor third lower – i.e., a region of two juxtaposed thirds, one of which is chromatically filled out (here, again, the interlocking of symmetry and asymmetry). This proportional field is structured in ever new ways (see *Zeitmasse*), by

the disposition of note-registers, note-durations and intensities. Thus a proportioned time-structure applies throughout the piece. But since proportions are composed, the elements' significance comes not from their predetermined size but from their power of forming relationships. The individual events are important as foci of the relationships. In each piece there arises a dense network of relationships, which is further intensified according to the degree of polyphony. Here is a summary of the relationships of neighbouring notes.

In this network of relationships, dissociated time is knitted together. Moreover, the constant presence of 'nuclear proportions' keeps the entire flow constantly present.

This music demands a new attitude of the interpreter. He has to play intervals of notes, of durations and of intensities. But in this way the inaudible is made audible – as when one spots proportion in superimposed durations even before their constituent notes have come to an end. If the interpreter succeeds in playing such proportions, the music becomes flexible, and takes on a Chopinesque sensibility. But not only that. Construction becomes audible, and with it the work-idea – and time is compressed to become the moment.

VI

Construction, work-idea: this is the code of the work, or even of a series of works derived from it down to the smallest particle. Great exertions are needed in order to arrive at such a code; one must condense time to form a constant presence, and one must also formulate what is 'timely' – take up and further develop something already developed, so as to link progress and regress. But in undertaking this, one is defining (in both senses) the historical moment; it is a matter both of seeking out the moment – what and how much is possible at this point in time – and also of the historical deed itself, depiction of the explosive power of the situation. This can only be done by presence of mind – which Stockhausen possesses to a high degree. Then, however, the process of creation is like lightning – illumination and endless work at the same time. In fact Stockhausen conceives the 'code' of a work in a flash. The complete works show the signs of such an origin. As a flash of lightning flashes through the night, these works, when performed, flash through space. And so one can not evade the effects of this music. It imposes itself on the listener, 'informs' him, whether he will or no. But one could well take the same attitude to this music as to history itself; it produces, and then provokes, energies – the 'nerve' which alone enables one to face the ills brought forth by history.

* * * * *

'Zeitmasse' or Speed as a Factor in Time[3]

Each of Stockhausen's works demonstrates something special – and new. *Kontra-Punkte* attracts by its richness of figures: in the first piano piece the abrupt juxtaposition of shapes is striking, in the second the changes of movement: in the third piano piece one is fascinated by the suppleness of the music, in the fourth by the disintegrated quality of the sound-web. The succeeding works, too, display comparable peculiarities. Each time, one is given the impression of a specific sound-structure. This is so because each of Stockhausen's pieces realises a specific sound, whose characteristics pervade the details and overall flow of the piece.

Sound is a vibration-process; air impulses follow each other. The impulses of low notes can almost be perceived separately. We speak of 'booming' notes, thus acknowledging that we can feel them as vibration. When we describe higher notes as 'buzzing' we have sensed something similar, but here the vibrations recognised are quicker. With high notes our perception of this decreases, since the air-impulses now succeed each other enormously quickly – 1000 and more per second. The note now gives the impression not of having been assembled but of being a unit. But if vibration is even slower than in 'booming' notes, we then perceive the individual air-impulses. One hears a rhythm, though a very quick one, and the further apart the impulses lie, the slower its tempo.

Music offers many such vibration-processes. We experience successions of impulses in the course both of separate notes and rhythms. These impulses can flow periodically, in which case we hear notes or periodically flowing rhythms; or they can flow aperiodically, in which case noise-like sounds are produced or unintelligible rhythms, 'time-noises'. The impulses can be quite aperiodically arranged but periodically modulated, in which case we perceive noises with a definite pitch, or time-noises with a definite rhythmic movement. In short: these successions of impulses may be very variously structured – simple or complicated, perspicuous, unintelligible or both to varying degrees, more like 'sound' or more like 'noise', according to how the time-intervals between impulses are laid out. But this produces the 'breadth' of the sound (frequency-breadth).

A further structural factor in a succession of impulses is the tempo, which is evident even in a succession of two impulses. If these are widely separated, the result is a slow tempo; if they follow each other closely, a quick tempo. The tempo becomes more distinct if more impulses succeed one another at the same distance of time. If the last impulse of one measure is at the same time the first of another, then one tempo changes into the other. This change is obscured if a tempo only manifests itself in two impulses; one then gets the impression of *one* variable tempo. Thus these series of impulses express different tempo-structures according to their arrangement. Impulses that lie close together constitute a quick tempo, those lying far apart mark a slow tempo. In the realm of notes, we refer to high or low notes; in that of rhythm, quick or slow movement. If the impulses' entry-delays are irregular, the tempo begins to oscillate, and according to the amplitude of this oscillation an average tempo (or possibly only a tempo-band) is established. This sort of tempo-flow is, however, characteristic in the case of note-registers (frequency-registers).

[3] Ed. Note: The section '*Kontra-Punkte* or the Morphology of Time' could not be included here, but will appear in a later volume of *Die Reihe*.

Let us repeat: music appears as the composition of groups of impulses of differing effective speed. As far as the category 'tempo' is concerned, this means that impulses transported at varying speeds are brought together. Music, then, is vertically a stratification of different tempi, horizontally an unbroken succession of them.

II

How are these many tempi now organised? In general it can be said that they are brought into relationship to one another. Just as nature relates the overtones to a fundamental, tonal music related the individual notes to a so-called tonic. Similarly, in the rhythmic field, a basic tempo formed the centre of relations. Thus in the realm of notes and rhythms one tempo holds good in each case, even when it does not stand out (as is often the case). The remaining tempi play merely the role of hangers-on; they are there to add lustre to the basic measure.

In our historical period, with its serial music, things are different. Here the aim is to annul the principle of dominance. No longer are the elements, in this case the individual vibrational tempi, to be subordinate to one dominant element; they are to co-exist as individualities. They are to form a 'series'. So in composition one first has to create space for this. One fixes a proportional field, i.e., one settles what are to be the relationships into which the juxtaposed tempi enter. The relationships now remain fairly constant, but it becomes possible for the tempi themselves to vary in many ways. Once chosen, these relationships regulate the piece in general and in detail – they stamp themselves on the overall form, the parts of this form and the elements of which the parts consist. If, for example, the chosen proportional field is that of five vibrational tempi closely related (as in Stockhausen's third piano piece), then the overall form will perhaps exhibit five sections, each with a different average speed, the notes will show five-note successions that are always analogous, and the vibrational tempi, which contain the two impulses in a note-duration (beginning and end of the note), will also manifest this proportional field in constantly new ways.

III

Our music, up to this early stage of serial technique, uses mainly unvarying tempi. Thus when vibrational tempi are brought into relation to one another, they are thought of as homogeneous. There is basically *one* tempo which appears, modified, in transposition. Thus it is appropriate that here, as in tonal music, the same single tempo is retained for each piece, even though it is variously manifest in the effective tempi of the sections. In this respect Stockhausen's most recent works (such as the electronic work for five groups of loudspeakers, *The Song of the Youths*, and the wind quintet *Zeitmasse*) introduce many developments. First, more complicated forms of tempo are brought into relationship – statistically assembled speeds, which then produce variable effective tempi, average speeds or tempo-bands. Also, gradually altering tempi pile up. Moreover there are frequent alterations between pre-set tempi. The very beginning of *Zeitmasse* contains a strong contrast, after which the tempo changes six times in the first twenty bars. Even more happens later on. There are wavering tempi, and in the piece's 'mass-structures' the most varied speeds and tempo-forms are superimposed; one player will have to play in a tempo exactly set by the metronome, another to play notes as fast as

ever he can, another as slowly as possible; and yet another will have to start at a fast tempo and then slow down.

Many such passages defeat the traditional way of listening (which used to perceive tempi as a whole) – e.g., crotchets were felt to move slowly, quavers written in this context were felt to move twice as fast, and the two speeds were then related to one another. It did not matter which way the relationship ran – crotchets to quavers or *vice versa* – since, after all, one was relating both to a basic measure. Measured against the latter, there were then absolute tempi in definite proportions. But these were only absolute because one recognised a dominant and homogeneous basic tempo, on which one modelled the remaining tempi. The result: a hierarchy of fixed speeds. Now such sacred order has abdicated. One relates tempi to each other and alters them. The acoustic 'picture' alters as a result. For if a constant tempo occurs at the same time as an accelerating one, the process is sensed differently according to the way in which one relates the tempi to each other. If one hears in terms of the even tempo, then one perceives the other as gradually accelerating to overtake the tempo it is linked with. If one hears in terms of the accelerating tempo, then the constant one appears to slow down. To hear and relate in this way means that one more relic of the tonal system vanishes – the single, constant, stopwatch tempo, dominant and central, to which all tempi had to adapt themselves, whereupon they received the accolade of apparently absolute existence.

But the barriers set by 'nature' are broken, not only in this matter of subjective speeds to be realised by the performers of a musical work, but also in the objective movement of the acoustical phenomenon we call music. Just as subjective movement was once modelled on clock-time, objective movement was modelled on the speed of sound. Each musical phenomenon came glowing into space at this speed. Since Stockhausen's *Song of the Youths*, musical structures travel around freely in space, and their tempo is no longer that of the speed of sound (even though sound-waves of this speed emanate from the phenomena as they move).

Since the movements composed are highly varied – movements both on the part of the musically active subject and within the object 'music', the problem arises, how are such movements to be interrelated? 'Doppler effects' will occur. Frequencies will alter in accordance with higher-order movement and with the nature of their relationship. One will increasingly compose relationships, and will seek above all to fix their direction. One will make audible ever more movements, and thus make time truly effective as a directed flow. But in addition one will apply the theory of relativity. For according to this theory the movement of a clock that is going, and which keeps a constant tempo, is slower for observers in a state of rest than for those who travel with it. Thus *Zeitmasse* and *Song of the Youths* throw open doors to unheard-of possibilities. This is the important thing – not the realisation of these possibilities (which can safely be left to the mediocre). But the doors thus opened finally reveal to one's gaze a better time, and music breaks the spell cast upon it by a 'nature' which up till now appeared to be a myth.

CONCLUSION

Our discussion has aimed primarily at conceptual formulation of the matter under discussion. In thus 'working up to the matter' our interest was directed at the objective historical facts contained therein. The result was, on one hand, that certain important factors in Stockhausen's work had to remain unexamined, and, on the other, that no explicit criticism could be made while setting out the matter in this way. But today criticism is more important than ever, and unqualified praise does more than anything else to bring its object into disrepute. It was not our intention to write an apologia. At times that is what resulted, as is natural when a writer takes it on himself to describe the work of one composer as demonstrating the course and significance of history. None the less, our description contains criticism – if only in negative – just by selecting certain factors in Stockhausen's composition and neglecting others. To develop this criticism in a positive way is not one of the prior intentions of our work – but one could well think on critically. However, it is not criticism to attack inconsistencies in this work (since today all straight-line progress anywhere is suspicious), nor to attack Stockhausen's work for being systematised, since a forward-looking historical momentum is manifest in the very fact that his output is so systematic. The only true criticism is to make clear in what respects Stockhausen still lags behind the possibilities he has created, and still plays the traditional game without anyone's realising it: e.g., that in *Kontra-Punkte* and *Zeitmasse* a closed form of the old type is built up; or that the sections of his works stand alongside one another, as once movements did, so that the music is deprived of the dialectic it created; or that, for all his concentration on the moment, he is still imprisoned by the flow of time, and hardly achieves the brevity and pregnancy already attained by Webern; that . . . But such criticism is immanent in our discussion.

die Reihe

5

Reports
Analyses

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*Translated by Leo Black
† Translated by Ruth Koenig

DEBUSSY'S 'JEUX'

HERBERT EIMERT

Only very recently has Claude Debussy's ballet *Jeux* been recognised as one of the most important works in the early development of modern music. The reasons for this reassessment are not immediately apparent, for *Jeux* does not depart from Debussy's normal style. None of its musical resources is outside his general line of development, none of them is novel, sensational, revolutionary or whatever one calls the radically new features of works such as Stravinsky's *Rite of Spring*, or Schönberg's *Pierrot Lunaire*, written about the same time. Debussy is the least revolutionary among the great renovators of music. More than any other man he altered his musical environment, the music of the late nineteenth century. But he did not rebel against it, he transformed it delicately and with gentle decisiveness, by altering its content of tension. The newness of his contribution was a saving in traditional terms. Processes of this kind can often be summed up only negatively. One can see what Debussy's musical form 'no longer' is; much harder to say what it is. One makes least progress if one tries to apply to Debussy the standard concepts of musical theory. It is a mistake even to refer to themes, periods or paragraphs. The same applies to traditional formal schemes. To describe Debussy's music, a fluctuating middle layer of concepts would have to be specially discovered.

With *Jeux* there is the added difficulty that certain stylistic features thought particularly typical of Debussy play no part in it worth mentioning. Whole-tone figures occur only in the prelude and postlude, in which a chord containing all the notes of the whole-tone scale occurs in various inversions. Anhemitonic pentatonicism is not found at all; at most, the note-succession b–c sharp–e–f sharp–a, the basis of an episode toward the end of the main section (bar 611-626) can be described as a pentatonic figure, or a free pentatonic variant growing out of the organic, 'vegetative' inexactness which will be discussed later. Such inexactness is one of the principles of variation used by Debussy, who has won freedom of this kind after a conscientious process of work, exact to the point of pedantry.

Whole-tone scale and pentatonicism represent acts of selection from the available store of notes. They involve the exclusion of chromaticism. Recent comparisons with the *Estampes* (1903), the second set of *Images* (1907) and the first volume of Preludes (1910) have made clear Debussy's development from chromaticism to diatonicism during this period in his career. But even the Mystery, *The Martyrdom of St Sebastian* (1911), with its bold, subtle and far-reaching harmonies, can not be quoted as an example of chromatic purism, and *Jeux* return wholeheartedly to the use of the full resources of the scale, without settling for any one mode. The work uses chromaticism and diatonicism, employs the non-functional harmonies of chordal chains, and occasionally makes delicate use of polytonality.

But all this would not be enough to give the work special stature; nor would its

rhythmic aspect be sufficient reason. The rhythm in *Jeux* is indeed pointed with unusual finesse, but it is subordinate to the stage action and constantly takes its cue from the course of the ballet, however much one may wonder at the way Debussy has based his symphonic freedom on the choreographic dictates of Nijinsky's libretto, thanks to unlimited powers of elasticity and adaptability.

Rhythm and tempo do indeed already draw our attention to the form of the work – a bewildering and vexing form if one adheres to traditional ideas of structure and thematicism, but a real stroke of genius if one knows Debussy's principle of 'endless variation', which here more than in any other work he has made real and led to its goal. Debussy's handling of form is a withdrawal – he reduces it to the movement of ornaments, motives and flocculi, which have a secret associative power so great that it seems of its own accord to give rise to the form-building act. Is this partly an after-effect of Mallarmé's concept of analogy? The question is unimportant where purely musical coherence is to be investigated. But such 'withdrawal' – threatening word, so akin to that at the climax of Mann's *Doktor Faustus* – means a reduction in sound. What is withdrawn is the expansive nineteenth century of music. Every twentieth-century composer is concerned in this. Only two of them have withdrawn anything more than sound: Debussy and Anton Webern. In *Jeux* Debussy reduced not his sound but the function of traditionally constructed form. In so far as there are still 'themes', they are no longer complete, but only halves, literally halved. And the motives no longer 'work', they play their part in the ornamental linear coloratura, which combines with the play of timbre to form a most perfect unity. Debussy melts down categories of form, producing figures whose musical function he himself has described as 'rhythmicised time'. In these rhythmicised sounds, timbre functions as another integral category of form. Movement and timbre of a sound can not be separated; the kinetic curves of time are coloured – this goes far beyond Wagner and beyond the merely muffled sound of impressionist music. When one listens hard to the sound, 'listens in' to it, psychology suddenly mutates into naturalism. The metallically bright brass of *Jeux*, reduced from themes to arabesques, and released from the thematic box of tricks, seems already to be settled 'outside', and the softly trembling mass of melting outlines seems to contain a stream of acoustic essence. Lack of meaning in thematic terms becomes true significance, the symbol of coloured kinetic curves, in which time passes, blooms.[1]

Jeux, Debussy's last major symphonic work, was composed in 1912 and performed as a ballet the following year. The first performance seems to have made no very lasting impression. 'The animation and vivacity of the score', says Stravinsky in his *Chronicle of my Life*, 'merited a warmer reception than it got from the public.' The work's discreet modernity not only remained unrecognised, but was a victim of the new development described by Debussy as 'the rhythmic rule of violence'. The remarkable scandal of the *Rite of Spring*, fourteen days after the first performance of *Jeux*, put Debussy's work in the shade, where it remained until almost the middle of the century, although a few judges such as Léon Vallas and Heinrich Strobel had earlier pointed out its importance. Thus forgotten, the work has been recorded rather inexactly in the annals of modern music, as we see from the confusing data given wherever it has been discussed in print.[2]

Jeux, Debussy's most precious and vital orchestral score, approaches the *Rite* not only in point of time. Its way of deriving form from ostinato, and some polytonally distributed sonorities, mark the point of nearest contact between Debussy and Stravinsky, who was twenty years younger. There is little concrete evidence to show the extent to which this contact had immediate effects in the work of the two composers. If Stravinsky, in his *Answers to 34 Questions*, says that in his development as a composer the man to whom he owes most is Debussy, he does not forget to express his doubts as to whether Debussy's art changed as a result of this relationship. Louis Laloy, Debussy's first biographer, has elsewhere described a remarkable domestic scene: Debussy and Stravinsky sight-reading the four-hand version of the *Rite*. This was a fair time before the first performance of the work – it was written between 1910 and 1913, but important parts of it were complete by the spring of 1912. Similarly, Debussy showed *Jeux* to the composer of the *Rite*. Certainly a remarkable moment, but not of historic importance. Looking at music in the perspectives of progress and competition (not a view likely to encourage an integral attitude to music), *Jeux* might seem to be an 'unfortunate attempt on Debussy's part to compete for the leadership of the musical avant-garde'. But this is an empty legend for the use of journalists. Debussy knew and admired the early ballets of Stravinsky. In *Jeux* one can find not the slightest trace of their stylistic influence. The immediate stimulus felt by Debussy must have been limited to considerations of musical dramaturgy. For all its discreet poetry, *Jeux* is realistic. It maintains close contact with the stage, without being merely the 'obedient daughter of the dance' – a virtue which Debussy praised in his letter to the publisher of the *Firebird*. For all the subtle organisation of sound in *Jeux*, directness, sturdiness, even urgency and enthusiasm are features that stand out with a new sense of actuality. Sound is no longer impression but new reality. What Debussy said in 1908 of *Images* is even truer of *Jeux*: 'I am trying to introduce something new – realities, so to speak. What idiots call "impressionism"'.[3]

Traditional Form

When a form can not be made to fit into accepted ideas it resists classification. Either it is not recognised as form, or else it is regarded, because of its deviations, as a new

[1] In one of my first lectures on electronic music I also quoted an example from Debussy to show 'points of contact'. A few characteristic bars from *Jeux* were juxtaposed with a short piece of electronic music that was similarly constructed as to time, density and timbre. Even if pure chance, such similarity only goes to prove the limited degree of scatter in the limited statistical field of play afforded by chance.

[2] Cf. the most recent edition of Riemann's *Musik-Lexikon:* 'Jeux (1911)'. Léon Vallas' book is the authoritative source of information about the composition and performance of *Jeux*. (Claude Debussy, his life and works, O.U.P., 1933; orig. Claude Debussy et son temps, 1932). Vallas has summarised his numerous writings about the composer in his book 'Achille-Claude Debussy', 1944. The widespread legend that Debussy's ballet was given on May 22nd, 1913, together with Stravinsky's *Rite of Spring*, dates from a mistake in Strobel's book 'Claude Debussy' (1940). Stravinsky's ballet was perfomed for the first time under Pierre Monteux on 29th May, 1913, at the Théâtre des Champs-Elysées in Paris. In his *Chronicle* Stravinsky surprisingly gives 28th May as the date. The premiere of *Jeux* took place on 15th May, 1913, in the same theatre and also under Monteux, the solo dancers being Nijinsky, Karsavina and Ludmilla Schollar. The work was composed during 1912. The copyright notice in the piano score mentions the year 1912; the date in the two scores is 1914. The libretto is described not as 'Poème de danse', as even the specialists on Debussy maintain, but as 'Poème dansé'. The piano score, which contains the choreographic indications, is by Debussy himself. He evidently attached a certain importance to this piano score, as is clear from the dedication to Madame Jacques Durand, the wife of his publisher; it is laid out with a view to ease of playing, and as a piano version it can dispense with many of the very exact and subtle dynamic and tempo markings of the full score. One curious thing: the full score numbers the bars up to 709, the piano score only to 708. According to the publishers, Debussy never objected to this mistake; it is obviously an error on the part of the engraver, and occurs in the first waltz bar (331), which is not repeated.

[3] Cf. Werner Dankert, 'Debussy', 1950. Dankert's discussion of Debussy's style is very perceptive. He is so sensitive to the composer's hovering, intermediate realms that it is surprising and out of keeping to find him using the theoretical apparatus of Riemann's functional concepts in his analyses (in any case fragmentary) of the works. The supplement to the book contains a bibliography that in 1950 could be said to be complete.

form. Debussy, the renovator of form, despised 'administrative forms' more than anything else. Framework and ready-made professional patterns make music the 'slave of form', but 'it has nothing to gain from such servitude'. *Jeux*, unamenable to traditional form despite its slight similarity to a rondo, constantly juxtaposes new themes, motives and arabesques. Incidentally, mere addition does not produce form – except perhaps a potpourri. In *Jeux* the formal sections are not built in according to an administrative scheme; its form is an exception to the scheme of 'carrier' themes and developments. All the same, it remains form, since it replaces a framework by 'rhythmicised time', which has no time, so to speak, for functional thematicism and motivic work.

All the same, the traditional predictability of music is not sacrificed. In *Jeux* the repertoire of themes and motives is considerably larger than in usual formal practice. These figures are mostly repeated once or twice, then they submerge. The repetitions guarantee comprehensibility in the accepted sense, but incomprehensibility increases in so far as the material repeated is constantly new. These juxtapositions function in a linear, direct, straightforward way. They are freed from the framework, the web of references found in dialectically organised forms, to make up ornamental linear waves which glide away as if in free motion and give rise to further waves, whole coloraturas of waves, which for all their dynamic urgency are neither steered to definite goals nor represent a merely imposed decoration: they are rather flow and form all in one.

A characteristic feature here is the lack of purposeful upbeats and of bar-line caesuras emphasising the aspect of respiration. None of the important motives in *Jeux* has an upbeat character. Even the motto-like upbeat woven in at the beginning of the waltz (bar 335) does not proceed 'on to' the strong beat, but glides softly into it and is immediately repeated with a variant which spills over the bar-line. The absence of inspiratory, uplifting upbeats, nourished on will-power, is only one of the many characteristics of Debussy's ornamental-vegetative formal principle, which rejects thematicism directed by the will, just as it rejects traditional ideas of structure and framework.

When the literature about Debussy takes any notice at all of *Jeux* it describes the work as a rondo, a rondo-type movement or a free rondo. In a rondo, ritornello and episodes have a relationship like that between first and second subjects. Even from this point of view *Jeux* can not be described as a rondo, since the figurative, fleeting 'first subject' withdraws behind the much more important episodes to such an extent that it loses its unifying character as a ritornello. The work can not be made to fit the framework of an accepted rondo form. If one tried to force it to fit, the framework would fall apart. In the main section (bars 47-701), which coincides with the danced action, one could perhaps make out a rondo form in the first groups of motives:

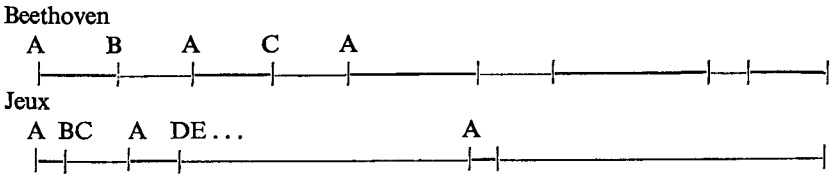
1st group of motives		Bars 49– 69
2nd „ „ „		„ 84–105
3rd „ „ „		„ 106–117
4th „ „ „	(Variant of Group 1)	„ 118–137
5th „ „ „		„ 138–173
6th „ „ „		„ 174–181
7th „ „ „	(Variant of Group 1)	„ 182–185

The rondo structure covering bars 49–185 would then have the form: A – B – C – A – D – E – A. From bar 196 onwards there are constantly new motive-groups, with some

interpolated episodes determined by the choreography and mostly in slower tempo. Not until bar 459 does motive-group A re-occur, and its opening motive returns very briefly four more times before the close of the main section (bar 701), like an object, already submerged, coming momentarily to the surface again. Division into motives and groups of motives (often veiled, moreover, by transitions of texture) is just as problematic as the idea of a rondo framework. If one insists on division into motives, without inquiring about the inner connections between the motivic-thematic figures, then finally one arrives (ignoring the latitude given by motivic 'indistinctness') at twenty-three different motives or themes, which are arranged in the following way, leaving out the episodic interludes:

A–B–C–A–D–E–A–E–F–D–G–H–D–G–H–I–H–I–F–H–K–H–F–K–
L–M–L–N–O–N–A–P–Q–P–Q–R–S–T–U–A–U–A–V–W–X–A–X–A–X

The main theme (A) dominates at only three points, for 21 bars (49–69), 20 (118–137) and 14 (459–452). The remaining four As are fleeting motivic hints. Thus, of the 655 bars of the main section 55 are given to the 'rondo theme'. In comparison with a normal classical rondo (Beethoven, Piano Sonata Op. 10, No.3), the proportion of ritornello and episodes would be as follows:



If the rondo pattern is inadequate for *Jeux* even from a purely formal point of view, it is completely ruled out if one examines the distribution of motivic and thematic weight, or when in listening to the work one realises that there are so many 'subsidiary points' that one no longer notices the main point, i.e., the rondo theme. The rondo form of *Jeux* is in much the same state as the residues of sonata form in Webern. Whoever would have recognised the overture form of the Orchestral Variations Op. 30, if Webern had not himself pointed it out? In order to make his meaning clear in private correspondence, he falls back on analogy. In this personal situation, the desperate situation of 1940, he conjures up not a lost system of order but a mere comparison with it. 'The first subject of the overture, so to speak', Webern says. And the word 'overture', too, is in implied quotation marks. 'Everything that occurs in the piece is based on the ideas given in the first and second bars.' And so it happens in this overture, 'throughout the whole piece . . . whose entire content is already present in germ in the series.' Monsieur Croche put it more poetically: 'One thinks of a legendary tree, whose buds all suddenly open.'[4]

Choreographic Form

In *Jeux*, which was composed for the Russian ballet, the dancer, choreographer and librettist Vaslav Nijinsky intended to create 'the plastic apologia for the Man of 1913'.

[4] Cf. *Monsieur Croche, Antidilettante*, first published in 1921, three years after Debussy's death; English edition *Monsieur Croche the Dilettante Hater*, Noel Douglas (London), 1927.

In *Jeux*, Nijinsky, whose eccentricity as a dancer and 'mathematical, intellectual manner' always repelled Debussy, for the first time introduced on the stage a motive from modern sport. There is no sporting activity in the ballet, and the object of Nijinsky's advocacy was obviously the dancer in sporting costume, who chases a tennis ball that has sailed into a park, meets two young girls and joins with them, after a certain amount of stage business filled with flirtation, jealousy and mocking irony, in a Pas de Trois. A tennis player was something quite novel on the ballet stage; perhaps he was the predecessor of those dancing actors who, ten years later, peopled the stage in training-suits, with a synthesis of gymnastics and balletic spiritual curves. But for the moment the dance studio had not yet conquered the stage: Debussy's 'games' are played in a traditional romantic park, which one can imagine, in the original décor by Léon Bakst, as a tenderly colourful, modish impressionist picture.

For his ballet, which earned him the reputation (as a soloist) that 'his element was the air', Nijinsky provided the following scenario:

> In a park at evening a tennis ball has been lost. A young man, and then two young girls, try to find it. The artificial light of the great electric candelabra spreads a fantastic light around them and gives them the idea of playing childish games; they play hide-and-seek, lose each other, chase each other, squabble, sulk for no reason; the night is warm, the sky is bathed in gentle light, they kiss. But the spell is broken by another tennis ball, thrown by some malicious hand. In surprise and alarm the young man and the two young girls disappear into the depths of the nocturnal park.

Another description of the work, which preserves the choreographic indications, is given in the programme of the first concert performance, at the Colonne Concerts in Paris on 1st March, 1914. The instructions given to the dancers for the harmless flirtation are the simplest imaginable. 'That is all' – so the programme-note ends; the writer seems little inclined to believe in the plastic apologia for the Man of 1913. It is tempting to interpret the simple action of the ballet as absolute dance, *ballet pure*, but this is ruled out by the historical situation of the ballet at that time. Despite the ephemeral nature of the stage action, abstract stylisation would be akin to retrospective use of a form of ballet which did not then exist; moreover, it would come into decided conflict with the music. In *Jeux* Nijinsky in fact founded a new and fruitful form of ballet, which was continued particularly by his sister Bronislava Nijinska; the 'realistic' ballet. This matches Debussy's 'new realities' not at all badly.

Debussy set the libretto very exactly – he composed 'along the text' with divine eloquence; obviously he makes use of the freedom offered when the musician determines the course of the dance, and he had sufficient reason to do so in a ballet whose subject is itself to a large extent the dance. Thus nearly all the production indications coincide with the beginning of new groups of motives or with musical caesuras. The four slow episodes, which match the stage action, broaden the $\frac{3}{8}$ barring of the opening tempo (Scherzando e molto grazioso, bar 47), to $\frac{4}{4}$. Only the last of these episodes is really an interlude – beginning with a figure on the high violins which passionately descends (*éperdu*), introducing the young girl's little catastrophe with a melancholy chain of thirds ($\frac{3}{8}$) on the clarinets: the girl, feeling neglected, puts her hand in front of her face and tries to run away. In their tender evocativeness and psychological

delicacy such arabesques, modelled on the stage action, touch on something almost inexplicable; the more so, since their strikingly concrete effect can hardly be explained by any deep-seated interpretation.

This applies particularly to the phenomenon, so far uninvestigated, of Debussy as a musical 'painter' who does not arrive at his picture along the byways of programme music, but captures pictorial associations of sound in the identity of space and time. The tennis ball falls on the stage; a preparatory, chromatically falling chain of seventh-chords with movement in thirds on the woodwind and a fluttering string line, a short crescendo, then a brief upsurge of C major with an added *a* in the high flutes and violins – there you have the tennis ball, after its brief flight, bouncing in rapid figurations and preparing, with a typical subdominant hesitation, for the appearance of the young tennis-player, who crosses the stage, leaping with his racquet raised. Bar by bar the dancer's few leaps are hit off as, to a two-note cello figure like a sigh of longing he disappears and makes way for the timid girls. All this, as simple as it is differentiated, painted with the playful certainty of a master's brush-stroke, and at the same time with the delicate poise of celestial harmony, is so perfectly integrated into the vibrating form that there is never a moment when musical and pictorial associations can be dissociated from one another; musical and choreographic form coincide.

The pictorial element in Debussy is even more of a problem than the programme of a symphonic poem, a form whose best examples are distinguished precisely by the fact that they also exist without a programme, since the effectiveness of their motives and themes results from a process of logical or dialectical working-out. But Debussy stretches music's bow to take in even the extra-musical. His direct painting is not converted into atmospheric values, it is inherent in the notes and lines, and is inseparable from the substance of sound. Thus *Jeux*, as a choreographic tone-poem, makes the entire visible action participate in an ornamental play of movement using figures and sounds. The resultant saving in 'cues for action' is compensated in the work's musical form, a flowing form of a novel kind, no longer amenable to formal bureaucracy. Nor has it any use for mere rhetoric, and its elastic structure is wholly free of the monotonously stamping rhythm often (and for the most part wrongly) called 'motoric'.

Debussy's dance-poem is the most transparent and discreet of all ballets, a freely unfolding flow of form equally without choreomanic obtrusiveness and symphonic profundity. As recent attempts to revive the ballet have shown, dancers do not feel particularly comfortable in music which makes the first attempt to dissolve thematicism into the play of time-curves; still less do ballet conductors, who try to make 'symphonic music' out of the score's bright metallically singing, streaming sheen, or else present it an impressionistically washed-out wallpaper pattern.

Ornaments, Motives, Themes

The table of motives (Example 6), is an attempt to cast light on the associative and motivic coherence of the melodic shapes* in the piece. Is one to call them this, or to refer to ornaments, arabesques, motives and themes? Any of these terms is a makeshift, just as it is a makeshift to define them as 'linear'. Debussy attaches more value to linear writing than to the character of a melody. He names as the basic form of all types of art the principle of ornament, and here expressly wants to distinguish between

* *Trans. Note:* 'Gestalten'. Cf. Pousseur's article in *Die Reihe* III.

the word 'ornament' and what musical textbooks mean by the term. 'Divine arabesque', according to Debussy, is of Gregorian origin; in it, music preserves all its nobility, its elastic, tender suppleness, its truth. Compact symphonic thematicism, on the other hand, provides padded seats for pampered prisoners (to quote Monsieur Croche).

The basic quality of ornament is its unobtrusiveness, its apparently incidental nature, its discreet carrying forward of a line by simple stepwise motion. Ornament is bound up with the use of small intervals characteristic of many works by Debussy. Nearly all the themes and motives of *Jeux* move by steps of a second or third; in the few places where they do not, their unusually thematic character is immediately emphasised, as in the theme quoted in Example 3, which uses wide intervals and is based on an altered ninth-chord (secondary seventh); this theme stands out strikingly from the ornamental stepwise waves: another example is a diatonic E–flat theme on the horns, a joyful call (*Joyeux*) woven round by the waves of the woodwind; as the waves move on, this is immediately smoothed down and ironed out, becoming ornament again (Example 1). Themes of this kind emerge with the pregnant quality of principal subjects, whose positional value within the form can no longer be measured according to the criteria of a rondo; they are thematic centres of gravity, according to the one and only rule of intra-formal alternation and opposition.

The ornamental formations based on close intervals move in simple waves, which circulate or are spun out, are repeated and give rise to fresh waves, a circulation which is always at its goal and therefore never 'going' anywhere, never building up thematic figures, with no motivic 'working-out'. Instead of this we find motivic association, which produces inexhaustible variants, not in fixed thematic form, psychologically bracketed off, but in a freely growing process of breeding. As a diastematic (melodic) formal category, arabesque is not subject to self-confirmatory motivic thinking. One should refer rather to chiselled work or to ornamental mosaic- and miniature-art, except that this would immediately suggest music of a merely entertaining genre, the type of movement which has taken as its point of departure Beethoven's two symphonic allegretto movements and has then cultivated its manifold blooms along the downward path from symphony to salon-music. *Jeux* is one of Debussy's most difficult miniature-pieces – it is in no sense a 'genre' piece. Its motivic language does not aim to produce striking and unambiguous four-bar phrases and strophic correspondences; even though the themes and groups of motives in *Jeux* are mostly in four and eight-bars, they do not comply with traditional formal claims. Concepts such as antecedent and consequent are no longer applicable. If one tried to apply them, one would have to say that the themes of *Jeux* are made up wholly of antecedents.

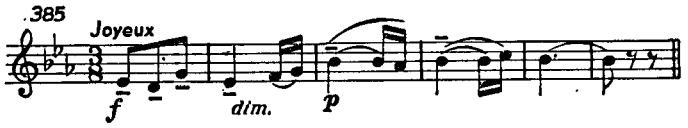
These antecedents, too, are subject to the principle of variation, the principle of Debussy's 'endless melody'. The themes are partly dismantled, are varied and run together to form components of the variation process. When the waltz theme returns in augmentation (bar 566) it is expanded into a thematic chain (bars 566–604), consisting of seven thematic components. Here the theme is constantly varied, not only in key and harmonic structure but also by expansion to a five-bar phrase (bars 566–570) by reduction to two bars (583–4) or by a sudden standstill of the line's swinging roll, accompanied surprisingly by the twirling figure of the 'rondo theme' (587–588). This chain of varied 'antecedents', themselves varied, can not give rise to a 'genre' piece; it is as if charged by a current, with constant tension in its elastic brilliance, whose

most wonderful quality is an unchanging vibration. The hidden impetus of the current creates a new organic coherence, that of flowing form, an ornamental kinetic form which makes the cellular plan and line-by-line structure of the four-bar phrases so supple that they can freely follow the vibration of the form and can themselves become flexible form. This is what Debussy means when he refers to 'free speech in free music'. One can not, indeed, take this to mean ready-made musical prosody, but at last the 'un-grammar' of themes that are all antecedents. Debussy, the sworn enemy of rhetoric, of the colossal, of grandiloquence, does not think in themes that have intention and function. His bisected themes mutate to wholes, because they make the jump from the logic of fixed formations to the freedom of endless variation, of endless melody.

All the themes (motives) of *Jeux* appear at least twice; most of them are repeated immediately. The most frequently appearing form is: Theme – Theme – Interlude – varied Theme, with further variants by repetition and thematic alteration. In the vegetative circulation of the form there is no development, no intensification or return of themes. As a rule, what has been said once is not returned to again.

Only a few motives and themes using other intervals stand out from the stepwise, wave-like lines:

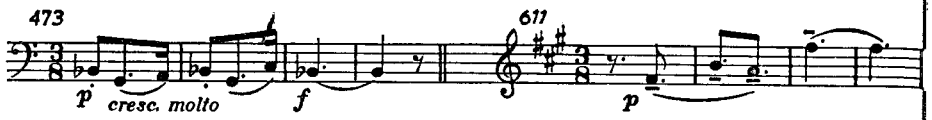
1. The whole-tone-chord motive of the slow prologue, which is repeated at the end of the prologue and appears again in the epilogue.
2. The already-mentioned motive of the bouncing tennis ball (bars 70–72), which after 69 bars of chromaticism suddenly opens up a field of natural triads (Debussy's 'opening of windows').
3. The E–flat-major theme (also already mentioned), which begins as a striking call and immediately dies away (bars 358–363).



Example 1

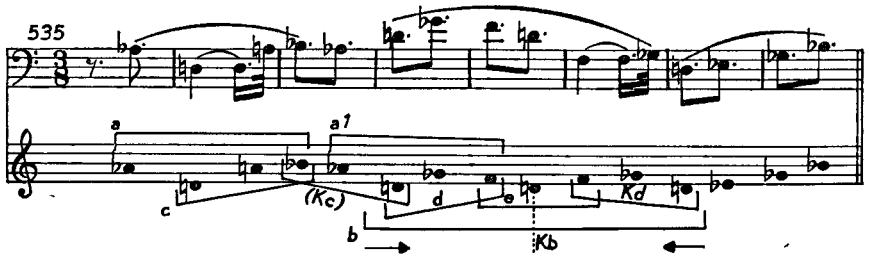
It is a typically Debussyan 'antecedent' which does not provoke a consequent such as could be invented without difficulty by any producer of musical clichés or anyone versed in academic music. 'A musician should not use standard forms', Debussy said; in the present case this would refer as much to the dynamics, which die away, as to the instrumentation, which by allotting the figure to the group of horns realises even here the principle of 'sound-exchange', and which introduces another variant distribution when the repetition occurs (bars 396–400). At the outset this theme is of the type which, as Debussy said, force themselves on one's notice by noise and muscle-power; so it is all the more significant that it then goes back on this symphonic significance, transforming its muscular thematicism into impulse and wave, giving the *Joyeux* passage a kind of envelope curve as it builds up.

4. The leap of a fourth characteristic of the E–flat theme occurs as a constituent motive only twice in other motivic formations:



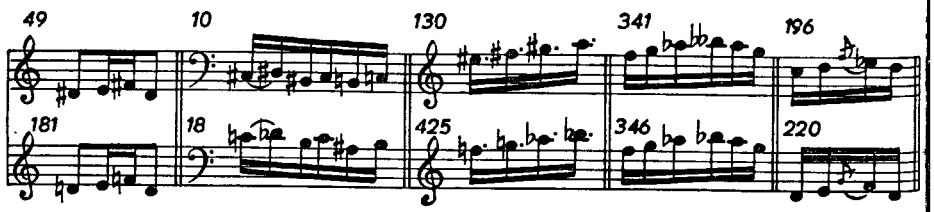
Example 2

5. The most remarkable of the lines in *Jeux* is that of the clarinets, bassoons and horns – in its contour and timbre it stands out significantly, in the Pas de Trois (bars 535–542), which is immediately repeated and leads with an altered final turn of phrase to a further development arising from one of its first two intervals:



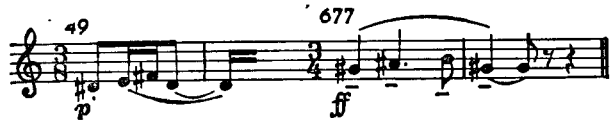
Example 3

The movement of the notes does not follow the typical wave line, it revolves within its own limits, rotates vexingly in the time-dimension, interweaves its motivic components to such a degree that they correspond to the choreography of the gyrating dancers: a perfect image of circling movement in time. If it is at all legitimate to talk of circular formations in note succession, then Webern's mirror series, with their logic of identity between left and right, upper and lower, represent such circular forms. In fact, to show circular form, one can analyse the Pas de Trois theme as it if were one of Webern's mirror series, however little the streaming continuum of Debussy's melody, derived from chromatic alteration, may belong in such a context. In our analysis, the cancrizan of motive C is marked Kc, in order to make clear the inexact nature of the mirror formation (it is not literal as to intervals). This inexactness leaves room for free mobility within certain intervallic spaces, and is one of the formative laws of endless variation. Such arabesques are formed with some of the organic inexactness of vegetation. The intervallic variants obey the wave-law of Debussy's linear writing. Thus there often arise diastematic alterations, which can be regarded as imperceptible extensions or contractions of interval spaces:



Example 4

No bloom on Debussy's legendary tree is quite like another, and yet they all belong to the same tree. If Webern said 'the same and yet ever different', the reverse holds good in Debussy: ever-different elements appear within the same unitary wave-movement, and in the process, what is markedly different is manifested in motives and themes that are striking, whereas 'the same' is often hidden in the latency of the wave-principles that are at work, and is hardly recognised by the listener. Thus the fifth line of the motivic table shows the motive beginning at bar 677 (called 5/677 in what follows): it is the powerful climax, a spacious release of tension, at the end of the main section ('a triple kiss unites them in ecstasy'), and is built out of the first four notes of the rondo theme, 1/49 (the curtain goes up on the empty park), or rather coinciding with the first wave movement of 1/49, since its intervals are not exactly the same but show the inexactness of vegetative production. The facts of the case make it impossible to tie down the two motives on the basis of a chance resemblance, for their coherent significance is as basically different as their pregnancy of shape, and nobody listening will hear a reference from one to the other. On the other side one must avoid the idealistically tinted concept of 'common substance', which has proved itself in the formation of classical themes; it would be too limited an approach to do justice to Debussy's method of motivic association. The way from the most subsidiary motivic particle to the ecstatic climax:



Example 5

marks the ballet's course of action – from the empty park to the *triple baiser*. By the end of the work, the fleeting motivic particle from the opening has soaked up highly significant content and swollen to giant size; it appears in the final 'apotheosis', not in the thematic apotheosis of the romantic symphony, but in Debussy's which is ornamental.

Debussy was richly able to transpose shapes, not in the linear way referred to by Gestalt theory but a creative, freely varying transposition into other Gestalt dimensions. How far this occurs consciously or unconsciously in the creative process may be of interest to psychologists, but one should not call the unconscious to one's aid where clear transformations of shapes are evident. And to relegate to the darkroom of the irrational everything that the listener 'does not notice' would be to believe that creation takes place in a state of trance. Another motivic comparison may make this still clearer; 9/224, on divisi strings, is a slow, divinely tender figure (the tennis player beings to dance, the marking is *doux et caressant*), in which the movement, just as when it is repeated with a slight variation (bars 245, 246), seems to come to rest, as if veiled round by some superhuman hand. The literal repetition in 8/515, which rules out any act of the unconscious, transforms the motive, now appearing in the woodwind, into a sparkling dance theme. Vice versa, the semiquaver figure of the beginning of the waltz (bars 340–343) becomes the later waltz theme in half tempo (bars 566, 6/340). In the entire main section of *Jeux* these are, incidentally, the only two references back to earlier motives, except for the rondo theme, which has a special place. The two literal Gestalt

transformations produce complete alterations of 'shape' – perhaps this is the reason why Debussy here made the one confirmatory exception to his rule of not repeating what has already been said.

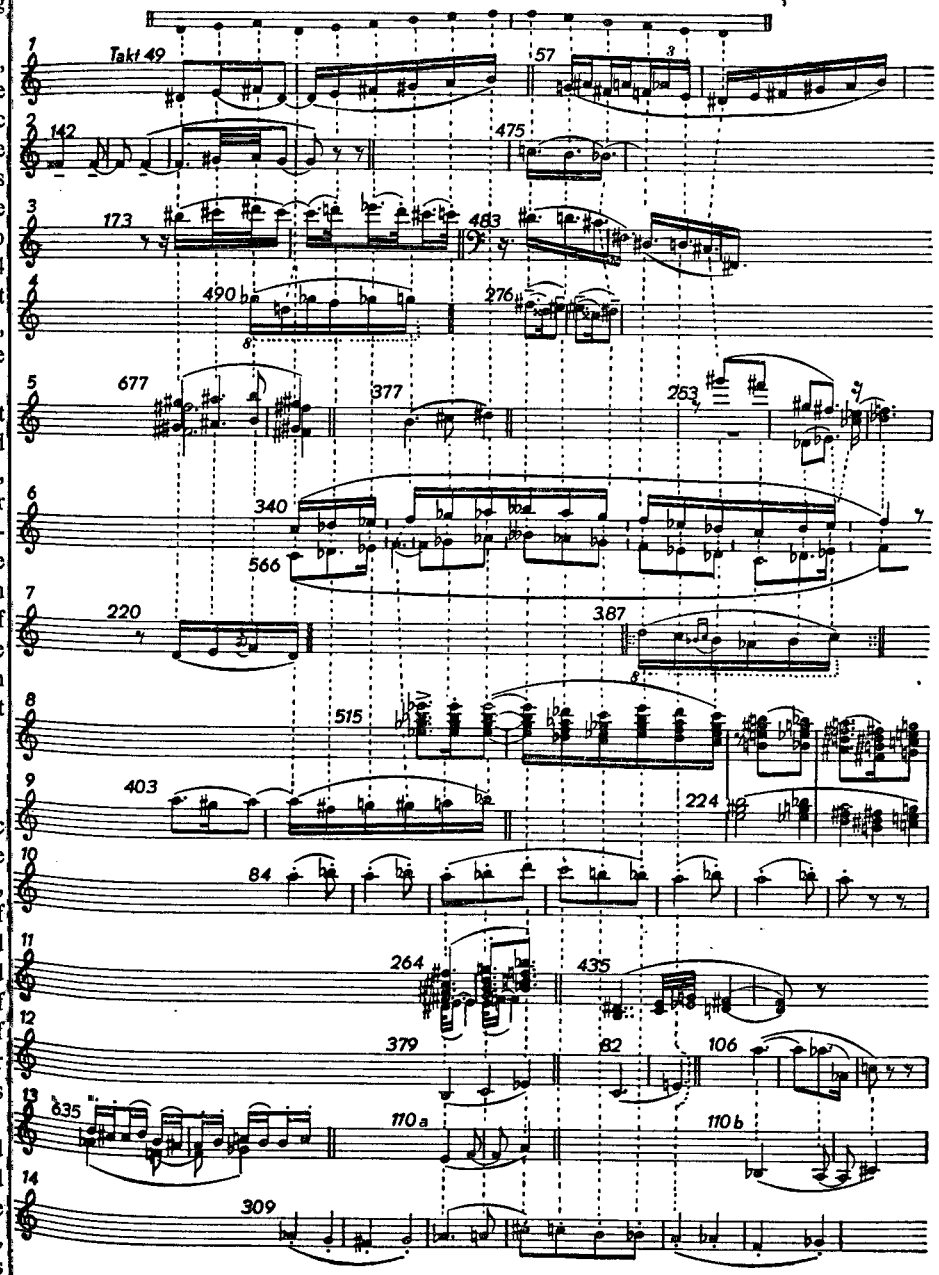
The motivic table's first line shows the free intervallic scheme of the wave movement, followed by all the motives and themes of the main section of *Jeux*, except the five already mentioned. The three-line scheme picks out only 'inexact' steps in diastematic movement; the intervals can be minor and major seconds or thirds, and scale-like movements go to make up the ornamental waveline; of these, the two waltz melodies 6/340 and 6/566, when reduced to the scale, are identical with the wave itself, and give rise to the smaller wave 7/387, a rolling figure which is extremely prominent by its crescendo and accelerando, and which later sets the waltz tempo going again. Lines 10 to 14 show the form of wave-movement culminating in the third, with many variants that go as far as the 'inversion' in 13/365 or the isolated third-formation 12/82, which, among the powdery sounds surrounding it, emerges as a melodic interval-event of the most wonderful kind: melody reduced to two notes.

The main, rondo theme 1/49 is the least apparent of the ornaments in *Jeux*, but we now see clearly that it is the main subject in a different way; as the sheltering ground which produces unity all the more deeply and forcibly the less it works in a commanding, thematic way. The motivic table is meant to make clear only this. To quote Monsieur Croche, it is not a thematic table to whistle, not 'to truckle to the desire for sentimentality of those of whom it is said that "they do so love music" '; it is rather a table of associations, or, to keep to the metaphor of organic growth, a table of vegetation which gives information about flowers and particles in the lines of *Jeux*. Even if references, chance similarities or material relationships are to be found there, they are not the only things that matter. Debussy's figurative conception of music touches on more delicate kinds of coherence. His method is to avoid being methodical, and let his line grow in endless variation.

Dynamics, Tempo, Density

Musical degrees of intensity in an orchestral work depend not only on dynamic markings but also on scoring. *Jeux* is written for a normal large orchestra (quadruple woodwind and brass, percussion, celesta, two harps and strings). Its dynamics glide, fluctuate, breathe; they coincide with the flow of ornaments and motives. Because of this adaptation, they are constantly in motion. They vibrate with the motives and arabesques; 'dynamic' dynamics, which alter in time. Their basic form is not loud and not soft, but becoming louder and softer. On the other hand, unaltered degrees of density are hardly ever maintained for more than a few bars. The even pianissimo of the first eight bars is almost an exception. Similarly there are no even alterations over more than four bars. On the other hand, one often finds dynamic motive successions of the form f < f < etc., or p > p > etc.

This highly developed art of transitions and shadings is still further differentiated by a wealth of performing indications. They can not be separated from the musical processes, and though they do regulate performance, they simultaneously mark the respiratory flux of movements which would not obey the commands of activating, functional dynamics. Schumann once said that in their totality, performing indications struck him as a 'second act of composition', but it would be almost unthinkable to



Example 6

B

detach from a work such as *Jeux* its finely moulded envelope curve of performance and expression. Debussy's movement-curves result from the closest interweaving of all the categories of form – which explains his much-misunderstood lack of essential, logically founded polyphony. Where horizontal and vertical no longer have any significance in constituting form, where they to some extent merge in the constant mean of the diagonal, traditional form can no longer arise – the same is true on a different level for Webern. In Debussy the entire form is in a state of flux; this is as manifest in his linear writing as in movements which press forward or hesitate, in dynamic transitions as in the varying density of the harmony and instrumentation. In these dimensions – nowadays they would be called 'parameters' – the law of vegetative, breathing movement applies. The categories of form take part all with equal weight in the wave-movement; motive and ornament, tempo, metre, dynamics and timbre – this, as it were, is the 'serial' aspect of *Jeux*, so long as one understands by this not serially regulated form but form in the indissoluble community of its equally valid dimensions. This is also in accordance with the observation that *Jeux* is a formless work in the traditional sense, without symphonic architecture, without thematicism by attraction, without contrapuntal evolution, not working out motives loaded with significance and relation-functions. What sounds at any moment is constantly adapted to what follows, often in a gentle shift of movement, but often in impetuous anticipatory action, which for all its urgency retains something hesitant: *en animant progressivement* is the performing indication for this at two places which are not motivically related (bar 403 onward, bar 611 onward).

Dynamic evolutions and gradations in *Jeux* are indicated not only by crescendo and decrescendo, but are equally manifest in the changing intensity of the sound-mass resulting from addition or subtraction of groups of sound – a process which is developed to its highest degree of subtlety in the course of the work. In the circumstances a *piano* in Debussy has a different relative loudness from that in Webern – this is always the result as much of style as of the specific milieu of sound. Attempts to draw up definitive scales for differences in loudness – and these go back to the seventeenth century, to Mersenne's octave-table for degrees of intensity – have so far failed to satisfy. All the same, loud and soft have their place in our powers of aural perception. Seen from this angle, *Jeux* is 'pianissimo-music' to a greater degree than are any of Webern's works for a large number of instruments. In Webern's Variations Op. 30, which differ from *Jeux* only in that they use single woodwind and brass, 102 bars out of 181 are marked *p*, and *pp*, 48 *f*, and 14 *ff*, while 17 have 'mixed' intensity markings. The corresponding figures for the 709 bars of *Jeux* are: 557 *p* and *pp*, 68 *f* (and 1 *sff*), 82 mixed. This produces, so far as dynamic markings have an approximate reliability, the following intensity proportions (to the nearest 1%):

	Jeux	*Webern Op. 30*
p & *pp*	79%	56%
f	9%	27%
ff	0·3%	8%
mixed	11·7%	9%

So according to the criteria of loud and soft, *Jeux* would be considerably nearer the 'brink of aphasia' than Webern's Variations, which are supposed to have filtered out all inessentials. They are not, because of their high degree of note-density. The proportion of bars in *Jeux* and the Variations is 4:1, their proportional duration (clock-time) is approximately 3:1. If one calculates note-density according to number of notes and overall duration, the proportions would be much higher.[5]

By comparing degrees of musical intensity in Debussy and Webern one can see what to think about 'aphasia'. And it is hard to imagine anything 'going dumb' except a note with its objective intensity and perceived loudness, so one must take it that the category of dynamics decides, more than any other, about the existence of a note – whether a note or a non-note exists, and whether the note is loud or soft; this contradicts the traditional theory of dynamics, which treats intensity as a peripheral characteristic of sound. The so-called central qualities – pitch and tone-character (Handschin) – had been called in question even before the most recent musical developments. To call the dynamics of *Jeux* peripheral shows that one has not caught even a whiff of its true essence.

The principal tempo in *Jeux* is that of a scherzo movement with the metronome marking ♪ = 72. For all the detailed variations in tempo, the natural flow of the $\frac{3}{8}$ scherzando is preserved until the first $\frac{2}{4}$ bar (284). It does not waver even when the two short slow episodes in $\frac{3}{4}$ (♪ = ♪) are interpolated. The $\frac{2}{4}$ barring is the first to induce a change-over in the flow of time, catching it as if in a grating; the flow of tempo becomes a tempo, obviously the one necessary to characterise the action on the stage (*Dépit et légère jalousie de la seconde jeune fille*).

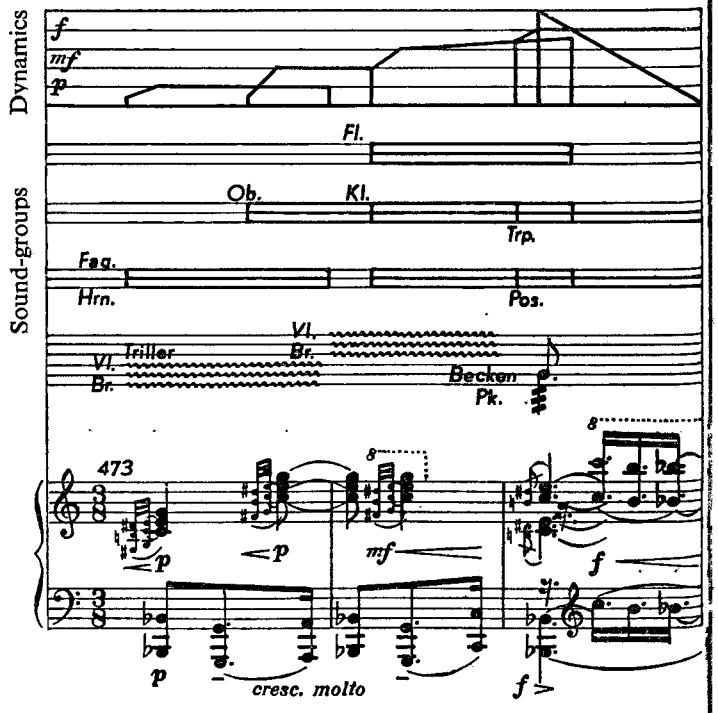
In this first part of the main section (bars 49-283), that is to say until the beginning of the $\frac{2}{4}$ barring, there are no fewer than 39 adjustments of tempo (slowing, holding back, pressing, gradually picking up the tempo, rubato and of course a constant return to Tempo I). The duration from the first tempo modification (*retenu*, bar 82) until the end of the section that runs out on *plus retenu* (bar 283) is 5′ 16″,[6] i.e., on an average the tempo would change every eight seconds. Taking into account also the natural alterations of tempo implied in performance, the various types of agogics and the 'written-out' ritardando in bars 128–130, and accelerando in bars 258–260, one is faced by an image of ceaselessly fluctuating time, a permanent tempo rubato which brings the stream of time into the basic wave form of *Jeux*. We find here that eight seconds is only a calculated mean value, for in reality rubato also has form on a large scale, as higher-order regulation of time; the waves of time develop gradually (bars 82, 116, 156), and then become ever denser (bars 167, 168, 172, 174). They form a whole system of waves, arising from time that is not organised but organic.

[5] Experiments with two stretches of time lasting 8 and 12 seconds and more or less comparable in tempo produced, counting in a primitive way, the note-density-relationship 4:1 and 7:1 respectively. But such attempts fail because there are no methods of musical statistics by which the frequency of occurrence of notes and note-constellations can be meaningfully grasped. Statistical investigation of language (cf. *Nachrichtentechnische Fachberichte*, Vol. 3, 1956, *Informationstheorie*, edited by Prof. W. Meyer-Eppler) have helped to discover mathematical laws which are adequate to describe the formation of all words and sentences. In view of such insights one would have first to say that music is infinitely more complex than a language in which a given store of words is investigated in order to discover authoritative data about the relative frequency of occurrence of sounds within syllables, that of syllables within words, substantives within sentences, etc. These are comparatively one-track investigations in a dimension fixed in writing and print, in which at most one has to consider accents and emphases, but in which everything phonetic is ignored. The elements of music, related and arranged in many dimensions would, however, have to take into account pitches, durations, octave-registers, and octave transpositions, timbre and performing indications; for the moment there are no prospects for such an attempt.

[6] In one of Hans Rosbaud's interpretations that has been recorded on tape.

The musical domain of rubato-time is arabesque; it is no longer an artificial form of decoration, an ornamental mannerism, but a labile formation, bound up and extended in breathing rubato-time, particle and floral tendril on the waves of time. If in a traditional structure built up in fixed periods one applied the permanent rubato which takes hold of *Jeux* for whole stretches every second or third bar, it would become an intolerable mannerism. The constant rubato of *Jeux* takes on meaning only beyond the realm of performing indications; it is an independent category of form – time which in rubato is as if moulded in curves and adptable only to ornaments, not to functional themes. Dynamics become the formants of time; they would function so, even without embodiment as notes, just as language still functions when one whispers. This seems to point to a musical concept of time which transforms conventional performing indications into temporal action-indications. The unity of action bundled up in simultaneous time-curves is confirmed by the fact that eighty or ninety orchestral musicians can exactly follow such oscillations of duration. The whole of psychology is implicit in this extreme rubato, which carries to its logical conclusion something that can no longer be called 'rubato'. Some composers of the present day have made a practice of orientating musical time not on the barline but on the movement of the hands of a clock. This predicates that psychology is to play no part in variations of tempo, and its result is that the time-carrying elements can be asynchronously displaced.

In contrast to note-density, criteria of orchestral sound-density can be directly seen from the score, and can be noted empirically. The breathing of lines and dynamics is



Pos = Trombones
Pk = Timpani
Br = Violas
Becken = Cymbals

Example 7

matched by that of the orchestral sound, which begins to open out toward nature, as if it, too, were sick of 'psychology'. These naturalistic sound-wonders – deep, unfathomable secret of *Jeux*, for all its normal orchestration – are not apparent when one merely examines its scoring. They often arise from a quasi-statistical accumulation of sound – as if the hand of a genius had thrown sounds together to form sounds, according to a method of spectra which makes the timbres glow and hiss. If one wished to give examples of this, one would have to quote numerous pages from the score (and to take for granted that the reader was very well acquainted with the way they sound). To show the build-up and alternating play of piled-up groups of sound, let us select at least one example from many: see example 7 on preceding page.
Anyone who knows how this passage sounds will find its unusual design confirms what is hinted at in the combination of piano score and acoustical diagram.

Amid these withdrawn dynamics and evenly pulsating rhythms there arise those tender, hypnotic balletic images whose sound still has something of Debussy's 'Javanese counterpoint' – here again we find the step beyond psychology, the mutation into 'nature'. This has nothing to do with attempts at realistic sound-painting, but produces a direct, oddly immediate relationship to sound. However one tries to describe or sum up the sound of *Jeux*, one constantly runs up against the sound-phenomenon of open or opening sound, which for all its extreme refinement and even psychologising remains linked in a natural way to the world, without any naturalistic obtrusiveness, without detours via functions of meaning, without a false emphasis on 'depth'. This is confirmed throughout by the work's bright, transparent, 'direct' orchestration, whose specific acoustical qualities have been pointed out by Pierre Boulez in his remarks on *Jeux*.[7] Such acoustical directness expresses itself just as much in the metallically open sound of the brass as in the celestial enveloping of dissolved, evaporating contours. Debussy's natural sound is not the triad, from which the romantics derived effects of nature-symbolism. The veiling of sound in *Jeux* is often aided by blurred, scattered triadic trills, whose light fluttering and hovering is doubly justified by poetry and by acoustics. Also near to acoustics, in another way, are the triadic and four-note-chord passages of the brass; in their parallel part-writing they form ornamental bands of sound; a band-technique* deriving from the mechanics of nature, which may paradoxically be compared with the electronic technique that can carry out parallel shifts of sound without altering the duration of reproduction, by means of a register-regulator. The bands of sound have the same relationship to functional harmony as energic sound-tensions have to the acoustic mechanics of nature.

The transparent, nervously vibrating and finely complex sound-picture in *Jeux* often shows characteristics of sound-distribution typical of chamber music: in its totality it is thoroughly orchestral. But against all 'administrative' practice the full orchestra is not employed, even though the work is an unlyrical ballet. There are no closed tutti-sections in *Jeux*, in fact there is not a single bar in the whole work where all the instruments play at once. The instrumentation is always selective, even where the stream of sound is worked up to an ecstasy.

Veiling, mostly in the 'outer registers', occurs by means of tremoli that dissolve the contours, trills that play around the lines, fluffy touches of pizzicato, ornaments like

[7] *Gravesaner Blaetter*, II/III, 1956.

* *Trans. Note.* Here there is a double-play on the German word *Band:* 'band' and also 'tape'. Cf. a few lines later.

particles, rapid chromatic scales in thirds or chordal trills. 'Acoustically' instrumented sound emerges most strikingly on the limits of the aural plane; the metallic directness of the forte is matched at the pianissimo threshold of hearing by rustling, cloudy sound, which also seems to open according to natural spectra. Particles with a discreet effect of call and echo (bar 78–81, *un peu marqué et s'éloignant*, also bars 690-696) should also be considered; similarly, in the epilogue, the twenty-four-fold repetition of a chromatic figure in quintuplets[8] (*murmurando*), which can be aurally evaluated as a noise spectrum with spectral components in three aural regions (octaves). To this context of spectra there also belong the countless performing indications for giving special colour – *sourdines, étouffez, col legno, flautando, trem., serré, sur la touche, près de la table*, among others.

Transparency of the outer registers is characteristic of some polytonal sound-dispositions in *Jeux*. Traces of polytonality occur in *St Sebastian*, the second volume of twelve Preludes and in the Sonata for flute, viola and harp. Polytonality is more marked in *Jeux*. The process of playing simultaneously in two or more keys, developed later, above all by Milhaud, is foreign to Debussy. His harmony renounces neither inherited basic steps nor chordal functions, even though it makes free play with the succession of chords, which are no longer juxtaposed according to degrees of relationship or leading note tensions. Whatever the freedom that prevails within the harmony, none of its formations go outside the circle it describes. Therefore one may doubt whether the polytonality of *Jeux* is really to be so regarded at all; it is always built up over sustained parts that are like pedal points, permitting the transitional use of notes foreign to the harmony. Polytonality remains in the harmonic climate of the work – it is, so to speak, one-way. Signs of this are the static character of the extended harmony and a texture which 'runs' in the extreme registers; e.g., at the vertical f sharp major – c major, bars 84–97, with the a sharp (= b flat) as fulcrum of the dominant of F major, and in the A flat major – A major, bars 403–406, and its polytonal continuation until bar 416, in which the basic A flat major communicates with the superimposed A major through the D flat (= c sharp) of the violins, So, too, in less highly developed passages (bars 174–181 and 264–267), which can, however, be equally well explained on the basis of parallel displacements.

If here we have attempted to analyse *Jeux* by unusual methods, this does not mean that we are retrospectively interpreting 'modernity' into it. But it must be emphasised that traditional musical theory is helpless in face of this work. The inconspicuous novelty of *Jeux* lies not in its construction, but in time, the pre-constructive, true element of music, which has only today become theoretically accessible. 'Music', says Debussy, 'possesses timbres and flowing tempi', and he adds that it is 'a very young art, both in its resources and also in respect of its appreciation'. To appreciate *Jeux* one must be familiar with the resources of present-day composition. They are methods of musical time, not introduced as ornament and colour but engendered from within the work itself – this is the eminently new thing about it.

[8] Wrongly written in the score as hemidemi- instead of demisemi-quavers.

ABORTIVE CONCEPTS IN THE THEORY AND CRITICISM OF MUSIC

HEINZ-KLAUS METZGER

'Where there are no ideas, some word always takes their place at the appropriate time': this saying from 'Faust' has become, in German, not just a familiar idea but a proverb.[1] But even though it is not accepted philosophical or even philological terminology, it implies a distinction between idea (concept) and word, defining a word as 'verbiage' (to use the journalistic jargon whose ideas in the field of musical criticism I wish to criticise). If an idea or concept is a word which grasps a subject, then a mere word, which does not grasp a subject, is an abortive concept. The frequent occurrence of such words in music criticism results from a lack of concepts, and even musical theory that claims to be serious rarely rejects them – more often it hastens to appropriate them, unless it has already invented its own. 'Vital', 'motoric', 'elemental', 'statement', 'engineers' art', 'pointillist', 'aleatoric', 'musical splitting of the atom', 'sincerely felt', 'electron music', 'competent', 'alchemists' kitchen', 'the twelve-tone', 'rhythmic', 'atonal', 'human', 'serial', 'experimental': these need analysing.

Some of these words have a rational meaning, if they are regarded as vehicles for concepts, not as substitutes for them; others, such as the 'innate musicality' one often reads about, are merely badges advertising irrationality, with no reference to anything concrete at all; they function simply as labels worn on the backside, so that like minds without a single thought can recognise one another. There are also a number of words, such as classicism or romanticism, which come nearer the meaning they lack than a more exact expression would; their context can always poke these dying embers of words into life, make them glow a little, transfer some of its surplus meaning to them. If 'classicism' means acceptance, resignation, withdrawal, stagnation – desiccation, in short – then it is not a bad substitute for a concept; it is, however, if turned positive side outwards, in which case it often appears together with 'maturity'. In fact this kind of positive classicism has no real meaning, certainly not a concrete one; furthermore, 'to classicize' (as John Cage has pointed out) is simply a less elegant substitute for 'to classify' – that is to say, it hits off the favourite method of opting out of a true perception of phenomena. However, in so far as works are not classified by their very nature, this lack is remedied by musicologists, who take it on themselves to rule over the course of musical history, and by so-called constructive or synthetic criticism, whose *contradictio in adjecto* was recognised even by the Nazis (they preferred to refer to 'Kunstbetrachtung', 'observation of art'). Here we should mention one quite separate and self-contained delusional system, the attempt at categorisation which simply classifies composers as lyrical, idealistic, vitalistic, mystic, orphic, artistic, pathetic, and all the rest of it. Here one pigeon-hole has been forgotten – for the left-overs, who would certainly have to include every composer who has so far come to light. But this is the case with almost all classification.

[1] *Trans. Note.* There is no one English word to translate the German 'Begriff': it can mean 'concept', 'idea', occasionally 'term' and also 'household word'. In the course of this translation it has been necessary to render it in various ways, so that the stylistic elegance of the original is necessarily somewhat impaired.

There has not yet been a history of musical catchwords; it would be largely the history of their decay. It is hardly splitting hairs if we give them credit for having seen better days. In fact, although they were threatening heralds of the rising dictatorship of the culture-industry, until this had expanded its power to the point of completeness they were no worse than academically postdated philosophical errors, mere betrayal of emphatic generalities over their submersion in the particular – simple memorials of suppressed dialectical mediation between the general and the particular. In so far as the shadow thrown ahead by disaster is not yet disaster itself, they were as harmless and impotent as the self-assertive generalities which, since they had not swallowed up their subject-matter, did not claim to be generalities, but merely labels stuck on their subject: mostly unacceptable but always easy to detach. It was not errors in thinking that led to Fascism. The latter belongs rather to a state in which concepts no longer have to feed on the fullness of a subject in order to exist – where they are invested with the authority that stands behind them. Just as, in advertising, a 'household word' is a sign of quality, social power elevates concepts to generalities and supergeneralities, which because of their objective weight are no longer easily detachable from the subjects they burden, and whose perception they obstruct.

'Atonal' was a good catchword: one is almost sorry to see it go. We know how vehemently Schönberg fought against this word, particularly in the *Harmonielehre*. He felt that 'atonal' could refer only to something completely contradicting the nature of sound – and he had nothing to do with that. It has, of course, repeatedly been said that he, and all the later composers who followed him rather than falling behind, have had to do with precisely that. Sound has been held to be a phenomenon with an intrinsically tonal constitution, based on its inner structure of partial tones, and thus basically unsuited to a type of composition lacking tonal orientation. Hindemith in particular has argued this way. It is to be doubted whether any composition, of any degree of differentiation, would in fact comply with this definition of sound – particularly on the level of highly developed tonality. The 'Tristan' prelude and the later piano pieces of Liszt, but also Beethoven's Great Fugue, can certainly not be reduced to such extremely strict relationships of natural tones. Faced by such highly organised structures, Hindemith's concept of tonality looks as if had been developed on the Alphorn; moreover, he relies on experiences which, as he confesses in 'Craft of Musical Composition', kept within the limits of the monochord and broke down by the time he reached the seventh overtone. The 'Harmony of the World' is as modest as that. None the less, people have had the impudence to make these simplest of numerical relationships, the harmonic spectrum, into a fetish: 'Nature', as if instruments had not had to be specially built so that man could produce it. They were certainly not built for atonal music. Composition that seriously breaks out of the system of tonality, that wishes to extend to its own constituent particles and to determine even these, can in fact not make do simply with harmonic spectra such as those provided by instruments; it demands highly complex formant relationships (they may be statistical, if this is provided for by the structure), and these apply to the individual element, which moreover becomes noise. All this, which is to form the inner coherence of the composition, can only be produced by means of the techniques of the electronic studio; it has been comprehensively realised in Gottfried Michael Koenig's *Klangfiguren II*, after Stockhausen's *Studie II*, composed exclusively with tone-mixtures, had unfolded the concepts of harmony and timbre as far as the point where they are seen to be identical. In *The Song of the Youths* Stockhausen then showed in principle the continuum of all spectra.

Instrumental music, on the other hand, has until today had to make do with the notes provided by instruments – even if these are electronic playthings such as the Ondes Martenot, from which Sylvano Bussotti has recently derived a mode of composition taking in really wide perspectives – though these notes have become problematical as a basic condition for composition. Stockhausen has mercilessly pointed out this contradiction, which takes on itself to show that the word 'atonal' is ultimately a legitimate concept because of the way it works out in practice; he has at the same time demanded an electronic instrument which will resolve this antinomy through its ability to vary the degree of phase-constancy of the oscillations produced. Until then, atonal instrumental music really does have something about it that is atonal in the pejorative sense of Schönberg's definition, the only exceptions being cases where the instruments are consistently used in the unusual way sometimes found in Cage.

But in historical perspective, too, there is a strong case for the word 'atonal', just as the concept of atonality marks the convergence of history and historically unvarying acoustical data. Indeed, long-standing ignorance of linguistic usage is necessary if one is to do as did H. J. Moser in his 'Musiklexikon' – assert, with the air of one announcing an epoch-making discovery, that 'atonal' means not tone-less but lacking tonality, since the word had been used in this way from the outset (for at least fifty years). At first it was a piece of invective, a critical four-letter word, like 'impressionism' (which also had an earlier version, 'impressionalism'); it reminds one of vocables such as 'extonal' and 'antitonal', which were still in journalistic currency during the twenties. Whereas the concept of impressionism was transplanted from painting to music, probably so that the names of Debussy and Ravel could be harnessed together (for no imaginable reason), atonality, more than any previous catchword, was originally coined with reference to music. The privative 'a' marks the negation of tonality, and the way this negation constantly refers atonal music back to tonality; 'saved-up' tonality, as it were. This is dialectical enough, and in view of Schönberg's work it has all the dignity of a concept; if Adorno says 'atonal', it would be unjust not to notice the way negation simultaneously emphasises what it negates. It is to be doubted whether critics use the concept in this way, but also whether in some of Webern's last works, which are wholly self-contained in their linguistic autonomy, tonality is even yet really negated. Herbert Eimert has written:* 'It is crystal clear how Webern achieves spatial tension by, so to speak, knocking in his acoustic objects right at the edge of the octave-gaps, thus creating for himself a complete system of barbed hooks, an autonomous, tightly-braced, freely-floating system from which the last trace of tonality has been erased'. This marks out the border of atonality and at the same time that of tonality; the major sevenths and minor ninths, which in these works erase the last trace of tonality, lie close to the octave, tonal index *par excellence*. So here autonomy is still dialectical, a matter of barbed hooks. These works indeed afford a glimpse of an atonality whose definite negation is directed at the tonal resonance system of the ear itself. This is in accord with the historical innervation of the works. Since there is no longer any pre-existent musical language, but rather each work must first build its

* *Die Reihe* II, 'Anton Webern', p.34.

own, the relation between this language and the objective linguistic state of the historical moment is, like its negative function of critical reflection on earlier stages, a condition immanent in the very business of composition, and not primarily a question of situation in musical history. The great conceptions of Boulez, Stockhausen and Pousseur draw their strength not only from their quasi-systematic consistency, but equally from the way they 'compose out' their historical positional value, and as their act of negation emphasises the concept of what is negated, this concept gives them an exclusive claim to be the legitimate tradition.

As a theorist, Schönberg, who tended to indulge in ancestor-worship of his musical predecessors, never attempted such negation; he proposed the expression 'pan-tonal', which strikingly shows the extent to which he regarded his historical achievement as merely continuing and amplifying what had gone before; a musical Fabian. Since Schönberg's genius could usually prevail over his practice, one hardly finds in his works this kind of preservative amplification, but it would mean a disastrously abstract negation of what was to be continued, rather than its preservation, in all cases where the negative function in the relationship had not been successfully absorbed. The loss of tension, which was a subject of my controversy with Adorno about recent music, was largely connected with the degree to which this music's negations are abstract or dialectical. Pantonality, which moreover recalls Fétis' concept of *ordre omnitonal*, could perhaps be applied to the kind of atonal music (if for once this useless expression were taken seriously) in which the recollection of tonality is no longer negatively implied, so that all connections are left free: for instance, triads in Schönberg's twelve-tone works, which, in extreme contrast to the triadic harmony at the close of *Pierrot Lunaire*, show a remarkable indifference, and certainly lose all trace of allergy in their relationship to tonality.

But when the consistent principle in a work is pantonality for which all constellations are right – and so far this has only occurred in the most recent works of Cage – the resulting separation from the general situation of our epoch is so astronomical as to be transformed into the most dialectical negations; in a sense it gathers together all the shock effect that was not allowed to find an outlet in the previous history of music. In art, what has any significance at all is measured by its deviation from what is established. Here I agree with Adorno that only what is 'wrong' is right. But outside this dialectic the word 'atonal' loses all significance.

The expression 'twelve-tone music' never had any in the first place. The fact that a piece uses a series of twelve notes in a fixed succession of intervals tells us nothing about the state of composition conceived in it, nor even what use the series is to it. Twelve-tone music is not a category, not a musical species. In Schönberg, twelve-tone series function wholly as a vehicle of what I once called panthematism, rather as in Boulez' concept of *ultra-thématisation*, which means the same: pre-forming of pitch material so as to allow even the smallest accompanimental figure, and in given cases chordal formations, to be organised into the total thematic unity. This carries to its end a tendency which developed in the music of Beethoven, Brahms and also Liszt, and which was already ostentatious in Debussy's String Quartet.

Webern's twelve-tone series are the absolute opposite of this, bidding an ever firmer farewell to thematic ways of thinking; as a formulation of pitch intervals they become a parameter of a structure which blended the separate traditional categories of

composition to form a new entity, by a technical unification of harmony, counterpoint and form. Incidentally, Berg, in the few works where he used twelve-tone series at all, really only consulted them, but relied basically on other constructive resources. This is no more a hindrance to critics and even historians than is the extremely important proposition that the major part of Schönberg's and Webern's production also does not use such series – the better part, too, bearing in mind the importance of their orchestral pieces and Berg's: Schönberg, Webern and Berg are unanimously classified in newspapers, periodicals and even books, as 'twelve-toners', and a few names such as Dallapiccola, Leibowitz and Krenek are added – all this with unutterable crudity of concept, and arrogant blindness to even the most banal facts. One laughs at music students who, when asked in an examination what Handel wrote, answer 'The Largo'. If today one reads such articles, one might think that Schönberg wrote or invented The Twelve-Tone – which, unlike Handel's slow movement, does not even exist. We do not know who invented The Twelve-Tone, that linguistic barbarism; to see who is not afraid to make use of it, one has only to read the literature concerned. But Schönberg referred to a method of composition with twelve tones related only one to another, hoping that it would be impossible to distil a catchword out of such a long name. Indeed the note-relationships in his works contradict his concept; for the rest, when it is a question of the flow, gesture and relationships of twelve-tone series, one can refer to twelve-tone technique.

This technique has since been incorporated into the more inclusive techniques of serial music. 'Serial music extends rational control to all the musical elements' – a definition taken from the first volume of this aperiodical. The word is borrowed from French usage, where *technique sérielle* can mean any kind of technique with series, including twelve-tone technique, whereas the use of 'serial' developed in Germany is designed to describe music in which not only pitches but also durations and intensities, and possibly also timbre and the placing of sources of sound are organised by means of serial formations. If one wishes to retain this meaning for the word serial, one can not automatically translate *sériel* as 'serial', but only when it applies to composition that extends to all the parameters. This is often overlooked. Unless for some reason one likes to fish in the troubled waters of semantic confusion, one must now consider seriously whether the concept 'serial' is any longer quite appropriate to those works of Stockhausen which in their construction are derived rather from the concept of groups; it is certain that this label should not be attached to Cage, whose composition does consider all the parameters to a very high degree, but who has developed strictly aconstructive modes of procedure, and who will have nothing to do with series or anything resembling them. But one may well say of a composition that in it some particular parameter is serial and another not. If one uses words, then nowadays it is not enough that one's terminological intentions are honest – one must also prove one's terminology is appropriate.

I am indeed on tenterhooks to see whether critics will make use of the expression 'aconstructive' which I have just let fall. For long enough they have attacked important musical works as 'constructivist', only there was no available word for its opposite, which they were so anxious to see. But they hurl themselves on each new idea thrown to them, deprive it of its meaning and adapt it as a vocable which can then be used wherever they have failed to understand something. In this way the press arrived at

'pointillist' music, and stuck fast. The concept of 'pointillism'* was precisely articulated when Herbert Eimert introduced it in a lecture at Darmstadt in 1953. What is meant is a method of composition which isolates the individual elements in such a way that their relationships and proportions can be grasped; the counterpole to this is the concept of the statistical, which developed along with composition whose complexity no longer permits a point-wise hearing of each individual element, but rather provokes higher-order categories of perception, which try to refer to average density, pitch, duration, intensity of passages, to rising, falling, swelling or ebbing tendencies, and so on. This pair of concepts expresses the dialectical proposition that greater complexity and finer organisation are penalised by cruder perception. Many of the most important works of the last few years realise this dialectic in their conception, but critics have referred to 'pointillist' music as if within the statistical note-flocks in these pieces they had been able to perceive only one single element as a point. Indeed the higher-order statistical criteria may equally have escaped them. But meaningless terminology has been dragged into pretentious musico-theoretical texts as a visiting card proving that the owner has refused to take the trouble of working out his ideas.

Recently the word 'aleatoric' has reached the press. Its currency dates exactly from the publication of the first volume of 'Darmstädter Beiträge', which contains my translation of an article by Boulez entitled 'Alea', and dealing with the function of chance in the technique of composition, particularly in connection with the possibility of so-called open forms. The critics obviously read only the title of this text and made a brief note of its theme. They also remembered vaguely that in the first volume of *Die Reihe*, in the heading to the first paragraph of Meyer-Eppler's article, they had read the adjective 'aleatoric'. It is usual to read headings rather than texts. But to produce a connection between Meyer-Eppler's heading 'Aleatoric Modulation' and Boulez' heading 'Alea' they must have read at least the very first words of Meyer-Eppler's first sentence: 'Aleatoric (from Alea = dice . . .)'. Since then, however, they have obviously forgotten the definition formulated in that sentence. So they all wrote, and write, particularly the famous senior critics of the leading newspapers, about aleatoric forms, when they are thinking of Stockhausen's eleventh piano piece and Boulez' third piano sonata (which is indirectly referred to in parts of Boulez' article). The forgotten definition is: 'Aleatoric . . . processes are those whose course is determined as a whole but whose individual details depend on chance.' The formal course of the two works for which they have coined their catchword is, however, the exact opposite: as a whole it is the result of chance, whereas the individual details are determined.

If the critics had taken the trouble to read Boulez' text, instead of just shamefacedly suppressing their gratitude to him for a possible catchword that they could have laid their hands on years before in Meyer-Eppler's article (which incidentally also provided European musical theory with the concept of the parameter), then they could hardly have failed to notice that Boulez does indeed refer to 'aleatoric happenings' within a possible composition, particularly to 'a certain number of aleatoric processes within a mobile duration', but not to aleatoric forms. There are indeed forms that could be so called, particularly in Cage and his school, in Morton Feldman and Christian Wolff;

* *Trans. note.* 'Punktuell', which literally means 'point-wise', is indeed not ideally translated by 'pointillist': the paintings of Seurat have only the obliquest of connections with the music of the last fifteen years. But the term is beginning to stick, and it is hard to think of an alternative.

concept might just cover a work such as Pousseur's *Mobile*. But since this plundered vocable, carried on the triumphal chariot of clumsy looters who had not even taken the trouble to make sure what it was they were carrying off, spread in a few days through the entire German press, and now obviously awaits admission to serious theoretical works, it should be said that these authors doubtless meant the opposite of what, in their ignorance of foreign words, they had written.

They are forever writing the opposite of what they mean, more often than can easily be imagined. For instance, since Ernst Kurth's concept of linear counterpoint has passed in infantile versions down to the vocabulary of the youth- and school-music movement, they regard all counterpoint as horizontal; no longer as the art of relating simultaneous parts, complex relationships of horizontal and vertical, which are the sum total of counterpoint. Thus in the newspapers 'contrapuntal' often denotes the absence of counterpoint: parts with no relation at all to each other.

It is the same with the notion critics and theorists obviously entertain about 'vitality'. One can understand their following popular etymology (which is about their level) and describing music by means of a word derived from 'motor' and its monotonous noise – 'motoric'; but only a psychoanalyst could explain how they come to regard this mechanical clockwork rattling as 'vital'. Here we should mention what they imagine to be rhythm; the absence of rhythmic articulation (i.e., of all work with subtle time-relationships), its place being taken by stiffly-maintained periodic metre for foot-stamping, with perhaps a few syncopations. But to them 'experimental music' means music which is still in baby shoes and which has still to become something genuine; not, as one might think, youth and school music, where indeed it would be hopeless to await anything of the kind, but the most advanced, highly deployed music of any particular time: in short, the definitive state of composition, which is expected to want to return to Mozart, to wholeness, to the true spirit of the adagio, to be 'the apologia of present-day humanity' (to quote a provincial critic), or to realise any other of their childhood fantasies of the solid and unquestionable. Incidentally, the concept of wholeness, which is nowadays so extraordinarily in favour, is appropriate only in its legitimate scientific context, that of Gestalt theory – elsewhere it is merely an irrational piece of abracadabra, covering up the inability to analyse; it is a basic part of the mumbo-jumbo of musical witch-doctors.

But the term 'experimental music', if it is to be given any other meaning, could refer only to music which by its own terms of reference is an experimental arrangement, and can therefore not foresee the results that will work out in performance. Cage's Piano Concerto perhaps, and his *Music Walk*, two of the most important musical performances in recent years, could be called experimental works in this sense. But we should point out very strongly indeed that none of the electronic compositions which have so far reached the public are experimental; the realisation or indeed the conception of these works was sometimes preceded by long-drawn-out experiments in the studio, but this happened for the very purpose of preventing the actual pieces' being experimental. Cage, however, has written a work, *Fontana Mix*, which for the first time applies to electronic music the principles of experimental composition found in his instrumental music; but up to now the critics have wasted the term 'experimental music' almost exclusively on its exact opposite, since they have taken truly experimental music so little seriously that they would not even give it the name. Thus the term is

in as bad a way as 'rinforzando', which critics, like most interpreters, have taken to mean 'sforzato', whereas every composer who has used it meant the very opposite of a dynamic shock – a gentle swelling of intensity.

On the other hand, I imagine that the catchword Electron Music in H. J. Moser's 'Musiklexikon' owes its origin to hardness of hearing on the part of a critic when electronic music was being discussed; he was then copied by all the others, in the way they always hawk these words around to one another and to their readers as soon as they find one that can be made into a catchword. They are, of course, rather slower at understanding music. They obviously believe in all seriousness that certain composers have composed with electrons, and therefore speak of musical splitting of the atom – which must indeed have preceded such composition, though not musically; and they talk about music of outer space, since after all astrophysics is just as much part of physics, or even about Sputniks. Where ideas are lacking, the most varied words do indeed take their place at the wrong time. 'Electrons in concentric attack', wrote one critic; another ended an article on 'Electron Music' (subtitled, of course, 'Betrachtung' – cf. p. 21); 'Man in God is stronger than a storm of electrons'. This is not always found to be so when there is lightning about, and may seem relevant to music only within the limits of communication by means of radio sets: perhaps one earths these so thoroughly in order to sense one's command over Nature? Of course the man in the street welcomes the sound of electronic valves, so long as it is pressed into service to reproduce works not conceived for it (the same applies to photographic reproduction processes as used for picture postcards); a pop number, that triumph of natural spontaneity, obviously pleases him best when played by a juke-box.

Here, incidentally, the critics' concept of 'true feeling' comes strongly into play: the fidgeting of slickly polished psychic reactions. But string quartets and symphonies, too, are thoroughly enjoyed when reproduced by loudspeakers, however inadequately they may come over. The only thing that must not come out of the loudspeaker is a work directly conceived for it; as in painting, confrontation with an original makes that comfortable feeling disappear, and out comes the term 'laboratory music', unless the critic is bold enough to use words with a mediaeval aura such as 'alchemist's kitchen' or 'witches' kitchen' – these do at least take into account the fact that electronic-music studios do not have the use of cyclotrons. When music critics and musicologists say music would do better to be content with mechanically produced oscillations, vibrating strings, air-columns and membranes, because these are more human, one can be pretty sure they own a radio set. When sound is produced electronically rather than mechanically, what do they call it? Mechanical.

But here we enter the special field which they indicate by the use of quotation marks, as if to say that such music is no longer music at all. How far back this critical and musicological tradition reaches, I can not say. Hindemith attributes it to Fux, writer of counterpoint books, a contemporary of Bach who none the less willed music to end with Palestrina; and Hindemith quotes Fux as his authority. Certainly Eduard Grell and Heinrich Bellermann, even in the progressive nineteenth century, refused to acknowledge that true music could be made on instruments, and rejected Beethoven, not to mention all his successors. They regarded the note of an instrument as, in present-day usage, a 'pre-musical tone', which only took on true musical significance when combined with human language. Nowadays electronic music is placed in quotation

marks in this way, and sinus-tone, noise and impulse are denied musical qualities.

But atonal, experimental, serial music are also regarded in this way by various authors. If one reads critics and books, music is forever coming to an end. So ultimately the concept of music itself must be included in the list of abortive concepts, so long as theorists and critics fail to grasp that what is stringently composed is itself a constantly new and unique reply to the question, 'What is music?'. To recognise this fact certainly requires a method which is immanent in the matter in hand, and which also points beyond it, instead of classifications which never touch it at all, or the vague conviction that a work is competent – the critics' favourite word for something that happens to please them. What someone has created, he could indeed always have created; if he has already done it a number of times, then he has a routine which may help him to knit some more pieces together. But important works are never competent; they are always almost impossible efforts, and are altogether opposed to the possessive character of acquired experience.

As a happy end, I should like to pay homage to a few terms which are always correctly used and therefore always horribly cutting, in whatever context they occur. First and foremost there is the concept of the 'musicianly'.* It is interpreted identically by the members of the youth- and school-music movement (who advocate it), and by Adorno (who analyses the horrors it comprises), as the blind practice of singing and playing, without reflecting about the work concerned – in so far as works are concerned at all. If a critic calls a piece or a performance 'musicianly' one can be quite sure he is telling the truth, whether or not he realises what a devastating judgment he is making.

It is the same with the terms 'elemental', 'elementary'.† Their automatic companions are often the pre-civilised, natural energies, and the like. If 'elemental expression' is mentioned, one sees clearly the extent to which the image of an earlier state of humanity, of barbarism, can nowadays reckon with general approval: people react to it. But however far back the terms 'elemental' and 'elementary' may reach – whether to one's first music lesson or back to pre-historic tribal customs, – when used as a description of hair-raising crudeness they invariably provide accurate information about their subject. So long the phenomena comprehended by such concepts continue to exist, they must be retained, to give a name to what should not continue to exist.

* *Trans. note.* 'Musikantisch' is most vividly translated as 'note-spinning'; there seems to be no corresponding English word with the same positive and negative connotations.

† *Trans. note.* The English language has these two words for the two meanings of 'elementar', so that the author's linguistic point does not apply in English. The paragraph has been retained because his other points remain valid.

STUDIUM IM STUDIO

GOTTFRIED MICHAEL KOENIG

Since electronic music has existed – that is to say, for about half a dozen years – there has been uninterrupted discussion about it. Not only has it been violently attacked from certain directions; objective discussion itself is full of pros and cons. Now, it is easy to rail against what is new, particularly when one can be sure that it and its terminology will be unknown, certainly not familiar, to those before whom polemics are delivered. But I do not wish to disarm attacks, nor to try to adduce convincingly positive arguments with the aim of building an ideological protecting wall around the electronic studio. The authors of this music knew beforehand that it would not fit many people's favourite preconceptions; and they will not be surprised when the shocked listener informs them that he feels electronic music to be a mockery of 'real' music. I wish rather to report on the daily work carried on in the studio, but particularly on the fact that many young composers from all countries come to Cologne to continue their studies there, and on the specific experience they acquire here.

At first there was (perhaps there still is) a widespread opinion that electronic music was the concern of a few composers who, for reasons that we do not need to consider here, had renounced the existing corpus of instruments in order to create, under the pretence of novelty and under the protection of ostensibly revolutionary ideas, music which in the end becomes unapproachably specialist, shutting out their colleagues (who write 'only' for traditional instruments), the critic (since in doubtful cases he sides with the public) and the listener (since he has never yet properly understood anything about music). It seems as if the radio, remembering its role as Maecenas, had set up a quiet corner for composers, in which they could tinker undisturbed. Indeed there are a number of features suggestive of makeshift rather than a university seminar or a complete laboratory. In keeping with this, the circle of colleagues was small at first; apart from the initiators, only a very few guests worked in the studio. But since then the situation has radically altered. Apart from composers from Germany, Sweden, the U.S.A., Belgium, Italy and Israel, who have already come to Cologne and realised pieces, there are at the time of writing (1959) four colleagues from Hungary, England, Argentine and Korea, who study and compose here. In this way the task of informing has been supplemented by that of teaching. Here I refer only to composers who have been able to obtain the necessary scholarships in their own countries; there are many others who lack the money for such study.

Whether this pedagogic duty must also be counted among the tasks of the radio is a question which must probably be answered in the negative. In any case, the studio in its present form – and this applies equally to the studios in Milan and Brussels – is not in a position to comply with such extensive obligations. It lacks rooms, apparatus and helpers with sufficient technical qualifications. The question whether, for that matter, electronic music deserves such expenditure, can be answered by saying that in the academic field – and every subject which for any reason becomes a matter of research belongs in this field, particularly when students, if at first only a few, wish to make

this new field the subject of their study – that in the academic field the installation of a pedagogic institute follows on the presence of a field of research which attracts students and thus becomes the subject of public interest – it depends less on the immediate usefulness of the subject itself. If nowadays the musical conservatoires arrange classes in jazz or instruction in the use of instruments, such as the recorder or viol, which have already become obsolete, this is not because jazz or playing on old instruments meet some sociological necessity, but because academic institutions do not stand in the way of their pupils' desire for instruction. Comparison with these disciplines does not of course imply that sociological needs are ignored, But since the democratic constitution under which we live has no way of judging sociological needs, it can not neglect one at the expense of another, providing they both arouse the same amount of interest. From this point of view it seems necessary to set up an electronic studio which can adequately carry out its pedagogic tasks – and here I am going to discuss only the pedagogic side.

Electronic music can not be taught purely theoretically, any more than can instrumental music or an experimental scientific discipline. One needs rooms and apparatus, to work practically. Indeed, all the composers who have so far come into the studio had already composed for orchestral instruments and had acquired practical experience through performances of their works. But music is not a subject with a range of practice, fixed once and for all, which can be used to dispose theoretically of everything further. As an acoustic event, music is perceived by our sense organs, and abstract connections can only be transmitted through sensory experience. This means that successful musical communication coincides with the exact transformation of a process of thought into sounding reality. If a composer wants to communicate a *new* process of thought, he must convince himself by trial and error that it can be transformed into sound-phenomena. This was already true of instrumental music, in which all the instruments are familiar, and where it is only a question of new combinations or new ways of playing or combining the instruments. But if a composer finds that his acoustic imagination can not be realised with orchestral instruments, he looks around for new ways of producing sound. So he arrives in the electronic studio. Here, however, he will not get very far with experience acquired in instrumental music. Instead of playable instruments he is faced with electronic generators, which one can only adjust but not 'play'. But this need not alarm him; for it is of no importance whether a musical event, in the final form of its time-flow, is immediately 'played' or must first be assembled in a number of work-processes; the decisive thing is the result, for which the suitable means of production must in each case be discovered. Apart from this we must consider that a difficult instrumental work, too, is impossible to play at a first attempt; to start with, each musician practises his part, then the conductor rehearses with single groups of instruments, then with the entire ensemble, until finally the performance materialises. This, too, is a kind of montage, which, as the work of rehearsal expands, hinders the individual musician's subjective spontaneity to the corresponding degree.

Now, to appreciate the situation of the composer when he comes into the electronic studio, we must, at least briefly, sketch two processes: one is the method of producing electronic music, the other the relationship of this method to the composer's imagination and experience.

As already mentioned, electronic music is not 'played' on instruments. The initial

material is produced by generators. These generators are not tuned to the semitones familiar in our tonal system, but are adjusted to technical data. The so-called 'pitch' of a tone is measured by the number of vibrations, those of a violin string, a column of air in a flute or – in this case – an electrical circuit's number of vibrations per second. Our ears can hear vibrations in the region from about 50 to 15,000 per second: but the semitones of our tonal system – which correspond to the keys of a piano – represent only a small section from these 15,000 frequencies. So not only do the tones used in music up to now correspond each to a numerical value which indicates the number of vibrations, but there are many more tones which the generator can be adjusted to produce. These generator tones are called *sinus tones;* they are, as it were, the simplest tones imaginable, elementary models. The timbres of conventional instruments are assembled in complicated ways from these elementary tones. This means that to produce varied timbres these sinus tones must be combined according to laws which one discovers on analysing the timbre of orchestral instruments. Here one finds at the same time that only quite specific combinations of sinus tones produce timbre in the accepted sense; most of the conceivable combinations have the character of noise. Here the composer runs up against a phenomenon which in instrumental music is only found at the periphery; the gradual transition from musical tone to noise. But noises do not necessarily have to be assembled from sinus tones; there are generators which can directly produce the most complex noise, *white noise*. This is just as elementary as the sinus tone; but whereas sinus tones must be assembled to give various timbres, white noise is filtered, that is to say split up into separate regions. Finally we have yet a third acoustic event of a model character; the *impulse*. It has no 'duration', like sinus tone or noise, but represents a brief energic impetus, comparable to a leaping spark. Consequently it has neither pitch nor timbre. But it encounters an object and sets it vibrating, it becomes audible; as pitch, noise or timbre of the object which has been impelled and which now continues to vibrate because of its inertia. If this system impelled by the impulse is constructed so that it continues to vibrate periodically, like a tuning-fork, the result is a pitch; if, on the other hand, it continues to vibrate aperiodically, like the membrane of a loudspeaker, which is indeed intended to transmit all pitches equally well and therefore may not give preferential treatment to any, the result is a noise without definite pitch.

Work with a material which, unlike orchestral instruments, can be called elementary, creates new problems for the composer. Although dissatisfaction with the timbres of the orchestra made him turn to the electronic studio, he does not find any stock of new timbres here. They have rather to be assembled from the elements mentioned. This only becomes significant in the appropriate musical context – moreover it requires an effort of composition on its own. The didactic significance of the electronic studio is fulfilled when this effort is directed toward the elementary material as object of composition. The expectation that electronic production of sound would widen the so-called 'palette' of the orchestra is one of those obstinate misunderstandings that arise from a consumer's way of thinking – as if the purpose of music were merely to place new articles on the market so that existing customers are at least retained, even though no new ones are acquired.

If we now compare these three models (sinus tone, noise, impulse) with the instruments already known, this is what we find:

The sinus tone corresponds to the sound of a stringed or wind instrument, with the difference that the instrumental tone already has a timbre, and that its timbre can not be altered at will, whereas sinus tones must first be assembled to make timbres, but are completely free as to how they assemble. Noise corresponds to struck cymbals, with the difference that the various timbres of cymbal noise are determined by the various types of cymbal and attack, whereas the white noise produced by a generator is in fact colourless (like white light), though on the other hand it can be broken down into regions that are graduated as one pleases. Metal orchestral cymbals may seem superior to generator-noise in richness of timbre, but one can easily recognise the material from which they are made, whereas with generator-noise such associations are less likely. Apart from this, the indistinct pitch-region and the noise-'breadth' of cymbals can hardly be altered, whereas it is just these dimensions which can be exactly defined by various filterings of white noise. One can make a gradual transition from white noise, which takes in the entire breadth of the auditory region, to a tiny 'band' of noise, which approximates to a sinus tone and can thus be exactly placed as a pitch. Lastly, the noise produced by struck cymbals diminishes in loudness, whereas electronically produced noise can be prolonged as long as desired and can even increase in loudness. Finally, the impulse would have its equivalent in such a thing as a drum beat. There are very many sorts of drum, as we know from dance music and jazz in particular; their characteristic timbres, like those of struck cymbals, are very difficult to imitate electronically; but no composer is likely to use a generator instead of a ready-made instrument. The impulse, like noise, can be filtered as one pleases (or, to put it more exactly, one can use it to impel the most varied filters); this is the way of exactly defining its 'breadth' and also its pitch.

The production methods of electronic music thus consist of recording, further transformation and assembly of acoustic models, in contrast to orchestral instruments which, like a painter's tubes, deliver ready-made timbres. The models are sinus tone, noise and impulse; the main methods of transformation are electric filters and the various possible tape-techniques.

Now to the second point, the relationship between these methods and the composer's musical imagination and experiences.

The process of composition is usually imagined as follows: a composer 'thinks of' a melody and fixes this melody on paper by means of familiar symbols. If we for a moment ignore the aesthetic factor, a musical process consists of a number of notes, which have specific pitch, intensity and timbre, and which succeed each other, or sound simultaneously, in certain specific ways. One may imagine that a melodic inspiration is still undefined rhythmically, and that its time-relationships are only fixed later. One can equally imagine the existence of an initial rhythmic framework, a succession of points in time, for which pitches have subsequently to be found, and intensities and timbres, that is to say instruments which perform the points of sound. That music of any kind is thought of as such a succession of single points, each separately defined in terms of pitch, timbre, intensity and duration, is a fact obviously connected with the 'instrumental' development of music. It is now impossible to tell whether the human voice or an instrument came at the very beginning, and it is also not the crucial point: if music began as song, it only started when men no longer howled or shouted but produced specific and considered pitches with their larynx.

One can not sustain a note as long as one likes; moreover there is a limit to one's powers of modulation. This is equally true of an instrument. It produces single notes or noises whose length, intensity and timbre depend on its construction, material and the way it is played. Instruments alternate – as many as there are in the ensemble concerned – and on instruments pitches, intensities and durations alternate. Nowhere is there any idea of a continuum. Naturally not, for primitive man regards continuity as the characteristic of nature, which he must dominate and not allow to submerge him. The individualisation of musical events runs parallel to that of man. He seeks recognisable individual units, gives them names, defines and thus places himself at a distance which renders the elements amenable to manipulation – at first by magic, then in myth, later in the way of classical religions, and in the end scientifically. The process of enlightenment dissolves any continuum in logic; this has its counterpart in reduction to first principles and their manipulation – that is to say, cunning, as a means of domination. But the more one isolates facts, the more the distinction between them shrinks, the more the individual details merge again in the continuum. The decisive thing is the degree of consciousness accompanying this process – how one articulates the relationship between the dissolved continuum and the single phenomena whose mass nature gives them back a statistical, continuous character; this decides whether man relapses into myth or proceeds along the path of enlightenment so that in the end a rationally ordered world becomes visible, instead of opaque, petrified relationships in which man is just as caught up as in magical spells.

The generators in the electronic studio produce an elementary sound material whose elements almost submerge again in a continuum. In our comparison with instrumental music we have seen that this 'fine grain' of electronically produced material particularly suits the assembly of timbres after the manner of orchestral instruments, and their differentiation to a considerably greater extent than was previously possible. Our philosophical digression has made us regard this fact as a problem rather than accepting it without examination. On one hand, the course of history has dissolved the continuum of natural noises into isolated instruments; on the other hand we have assumed that this 'instrumental development' makes probable a particular type of musical thinking on the composer's part. He has renounced the orchestra, in order to be able to define still more exactly; in the studio he realises that continued atomisation strikes back into undifferentiation. This cannot fail to have its effect on his ideas of music; to study electronic music, I should say, means essentially to run up against this problem and to find a solution. This is for the moment the limit of our pedagogic task, which is more important than the handling of electronic apparatus instead of musical instruments. We can be more precise on this point. Let us assume once more that the composer assembles his music out of a number of 'parameters', out of points distributed in time, which, in order to become audible, must first receive an intensity value, a pitch and a timbre. At first, then, there is an abstract framework, which must subsequently be 'scored'. We would use this word in its broadest sense, not only for the application of timbres but equally for the fixing of the other parameters without which the abstract blueprint can not be realised in sound. But 'scoring' is not to mean merely definition, but definition for instruments, that is to say choice from among a number of *existing* instruments. We have meanwhile seen that this is just as possible with the resources of the electronic studio as with those of the orchestra. One can

compose an abstract blueprint and consider whether each point in time is to be scored with a sinus tone, a timbre assembled from sinus tones, a filtered noise or an impulse. I believe it is quite obvious that in this case we should be dealing with an extension of the traditional orchestra – not, indeed, that electronically produced tones could be used forthwith on the podium (this leads to great practical difficulties in performance), but that, by analogy, one would merely use other 'instruments', without relinquishing the idea of 'instrumentation' as just defined. In so far as one clings to the idea of instrumentation every extension of the orchestra will be welcome. But in fact there have been very few attempts to construct new instruments. Quarter-tone pianos, electrical stringed and plucked instruments (apart from the electric guitar), the trautonium and so on, have been unable to win a lasting place. One may well imagine that success awaited anyone in a position to try out all the known materials, nowadays supplemented by countless types of plastic, in order to build instruments with new timbres and extended possibilities of dynamic gradation, instruments for the representation of complicated time-flows and pitch scales. Nothing of the kind has occurred, or at least such attempts have had no practical success. There have indeed been many experiments with electrical resources, but again there has been no basic addition to the existing orchestra.

Electronic music alone strikes out into a new world of sound – not, however, by way of new instruments, but via a production process which stands in opposition to the orchestra. 'Instrumentation' seems to be as 'antiquated' as its instruments. But young composers' dissatisfaction with the orchestra and its possibilities is not identical with the discovery that dissatisfaction could be directed at the idea of 'instrumentation'. If I believe that the pedagogic problem in the electronic studio is to be found where experiences with the orchestra or certain of its instruments are transformed into dissatisfaction and provoke the desire to break the spell of instruments by electronic means, I believe it because I have been able to observe that almost every composer has first attempted to produce new timbres with the electronic apparatus in the studio, and then to introduce them into a score which differs from a score for orchestra only by the fact that it is worked out with finer distinctions.

Earlier in this article I made a comparison between the models for sound material producible by electronic means and familiar instruments, and I should like to continue this comparison. I said the sinus tone was comparable to violin or flute tone; both have a definite pitch, can be held for a long time and can get louder and softer. They differ in their inner structure (sinus tone = single vibration, instrumental tone = an assembled vibration; this we call a 'spectrum') and in their possibilities for combination or dissolution; sinus tones can not be further broken down, but can be assembled to form spectra, instrumental tones can be broken down, though only with the help of measuring instruments, not during a performance; but at least they can be altered – by the use of mutes and various methods of sound-production – embouchure, plucking of a string, bowing *sul ponticello* or *sul tasto*, etc.

Whereas the sound mutations of orchestral instruments are limited and also familiar, sinus tones can be assembled in very many ways, not only to form so-called 'harmonic' spectra, corresponding to the timbres of instruments, but also to form 'sub-harmonic' spectra, with a bell-like sound, and all the other possible combinations which either obey laws such as that of geometrical progression or else quite ignore mathematical

rules. Here we shall discuss neither such laws nor the many further possible ways of producing sounds from sinus tones through dynamic gradations of the partial tones.

The following fact is more important; a musical tone with a timbre, resulting from the combined effect of five sinus tones, can most conveniently be produced electronically by using five sinus tone generators, each adjusted to one of the five frequencies, then recording the total sound on tape. It should be noted that this does not produce a 'chord', since there are not five instruments playing together, but what musical terminology calls a 'note' (in acoustics a 'sound'), since five sinus tones whose frequencies are determined by the mathematical law of harmonic progression combine to give an overall impression of one definite pitch to which we simultaneously attribute a timbre. To use this 'note' within an electronic piece, we need only take our scissors, cut off a piece of the required length from the tape on which it was recorded and stick this piece where it is supposed to occur. In this way we should have 'scored' a predetermined point in time, according to the definition given earlier. We now continue our thought-experiment and demand that before this note has died away a second is to begin. We assume that the length of this second note has also been fixed, but also the distance between the points of time at which the two notes are to enter. This distance we call the 'entry delay' (earlier 'interval of entry'). Let us now consider how to carry out our task in technical terms; the two pieces of tape are played back on two tape recorders so that the second reaches the playback head the specified amount later than the first. This can be managed by sticking on at the beginning of the second piece of tape a non-magnetised tape of the desired length. If now both machines are started simultaneously, we can record the result on a third machine. We call this procedure 'synchronisation' and it obviously plays a great part in the production of electronic music. One thing, though; in this thought-experiment we have started from a false hypothesis: in fact we do not have five generators in the studio, but only one. Thus we must help ourselves out by recording each of the five sinus tones separately and uniting them by the method of synchronisation. Here we run up against the following question: could one not make the five sinus tones enter successively, as we have just done with the two sounds? Many composers wish to define the individual processes in their music much more exactly than has for a long time been possible; and here we find a way of influencing the behaviour of the elementary processes in music in a way which is out of the question so long as one uses ready-made musical instruments.

We know that one not inconsiderable pleasure afforded by music consists of noticing relationships between the sections of a piece. Many people are delighted when a theme returns in a form already heard; this is the relationship of identity. Others are glad if in the meantime the theme has undergone some alteration, so that for example on its reappearance it has a new character; this is the relationship of variation. Finally, classical sonata form has made us familiar with the exposition of two different themes, which are reconciled in the course of the development so that in the recapitulation one recognises them as in many ways related. This would be a dialectical-evolutionary relationship. These relationships are striking; they stand before the musical work like a façade which makes clear its major articulations. But in its interior there is a play of countless relationships which between them make up the density of a piece and which constantly feed the attention with which one follows the course of the work. So it is much more the composer's business to place his material (pitches, intensities,

timbres, time-relationships) in ever new constellations, instead of speaking an inherited language which in any case is declining into jargon, as if it were being prepared for sale in the market.

I have just shown how two sounds can be synchronised. Let us assume that for a short musical structure five such sounds are to be synchronised; let us also take it that the composer wants four different delays between the entries of the five sounds. He could now have the idea of using these four infra-structural delays within the very first sound, which is to consist of five components (and in a varied form within the other four sounds), in this way binding together the individual sound and the structure built by his sounds. It could also happen that the whole piece consists of five sections, whose entry delays again bore the same relationship to each other. Thus the total form would be linked to the tiniest detail.

Let us halt here, to consider what are the consequences of this. The composer, brought up on instrumental music, comes to the electronic studio and finds that the components of an instrumental note, as analysis has shown, are sinus tones, which can be taken from a generator and reassembled to form a spectrum, that is to say an instrumental note. Firstly, he will hardly try to imitate this instrumental note, but will start to produce new kinds of timbre according to the same laws, or others logically inferred; secondly, technical methods make it likely that he will manipulate the components of sound in a way that is impossible with instrumental notes, namely to regulate the entry delays of the components, and moreover to make them of differing length as far as possible. (I need not say that I am constructing a model case, and that the composer's encounter with studio resources and methods is incomparably more complicated). The resulting structure is not at all similar to those familiar as sound or noise – less and less similar, the more it deviates from its instrumental model. It is no longer an acoustical event which can be introduced into a score like an instrument, since the individual points in time are not charged with timbre, but themselves appear as 'sound'. Indeed, I wanted to regard 'instrumentation' as a choice from among a finite number of timbres (including their dynamic and other variations), which would be definitive for the piece concerned. But, given universal connection extending even to the elementary material – and our thought-experiment was supposed to indicate the possibilities inherent in this – it becomes impossible to draw up a list of timbres which can be introduced into the score. By passing the limits of instrumental music and carrying differentiation one step further, we obtain a structure which is no longer an invariable at the disposal of 'instrumentation'. To save the idea of instrumentation, one would have to forgo this step, and, with it, all the specifically electronic possibilities. But if one has the will – and it is documented by the decision to introduce the possibilities of electronic music into work along previous lines – to take this step, and to use the potential of the electronic studio where it extends beyond instrumental composition, one must inevitably drop the idea of instrumentation and carry out a thorough reappraisal of the whole connection between isolated, or at least 'isolatable', events and their singular constitution. Events such as those outlined above, which can no longer be 'introduced' in the instrumental sense, but rather articulate the reversal of timbre into construction, can no longer be differentiated according to concepts which merely indicate the suitability of resources to their purpose – that is to say, whether the sound employed lifts sufficiently clearly into consciousness the point of time which

it clothes; not to mention judgments such as 'beautiful' or 'ugly', which can, however, be retained for the discussion of new wallpaper.

When one discovers and applies the proposition that 'timbre' is the psychic reaction to a mathematically described relationship of overtones, an illusion is certainly destroyed: the illusion that timbre is something like a natural product and that its selection is a matter of taste; but an objection is also aroused, and the answer can again be clarified by the didactic function of the electronic studio. We have described a process of sound-'demontage', which consists in a mutual time-displacement of the partial tones of a spectrum. A precondition was a sound with a length that would be familiar from existing music, let us say a second. If the five components of this sound are mutually displaced in their entry delays – and here the duration of the components may also alter, so that they perhaps vary between 0·7 and 1·4 seconds – a polyphonic formation results, whose component parts remain clearly perceptible. Like an extensive structure made up of sounds, this could be called a 'time-table', and I should have laid myself open to the charge of having 'instrumented' it, not with spectra but with sinus tones. Admittedly the acoustical results of our thought-experiment would lag behind theoretical expectation; but one should ponder the fact that the implied preconditions which led to demontage were incomplete. To compose timbres is, after all, not only to find the right relationship for their components (with regard to frequency), but, equally, to determine in the right way the higher-order relations with regard to their absolute durations. If a sinus tone is sustained, it is not really any different from an instrumental tone; the sinus tone, too, has a timbre, and in both cases no alteration occurs between the beginning and the end (except perhaps a dynamic one). But my tacit assumption of a sound of 'normal duration' was not only meant to ensure a connection with traditional music but was at the same time conditioned by the technical peculiarities of the electronic studio. If the frequency of a tuning *a* is 440 cycles, this means simply that an oscillating body vibrates 440 times in a second. The individual vibration – a period – thus lasts 1/440″. But the studio has no device at its disposal which makes it possible to open the generator for this length of time, should one want to use only a single period. Even if such a device were available, the tape would still have to be cut as if it were not, if one wanted to isolate the period recorded on tape; even if one used a tape speed of 30 inches per second, which has now practically fallen out of use, one would have to cut off 0·068 of an inch. If, however, five periods recorded at the now customary tape speed of 15 inches per second are to be cut, the length of tape involved would be 1·705 inches. A note two octaves higher (*a* above the fourth treble ledger line) would reduce this value to a quarter. (Here the difficulty is not so much the small values themselves as the fact that it is impossible to distinguish between the smaller intervals when working in this way; five periods of *a′* would be 1·705 inches long, five periods of *b′flat* would be 1·61 inches). But this is where our reasoning leads us: if timbre is defined simultaneously by the relationship of its components and their invariability between beginning and end, it must, as an instrumental category, be destroyed in both parameters; it has become possible to assemble timbres from components in the studio (as shown above), but on the other hand it is impossible to determine their absolute duration at will, because (once again) of the limitations of an 'instrument', namely the apparatus in the electronic studio. But if one could get round this obstacle (and the technical conception exists), composition of timbres could be

transposed to a time-region in which its individual elements would hardly be audible any longer; the demounted sound would not last seconds (so that a polyphonic sinus-tone structure appears in its place) but only milli-seconds; losing its duration, it would indeed lose its existence. Instead of five sounds (as in the above example), we would 'compose' perhaps fifty, so that the number of points in the timetable would radically increase. But these points would not be filled out with sinus tones perceptible as such, but single periods, which would be audible only *en masse*, as a fluctuating timbre.

Even this time-table could – but hardly justly – be called an 'instrument'. The definition of an instrument would suffer; it was planned and constructed as a tool for a particular purpose, and it will only fulfil this purpose so long as it keeps its consistency unaltered. If the marking 'oboe' did not ensure, within a slight field of variation, a constant timbre, technical conditions that were always the same, then the composer would be unable to score an orchestral work in the accepted sense. In the terminology of serial technique, the parameter which could indicate the relationship between the orchestral instruments – the 'timbre-gradient', as it were – remains constant in all instrumental compositions, however all the other relationships may alter. Composition of the spectrum in the electronic studio already makes this parameter fluid; it would completely merge with compositorial disposition if one could work with periods instead of sinus tones. Timbre would finally lose its instrumental character; the 'time-model' into which periods are inserted would be so flexible that it would refuse to serve as an instrument.

But from this point of view the thought-experiment developed above could be useful pedagogically; it shows how electronic music alone would be possible as composition of time; at the same time it opens our eyes to the undecidedness of which I spoke at the outset; wherever the construction of atomised material comes from, where it goes is the composer's responsibility. But instead of striking the word 'instrumentation' entirely out of musical terminology – which would be nonsensical, not only because it is a token of history, but also because composition for orchestral instruments continues and will continue – we must decisively widen its meaning. *Instrument* would henceforth mean not only a piece of musical apparatus; in matters of musical composition it would equally mean the sound produced by this, and ultimately the laws according to which the sound is made, its formal or structural model. 'Serial technique of composition' is nothing but the canon of quantitatively describable structural models. *Instrumentation* would ultimately mean the discovery, linking and realisation of such models, and would be elevated to the category of composition. This is the only way in which electronic music can be learned. Since work with generators runs in the opposite direction to work with customary instruments, composers who feel the orchestral palette to be insufficient find themselves disillusioned in the studio.

Electronic music is not a closed system like the classical disciplines of counterpoint and harmony, in which one can take courses. It is rather the very stuff of the composer's effort: an activity, not a profession. Even if it is impossible to give instruction in the studio, in the institutional sense, it still serves as the pedagogic province for those composers who determine musical sound in its elementary dimensions, who wish to dissolve the discrepancy between abstract time-scheme and acoustic-sensory impression: the sound would not be introduced into the time-scheme, but would be conceived *as* a time-scheme. In this way, electronic music could fulfil the intention of instrumental music.

TONE-CLUSTERS, ATTACKS, TRANSITIONS

MAURICIO KAGEL

'The aim of any technique is to perfect the means of expression', wrote Henry Cowell in the introduction to his book *New Musical Resources*,[1] written in 1919, published in 1930. Cowell had made it his task to build up a system which would coordinate all the elements of musical language in a logical way. Here we shall consider some extracts from this book, which even today is still one of the few documents to treat concretely and shrewdly the ideas about musical theory developed during the first half of the twentieth century.

The beginning of a new stage in music's development has always given rise to justification or attack, two *états d'esprit* which have provoked both theoretical essays and the production of works. The present-day generation of young composers feel they must get to know the theoretical conditions affecting composition, and find a methodical basis for it. But analysis of the manifestos, pamphlets, essays and books produced in the first half of this century has disappointing results. One finds mostly subjective arguments and 'unconscious aesthetic interpretations' – these are far more prominent than methodical and theoretical investigations. The explanation is that the creative urge in the first decades of the century was concerned to liberate, to absolve from the past, and that this was no state in which to lay the foundations of order and considered investigation.

A particular phase in this development was marked by Schönberg's creation of the twelve-tone system, the forerunner of which was the 'emancipation of the dissonance'. But Schönberg's intention was not simply to lend order to dissonance with his new compositional method. In a lecture on twelve-tone composition he emphasised two ideas: 'The two- or more-dimensional space in which musical ideas are presented is a unity', and moreover he said, 'The unity of musical space demands an absolute and unitary perception.'

These two ideas may be regarded as the basis of Schönberg's twelve-tone system, which by its new technique of serial treatment opposed certain basic traditional ideas about musical configuration.

The necessity to base the perception of musical space on a law that would justify a wholly technical process led Schönberg to identify the basic shape of a series, its inversion and their two cancrizan forms with the multiplicity of musical space. Is this an acceptable approach? Can one compare the use of a series in various directions with the perception of musical space? In dodecaphony Schönberg established a system of note-relationships where intervals are indeed interchangeable, but the relationships of pitch, dynamics or duration – the three structural parameters of sound-phenomena – are not organised. Without a common basis for these three parameters, however, twelve-tone technique can not be regarded as regulation according to laws or as an organising system for musical space, as it was originally called.

[1] Alfred A. Knopf, Inc., New York.

Almost at the same time Henry Cowell developed a theory in which the systematic inter-relationship of notes was transferred to the field of tempo, rhythm and dynamics. These experiments have so far been ignored, and we return to them not in order to discover an unknown method but to show that, even today, Cowell's reasoning can be reconciled with the newest problem of serial music.

> In a later volume of *Die Reihe* we shall analyse Cowell's theory as a whole, particularly the concept of rhythm, by which Cowell prophetically understands time, metre, dynamics, form, the linking of metre with time, tempo and finally rhythmic scales. With astonishing coherence Cowell logically assembles the syntactic elements of musical language, and by applying to the empirical parameters of composition the relationships of the overtone series he obtains a result that permits him to sum up his conclusions in a 'Theory of musical relativity'. He avoids questions of aesthetics, or 'philosophical discussion of what is good and bad, what should or should not be done, or what may or may not be done.' His book is therefore a document whose theoretical approach, still relevant forty years after it was written, illuminated aspects of technique, while not burdening itself with outmoded aesthetic demands.

Cowell starts from the relationships of the overtone series, assuming that this physical phenomenon is the decisive factor, and marshals his conclusions in a system which logically provides mathematical evidence of the production of overtones. As musical language and harmonic theory developed, the patterns followed by the overtone series were only gradually drawn into composition. Taste, academicism and theories of composition gave rise to rules and harmonic formulae which in each period of musical history were altered almost to the point of arbitrariness. The end-product of this long process undergone by the harmonic language of Western music appears as a chord containing all twelve chromatic tones.

Cowell did not reject this process, but pointed out that the intelligibility principles of traditional harmony are closely tied to other laws irreconcilable with the principles mentioned. He also examined the possibility of using overtone series in composition, without being influenced in his attitude by selection *a priori* – a selection which until now has been decisive for the very factors that prescribed the use of consonance and dissonance. The labile objectivity with which attitudes were canonised also meant – and this is proved by analyses of the principles which have regulated the various periods of musical history – that contradictory assertions could co-exist, not producing solutions but aiming only to ensure the outward illusion of schematised sound. Whether one attaches special importance to subjective determination of the relationship between consonance and dissonance is a matter of taste, and Cowell does not; for him, the overtone series is an equally valid way of organising tones.

We shall concern ourselves in particular with the chapter about the formation of tone-clusters[2] in Cowell's book.[3] He says that tone-clusters are chords built out of major and minor seconds, which for their part can be derived from the upper reaches of the overtone series – from the 16th partial tone onward; thus they have a funda-

[2] A term invented by Cowell to distinguish between chords built out of seconds and those built out of thirds and fifths.

[3] Section III: Chord-formation, p. 117 onward.

...al. In the ensuing discussion *we shall call clusters only those sounds which are at ... a major third broad and filled out with major and/or minor seconds.*

...mentary on the Table

The table of tone-clusters (Example 1), extends the principle developed by Cowell ... his book. The examples relate only to the piano, but apply in the appropriate way ... all instruments (or combinations of instruments).

...ixed tone-clusters

The four basic forms serve as the basis for larger clusters, which can differ widely ...ause of the many possible types of superimposition.

A fixed tone-cluster can well be compared with the superimposition of thirds in traditional harmony; one finds an exact correspondence:

(1) A major third below and a minor third above: major triad.
(2) A minor third below and a major third above: minor triad.
(3) A minor third below and a minor third above: diminished triad.
(4) A major third below and a major third above: augmented triad.

Moving tone-clusters

A moving cluster is distinguished from a fixed one in that it moves from a defined ...al breadth to a different final breadth. Thus a moving cluster can be portrayed as ...angle. There are three forms of extension for a cluster:

a) 1. Movement upwards.
2. Movement downwards.
3. Movement both ways at once.

The opposite is equally possible:

b) 1. A fixed cluster is attacked, and all the notes are released, beginning with the lowest and moving upwards.
2. The same process, beginning with the top note.
3. The notes are gradually released from both ends of the cluster moving toward the middle (or vice versa).

Lastly, the following basic form is produced:

c) When there is no longer a recognisable transition from a fixed cluster to a ...wing one, since a fixed one moves by shifting along the available keyboard.

Large tone-clusters by addition

One superimposes several clusters to obtain a large cluster. If the superimposition ...curs successively, one must not forget that the individual clusters must continue to ...nd until the large one has been completely built up. This procedure is also possible ...ng chords.

Small tone-clusters by subtraction

Out of a very large cluster one allows only smaller regions to sound. This process is ...miniscent of the electro-acoustic production of 'coloured noise' – frequency bands of ...rying breadth are filtered out of 'white noise'.

A cluster and a frequency band are, however, different in that the cluster is a super-

imposition of periodic vibrations in an equidistant pitch scale, whereas a frequency band (coloured noise) is a superimposition of aperiodic vibrations. One can also let chords go on sounding out of a large cluster.

5. *Clusters of harmonics*

These are produced when one depresses keys silently and plays lower notes or clusters which serve as fundamentals. Any of the forms 1-4 can be combined at will to produce them. From the combination table (Example 2), we see various categories of superimposed basic forms. Many of these combinations, both vertical and horizontal, can not be performed on a single instrument: it is impossible on the piano or other keyboard instruments, where the pedal is employed to a large extent for articulating *one* cluster, so that it cannot be used to superimpose various categories. In structures of this kind the density can be determined in three dimensions (vertical, horizontal and diagonal), taking into account the entire region between the highest and lowest notes and the vector between the space-time coordinates. The interval-breadth of a cluster can become gradually smaller or greater. A fourth dimension of density would be subordinate to dynamics; at constant intensity a denser cluster is felt to be louder than a thinner one.

The mechanism of dimension-connections is characterised by the relationship between any cluster's time-organisation and its vertical density.

The duration of a moving cluster does not necessarily have to depend on the number of notes available but can also be guided by register (the higher the shorter, the lower the longer), and by the combination of instruments, which organises the timbre (e.g., piano longer, xylophone shorter).

In a cluster, time and its measurement by a tempo are linked to form a unity. The duration of a fixed cluster can not be measured as a tempo. In a moving cluster, on the other hand, duration can be performed in relation to a tempo: a succession of connected tones whose entry-delays can be regulated by a given tempo. This characteristic of the cluster opens up new possibilities of variation and shows the transformation of tempo in relation to density and register. Duration is given by the vibration duration of the cluster; tempo articulates the internal time-relationships.

How can one explain the application of clusters to the technique of serial composition?

For Cowell, clusters are second-chords. In serial composition the formation of harmony is not governed by laws based on a unit interval such as second or third, but is determined by the arragement of the notes in the series. In this way simultaneity is produced as the result of a superimposition of notes of the series, not through an interval which is varied in size and filled out with seconds. Although this description of serial 'harmony' is theoretically acceptable, it is contradicted by the need to arrange the notes so as to avoid the occurrence of intervals undesirable because of their semantic associations.

> Before the 'democratisation of the notes', mentioned by Schönberg, could turn into a similar political phenomenon in the field of intervals, classical and romantic theories about intervals first had to be demolished; one would then have had to accept that a major triad has the same justification as a superimposition of two fourths, in order to be able to forget in the end that these

> two chords could not be equally justified. But one does not forget, and in almost all dodecaphonic music hierarchy is much more marked than the proclaimed equality of the elements. The wealth of seconds is an example of this. They are faithfully derived from the series, but their effect is indisputable, even if they are meant only to avoid some doubtful seventh-chord.
>
> The emancipation of the dissonance is a fact; emancipation from the dissonance is a possibility. The need for self-expression in dissonant language arises not from deciding between two alternatives – consonance or dissonance – but from the choice of a single 'list', which offers the smallest probability of disappointments.

Cowell seems to foresee that tone-clusters could be rejected because, being premed second-chords, they are a harmonic manifestation that is not serially articulated; he cluster must be treated like a single unit, as a single tone is treated."[4]

> We should also agree, in cases when the tone-cluster were a non-serial element. But the mechanics of serial technique can make the cluster part of a coherent musical structure because they discover its hidden internal processes, so that it is no longer used as an effect out of context. After these processes have been elucidated, it will perhaps be possible to use clusters again, without subordinating them to a more immediate technique.

If the tone-cluster is really treated as a single tone, one must add a new parameter to the other three (pitch-register, note duration and intensity); the breadth of the cluster. This points to new relationships between the various properties of sound. If during the duration of the cluster its breadth alters, its pitch-register can remain constant; the alteration in breadth will be perceived as pitch-glissando. If the breadth is varied, the density automatically alters (here we take this to mean a larger or smaller number of vertically accumulated tones).

If several instruments play a cluster, the result is a complex mixture of timbre: this we call a 'sonority'. If the tones of a cluster are played with different intensities, the sonority alters even if the mixture of timbres remains the same.

If two clusters are played successively on the piano, with the same intensity and breadth in low and high registers, the lower is felt to be longer and – because of its many oscillations – also denser; the higher one is felt as shorter and more transparent.

The degree of alteration of a moving tone-cluster is determined by its internal structure; the parameters mentioned are dependent on one another to such a degree that alteration in one parameter automatically leads to a reaction in the other parameters.

If the structure of the cluster is serially arranged, then one is dealing less with a developing process in time than with a special process in a virtual space, limited by the highest and lowest notes of a cluster.

Piano, celesta, harmonium, harpsichord, xylophone, vibraphone and glockenspiel, harp and bells are some of the solo instruments best suited to production of clusters, though indeed they can not articulate their finest degrees of variation.

There are fewer possibilities of variation on keyboard instruments than in the orchestra or instrumental groups, where the sonority of the cluster can alter, and the

[4] P. 121.

mixture of different families of instruments enriches the cluster's structure. In the recently composed orchestral piece 'Apparitions' by György Ligeti, and above all in earlier works by Charles Ives, Henry Cowell and Edgard Varese, this process of alteration is exploited.

In the orchestra large moving clusters (see 2, 3) can be produced, Narrower clusters can be denser than broader ones. Mobility of the individual cluster within the large cluster is obtainable if one uses several instruments; on the other hand, this mobility is limited at the keyboard of a piano. A combination of instruments avoids the rigid monotony of piano tone.

So far, clusters have generally been used as a kind of anti-harmony, as a transition between sound and noise. In John Cage's procedure – for which I should like to introduce the term 'prepared timbre' – the tone-cluster becomes extremely differentiated and is extended, becoming a noise-like process. Cage has not been content with the chromatic cluster of the piano, but has introduced noise processes into the cluster by means of piano-preparations.

It is as well to use a whole series of clusters.[5] The choice of register in which they are articulated is doubtless decisive. Only then can one perceive a process of variation, in so far as the clusters occur in varying regions, and with differing modes of attack, breadth, duration and intensity. The action by which a cluster is produced on the keyboard rules out the traditional mode of attack with the fingers. The forearm, the flat of the hand, the fist, the edge of the hand, these are some of the means of producing a cluster. The change in mode of attack points to new relationships between gesture and the resulting sound, and seems a natural step towards a metamorphosis of performing practice. In ensemble music the tendency toward individualisation of dynamics for each instrument (to avoid package treatment) is accompanied by a correspondingly individualised approach to attack.

Tempo beaten by the conductor produces in the performer a series of reflex gestures, which depend on the visual tempo. Since an individual approach to tempo is not usually prescribed, the instrumentalist must adapt the performance of his part to the conductor. The conductor does not simply beat the tempo, but suggests to the performers the close relationship between the kinetic energy they put into their attack (or touch) and the dynamics aimed at. Thus one can mostly indicate the mode of attack as a dynamic evaluation of the tempo, which is carried out in a unit of time corresponding to the measured tempo.

The upbeat is usually the metronomic unit of the immediately succeeding tempo; the amplitude of the gesture is a measure of the dynamic amplitude of the sound. Pointillist technique and the treatment of dynamics and tempo in serial structures are hastening a revision of the traditional upbeat. The conductor no longer forms dynamics and tempo simultaneously by his gestures, since the allometric growth of series produces a differentiation of the individual parameters. If the conductor assumes the role only of a living metronome, the instrumentalist is forced to defend his part by the valuation of his individual performance, which up to now has been limited in ensemble-

[5] The formation of large clusters on the black or white keys is a less good idea, since they produce respectively pentatonic scales and major or modal scales.

performances to a special technical effectiveness, contributing to the conductor's unifying interpretation.

If one examines the modes of attack needed to produce a tone-cluster one notices that the breadth of the cluster depends on the surface of the member used to strike the keys.

The limits which one can approximately attain, to articulate a cluster consisting of minor seconds, are roughly as follows (on the piano):

With the hand

Fingertips. 1.

Surface of the hand with fingers closed. 2.

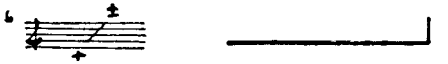
Surface of the hand with fingers spread. 3.

Edge of the hand. 4.

With the fist 5.

With the forearm

Without the surface of the hand. 6.



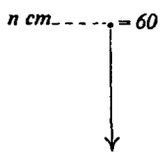
With the surface (edge) of the hand. 7.

An attack is determined, by four characteristics: duration, energy (speed), weight and form of the object or part of the body carrying out the attack, and distance. All these are in causal relationship to the dynamics aimed at, the constitution of the instrument, the phenomenology of the process and the register. If one investigates the relationship of each of these four characteristics to the others, one reaches conclusions which allow the inclusion of a syntax of gesture in the process of composition.

In fact musical language must be determined by the technique of composition; current modes of thought do, however, suggest a tendency not to adapt to this demand the connection between the organisation of tones and their auditive physiognomy. Music composed in this way can not be realised, not even in the attempt to achieve an 'ideal interpretation'. The open interpretation of an polyvalent form depends not only on its form – or rather, on the representative function of musical form. (Perhaps we should find an open definition for the concept of open form.)

It is the same with sound-ideals. Although it is the task of the conservator to investigate their qualities, an investigation of the acoustic constitution of present-day music, with a view to formulating a unifying concept, would be just as difficult as trying to read a text written directly on to the roller of a typewriter. In electronic music, timbre has found the way to emancipation; the composer does not limit himself to articulating the individual version of a collective sound-ideal, he uses his material to acquire the experience necessary to mulptiply his '. . . ideals'. Why, then, should one be angry with a composer because after drawing up the parametrisation of the system he does not succeed in offering a coherent experience as a resultant?

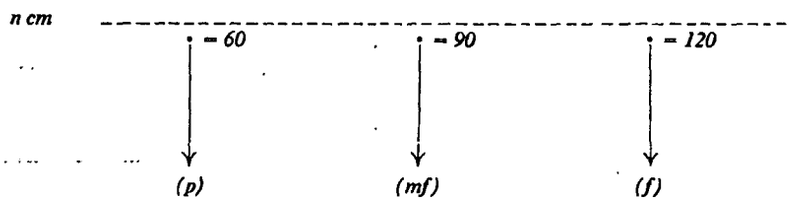
Duration is a measure of movement, and can be indicated in metronomic units:



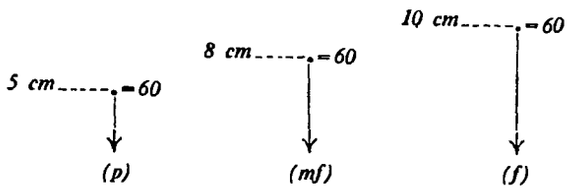
determines the time needed by the object between leaving its point of departure and striking the instrument (1″).

Throughout the ensuing discussion, duration of movement is regarded as a constant value; it is thus to be independent of acceleration or deceleration.

Speed, on the other hand, can be dependent; it is determined by the duration (metronomic unit) and distance (inches). Speed automatically includes energy, which produces the required degree of dynamics.

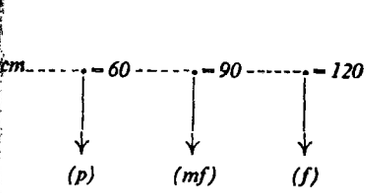


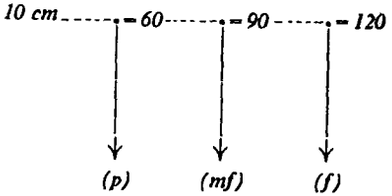
One attains the same result if the duration remains constant while the distance varies:



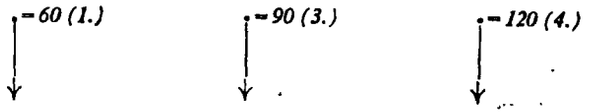
Energy (speed) thus appears as a dependent quality, since one need only allow the other qualities – within their own definition – to increase, in order to produce a proportional increase in growth within the resulting dynamics.

One can produce various dynamic scales, if different distances are fixed for each. A series of attack durations is determined for each distance:



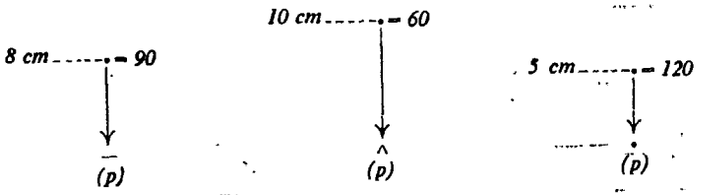


Thus one obtains various *p*s, *mf*s, or *f*s, which one cannot compare one with another, but which correspond to values in a scale of durations at various distances. It would be possible to number this scale of durations:

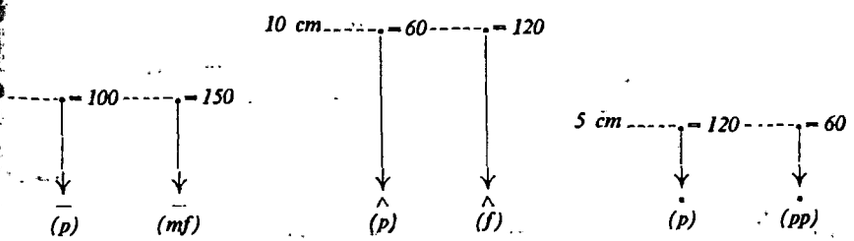


If one works with a fixed distance, no special indication of dynamics is necessary; it is implied by the duration of movement.

Since for the same *p*-sign one indicates various modes of attack — ∧ ·, it is necessary to accommodate duration and distance to one another:

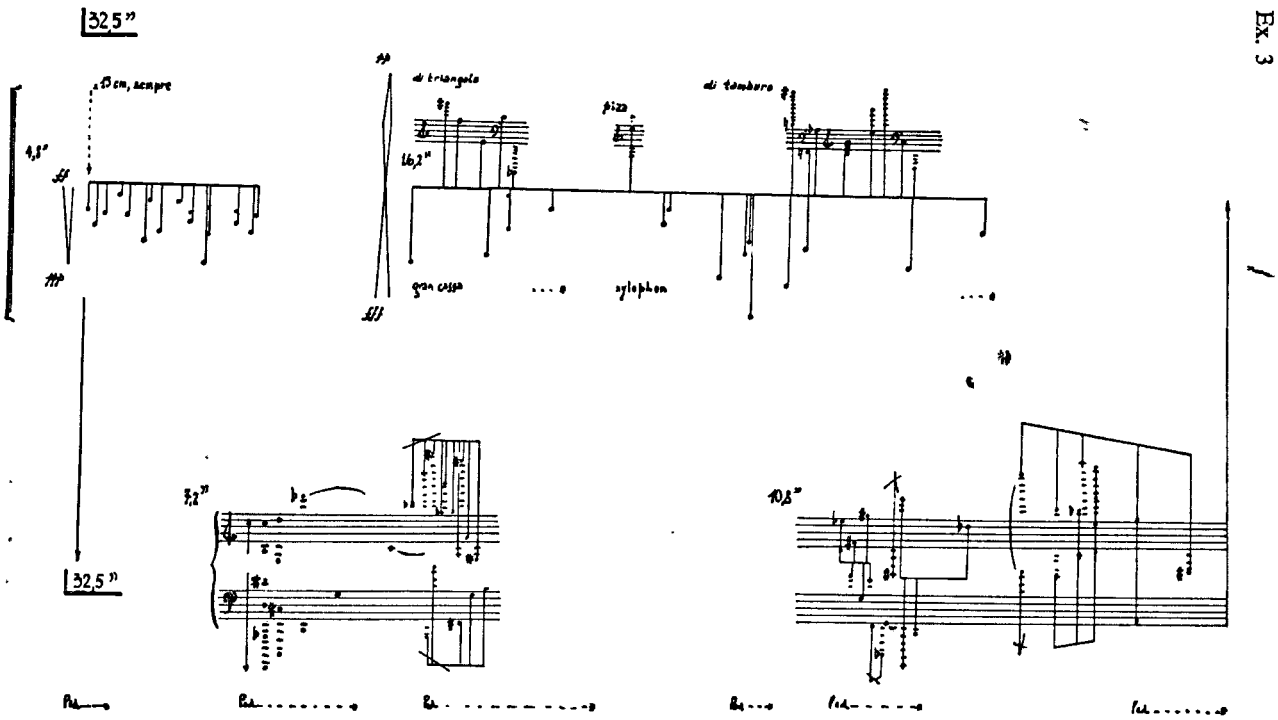


Modes of attack, coupled with duration- or distance-scales, can lead to greater differentiation. The following scales are then possible:

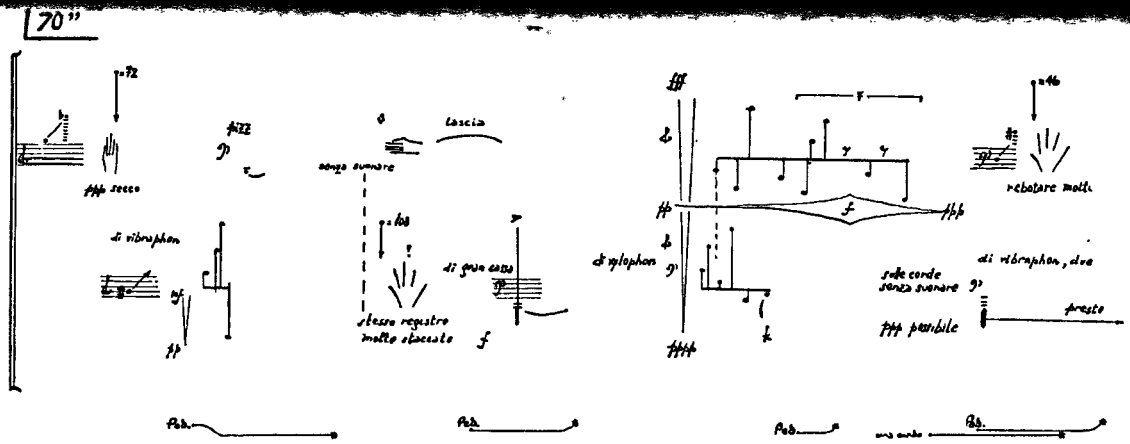


The resulting dynamics will also be related to the weight and shape of the member (or object) used.

Ex. 3



TAPE II [247 cm] 4 times



TAPE I

In striking note-clusters on an instrument the cluster-breadth determines a corresponding density; distance and duration are not independent of breadth. Thus one can predetermine different duration- and distance-scales for each cluster-breadth.

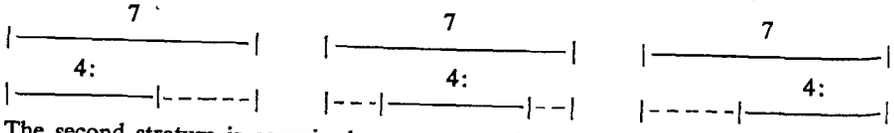
Interpretation depends on the strict or flexible description of action. Interpretation of dynamics is not necessary, since it results from the description of action.

A better knowledge of the relationship between action and dynamics leads to exact results. Dynamic articulation is really a field where relativity still prevails. To quote Cowell, 'Who can say exactly how soft *p* is, or exactly the loudness of a *ff*?'. All that has happened with the advent of the pointillist technique of composition is that the composer's own sensitivity to dynamics has been stimulated; as a rule, one can perceive hardly more than a mezzoforte (the celebrated 'mezzo-fortissimo') in the works that have been written with this technique. Perhaps it is time to find a common denominator for this territory, so that when a work was reproduced it would be possible to attain the dynamic scale the composer had in mind, irrespective of variations between various concert halls, instruments and performers. On almost all instruments one obtains a *p* or a *f* through a corresponding dosage of energy or breath, and with the duration allotted to these. If one achieved an intuitive balance between the characteristics of attack-movement and intensity, perhaps conscious balance would also become a part of the concept of reproduction.

In my work *Transicion II* a pianist and a percussionist play simultaneously on a piano. In certain sections of the work I have tried to solve some of the problems discussed above. The percussionist uses only his sticks (from the triangle stick to the bass-drum stick), playing on strings and sounding board, also on the casing of the piano; the pianist limits himself to the keys. (The relationship between the two performers resembles that of an organist to his assistant whose task it is to carry out registration.)

Three superimposed strata make up the work; the first is produced by the combined action of the two instrumentalists (direct performance); the second is a tape-recording of the sounds which have just been played by the two instrumentalists; the third stratum is produced during the performance, as certain periods of the piece are recorded by a special recording-head,[6] and rings of tape of various length, whose filtered products are played back into the concert hall through loudspeakers (mediated performance).

In the first stratum a time relationship between the two instrumental parts is produced through overlapping of the limbs of a proportion. In the proportion 4:7, for example (both figures indicating seconds), 7 is the limb of maximum duration, within whose limits 4 is mobile:



The second stratum is conceived as a permutation of a growing series of entropic values.

[6] This special recording-head differs from a normal one in that the erasing, recording and reproducing heads are differently arranged, so that on one tape one can superimpose various strata (up to about six strata, for technical reasons). In the electronic studio this head (usually called a copying-head) is used mainly to superimpose sinus-tones to produce tone-mixtures, and to obtain impulse-structures with varying speeds. If one uses a ring of duration *s*, one combines it with a duration *t* as many times as is permitted by the length *s*: $\frac{t}{s}$ = total of superimpositions.

Entropy is to be regarded as a measure of disturbance, and here the disturbance lies precisely in the abolition of the original qualities of a material by means of successive alterations, which are arranged in a rising scale and appear in mechanical permutations. Composition with electronic resources has accelerated certain thought-processes which, though they were already conceived in instrumental music, were not yet exactly formulated. In certain cases, negative signs had to be given to compositional elements which would otherwise have been positively marked.

Thus, for example, during the backward flow of processes within the two forms of irreversible time – sound-duration and prepared sound-structure, which in the course of the compositional process was still further articulated internally, by rests and other sounds – new categories of movement were produced. Their qualities – defined by the constitution of the material used – have opened up new possibilities for musical syntax. In this way one could add the following denominators:

Acoustic structure, reversible (e.g., white noise)
\+ Time, irreversible
reversible

or

Dynamics, reversible, e.g.,
\+ Time, irreversible e.g., formant glissando, rising
reversible

The sounds of piano and percussion are subjected to a series of procedures which alter their timbre and build-up processes so much that it is impossible to recognise the original sounds in the material that finally results.

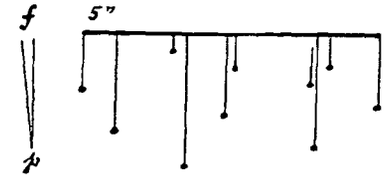
The third stratum consists of several takes with the copying head and various rings of tape which are shorter than the structure they record.

Thus in *Transicion II* the three basic structures arise in mutual dependence on time, both in the morphological process of composition and also in performance. A continuum is formed from the above-mentioned tape recording, the direct action of the pianist and percussionist (which is recorded as they play), and its immediate reproduction over loudspeakers. These three structural strata run together to form the density flow of the piece.

Remarks

Example 3 shows two different periods from *Transicion II*. The notation in the percussionist's part is as follows:

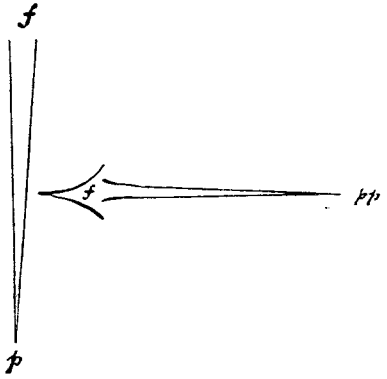
Sounding board



which means a series of noises produced (in this case) on the sounding board, their total duration 5 seconds. Each noise is given a different dynamic value which is fixed approximately in relation to the continuum between loud and soft:

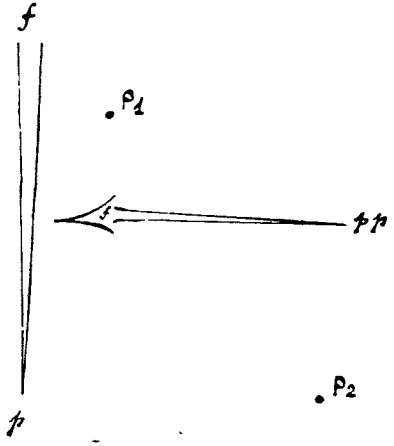
The durations of the noises depend on visual assessment of the distance between the points in each particular piece of graphic notation.

When there are two crescendo markings at right angles, the vertical hairpin alters in relation to the crescendo or diminuendo of the horizontal one. Thus each dynamic value is determined by two components.



The component determined by the vertical dynamic hairpin is altered by the horizontal crescendo. This process can be called *dynamique ajoutée.* Thus crescendo and decrescendo of the horizontal hairpin do not mean the two dynamic components are equivalent, since the maximum intensity of the decrescendo will be softer than the minimum of the vertical hairpin.

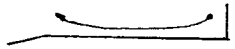
For the latter, dynamics are given as a linear scale, whereas the crescendo-decrescendo is to be regarded as a hairpin describing a logarithmic curve running in two stages.

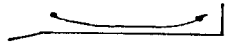


The horizontal hairpin begins at *mf* (defined by its relationship to the vertical one). Thus the dynamic of P^1 is an added one: the first value of the vertical hairpin, *quasi forte*, plus the second value of the horizontal hairpin, *forte*, *giving quasi ff*. At P^2 the resulting dynamics are *ppp*, a summation of the upright *p* and the horizontal *pp*.

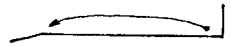
The movement of the forearm on the keys for the clusters of harmonics in the piano is notated as follows (for the right hand):

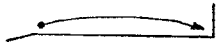
1. Keys depressed with the entire forearm (with or without hand, then successively released, so that

(a) the elbow 

(b) the wrist (or elbow joint) remains on the keys as a fulcrum. 

2. The forearm laid on the keys so that they are successively depressed:

(a) beginning with the elbow joint, 

(b) beginning with the wrist. 

SOME REMARKS ON BOULEZ' 3RD PIANO SONATA

GYÖRGY LIGETI

Pierre Boulez' Third Piano Sonata grapples with one of the most immediate problems of musical creation and performing practice, especially with the problem of the proportion between what is strictly composed, that is to say fixed by exact notation, and what can be interpreted freely. After a period, beginning roughly with Beethoven and culminating perhaps with Stravinsky, in which composers tried to determine ever more exactly the way their works were to be performed, there nowadays appears a tendency not only to allow the interpreter to choose between various possible realisations of a composition, but even to allow him a certain participation in the architecture of pieces – to present him not with completed buildings but with prefabricated building elements, with which he is free to construct as he pleases, within the limits laid down by the composer.

But at this point we must already mention that in these cases there is no question of obscuring the boundaries between the realms of creator and interpreter, since composers are scarcely prepared to let the reins leave their hands and to entrust the fate of their musical progeny wholly to the judgment of interpreters. The new freedom of performers is not freedom to improvise, of the kind permitted to a limited degree in the age of discant or thorough-bass; it is only freedom to select the appropriate building possibility from the list prepared in advance by the composer. Composers are wily enough to allow interpreters merely an illusion of freedom, since in conceiving a work they bear in mind all the possible ways of performing it, and in handing over their work to the play of fancy they look on with maternal care.

It is remarkable that the extension of interpretation comes just in the present period, since one can see in the technique of composition a tendency, not customary before, toward the strictest predetermination of the musical elements. Melodic relationships – that is to say, the succession of intervals – rhythmic and dynamic proportions, type and alternation of timbre; in the most recent works all these are generally pre-stabilised, with great precision, and the operations to be carried out with these series of musical elements – that is to say, the type of formal build-up on the basis of the given series – are also often carried out according to principles that are most firmly anchored. But this does not contradict the above-mentioned freedom of the interpreter, since in past music, too, prescription and arbitrariness co-existed; only their roles are reversed. In Reger, for example, one finds such a piling-up of performing indications that interpretation is settled to a very great extent. On the other hand, the very process of his composition is deeply permeated by 'ad libitum'; adventurous modulations, and, as one of their consequences, the entrainement of periodic structures, seem hardly to be organised beforehand but to result from the composer's choice and fantasy at each moment. In Stravinsky there is a still greater tendency to determine performing indications. From the most exact metronome markings to the various kinds of drumstick, every conceivable indication is laid down in advance, apparently out of panic

lest performers should interfere. Despite this striving after precise performance the inner structure of Stravinsky's music is extremely mobile; it is often possible to interchange what is simultaneously superimposed as well as what is successive. This makes possible a technique of quotation and produces the mosaic-like quality of many of his works. The interchangeability of later with earlier, and of higher with lower, is really the principle which has now reappeared in recent serial works. Since in composing Stravinsky has already tried out the various combinations and has fixed the final solution in the score, in his music these possible displacements are restricted to the composer's workshop. On the other hand some young composers transplant this process into their performers' territory. Thus Karlheinz Stockhausen recently wrote a piano piece in which the succession of the individual sections – and thus the overall form of the piece – is left to the pianist; and Henri Pousseur has realised similarly arranged pieces for electronic sounds, which he has logically enough called *Scambi*, 'Exchanges'. This delivery of building bricks is, however, not arbitrariness on the part of the composers mentioned, but results inevitably from the transformation of musical technique.

Here we shall mention only two of the many reasons for this upheaval. First: the dissolution of tonality – which already began with the establishment of tonality, became particularly acute in Wagner and was completed in Schönberg – led at the same time to the destruction of forms based on development, since development became impossible when not directed at a goal, deprived of tonal centres. Forms resembling one-way streets, the sonata for example, faded with the death of modulation, and the way was clear for static musical structures, circling within themselves, forms which can be passed through in more than one direction. Second: when performing indications became so excessive that they could no longer be observed, precision of performance was changed into vagueness. This process, this leap into the exact opposite, can best be followed in the works of Pierre Boulez. In the strict logic of a serial technique for pitches, durations and timbres, arrived at through the study of Webern and a piano piece by the Flemish composer Karel Goeyvaerts, and also by further developing a technique of rhythmic cells stemming from Messiaen, he arrived at a differentiation of rhythm and dynamics which was unparalleled until then, and which can hardly be realised exactly. Here, where the performer must take such care that he can no longer take care at all, the indeterminacy of realisation finds its way into the total determinism of structures woven by means of serial technique.

The two processes discussed finally link up; interchangeability within non-developing form and package-interpretation of durations and intensities gave Boulez the idea of not leaving this freedom to mere chance, but of guiding it within certain limits, taking over the steering of the musical form that was unfolding, making the interpreter the chauffeur, who can drive in any one of a number of directions along the routes planned by the composer and signposted in advance.

The written text of Boulez' third sonata represents such a map. In outward appearance it does indeed resemble a map of a city, since the performer is handed a multi-coloured and variously folded convolution. There are for the moment five major sections – formants, as Boulez calls them. 'For the moment', since Boulez does not regard the work as finally completed, but intends to link the individual sections in further combination. This conception of an interchangeable, constantly variable work of art goes

back to the great book planned but never completed by Mallarmé, that remarkable *Livre*, sketches for which have very recently been discovered by Jacques Scherer.

The five existing formants can be played in various orders, but the longest one, lasting twelve and a half minutes, must come in the middle. This formant is called *Constellation*. Groups of notes are strewn in various ways about long unfolding sheets, and in fact the way these notes hang together does produce constellations. There are particular rules of play for the succession of these groups; to ensure better orientation they are written in green and red ink. The plan is laid out so that in performance there is a constant oscillation of register and density, a wave around a central line, as it were. In two of the other formants the registers are fixed; in *Strophe* everything happens low down, whereas *Séquence* takes place in the top register. These two last hardly more than a minute each. *Strophe* does in fact have a quasi-strophic structure; single lines, which are chosen according to a rule of play. In *Séquence* the succession of the groups is still more variable, regulated only by a stencil made of transparent paper, which the performer can lay on the sheet of music wherever he pleases; he plays whatever appears in the gaps in the stencil. A further formant, *Antiphonie*, consists of pairs of lines, which are mutually interchangeable. Finally, the formant *Trope* consists of obbligato groups which can be variously permutated with each other, and further groups which are interpolated between the obbligato ones, and which can be played or left out as the player pleases – thus they have the effect of parentheses or footnotes. This form is to some extent related to the mediaeval trope, but in Boulez' work we find not merely melodic interpolations but intercalations of whole complex structures.

It will now be clear that a very large number of possible forms exist. The varying folds of the music sheet, the stencil, different colours make possible these various ways of passing through the work, which offer constantly new views of the same landscape.

(March 1958)

TWO LECTURES

KARLHEINZ STOCKHAUSEN

Electronic and Instrumental Music[1]

I

Electronic music has existed since 1953. We owe the foundation of a 'studio for electronic music', under the direction of Herbert Eimert, to Hanns Hartmann, former head of the Westdeutscher Rundfunk, Cologne. Five public performances in the concert hall of this radio station, many radio broadcasts and public demonstrations in other cities during the last five years have shown the results of this work. How did we come to this music?

Having studied the music written during the first half of this century, several composers became thoroughly sceptical about European music: not only with respect to matters of language, grammar and vocabulary, but also with respect to the conventional materials, in fact, to the sounds themselves. We realised that the historical development of instruments was closely linked with a music which was no longer ours. Ever since the turn of the century, composers had had the idea of saying something new, but they employed as before the old notation, the old means of communication. This resulted in the fundamental contradiction between the physical nature of the traditional instrumental sounds and new musical ideas concerning form. (See *die Reihe* 3, page 20). In 'harmonic' music (often called tonal music), the sound materials and the construction of the instruments were directly related to musical form. Twelve-tone music and its consequences in the field of instrumental music utterly destroyed the former harmony between the structure of sound material and musical form. For this very reason, the radical twelve-tone music of the first half of the century appeared 'impure' because the operations of composers with the given materials were not functional. Expressionist music actually exploited this contradiction, thereby obtaining its best results. In twelve-tone composition harmonic and melodic relations between fundamental tones have nothing in common with the micro-acoustical relations in the interior of instrumental sounds.

What are the consequences? Wherein lies the difference between instrumental sounds, between any audible events: violin, piano, the vowel 'a', the consonant 'sh', the wind? In the group 'musique concrète' in Paris during 1952 and 1953, I made many analyses of instrumental sounds – especially percussion, recorded in the Musée de l'Homme – also of speech and noises of all kinds. The sounds and noises were recorded in various kinds of rooms (anechoic chamber, room with normal acoustic, reverberation room). Electro-acoustic apparatus: filters, oscillographs, etc., was used to determine the sound characteristics. What people call a 'tone' in music – without asking what it actually is – has been discovered to be a more or less complex wave-structure transmitted to the ear. Acousticians speak of 'sound-spectra', and describe these by

[1] This article was the basis of a series of lectures held at American universities in November, 1958.

means of a series of factors in a space-time diagram. Analysis of sound by electric filters can be compared to analysis of light by prisms. Today, physicists are not very interested in research in sound. For purposes of theoretical study in this subject, literature on phonetics has proved to be the most useful.

The musician, therefore, for whom the question of research in sound had for the first time become acute, has been obliged to undertake a considerable amount of this research himself. He has had to expand his métier, and to study acoustics, in order to better the acquaintance with his material. This will be indispensable to those composers who are not content to accept sound phenomena as given facts, but who, in opposition to the dictatorship of the material, attempt to drive their own formal conceptions as far as possible into the sounds in order to achieve a new concord of material and form: that of acoustical micro-structure and musical micro-structure.

The existing instrumental sounds are pre-formed, dependent on the way instruments are built and played: they are 'objects'. Did the composers of today build the piano, the violin or the trumpet? Did they determine how they should be played? What does an architect do if he has to build a bridge without supports, a skyscraper or an aircraft hangar? Does he still use adobe, wood and bricks? New forms demand reinforced concrete, glass, aluminium – aluminium, glass, reinforced concrete make possible new forms.

This gave rise to thoughts of giving up the pre-formed instrumental sounds, and of composing the sounds for a particular composition oneself, of combining them by artificial means according to the laws of this and no other composition. Composition goes one step further than before. The structure of a given composition and the structure of the material employed in it are derived from one single musical idea: material-structure and work-structure are one and the same thing.

Briefly: it has become technically possible to realise this intention. Practical analyses and studies gave us the idea; if sounds can be analysed, perhaps they can also be synthesized. Goeyvaerts wrote to me in Paris at that time that he had been making inquiries in Brussels and had heard something about generators of sine-waves; I should begin some time to produce sounds with the help of such sinus-tone generators. I made the first attempts at a synthetic sound-composition with sinus-oscillators in the Club d'Essai, Paris.

I began working at Cologne Radio Station in 1953. Among the sound-sources in the Cologne studio at this time were electronic music-instruments – a melochord and a trautonium – which served in some experiments as sound-sources, but which were soon discarded when the idea of sound-synthesis asserted itself.

II

Before describing details of this work, I should like to mention a few instrumental compositions which were written during this time. This is to remind us that the language of new instrumental music and that of electronic music are the same (so far, but it will be difficult to prevent electronic music from becoming vulgarised in the long run). When visitors come to the Cologne studio to hear electronic music, they quickly get over the first shock caused by the unusual sounds; and they ask why there is no rhythm (perhaps they mean regular metres of $\frac{3}{4}$ and $\frac{4}{4}$), why no melody, no repetitions, etc. Thus the discussion is usually not at all about electronic music as such, but about the

in which it is composed, about language. We therefore then play recordings of ks by Anton Webern, written, for example, in 1910. Then we play newer instrutal compositions by Edgar Varèse, John Cage, Pierre Boulez, Henri Pousseur.

n some instrumental works which I had written shortly before beginning to compose ctronic music, I attempted to integrate all the characteristics of the material in one form musical organisation – instrumental timbres excepted. I had to accept these bres as given, and it was not possible to set up a relationship or even a continuum ween the sound of a clarinet and the sound of a piano. The only possibility was to ange these instrumental timbres in a sequence of contrasts – analogous to a colour uence such as red-yellow-blue – or, by mixing, to compose something like timbreerval or timbre-chords. It was impossible to make all the various timbres germinate m a single seed, so that a clarinet-tone and a piano-tone could appear as two difent specimens within a 'sound family', or larger sound-continuum: as long as one st compose for the classical orchestra, this must remain a Utopian concept.

III

hat technique was applied in the synthesising of sounds for the first electronic studies? For the last few decades there have been electro-acoustical generators and oscillators acoustical laboratories and in technical divisions of radio stations. In the beginning, worked only with sinus-tone generators. They are so called because the waves proced obey the sinus function. Compared to any instrumental sound, which has, besides 'fundamental tone' a certain number and certain selection of 'partials' (also called vertones'), the sinus tone is a 'pure tone' (without 'partials'); each 'partial' in a tionary sound spectrum' is such a 'sinus tone'.

The number of partials in a sound spectrum, the frequency of each partial, the plitude curve of each partial, the duration of each partial in relation to the other rtials in the transients: these characteristics make it possible to distinguish one sound ectrum from another. In its middle register, a sinus tone sounds rather like a flute, hich, among the orchestral instruments, has the smallest number of partials. Such nus tones were the first elements with which we com-posed (literally – put together) rious spectra according to the structural demands of a particular composition. *ach single sound is therefore the result of a compositional act.* The composer deterines the various characteristics (also called 'parameters').

Practically, we proceeded to work in the following way with sinus tones (in Cologne e are still forced to work in this complicated way owing to the lack of more suitable pparatus): a sine-wave is recorded on tape, a second, third, etc., is added. Electrically ontrolled, each sine-wave is given its own intensity curve, and then the intensity curve f the entire complex ('envelope') is once more regulated. The duration of the sound is xed by measuring the tape in centimetres in cutting it – the speed of the tape is 30 or 5 inches per second. Thus, one by one, the sounds are put together and catalogued. When all the sounds for a composition have been prepared on the tape, the pieces of ape are stuck together according to the score, and if necessary, are superimposed again y means of several synchronised tape-recorders. As soon as the realisation of the piece as been accomplished, the catalogued sounds and all intermediate results are erased; here is thus no catalogue of sounds which could be enriched by some hundreds or housands of sounds 'for general use' after realisation of a composition.

It was necessary for the composer of electronic music to find an adequate form of graphic notation in order to describe all the details of sound-production and montage.

Obviously, no instruments are employed which can be played by an interpreter according to a score. In electronic music, the interpreter no longer has any function. The composer, with the cooperation of a few technicians, realises the entire work. Each work-process can be repeated as often as necessary in order to achieve the desired exactitude. The first results of the work just described were Eimert's 'Glockenspiel', Goeyvaerts' Composition No.5, Pousseur's 'Seismogramme', Gredinger's 'Formanten' and my own 'Studies' I and II.

This music can only be played by means of loudspeakers.

IV

It is clear that the composer of electronic music should not attempt to imitate timbres of traditional instruments, or familiar sounds and noises. If he should happen to need such a sound, it would be unfunctional to produce it synthetically: it is recorded with the least possible ado. If sounds similar to those of speech are required, it is better to record speech than to synthesise it. In general, one can recognise a first criterion for the quality of an electronic composition by hearing the degree to which it is free from all instrumental or other auditive associations. Such associations divert the listener's comprehension from the self-evidence of the sound-world presented to him because he thinks of bells, organs, birds or faucets. Associations are formed by our own experiences and can be lost again; they tell us nothing about the form of the music or the meaning of the sounds and noises in a particular composition. From this we should conclude that it is best for electronic music just to sound like electronic music, that is, that it should as far as possible contain only sounds and sound-connections which are unique and free of association and which make us feel we have never heard them before.

But it is also clear that the variety of sounds which can be electronically produced is not unlimited. Electronic music as a species has – in spite of all the ideas we had at the beginning about the abolition of 'species' in the musical sphere and the inclusion of all possible sound processes – its own sound-phenomenology, which depends to no small extent on the fact that it is played over loud-speakers.

Take, for example, 'Artikulation' by Ligeti. Every time this piece is performed, members of the audience laugh at three places, the first time loudly, the second somewhat less so and the third time deafeningly. During the realisation of this piece, the composer and his collaborators also laughed. In the newer instrumental music, too, unusual sound-connections arouse laughter, for example in the works of the American, John Cage. What is the reason for this? Certain sound-events make one associate them with the places and circumstances where they normally occur, and the unusual juxtaposition of such associating sounds and noise in a piece of music is at first comic in effect. A whistle and a piano-tone do not – separately – excite laughter; but piano-tones and whistles together in a composition of Cage cause laughter in the audience.

V

In the existing electronic compositions, sounds with harmonic partial-relationships – which can, for purposes of comparison, be called 'vowel sounds' – were used much less than noise. Noises have seldom been employed in occidental music, and most musicians

consider such consonant-like sounds to be musically inferior material. Percussion instruments producing sounds with only approximate or completely unfixed pitches have been paid little attention; they have therefore remained on an extremely primitive level in the development of instrument-construction. This can be explained by the one-sided harmonic-melodic development in the sphere of fixed basic pitches with harmonic partial-relationships. It can therefore be said that, until today, occidental music has been mainly music of vowel sounds, 'pitch-music'. The last stage of this development was twelve-tone music.

Schoenberg wrote a treatise on harmony which deals only with the relationships of fixed frequencies. It was not within the perspective of his time to account for 'consonant' sounds and to pursue in inseparable connection with harmony the questions of metre, rhythm and dynamics, let alone those of sound-colour. He and his school thus spent their entire time dealing with problems of a new pitch-composition in which new laws of equal rights were formulated, remaining at the same time slaves of classical metre, rhythm, dynamics and timbre which, because their laws are hierarchic, stand in crass contradiction to dodecaphonic melody and harmony. This makes Schoenberg's allergy to the term 'atonal music' understandable; today, we realize that this term proclaims a basic alteration of the musical material-concept: that music with 'tones' becomes a special case as soon as sounds with constant periodic fundamental vibrations and harmonic partial vibrations are arranged in the continuum of all 'tone-colours'. In 'atonal' music, then, 'tones' simply do not occur, only sound-events which can be defined by the collective term 'noises', non-periodic, 'complex' vibrations. For us, vowels and consonants – sounds and noises – are in the first place nothing more than material. Neither one nor the other of these acoustical phenomena is by its nature good or bad. The only important thing is what one does with them.

In the first half of this century, the compositions 'Ionisation' by Edgar Varèse and 'Construction in Metal' by John Cage had already initiated a completely new development independent of tone-music. The beginnings of musique concrète were also stimulated by Varèse and Cage.

The category of noise is no less differentiated than the category of sounds. On the contrary; we find, for example, in some languages a preponderance of unvoiced consonants over vowels. It is natural that in the new musical language *non-periodic phase-relationships determine all aspects of the form – on the small scale as well as on the large scale;* periodicity thereby becomes an extreme case of non-periodicity. Consonant, noise-like sound-phenomena play an extremely important part in this, and their significance will continue to increase.

I shall take Henri Pousseur's composition 'Scambi' as an example. In this piece, only noises with more or less determinable pitch-registers are used. We speak of noises as having different widths of frequency-band, and term them 'coloured noise'. In order to produce such 'coloured noise', one can sometimes superimpose sine-waves in thick bundles; but one usually chooses a more direct way: the initial material is delivered by a noise generator, which produces 'white noise' (the terms 'white' and 'coloured' are borrowed from the sphere of optics). 'White noise' can be described as the simultaneity of all audible vibrations: it sounds like the sea. We can, by means of various electric filters, filter out frequency-bands, 'coloured noise' (consonants such as sh, f, s, th, etc., constitute such noise spectra). The sound-continuum between the 'pure tone' and the

'white noise' can, for example, be defined in such a way that the 'pure tone' is the narrowest 'noise band' or, vice versa, that the 'white noise' is the densest superimposition of 'pure tones'.

VI

Where is electronic music produced?

The first studio was established, as already mentioned, in Cologne Radio Station. This is significant, for the present-day acoustical communication media at hand – and in whose hands we are, perhaps – are chiefly transmission, tape and gramophone records. Tape, gramophone records and transmission have radically changed the relations between music and listener. Most music is heard through loudspeakers.

And what have the manufacturers of records and radios done up till now? They have re-produced; re-produced music which was written in the past for concert hall and opera house; exactly as if film producers had been satisfied by photographing old plays. And the radio tries to invest these concert and opera reportages with such technical perfection as to make it increasingly difficult for the listener to distinguish between the original and the copy: the illusion must be complete. The intentional deception has become more and more perfect, just as today modern printing methods can make Rembrandt reproductions which not even an expert can distinguish from the original. All this is steering towards a society whose culture, too, comes out of cans.

Although radio had thus become a canning factory, something unexpected happened: electronic music entered into things, music arising functionally from the specific facilities of radio. Nowhere is this music recorded on a platform by a microphone in order to be preserved and later reproduced. It arises, rather, with the help of electronic valves, exists only on tape and can only be heard through loudspeakers.

The actual significance of a legitimate, functional loudspeaker-music can only be estimated by one who has looked through the glass panel of a recording studio's control booth and seen musicians, as if in an aquarium, playing for hours on end, literally to the wall; with lots of precision and no spontaneity, without any contact with listeners. And what are they playing? Music which was written for completely different purposes and without radio in mind.

No matter what one's opinion of electronic music is today, its necessity exists in the bare fact that it indicates the way to radiophonic music production. Electronic music no longer uses tape and loudspeakers for re-production, but for production.

People listening to loudspeakers will sooner or later recognize that it is more sensible for loudspeakers to transmit music which can only be heard at the loudspeaker and nowhere else.

The same problem arises moreover in television. For some time yet we shall probably see television producers using this new medium unfunctionally, that is, wrongly. It will not be functionally used until the camera – the microphone of radio – is employed only for 'live-reportages' or not at all, and electronic-optical compositions, appropriate to television, are transmitted.

VII

Since the inauguration of the Cologne studio, more studios for electronic music have been set up: at Milan Radio, directed by the composer Luciano Berio who works there

th Bruno Maderna; at Tokyo Radio, where the young Japanese composers Mayu-mi and Morio work; in the Philips Works at Eindhoven, where Henk Badings and dgar Varèse have worked; at APELAC, a company in Brussels, which manufactures ectronic apparatus and where Henry Pousseur works; at Warsaw Radio, where the mposers Kotonsky, Krenz and Serocki work; at Südwestfunk, Baden-Baden, where oulez has recently begun to work; at the French Radio, whose studio for musique ncrète has of late shown itself to be more and more a studio for electronic music; Columbia University, where the composers Vladimir Ussachewsky and Arthur ~~Luening~~ work. Other radio stations are at present making preparations for studios: adio Stockholm, Radio Helsinki, Radio Copenhagen and the BBC, London.

At the moment, all these studios are working in a very primitive manner with pparatus built for other purposes – for analyses of sound or technical measurings – nd to be found in all electro-acoustical laboratories and radio stations. This transitional tuation is limiting, for the musicians' ideas are far in advance of the technical possi-ilities of realisation; and results are not proportional to the amount of time and effort ent in obtaining them. Purely financial considerations do not permit studio equipment be standardized, although this is highly necessary. In the USA, moreover, a machine s been developed by RCA, the 'Synthesizer II', which in my opinion approaches a great extent the equipment demands of studios for electronic music. Recently the olumbia University studio was granted the necessary sum and thus will become the st to possess this machine.

The first experiments with computers (Massachussetts Institute of Technology and niversity of Wisconsin, Madison) seem to me to be significant in that they aim at con-ntrating composition exclusively on the planning of a piece and at leaving the entire ork of realisation, including automatic production of structural patterns, to the achine. One of the most extreme consequences would be that composers would have learn to rearrange their methods of thinking. Whereas the act of composing has up now consisted of selecting particular elements and constellations of elements to t the sounds one had in mind and their presentation in concord with one's material, e would be concerned, when planning an electronic composition-automaton, not much with determining axioms to define the desired results as with determining the ioms of those structures which are not desired. The electronic automaton is built compose pieces from all possible combinations of a defined number of elements or ws of combination defined by the composer; the work of planning would therefore ve to eliminate undesirable combinations except for a few, or for the one which one nted to employ.

VIII

oes the rise of electronic music mean the end of the age of interpretation? Are rformers condemned to play in future only the old instrumental music for 'collegium-usicum' concerts and for music museums on tape?

It is a fact that in the development of instrumental music, performers have been more nd more forced to translate increasingly complicated scores into sound. The musician as becoming a kind of substitute for a machine, and there was no longer any room for ree decisions', for interpretation in the best sense of the word. It was a natural develop-ent for sound-realisation to be transferred in the end to electronic apparatus and

machines. These machines give the desired results exactly according to the measure of technical data; and one does not have to engage them in conversation for hours on end in order to convince them of the meaning of modern music before they will emit a single tone.

It is, however, remarkable that the same composers who brought electronic music into being have since 1956/57 and *parallel* with this work published compositions which set the performer a new task. In contrast to electronic music, where all sound-events are predetermined down to the smallest detail and fixed by technical measures, the player of this new instrumental music is granted opportunities for free, spontaneous decisions inaccessible to machines. Man has qualities which can never be replaced by a robot; and robots – in spite of, or maybe just because of the fact that man invented them – have possibilities which surpass certain limits of human capacity; they are there so that he shall have more time for the truly human tasks – those of creation.

Lately, directed chance has been becoming more important for compositions to be played by players in the presence of listeners. The uniqueness of a performance – unrepeatable as the player himself, who is never the same; the various degrees of freedom of action, experienced by the composer and described in a composition (and answered intellectually, instinctively or intellectually-instinctively by the player); the determination of the duration of the performance of a piece and even the choice of the number of players concerned in a performance: all these are criteria which depend on the players and which invest them with a responsibility they never previously had to this extent.

Examples are the 'Concerto' (1957/58) by John Cage, who was the first to employ 'chance-operations' in composition; the third Piano Sonata (1958) by Pierre Boulez; the work for 2 pianos 'Mobile' (1958) by Henri Pousseur; my own Klavierstück XI (1956).

In discussions about this new instrumental music, people have often said that it involves musical improvisation of the kind familiar from the age of figured bass or in jazz. But the compositions mentioned above do not involve the instrumentalist's having to invent something additional to a basic scheme arranged by the composer – such as a melody to a thorough-bass, variations to a given basic melody or melodic inventions within a given rhythmic and harmonic basic scheme in jazz. The composers of the above works have fixed all the elements and rules of combination; but they have been able to formulate in the scores that, at particular points in the course of a work, not only one single valid possibility of progression exists, but that several equally-justifiable ways are often open which can be taken during composition or, analogous to this, at the moment of performance (the choice of a way can again be made dependent on what a simultaneously playing musician is doing, as in Pousseur's piece).

As this new kind of instrumental music must still operate with classical instruments, it is at present unavoidable that the contradiction mentioned at the beginning between on one side the construction and ways of playing these instruments and the physical structure of their sounds, and on the other, new conceptions of form will be more strongly recognizable than it was when electronic music began. Little is altered when Cage dismantles the classical instruments and has the players blow, knock, rub or stroke the dismembered sections. Such methods of trying to demonstrate the 'injury of the world' and 'total anarchy' are out of date today. We do not need any more

scandals. What we do need is a continuum-instrument. The rise of new instrumental music has made it logical to start thinking about new, adequate instruments, and now for the first time we are slowly beginning to realize how these new instruments would have to be constructed.

If we believe in the meaning of new instrumental music, we must reconcile ourselves to the fact that it will have much more difficulty in making good than electronic music. The whole question of whether we shall succeed in finding a new form of communal listening which radio listening could not replace, and in making it vital, this question will depend only on the composers working at this new instrumental music. Some of the new instrumental pieces functionally include the direction and the movement of sound in space – similar to spatial electronic music. A radio transmission – even a two-track one, as is possible today – can only give an approximate idea of this 'plastic' music. People must enter the room where this music is being played if they really want to experience it.

IX

In this way, instrumental music could exist alongside electronic music. In either sphere, one must work functionally; each medium must be used productively: generators – tape-recorders – loud-speakers must produce what no instrumentalist would be able to play (and microphones should be left to reporters); score – player – instrument must produce what no electronic apparatus would ever be able to generate or imitate or repeat.

To compose electronic music means: to describe in mechanical and electro-acoustical terms that which sounds, and to think wholly in terms of machine, apparatus, wiring scheme; to reckon with unique production and any number of repetitions of the composition.

To compose – now again – instrumental music means: to establish the action of the player by means of optical signs and to speak directly to the living organism of the musician, to his creative, constantly variable capacity of reaction; to make possible from one performance to the next renewed production and unrepeatability.

Electronic and instrumental music would then complement each other, would constantly move further and more rapidly away from each other – and only thereby awaken the hope of really meeting each other in a composition once in a while.

The earliest works combining electronic and instrumental music received their first performances in 1958. We must find the superior laws of a connection beyond the contrast – which represents the most primitive kind of form.

Music in Space [1]

I

Recently, on the occasion of some first performances, examples from occidental musical history have been discussed in which the distribution in space of choirs or instrumental groups also plays a part. If the examples cited are examined more closely, it can be seen how little they have in common with the present-day musical situation.

In the middle of the 16th century, works involving several choirs were written for

[1] This article was the basis of a lecture held during the Internationale Ferienkurse für Neue Musik, Darmstadt, in 1958.

St Mark's Church, Venice. In 1527, Adrian Willaert arrived there as 'Maestro di capella', bringing with him from the north stimulating ideas of poly-choric music. At the beginning of the 16th century, a truly poly-choric way of composing can already be recognized in the works of the Netherlander, Ockeghem. There are reports of celebrations on the occasion of the meeting of the French and English kings in 1520 when a mass was performed, in the course of which the performance was distributed alternately between the two nations' choirs. The basic form of this poly-choric style was thus the dialogue, and the Venetian dialogue-technique links on immediately; the architectural construction of St Mark's, with its two organs set opposite each other, favoured this form. Echo effects were the forerunners of the later imitation style which, via the ricercar, culminated in the fugue. Alternating question and answer had long been a tradition in mediaeval church music; but, in the development via spatial antiphony, Cipriano de Rore was the first to transfer the outer alternation of parts to the inner structure of the madrigal. The later forms of symmetrical periods with 'open' and 'closed' half-periods as question and answer, and the classical form principle of simple repetition or correspondence of two-, four- or eight-bar phrases: all these are indirectly connected with the spatial music of the 16th century. (Martin has quoted a remark of Debussy's concerning the composition of sectional forms: 'repeat once, then you can go on'.) Giovanni Gabrieli, the nephew of Andrea Gabrieli, was, in his 6 – 16-part *Cantiones sacrae* (1578) and especially in the 'Symphoniae Sacrae' (1597 and 1615), far more successful than his predecessors and contemporaries in achieving what we recognize as 'constructive form' in spatial dialogue and antiphony. Poly-choric style attained effects of sound and timbre which open up an entirely new world of musical imagination, and indicate that the Renaissance is at an end.

From the classical period, we know two spatial orchestral compositions by Mozart. One of them is the 'Serenata Notturna' (K.V. 239, 1776) for 2 small orchestras (2 solo violins, viola and double-bass as soloists contrasted with a string ensemble, several players to a string-part, and timpani); the other is a 'nocturne' for 4 orchestras (quadruple strings each with 2 horns, K.V. 286). Both works make much use of baroque echo-effects, and since the orchestral groups are separated, for once we find a particularly clear outward manifestation of something which was in any case the formal principle of classical 'echo'-repetition.

Berlioz, finally, made space part of the dramatic function of music. He sought 'architectural' music and 'music-drama' (Mourning and Triumph Symphony for 2 orchestras and choir; 'L'Imperiale', a cantata for 2 choruses). The 'Requiem' is based on a plan of a colossal oratorio which he described thus: 'The dead leave their graves . . . the living, besides themselves with horror, emit piercing shrieks of fear . . . the heavenly hosts thunder in the clouds – that's how this music-drama would end.' He planned 2 main orchestras and 4 groups of brass instruments (which already indicate the 4 subsidiary orchestras of the later Requiem). It is clear that this use of spatial presentation in a kind of symphonic opera has as little as possible in common with the present-day situation.

II

In my 'Gesang der Jünglinge', I attempted to form the direction and movement of sound in space, and to make them accessible as a new dimension for musical experience.

The work was composed for 5 groups of loudspeakers, which should be placed around the listeners in the hall. From which side, by how many loudspeakers at once, whether with rotation to left or right, whether motionless or moving – *how* the sounds and sound-groups should be projected into space: all this is decisive for the comprehension of this work. The first performance took place on May 30th, 1956, in the main broadcasting studio at Cologne Radio Station. Today there are already quite a number of electronic spatial compositions.

Striking as this first experience of spatial music was, it also showed from the very beginning the difficulty of presenting this music in a hall built for entirely different purposes. New halls for listening must be built to meet with demands of spatial music. My idea would be to have a spherical chamber, fitted all round with loudspeakers. In the middle of this spherical chamber, a platform, transparent to both light and sound, should be hung for the listeners. They could hear music, composed for such adapted halls, coming from above, from below and from all directions. The platform could be reached by a gangway.

This would present acousticians and architects with the task, not of building castles in the air, but of providing a badly-needed solution of current problems.

If there were such halls in every larger town, concert-going would acquire a new meaning as compared with listening to the radio. Concert-going as we know it would – as far as hearing spatial electronic music is concerned – be superseded by something corresponding to visiting an art-gallery. There would be continuous programmes, changing at regular intervals, and one could hear the electronic programme at any time of day.

What, then, would be the purely musical reason for having sounds coming from various directions and with various forms of motion? All previous descriptions have been superficial: sounds coming from the left, from the right, moving quickly from behind me to in front of me above my head, rotating slowly to the right, remaining suddenly still at one point, etc.

The first pieces of electronic music and of 'pointillist music' in general, were extremely homogeneous in their sound-mixtures and form. All musical elements had equal rights in the forming process and constantly renewed *all* their characteristics from one sound to the next. If all characteristics of the sound are continually altered to the same degree, instead of one characteristic's remaining unchanged for a long time, then to be succeeded as the dominant one by another (for example long tone-sequences unchangingly in a high register, then in a low register; or several tones equally slowly, then quickly; or a group of tones played by strings, the next ones by wind; or first many loud sounds, then soft ones); if from one sound to the next pitch, duration, timbre and intensity change ('point for point'), then the music finally becomes static: it changes extremely quickly, one is constantly traversing the entire realm of experience in a very short time, and thus one finds oneself in a state of suspended animation, the music 'stands still'.

If one wanted to articulate larger time-phases, the only way of doing this was to let one sound-characteristic predominate over all others for some time. However, under the circumstances then prevalent, this would have radically contradicted the spirit which gave birth to the idea of equal valuation for all sound-characteristics. And a solution was found to distribute in space, among different groups of loudspeakers, or instruments, variously long time-phases of this kind of homogeneous sound-structure. Up

to then spatial composition of sounds had played no active part in music; it was therefore perceived as an 'entirely different' sound-property which would hardly be in a position to dominate over the sound-characteristics associated with time. (In the meantime this has fundamentally changed, and we notice more and more how all musical ideas are becoming increasingly spatial.) First it became possible to articulate longer pointillistic structures by having them wander in space, by moving them from one place to another. It was even possible to solve the problem of making comprehensible the simultaneous superimpositions of such pointillist structure-layers by means of spatial disposition; the previous dissolution of all 'polyphonic' principles, of the 'part' as a musical form-concept, left a permanent monody (as in Asiatic music) as the only possibility. The dissolution into 'points' destroyed 'simultaneity', since superimposed points result at best in more or less dense sequences of points; and only lines, i.e., continuous point-connections, make possible the presentation of various simultaneous processes. If one divides a point-structure into two groups and makes one sound come from the left and the other from the right, one easily perceives two layers of one and the same sound-pattern.

Just as in composing with electronic sounds (to be played over loudspeakers), a similar problem arose in composing with instrumental sounds.

In 1955 I began working on 'Gruppen für drei Orchester', and continued working – with interrruptions – until the end of 1957. Right at the very beginning it proved necessary to present more or less long groups of sounds, noises and a cross between the two simultaneously in various tempi. So that this could be correctly played and heard, a large orchestra of 109 players was split up into 3 smaller orchestras; each of these was to have its own conductor and had to be placed at some distance from the other two. The three orchestras have approximately the same number of players, and the following instrumental families occur in each: woodwind, brass, plucked instruments and strings; each of these 4 families is again divided into a sound-group with exactly defined pitches and a noise-group with only roughly defined pitches; for the transition from sound to controlled noise within each instrumental family, a variety of metal, wood and skin percussion instruments was selected; instruments such as piano, celesta, tubular bells, cow-bells, offer a propitious connection between sound and noise when appropriately used.

The similarity of the scoring of the three orchestras resulted from the requirement that sound-groups should be made to wander in space from one sounding body to another and at the same time split up similar sound-structures: each orchestra was supposed to call to the others and to give answer or echo.

As far as the orchestral sound of the groups as such is concerned, it was obtained from the typical facilities of the selected instruments, and it is wrong to speak of a 'translation of electronic sounds into orchestral ones' as has so often been done in the last few years: the 'Gruppen' were written for a particular orchestra, and their orchestral sound is the result of particular laws of a functional application of this instrumentation. This is modern orchestra and has nothing to do with electronic music; which in its turn has laws of sound-composition peculiar to itself. Electronic music does not need to flirt with orchestral sound, and orchestral music heard entirely in instrumental sounds does not need to dress itself up with pseudo-electronic effects; the only important thing

always the functionally correct sound, and not the sound-effect – and we musicians certainly know this.

It is too easy to forget that normal orchestras are still put together as was usual in classical-romantic music, and that in the 18th century, the Mannheim School and especially Haydn at Esterhazy's court experimented for decades with the basic consistency of the orchestra until the classical orchestral formation was fixed. Today, the normal orchestra still has about 50 string-players, whereas each wind group contains at most only 3 musicians, and there are 2-3 percussion players. If one wants to score for, say, 12 percussionists, 6 trumpets, 2 saxophones and a guitar, extra players must be engaged. It will still be some time before the thousand difficulties are overcome and agreements are made with orchestral organizations as to a satisfactory orchestral formation; before the demands of contemporary music are acknowledged instead of the orchestra's being one-sidedly equipped for music written between 1700 and 1900. An examination, however superficial, of the present-day symphony orchestras – they are not so called for nothing – shows how fatal is the general preference for the great heroic past, and how senile our present musical culture, which has hardly the courage to face up to the present. We shouldn't be surprised if our younger generation of listeners consoles itself with the orchestral sound of jazz imported from America.

It is best to hear 'Gruppen für drei Orchester' in a large hall in order to be able to experience the simultaneity of various time-spaces and movements. The big difficulty at present – as in electronic music – is to find or build the proper halls for spatial instrumental music of this kind. So as to do justice to the requirements of both electronic and instrumental spatial music – at this moment, work is in progress on the project of combining instruments and loudspeakers – one must from the very beginning consider halls which can be transformed. Boulez, Pousseur and Berio are also now working on compositions in which the spatial distribution of orchestral groups takes on significance.

Existing concert halls are the product of classical concert practices, the orchestra being placed on a platform in front of the listeners, and the distribution of the players on the platform remaining a secondary consideration – this is evident even from the superficial point that different conductors use differing seating arrangements. The 'Gruppen' require the 3 orchestras to be arranged in horseshoe form in such a way that – from the listener's point of view – one orchestra occupies the entire left side, the second the whole front (in Cologne, we used a rectangular hall lengthways, so that the middle orchestra took up an entire long side of the hall), and the third orchestra occupies the whole right side. In this way all the listeners are surrounded by the three orchestras. This requirement met at first with difficulties until we finally found a roughly suitable hall on the Cologne exhibition premises for the first performance. In this connection, too, it would be sensible to examine the development of the music itself when building concert halls, instead of basing one's actions, without discussion, on the supposition that we should only be playing 'classical music' until the end of time. If the classicists had thought in the same way as the architects and building contractors of today, they would have had to go on performing their works, as did their fathers before them, in churches and at a few royal courts – where all music had been played and sung up to then – since there were no concert halls. But they provided the initiative to build new, suitable concert halls.

Another question: why broadcast music written for space? Well: it is better to see a photograph of a sculpture than nothing at all; maybe one will get the urge to look at the original sculpture: this also applies to such broadcasts.

III

I have described the general musical viewpoints as to how musical spatial compositions have come about since 1955/56. The question now arises as to the consequences to be drawn in composition.

Since 1951 we have been meeting in composition the urge to treat all characteristics of tones equally; they should all take part in the formal process to the same extent, so that constantly new patterns can be presented in the same light. It was found, however, that this equal valuation of tone-characteristics was most difficult to achieve. In traditional music a hierarchy ruled which had been developed during the course of history; the individual qualities of the tones developed to varying degrees. The most marked difference was in the case of all *pitch*-relationships in harmony and melody (differentiation of the pitch-scale up to 88 steps); they were also the first to develop, and developed furthest, in notation and correspondingly in the construction of instruments. Less differentiated were the relationships of the *durations* of tones in metre and rhythm (ca. 40 distinguishable durations can be defined and played in traditional notation for durations between 8 seconds and $\frac{1}{8}$ of a second); in contrast to the logarithmic relationships of the pitch scale they are confined to harmonic and subharmonic scales.

The dimension of timbre (tone-colour) has been – since the beginnings of instrumental music – much less developed, and was raised at the beginning of this century to a stage of differentiation possibly comparable to that of melody. Up to the present, it has either had a decorative function (which can be easily seen in the numerous compositions 'arranged' by their authors for the most varying instrumental combinations), or it has supported – like the dimension of tone-loudness[2] – harmonic-melodic form-articulation (ca. 20 different timbres can be distinguished with help of the available orchestral instruments; this means that one and the same tone – for example c^1 – with constant duration and loudness, can be played in ca. 20 different orchestral timbres; most mixtures do not count, as they are heard as timbre intervals).

Tone loudness, the fourth dimension of sound, not emancipated until the middle of the 18th century and today still very vaguely differentiated, can only be notated approximately. Its only function up to now has been to support relationships of the pitches and their durations (harmonic fields, melodic phrasings, rhythmic articulation by 'accenting') on a small scale as well as on a large one (ca. 6 degrees of loudness are distinguished in notation).

The tone's property of being produced in a particular space and in particular places in this space, has not up till now – apart from the few exceptions mentioned at the beginning – been further differentiated at all: the *location of the tone* in the concert hall

[2] In the following, 3 terms are used in connection with dynamics – sound level, loudness level, loudness.
Sound level is the intensity which a tone has at the point where it is measured; this intensity must be purely physical. Loudness level is the intensity with which a tone stimulates perception in the ear after transformation of sound pressure; this intensity must be physiological (measuring unit 'phon'). Loudness is that which is perceived at a given loudness level; loudness must be psychological (measuring unit 'sone').
As we have here to do with musical tones, the term 'tone level' is employed instead of the usual, more general 'sound level'; the more special terms 'tone loudness level' and 'tone loudness' have also been introduced.
If a special distinction is made between 'tone' and 'sound', the term 'sound level' is used instead of 'tone level'.

ained fixed, not only during one piece but for all music written up to now (in front the listener, on the platform) and played no part in composition.

The hierarchy of tone-characteristics in occidental music up to now is thus as follows:

1. pitch (harmony – melody)
2. duration (metre – rhythm)
3. timbre (phonetics)
4. loudness (dynamics)
5. location (topography)

Before dealing with the 5th characteristic in more detail, let us examine an example what the latest development in equal valuation of tone-characteristics – the so-called rameters – is aiming at. If we consider composing to be an arrangement of acoustical nges, it must keep to the variability of the parameters. If we measure acoustical nges in change-degrees, each change-degree which can be represented in a parameter ght, in the case of equal valuation of all parameters, to be representable in all other rameters, too. We can represent a change by means of a proportion. If we change, example, an initial tone:

pitch: 92 cps (F sharp)
duration: 1 second
timbre: a formant-area from 200 to 1000 cps
loudness level: 80 phons
locality: 0°/5 metres (see below)

the ratio 3:1, then at the smallest change-degree V_1, on the basis 3:1, only one parater would change in the ratio 3:1; at the change-degree V_2, two parameters would nge; at V_3, three parameters, and so on. If there is completely equal valuation of parameters – which in this case means interchangeability – the change-degree V_1, example, ought to be representable in five different ways. Let us try this.

Changing the duration of the oscillation 3:1 is simple: we multiply the initial oscillan-duration, which should be three times as long as the next one, by 1/3; that is, we nspose the pitch (reciprocal value of the oscillation-duration) an octave and a fifth her: 1/92 sec. × 1/3 = 1/276 sec. (c^1 sharp). All other parameters remain unchanged.

We can also represent the change of duration (1 second) in the ratio 3:1 by means of nventional symbols; most musicians, however, are not yet used to reading 1/3 or 3 (this also applies to single quintuplets or septuplets), and they can't play them yet, her; in the simple case of our example one can, so far as the score permits, alter the te-symbol for the basic unit, and then the ratio 3:1 can be conventionally notated: ♩.♪. etronome markings correspond in duration-notation to the so-called clefs in the esentation of pitch, by altering the tempo, one would use the same signs to represent d make playable the most varied proportions.

We have again multiplied, then, the duration of 1 second by 1/3, and arrive at the sult of 1/3 sec.

The third possibility of a first-degree change is in timbre. The timbre of our initial ne being fixed by a formant-area of 200-1000 cps over the fundamental frequency cps, we could, as with the pitches, transpose this formant-area in the ratio 1:3, and ould also have to multiply the oscillation-duration in the formant by 1/3. The new rmant-area is then 600-3000 cps. It is not possible to perform such a change of timbres the prescribed ratio by means of the instruments used hitherto, as the latter can not

be accurately defined in their 'colour' and can be still less accurately influenced. The inclusion of the timbre-parameter requires automatic electro-acoustical methods of producing and modulating the individual timbres.

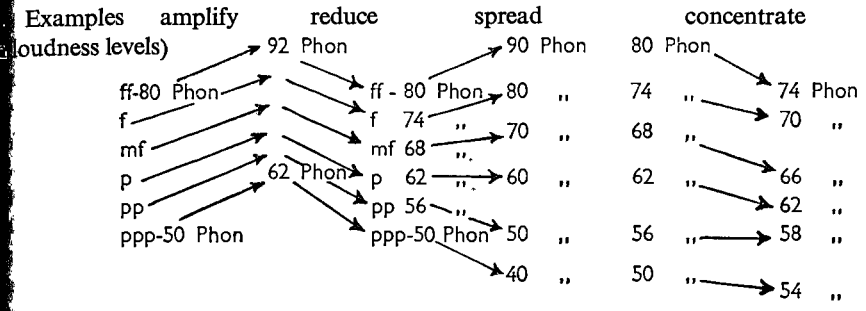
In the parameter of *tone-loudness*, there is not yet any very accurate way of proportioning (as far as instrumental music is concerned). We know no possibility of notating even the simplest changes such as multiplication of the tone-loudness by two or by one-and-a-half), let alone differentiated relationships as in the field of pitches or durations. Of course, in traditional music, too, tone-loudnesses have to some extent been more subtly differentiated, regardless of the primitive notation of ca. six degrees between ppp and ff. The so-called 'nuances' of some interpreters between extremely soft and extremely loud certainly achieve differentiation equal to that of durations, perhaps almost to that of pitches. This is, however, mostly subsonsciously produced, and bound to subjective standards of perception.

As regards the six or seven symbols that correspond to tone-loudness and are so interpreted, a few outstanding interpreters show an astonishing unanimity. A few years ago, I wanted to see what good interpreters would actually play if I used, for example, 6 different symbols for tone-loudness in piano compositions. For this purpose I checked tape-recordings with a voltmeter; the recordings were of Marcelle Mercenier and David Tudor. I purposely selected a voltmeter which was graduated in decibels corresponding to the phon-scale, and not a phon-meter, so that I would recognize the relative tension-relationships, independent of the loudness level or loudness.

Before giving the results of these observations, I wish to make another remark. Owing to the inexact notation of tone-loudness up to now, this parameter was the only one in which the interpreters adapted themselves to the respective hall: they thought in loudness-relationships, that is, they conceived the scale of tone-loudnesses as relative and not as one of absolute values (like pitches and – fixed to a great extent by metronome – durations, as well as – defined by the demands of the instruments – timbres). An interpreter could, for example, amplify the whole scale in a larger room, or reduce it in a smaller one; or, in a room with a bright acoustic, he could – admittedly this is a rare occurrence – according to the size of the room spread or concentrate the entire scale of tone-loudness (which can be reduced to a corresponding loudness level scale), so that the intervals would grow larger or smaller from one loudness level to the next.

Something corresponding to this in the duration sphere is usual only in church music, where, because of differing and very great echoes, the same piece is interpreted in duration-proportions greatly deviating from one another. But it would seem strange to us today if an interpreter were, because of certain conditions in the hall (for example, if a hall favoured the low frequencies or, vice versa, absorbed them), to transpose the music a selected pitch-interval higher or lower (either by re-tuning the instrument or – if the hall does not permit the extreme registers to sound but is only good for the middle register – by concentrating the pitch-relationships in the entire piece, thus proportionally diminishing all the pitch-intervals).

It is equally inconceivable today for an interpreter to adapt the timbre of an instrument to changeable conditions of performance, and to choose each time for the same part a different instrument belonging to the same family with a brighter or darker tone-colour. Conductors' practice of reducing, augmenting, mixing in a different way



even changing instruments – according to the hall – while rehearsing a work has indeed fallen quite out of use.

One realizes how greatly we are accustomed to absolute thinking and hearing in the sphere of pitches and, by now, in those of duration and timbre (although there is as yet no 'concert-duration' and no 'concert-timbre' to which all must conform). The entire musical development which is tending towards equal valuation of the parameters and therefore to the absolute notation of all parameters, at least in electronic music, naturally also striving after a general standardization of the concert halls in which this music is to be played, so that the meaning and purpose of interpretation, in the form of adaptation to given conditions of performance, disappear.

Let us return to the investigations in the field of interpreted tone-loudness-relationships. It was established that with both interpreters the graduations from one loudness to the next, defined by ppp to pp to p to mf to f to ff, were always around the same difference of tension, measured in decibels, the respective intervals amounting to 6 db. A difference of 6 db signifies no more than a tension ratio of 1:2, from single to double. For example, if ff was measured as being ca. 0 db, f was then ca. –6 db, mf –12db, p –18 db, etc. I was able to confirm this observation by listening to Debussy recordings of Gieseking, who has an admirable command of dynamics.

This means, then, that the interpreters interpreted proportions approximating to the 'octave' – if we choose to use this term from pitch-intervals to aid our imagination – in accordance with the dynamic markings. From the development of pitches and durations, we know that first octave-relationships were represented, that is to say the simplest, then the fifth-relationships and only gradually the more complicated proportions (in durations this means: relationships from single to double or from single to dotted: 1:2 ♩𝅗𝅥 and 2:3 ♩ ♩.). It can be said that the sphere of tone-loudness had, up to the beginning of electronic music, reached a stage of notated and consciously realized relationships which corresponded to that in early mediaeval pitch-composition and in later mediaeval duration-composition.

We shall define a ratio of 3:1 in tone level in such a way that the sound pressure is tripled; this is the same as an increase of ca. 10 db; the loudness level would thus climb from 80 phons to 90 phons. It is only possible to represent this proportion precisely by using electro-acoustical methods.

In our example the first three parameters pitch, duration and timbre were described simply by giving the time. We have transposed the basic oscillation from 92 to 276 cps, the duration from 1 second to 1/3 sec., the formant-area from 200-1000 cps to

600-3000 cps. But the change in loudness level from 80 to 90 phons has nothing to do, in terms of either measuring-technique or experience, with a definition of time. We described, rather, when giving measurements of the loudness level, a spatial property of sound: the perceived difference between the smallest and greatest expansion of a soundwave, the deflexion of the amplitude.

When we hear a sound getting louder in the open air, we assume at first that the source of the sound is coming towards us – or vice versa. The definition 'near' or 'far' is, however, mostly not a perception of loudness. If the source of the sound is right next to us, and the sound level changes from weak to strong, we by no means have the impression – not even with closed eyes – of far and near, but rather of unaltering distance and of mere change in loudness. A sound occurring in Nature is always less distinct, more 'faded', in the distance than the same sound from nearby – quite apart from the sound level. If one shouts in a wood and hears quite a loud echo, the words are much less intelligible all the same. The further away the sound is produced, the more often are the sound-oscillations reflected, and the arriving oscillation has a more or less strongly-modulated amplitude, the spectrum is more deformed. This hearing from the distance, then, depends especially on the difference of more or less strongly-deformed sound-spectra; even in the case of relatively pure tones, we estimate the distance according to the degree of amplitude- and frequency-modulation that we recognize by the amount of noise in the tones (one needs only to imagine the whistle of a steam-engine at night, which, according to how far away it is, sounds in varying degrees 'breathy'). There are hardly any reflections in snow, the sounds become quite 'dry', many partial-oscillations are absorbed, and the greater the distance, the less coloured the sound reaching our ear; in these circumstances we do not hear so far and find it much more difficult to judge the distance. In enclosed spaces there is, according to size, construction and building material, a deformation of sound which is also characteristic for each room. Here it is the multitude of reflections overlapping each other and mixing a more or less great amount of noise into the sound-spectrum (which is always assumed not to be stationary) that make individual partial-oscillations stand out, suppress others, and produce new partial-oscillations by distortion, etc. Thus the nearer one sits to the source of sound in an enclosed space, the more direct sound one gets, and one judges the distance mainly according to the degree of deformation of the sound. For example, if we hear from a loudspeaker the same sound reverberated to varying degrees at a constant sound level, we have the impression that the sound is being produced at different distances. However, the greater the sound level, the more distortions of the sound occur, and vice versa. The degree of distortion affects in its turn the loudness; even at constant sound level, the loudness can be considerably changed, according to the degree of distortion. The degree of distortion can also be described as a portion of spectral components; as well as the peak value of an amplitude measured in db, we must state the energy content of the sound, either as the band-width of a noise-band or as the degree of distortion of a line-spectrum.

The facts described will be simple to the musician if he thinks of the relationship between instrument and loudness level: the same loudness level on a trumpet can affect the loudness in quite a different way than on a violin; the trumpet-tone is more distorted (that is, its spectrum is enriched) and therefore seems louder. The same constitutes in principle the differences between various spaces and different spatial distances; it is

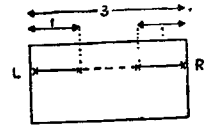
that a tone in space is not only linearly distorted but also aleatorically, and its portion of noise corresponds to this. The greater the spatial reflections, the more energy of the sound increases and the louder we perceive it. If we produce a tone h constant tone level first in an anechoic chamber and then in a chamber with strong flecting properties, the second is heard as being very much louder, although the tone el has not been changed.

We can say, then, that the tone level is a spatial characteristic of sound in so far as it ermines the amount of expansion of the soundwaves (the greater the distance, the aker the sound pressure); but that our perception of 'near – far' is chiefly orientated he spectral composition of the sound – that is to say, its temporal characteristics – ich is influenced by the combined effects of tone level and conditions of spatial nsmission (modulation, deformation).

The first determination of the *locality* of the tone, that of its distance away, is erefore described by data of timbre and tone level and can make no claims to be an dividual composition-parameter. But when we estimate the distance away of a tone, do not usually check its timbre and loudness level independent of each other, in der then to determine that the tone is such and such a distance away. If we do not cognize the tone at all (as being that of a particular instrument), it is hardly possible judge the distance; but it could be that the deformations typical of great distances exactly the peculiarities which a certain tone possesses when produced in immediate oximity. It is therefore also possible – building on this experience – to produce the sion of any distances of sound by means of electronically-generated sound-ents composed in certain ways. In consequence, it is only under very limited condi-ns sensible to treat the distance away of sound as an individual parameter.

The most important condition for this is in the use of a few timbres either already miliar to the listener or having become so during the course of a piece, and which would perceived as coming from various distances because of alteration of timbre and e level. In listening, it is precisely for the impression of distance that vision plays an portant part, and as there are always great practical difficulties in setting up instru-ents or loudspeakers at different distances in enclosed spaces, the distance away of e tone, as a variable characteristic, remains even more limited than it is by nature; e only way round this would be to use darkened rooms for listening to music in which e distance away of the sounds has an important function. It is different with the aring of *direction*. In some very recent compositions – electronic and instrumental – e fixing of the locality of the tones has been treated as an independent parameter. et us then return to our example and ask ourselves whether it is already possible to add the other parameters locality as a fifth parameter with equal rights. It ought then to possible to represent the change-degree V_1, which we had fixed as being the pro-rtion 3:1, in the field of tone-localisation.

Let us imagine the simplest case, that the sources of sound e placed in a line in front of the listeners. The possibilities localisation are then limited by the left- and right-hand alls (LR). If a tone first sounds at the left end of this line, e can make the proportion 3:1 clear by dividing the line cor-espondingly and letting the tone sound at the point arrived at:

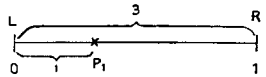


We represent a duration-proportion in a way that corresponds exactly; we orientate

ourselves by an initial value – by the duration 1 second, for instance – and make a second duration, amounting to a third of the initial duration, follow; what we here call a 'second' is the standard of orientation, the constant of comparison. In the case of tone-localisation, the 'second' is replaced by the possible expansion of space as standard of orientation, namely the line L-R. We wrote that 1 sec. = 3/3 in the proportion 3/1, thus obtaining a third. We correspondingly write that the line L-R = 3/3, and divide it.

The objection could be raised that the constant, 1 second, with which we are measuring durations is only a conventional measurement having nothing to do with the perception of durations; durations are just not perceived as fractions or multiples of a second but as absolute values unconnected with a standard measure, and each duration obtains its size not from the second but from the other values in its surroundings. Of course, the standard measurement of 1 second is only valid for our abstract example. All durations in a certain piece are referred to the longest time-value and defined as quotients of this reference value. For instance, if the longest time-value in a piece is 8 seconds, the duration of 1 second would not be defined as 1 second, but as 1/8 S(tandard) value. The same also goes for the presentation of a proportion on the spatial line L-R, which we at once fix at 1, whether it is in reality 10 metres or 15 metres.

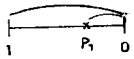
However, which of the two points L and R shall we define as 0 and which as 1? If L is zero and R 1, we follow the normal presentation of spatial relationships: the convention of putting 0 at the left and 1 at the right has a lot to do with the fact that we write from left to right (we also write events in time from left to right in our scores). This fixes the division of L-R in the ratio 3:1: the new point lies in the left part:



If the proportion becomes increasingly smaller (1/4 1/5 1/6), the point P_1 approaches zero; if the proportion gets larger (1/2 2/3 3/4), it approaches the value 1, or R. If we proceed from the point P_1 with the proportion 3:1, we must – according to our definition – look for the point P_2 left of P_1 at $(1/3 \times 1/3)$. But this means that a ratio from large to small (3:1) – a 'climbing' interval, as we say of pitches – would always signify a change from right to left on L-R. Let us check if this agrees with our experience.

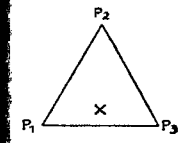
In the field of pitches, the high tones, that is, the short phase-durations, are written high up; the low tones, that is the long phase-durations, are written low down. Writing small things high up and larger ones low down has a close connection with our optical experiences (certain trees grow so that the largest part is below, the smallest above); if our experience were orientated 'downwards' instead of 'upwards', the larger things would be high up and the smaller ones low down (the smallest roots of the tree would be lowest, the larger parts would be above). When pitches are spatially represented from left to right – as in keyboard instruments or violin strings, for instance – low tones are associated with left and high ones with right (climbing intervals to the right and falling ones to the left). There are, then, general associations of low-left-near and high-right-far. An attempt to reverse the entire arrangement of the strings of a piano and to play 'climbing' intervals to the left and 'falling' ones to the right would meet with great imaginative difficulties and it is superfluous to wonder if such habits of orientation could be altered into their opposite. An analogy between spatial and temporal directions

relationships has existed for a long time in the musical field, and we can no longer arbitrarily determine where in the example of L-R zero and 1 should be. It is therefore not advisable to take over unhesitatingly presentation-methods from geometry, as we just did.

Example: let us imagine 48 musicians on the line L-R. They have to play a piece with a four-octave pitch compass, that is with 4×12 pitches equally spaced within the scale, and each player is to play only one of these 48 tones. They must now arrange themselves as it were in 'chromatic' order. Where do we put the low tones and where the high ones? According to what we have already said, we choose left for the low tones and right for the high ones. But this means that in the established space-time-analogy the shortest phases are presented at the right and the longest at the left: thus that which get smaller (higher) is at the right and that which get larger (lower) is at the left; 0 is right and 1 is left. The proportion 3:1 (the whole line L-R to its part) defines P_1 as follows: 

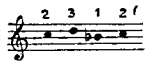
We can now relate proportions of pitch, duration, timbre and loudness with those of tone-locality, in the special case of a one-dimensional spatial arrangement of sound sources. We find the term '*space-melody*'.

But what happens if we arrange three sound sources in an equilateral triangle, in front of, right and left and the listener, for instance?



If a tone sounds successively at the points P_1, P_2, P_3 and P_1, we observe changes which at first appear to differ fundamentally from all those hitherto familiar in music: by progressive alteration in one direction of movement (round to the right) we arrive back at our starting point. All parameters mentioned so far are one-dimensional:

pitches between low and high
durations between long and short
timbres between dark and bright
loudnesses between soft and loud.

If we select the sequence 2 3 1 2 in one of these parameters, one interval (3-1) is greater than the other two. Example: 

However, in the spatial triangle the change P_2-P_3 is the same as P_3-P_1; the intervals are interchangeable.

Theoretically, hearing intervals still plays a large part in serial music, too. At present, however, a radical change in the function of the interval can be seen. In practice, intervals – which for Webern still represented the fundamental element of composition – play only a modest part (as a binding sequence of differences in size) in those works which are based on the concept of tone-structure and which are capable of realising it. The hearing of intervals is becoming increasingly repressed by the hearing of structures, which does not keep to the relation of element to element, but to the perception of equally-valuated complex structure-moments, and to the individual characteristic of entire, indissoluble element groups. All ideas of interval, interval tension, etc., come from music in which one indeed had the time and space to hear the intervals as such. But if one thinks – without elaborating on this now – of works such as 'Zeitmasse'

or 'Gruppen', one hears the interval-relationships only seldom, in quiet, slow, thin structures of narrow ambit. The interval has become 'colour', a structural 'lattice-characteristic', it operates in complexes; the hierarchy of intervals is dissolved by composition. But if we hear groups of pitches or durations as complex, equally-valuated 'moments', a sequence of very high and very low tones signifies a no greater change than a sequence of closely neighbouring tones.

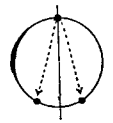
Something similar occurs in Cage's music; here, intervals are not blurred by great temporal density – tones are isolated to such an extent by unusually great separations in time that memory is not capable of jumping the pauses, and the hearing of intervals stops. Here, too, perception is concentrated on autonomous moments that have equal rights with regard to each other.

It can therefore be said that it is only seldom and in a few special cases sensible to prepare an element-series fixed in its intervals (no matter in which dimension) – for instance of a certain twelve-tone series for a composition. The more audibly transparent a musical context is, the more 'pointillist' it becomes, the greater is the extent to which fixed interval-series will be used; the more complex a structure becomes, the greater is the extent to which the elements become interchangeable and the smaller is the part played by the interval. There are of course in a composed equal status of structure-moments entirely new form characteristics to be heeded (for example the concept of 'band-width' in the place of 'interval').

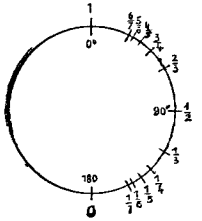
As far as our pitch-example is concerned, a new, independent relationship to each event can be obtained when listening, without measuring the leap from the preceding one to the next. If this were achieved, there would always be only a NOW, and the intervals would be of no consequence at all. Of course the ideas we have hitherto had in tone-space have come down to us from singing, from our movements and efforts in producing tones: larger intervals are more trouble than smaller ones (hence 'tension-thinking' and the qualitative hierarchy of intervals). We observe that we unconsciously adopt in imagination a quite definite position with regard to temporal processes, too – just as in space, where we sit in a particular place from which we judge occurrences around us. With pitches, most listeners imagine themselves to be 'in the middle' and orientate themselves 'upwards' and 'downwards'. Why aren't they 'up' or 'down', so that there is no 'middle' but merely 'nearer or further'? By means of the way in which tones are bunched together in a composition, the tones could be made to proceed for a certain time from the low or high register, so that the listener would be obliged to follow all changes from the extreme registers; but such experiments are exceptions. It is very difficult to bring into motion the stationary spatialized positions in time-perception (they are connected with the natural 'vocal register', with the way our capacity to perceive pitch has been educated, and with the physiological make-up of our organs of perception; what most nearly approaches these natural attributes of man are defined by him as the 'middle'). Perception of durations behaves in a similar way; here, too, most listeners quite unconsciously take up a position in the 'middle', from which 'distances' are measured as too short or long: orientation is based on the standard value of the second, which most nearly approaches the heart-beat. But it could happen that new and more thorough experience in two-dimensional, and still more in three-dimensional space-hearing could influence our ideas about the other one-

dimensional parameters to such an extent that the latter would also be changed – as it were, also 'bent'; they would become cyclic.

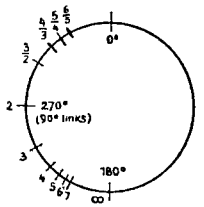
If tone-locality is included in composition as an independent parameter, three sources of sound are not enough, and we must use the continuum, the circle, as our point of departure. Let us assume that there can be a sound source at every point on the circumference of 360°. The listener should sit in the middle of the circle. In order to define the points on the circumference more exactly, it is possible to divide the circle into 360 degrees and to define each point by a degree. In naval and aerial navigation it is usual to define 'in front' as 0° and to have the degrees rotate clockwise (90° at the right, 180° at the back, 270° at the left). If a tone sounds at 0° and the next at 170°, we orientate ourselves to the right; if a tone sounds at 0° and the next at 190°, however, we orientate ourselves to the left, that is, we don't hear the second tone at 190° right, but at 170° left. It is therefore more sensible to define left and right by two semicircles each of 180°, rather than to use a full circle.

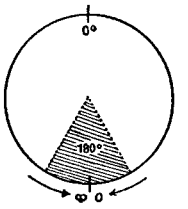


In order to define 0 and 1, let us again use a comparison with durations. With the orientation-point 'in front', we can compare a particular duration; we call it 1. The duration can become shorter; we represent this analogous to our experience in one-dimensional spatial orientation in the right-hand semicircle. 1/2 is then at 90°, 1/3 at 120°, 1/4 at 135°, etc. Near 180° we approach the value 0. 2/3 is at 60°, 3/4 at 45°, etc. We approach the value 1.

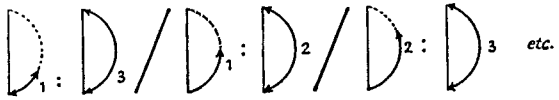


We have multiplied the value 1 by the fractions 1/2, 1/3, 1/4 ... $\frac{1}{n} \longrightarrow 0$ and 1/2, 2/3, 3/4, 4/5 ... $\frac{n-1}{n} \longrightarrow 1$. If we make the initial value 1 greater, we divide it by the same fractions and obtain 2 at 270° (90° left), 3 at 240° (120° left), 4 at 225° (135° left), etc., at 180° we approach the value ∞. 3/2 is at 300° (60° left), 4/3 at 315° (45° left), etc. At 0° we again approach the value 1. At 180°, then, infinitely great and infinitely small merge; we can define this field as the 'blind spot'.

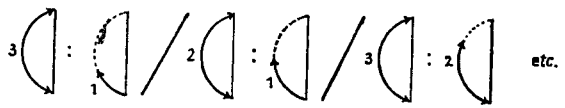




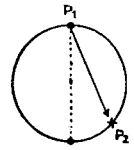
We have expressed the 'left-right' orientation in such a way that 'climbing' proportions are represented in the right-hand semicircle by the ratio of the smaller arc to the semicircle:



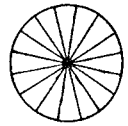
and in such a way that 'falling' proportions in the left-hand semicircle are represented by the ratio of the semicircle to the smaller arc:



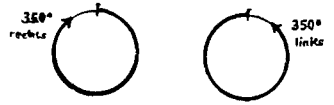
It should therefore now be possible to establish an analogy between proportions of time (pitch, duration, timbre) and the proportion of space in the circle. The proportion in our example was 3:1, so if a first tone sounds in front – at 0° – we put the entire possible change of the semicircle as equal to 3 and a second tone would have to sound at the right, at a third of the possible change of the semicircle, thus at 120°.



Just as in the parameters of pitch and duration – and in electronic compositions timbres and tone-loudnesses, too – it would also be sensible in the case of locality to substitute changes of fixed scale-steps for changes of proportion. For this, the smallest perceptible distance between the sources of sound on a circumference of 360° would have to be ascertained by experiments, and also the smallest perceptible angle between the connecting lines of the listener's position and the two neighbouring tones. One would thus obtain the scale of localities corresponding to the scales of pitch, duration, timbre and tone-loudness.



Continuous change of locality round the circle renders superfluous the differentiation of left and right; for a continuous change of locality from in front to, for instance, 350° is – unlike a discontinuous one – perceived as a change to the right, and the same holds good for changes to the left above 180°. In this case we can apply the locality-change to the full circle; definitions such as 350° right or 350° left are then valid.



At present, no information can be given about the inclusion of three-dimensional space with the orientation 'up' and 'down', as we have had no experience whatever in the musical field within this dimension. For such experiments, the spherical chamber which has already been mentioned, hung all round with loudspeakers, would have to be available.

JOHN CAGE'S LECTURE 'INDETERMINACY'

HANS G. HELMS

This lecture by John Cage is temporally organised. Each of the thirty texts of which it consists is to be read in one minute, the time-unit governing this lecture. If optically reproduced, each text is to be printed on one page, the spatial unit, whose shape is not predetermined. The texts vary in length; the maximum, */8'00" – 9'00"/*, determines the size and shape of the spatial unit, the page (in this edition the space between the time-indications at top left and bottom right), within whose limits each text is structured. This spatial arrangement – like the temporal one when the lecture is read – was not laid down by the author; all structuring within the spatial or temporal units is interpretation. The original English text is given at the end (pp. 115-120).

When the present spatial interpretation of the German translation of Cage's text was made its deviser did indeed know of the author's own temporal interpretation (in Brussels), but did not feel in any way bound to it; he consulted only the linguistic material used by the author, and worked with this. Groups of sounds were semantically varied (*/24'00" – 25'00"/*). Grammatical complexes fell apart into purely semantic, then purely phonetic units (*23'00" – 24'00"/*). Letters, words, grammatical complexes became blocks, which were then put into a spatial relationship (*/7'00" – 8'00"/*). Or else words were 'pulverised, fragmented' (cf. */18'00" – 19'00"/*). Blocks and similarly destructed material were united to form a macrostructure (as in */3'00" – 4'00"/*).

The direction of reading in this interpretation is always left to right and from top to bottom, although this was not predetermined and could equally have been right to left, bottom to top, spiral or variable within a unit.

John Cage Unbestimmtheit

Diese Anfang Oktober 1958 in Stockholm und Brüssel geschriebene Vorlesung hielt der Autor am 9. Oktober 1958 anläßlich der ***Journées internationales de musique expérimentale*** der Weltausstellung in Brüssel.

Übersetzung und räumliche Anordnung: Hans G Helms

Als ich noch ***Grand Street & Monroe*** wohnte, kam eines Abends Isamu Noguchi, mich zu besuchen.

Im Zimmer gab es nichts (keine Möbel, keine Gemälde). Kokosmatten bedeckten den Boden zwischen Wand und Wand. Die Fenster waren ohne Gardinen, ohne Vorhänge.

Isamu Noguchi sagte:

„Ein alter Schuh
würde in diesem Raum
schön aussehen."

1'00''

Zwar kennen Sie vermutlich die Geschichte von den beiden Mönchen, doch will ich sie trotzdem erzählen.

Als sie eines Tages fürbaß schritten, stießen sie auf einen Fluß, an dem eine junge Dame in der Hoffnung wartete, jemand möchte ihr hinüber helfen. Unverzüglich hob der eine Mönch sie auf, trug sie hinüber und setzte sie auf der anderen Seite sicher ab.

Die zwei Mönche setzten ihren Weg fort, und nach einiger Zeit sprach der zweite, der's nicht mehr für sich behalten mochte, zum ersten:

„Du weißt, daß wir Frauen nicht berühren dürfen; warum aber hast Du jene Frau über den Fluß getragen?"

Der erste Mönch gab zurück: „Setz sie ab. Wie ich vor zwei Stunden."

Einst,
als wir zu mehreren nach Boston fuhren, hielten wir an einer Raststätte, um zu lunchen. Einem Eckfenster nahe stand ein Tisch, von dem wir hinausschauen konnten und einen kleinen See sahen. Menschen schwammen darin und tauchten. Es gab besondere Vorrichtungen, um ins Wasser zu rutschen.

Im Restaurant stand ein Musikautomat. Irgendwer warf einen Groschen ein.

Ich bemerkte,
daß die Musik, die einsetzte,
die
Schwimmer begleitete,
obschon jene
sie nicht
ver-
nahmen.

3'00''

An ein
em Tag
, als d
ie Fen
ster o
ffen s
tanden
, spie
lte Ch
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n Wolff e
ins seine
r Stücke
auf dem K
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Schiffssi
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sie laute
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als die Töne des Klavier
s. Nachher bat einer Chr
istian Wolff, das Stück
bei geschlossenen Fenste
rn zu wiederholen. Chris
tian Wolff meinte, gerne
würde er so tun, doch wä

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gebung
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der
Musi
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räch e
n.

4'00''

88

4'00''

Eines Abends wanderte ich den Hollywood Bouleward h inunter und hatte nichts R echtes zu tun. Ich blieb s tehen und sah ins Schaufe nster eines Schreibwareng eschäfts. Ein mechanische r Füller war derart aufge hängt, daß er auf einem m echanisch abrollenden Pap ierstreifen jene Bewegung en des Schönschreibens üb te, die ich als Kind im d ritten Schuljahr gelernt h atte. In des Schaufenster s Mitte stand ein Reklame schild, das die mechanisc hen Ursachen der Perfekti on benannte, damit der au fgehängte mechanische Fül ler arbeite.

Fasziniertstandichstill ,
dennallesgingschief. Der
FüllerrißdasPapierinFetze
nundspritzteTintedurchsga
nzeSchaufensterundübersPl
akat, dasjedochleserlich
blieb.

5'00''

89

5'00''

Als
ich
nach
Boston
gelangt war
ging
ich in den
schalltoten
Raum der
Harvard University.

Jeder,
der mich kennt,
kennt
diese
Geschichte.
Ich
erzähle
sie

fortwährend

Nun

, in
jenem stillen Raum
hörte ich zwei Geräusche: ein hohes und ein tiefes. Nachher fragte ich den zuständigen Techniker, warum ich, obwohl der Raum
so still
war, zwei Geräusche gehört hatte. „Beschreiben Sie es," sagte er. Ich tat
es. Er
sprach: „Das hohe Geräusch war Ihr arbeitendes Nervensystem; das tiefe Ihr zirkulierendes Blut."

6'00''

In Chicago wurde ich vor Jahren
gebeten, zwei
Tänzer zu begleiten, die
auf einem Ball — in einem Saal
des CVJM —
berufstätige Damen unterhalten sollten.

Nach dem Programm wurde der Musik-
auto-
mat angestellt, daß ein jeglicher tanzen
könne;
ein Orchester war nicht anwesend
(die Damen waren sparsam).

Was sich
jedoch
ereignete, wurde sehr
kost-
spielig.

Ein Greifer in dem Musikauto-
mat
hob
eine gewählte Platte
auf den Teller. Der Tonarm bewegte sich in eine aussergewöhnlich hohe Position. Nach kurzem Halt fiel
er schnell und schwer herab
auf die Platte — und zerschlug sie.
Ein dritter Arm kam herbei und entfernte die Trümmer. Der Greifer legte eine andere gewählte Platte
auf den Teller. Der Tonarm
hob sich, hielt, fiel schnell herab
und zerschlug die Platte.
Die Trümmer wurden vom dritten Arm abgeräumt. Und
so weiter.

Und all die aufstrahlenden
farbigen
Lampen,
die solchen Musikau-
tomaten eigen sind,
funktionierten derweilen
vorzüglich
und ver-
zauberten

die Szenerie.

7'00''

7'00"

Als Christian Wolff die Übersetzung der ersten Vorlesung, die ich in Darmstadt gehalten habe, beendet hatte, äußerte er:

„Die Geschichten am Schluß sind sehr gut.

Aber vermutlich wird man Dich für naiv halten. Sieh zu, daß Du die Idee Ihnen austreibst."

8'00"

In Greensboro, drunten in North Carolina, gaben David Tudor und ich ein interessantes Programm. Wir spielten fünf Stücke je dreimal: das KLAVIERSTÜCK XI von Karlheinz Stockhausen, Christian Wolffs DUO FOR PIANISTS, Morton Feldmans INTERMISSION NO. 6, Earle Browns FOUR SYSTEMS und meine VARIATIONS. Die Stücke sind auf verschiedene Weisen komponiert, denen Unbestimmtheit der Aufführung gemeinsam ist. Jede Aufführung ist einzig, für Komponisten und Spieler so interessant wie fürs Publikum. Will sagen, jeder ist in der Tat Hörer. Ich erklärte diese Dinge dem Publikum, ehe das musikalische Programm begann. Ich wies darauf hin, daß man gewohnt ist, an ein Musikstück als an ein Objekt zu denken, das zum Verstehen und zur späteren Bewertung sich eignet, daß es sich dagegen hier gänzlich anders verhalte. Diese Stücke, so sagte ich, sind nicht Objekte, sondern im Wesentlichen zwecklose Prozesse. Natürlich mußte ich dann den Zweck, Zweckloses zu tun, erklären. Ich sagte, Töne seien nichts als Töne, und wären sie nicht bloße Töne, würden wir (ich benutzte natürlich das Zeitungs-Wir) — so würden wir bei der nächsten Komposition etwas daran tun. Ich sagte, da Töne Töne sind, gibt das den Menschen, die sie hören, die Möglichkeit, Menschen zu sein, die ihr Zentrum in sich tragen, wie es doch der Fall ist, und nicht künstlich irgendwo in die Ferne versetzt, wie sie es gewohnt sind, die auszuknobeln sich mühen, was da von einem Künstler mit Tönen gesagt wird. Schließlich äußerte ich, daß der Zweck solch zweckloser Musik erreicht würde, wenn die Menschen zuzuhören lernten; daß beim Zuhören sie entdecken möchten, daß sie die Töne des Alltags denen vorziehen, die sie gerade in einem Musikprogramm hörten; daß das, so weit es mich beträfe, in Ordnung wäre.

9'00"

/

Doch um
zu meiner Geschichte zurückzukommen:

ein Mädchen des dortigen College kam später hinter die Bühne und erzählte mir, daß sich etwas Wunderbares zugetragen habe.

Ich fragte: „Was?"

Sie sagte: „Eine der Musikstudentinnen denkt zum erstenmal in ihrem Leben."

Beim Abendessen

(es war ein Nachmittagskonzert)
erzählte mir der Chef der Musikabteilung, daß ihn beim Verlassen des Konzertsaals drei seiner Studentinnen angerufen hätten: „Kommen Sie doch mal."

Er ging zu ihnen.

„Was gibt's?" fragte er.

Eins der Mädchen sagte:

„LAUSCHEN SIE."

In je
nem K
onzer
t in
G r e e n s boro

kamen
David
Tudor
& ich
ein b
ißche
n dur
chein
ander.

Er begann ein Stück zu spielen und
ich
ein ganz anderes.

Ich hielt inne,

weil ER der Pianist
ist, der ER
ist

, und hörte zu.

Als ich David Tudor erzählte, daß diese Rede über die Unbestimmtheit nichts sein werde als eine Folge von Geschichten, meinte er: „Versäume nicht, einige Lobreden einzustreuen." Ich fragte: „Was in Gottes Namen meinst Du mit Lobreden?"

„Segenssprüche", sagte er.

„Was für Segenssprüche," fragte ich. „Gott segne Euch alle?"

„Ja," sagte er, „wie's in den Sutras heißt:

‚Dies ist keine müßige *Rede, sondern der Wahrheiten* höchste.'"

Da gab es einen Amerikaner aus Seattle; der reiste nach Japan, um Wandschirme einzukaufen. Er begab sich zu einem Kloster, von dem er vernommen, daß es dort besondere gäbe; und er erlangte auch ein Gespräch mit dem Abt, der allerdings während der ganzen Zeit ihres Beisammenseins kein Wort von sich gab. Mittels eines Übersetzers bekundete er seine Wünsche, blieb aber ohne wie auch immer geartete Antwort des Abts.

Sehr früh am nächsten Morgen jedoch klingelte sein Telephon, und der Abt selbst meldete sich, der, so erwies sich's jetzt, vorzüglich des Englischen mächtig war und erklärte, der Amerikaner könne nicht nur den von ihm gewünschten Wandschirm für einen bestimmten Preis einhandeln; überdies besäße das Kloster ein altes eisernes Tor, welches er gleichfalls erwerben könne.

Der Amerikaner erwiderte: „Aber, um Himmels Willen, was beginne ich mit dem alten eisernen Tor?"

„Ich bin gewiß, Sie können es einem Filmstar in Hollywood verkaufen," entgegnete der Abt.

13'00"

Wir haben
die
MUSIC WINTER
jetzt schon einige Male
gespielt. Ich
habe
nicht mitgezählt, wie oft.
Als wir
sie
zum ersten Mal
spiel-
ten,
wirkten die Pausen sehr
lang,
und die Klänge schienen
im
R a u m

getrennt zu sein, sodaß sie einander nichts zuleide taten. Droben in Stockholm aber, als wir sie als Zwischenmusik im Tanzprogramm von Merce Cunningham und Carolyn Brown spielten, fiel mir auf, daß sie inzwischen melodisch geworden war. Christian Wolff prophezeite dies mir schon vor Jahren. Er sagte — wir wandelten gesprächig einher — da sagte er: „Gleich wie wir's auch beginnen, es endet als Melodie." Soweit ich in diesem Betracht stehe, erging's Webern vor Jahren so.

Karlheinz
Stockhausen äußerte sich
vorgestern in Kopenhagen
mir gegenüber: „Zwei
Dinge fordere ich von einem Komponisten:
daß er er-
findet und mich erstaunt."

14'00"

'00"

Zwei Mönche kamen an einen Strom. Der eine war Hindu, der andere Zen-Buddhist. Der Inder begann, den Strom auf der Wasseroberfläche zu überschreiten. Der Japaner geriet in Aufregung und bat ihn umzukehren.

„Was ist denn los?" fragte der Inder.

Der Zen-Mönch sprach: „Das ist nicht die Art, einen Strom zu überqueren. Folge mir."

Er führte ihn an eine Stelle, an der das Wasser seicht war, und sie wateten hindurch.

15'00"

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MUSIC L

Wieder ein Mönch
schritt so für sich,
als am Pfade,
den er ging,
eine weinende Dame saß.

„Woran fehlt's,"
erkundigte er sich.

Schluchzend gab sie Auskunft:
„Ich habe mein einziges Kind
verloren."

Er schlug ihr über den Schädel
und sprach:

„Da,
das wird Dir etwas sein,
um drüber zu heulen."

Als in Amerika ich mich daran setzte, die Orchesterstimmen meines neuen Konzerts für Klavier und Orchester, welches wir am 19. September in Köln aufführten, zu schreiben, besuchte ich jeden Musiker, fand heraus, was er auf seinem Instrument spielen konnte, entdeckte mit ihm andere Möglichkeiten, unterwarf dann alle meine Funde Zufallsmanipulationen, um schließlich zu einer Stimme zu kommen, die durchaus unbestimmt in Bezug auf ihre Aufführung war. Nach einer Generalprobe, während der die Musiker das Ergebnis ihrer verschiedenen Aktionen vernahmen, brachten einige, nicht alle Musiker bei der Aufführung Töne einer Art hinzu, die in meiner Notation nicht zu finden war, die zumeist durch ihre dumm und unprofessionell gewordenen Intentionen charakterisiert waren.

In Köln arbeitete ich mit jedem Musiker einzeln in der Hoffnung, diesen unglücklichen Stand der Dinge zu vermeiden, und die Generalprobe war stumm.

[Ich sollte Ihnen sagen, daß der Dirigent keine Partitur, sondern nur seine eigene Stimme hat, so daß er zwar Aktionen der anderen Spieler bewirkt, nicht aber sie kontrolliert.]

Nun, wie auch immer, das Ergebnis war in einigen Fällen in Köln just so unprofessionell wie in New York.

Ich muß einen Weg finden,
die Menschen freizusetzen,
ohne daß sie dumm werden.
So daß ihre Freiheit
sie adelt.

Wie ich das erreichen werde? Das ist die Frage.

17'00''

Ob Frage oder nicht (will sagen, ob nun mein Tun auch die Situation lösen mag), meine Probleme erweisen sich mehr als soziologische denn musikalische.

Meinte das
Sri Ramakrishna,
als er dem Schüler,
der ihn fragte,
ob er die Musik
aufgeben
solle und ihm folgen,
zur Antwort gab:

„Keinesfalls.
Bleib' ein Musiker.

Musik
ist ein rasches Transportmittel
zum ewig währenden
Leben."

Und in einer Vorlesung,
die ich in
Illinois
hielt, fügte ich
hinzu:

zum Leben.
Punktum!

18'00''

'00''

Die Leute sagen immer,
Ost sei Ost
und West sei West,
und man solle sich nur hüten,
sie nicht zu verwechseln.

Als ich begann, orientalische Philosophie zu
studieren,
war ich voller Sorge, ob
ich damit wohl recht täte.
Das
sorgt mich nun nicht mehr.

In Darms
tadt sprac
h
ich von d
em guten G
ru
nd, der hinter Pu
lveri
sierung und Fragmentierung steh
t
:
wenn man
zum Beispiel Silben sta
tt Worten, Buchstaben
statt Silben in einem Ges
angstext verw
endet. Ich sagte: „W
i r nehmen die Di ng e
auseinander
damit sie
B
u d dh
a
wer d
en
"
„Und wenn dieser Gedanke Ihnen zu orientalisch dünkt," sagte ich, „denken Sie an den Satz der frühchristlichen G nostiker: Spalte den Stab, und Du hast Jesus."

19'00''

19'00''

Nun ja,
seit Darmstadt habe ich zwei Stücke geschrieben: eins im Verlauf einer fünfzehnminütigen Fernsehsendung in Köln. Das andere ist MUSIC WALK, während zwei Stunden in Stockholm notiert. Keins der beiden Stücke ist durch Zufallsmanipulationen entstanden. Die Unbestimmtheit des MUSIC WALK ist so beschaffen, daß ich überhaupt nicht absehen kann, was geschehen wird, ehe wir's nicht gespielt haben, David Tudor und ich, am 14. in Düsseldorf. Zufallsoperationen sind nicht erforderlich, wenn die Aktionen, die ausgeführt werden, unbekannt sind. MUSIC WALK besteht aus 9 Blättern Papier mit Punkten darauf und einem leeren. Ein kleineres durchsichtiges Plastikrechteck mit 5 weit voneinander parallel gezogenen Linien wird in beliebiger Position über sie gelegt, wodurch einige der Punkte aus dem Bereich des Möglichen in das der Aktion gerückt werden. Die Linien sind mehrdeutig; sie beziehen sich auf 5 verschiedene Klangkategorien in beliebiger Ordnung. Zusätzliche kleine Plastikquadrate mit je 5 nicht-parallelen Linien sind vorhanden; sie können benutzt werden (oder auch nicht), um die Art des zu produzierenden Schallereignisses näher zu bestimmen. Es gibt mehrere Orte, an denen gespielt wird: an der Tastatur, im Innern des Klaviers, an einem Radio. Man bewegt sich ständig von einem dieser Orte zu einem anderen, wodurch die Beziehungen der Punkte zu den parallelen Linien verändert werden.

20'00''

'00''

Kuang-Tse

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zu ängstigen .

21'00''

21'00"

Als ich einmal einen Vortrag am Columbia Teachers College halten sollte,

fragte ich Joseph Campbell,

ob ich etwas sagen

sollte

(es fällt mir ger
ade nicht ein, an
was ich dabei dac
hte).

Er antwortete:

„Wo

ist das

Sollte?"

22'00"

2'00"

Ist je Ihnen aufgefallen, wie Sie die Zeitung lesen? Sie springen hin und her, lassen Artikel unbeachtet oder lesen Sie nur zum Teil, wenden sich diesem und jenem zu. Es ist so gar nicht die Art, wie man Bach in der Öffentlichkeit liest, aber präzis so, wie man Christian Wolffs ***Duo II for Pianists*** öffentlich liest.

23'00"

23'00''

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24'00''

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Einer Eskimo Dame, die kein Wort Englisch
sprach noch verstand,
wurden einst freie Rei se nach den USA und 500
Dollar angeboten, wenn sie einen Leichnam beglei-
ten würde, der zum Be gräbnis nach Amerika
überführt werden sollte. Sie akzeptierte.
Bei ihrer Ankunft sah sie umher und bemerkte,
daß die Leute,
die den Bahnhof betraten,
die
Stadt ver lie ßen, und
sie
sie
nie
wie dersah.
Offensichtlich reisten sie an einen anderen Ort.
Ihr fie l auch auf, daß jene vor
der Abfahrt sich an ein en Fahrkartenschalter
stellten, dem Verk äufer etwas sagten und
ein Billet er hie lten.
Sie stellte sich ebenfalls
dort an,
lauschte sorgsam dem, w as ihr Vorgänger sagte,
wie derholte es und reiste
dann,
wo immer jener hinreist e.
In die ser Weise kam
sie im Land umher,
von Stadt zu Stadt.
Nach einer gewissen Zei t wurde ihr das Geld
knapp, und sie beschloß, in der
nächsten Stadt, zu der sie käme, zu bleiben, sich
eine Arbeit zu suchen u nd ihren Lebensabend
dort zu verbringen.
Doch als sie
die sen Entschluß faßte, be-
fand sie sich in
einer Kleinstadt Wiscon sins, von der an jenem
Tage nie mand mehr verreiste.
Immerhin hatte sie auf ihren Reisen ein
wenig Englisch aufge schnappt. Also ging
sie
sch lie ßlich an den Fahrkarten-
schalter und fragte den Mann dort:
„Wohin gingen SIE ,
wenn SIE gingen?"

Er nannte einen
kleinen Ort in Ohio, wo sie bis zum heutigen
Tage
lebt.

25'00''

Vor vier Jahren sprach ich mit Hidekazu Yoshida.

Wir saßen im Zug von Donaueschingen nach Köln.

Ich erwähnte Herrigels Buch des Titels ***Zen und die Kunst des Bogenschießens.***

(An seinem melodramatischen Höhepunkt handelt das Buch von einem Bogenschützen, der, obschon in völliger Dunkelheit, ins Schwarze traf.)

Yoshida erzählte mir, daß der Autor dabei etwas zu betonen versäumt habe,

nämlich:

„Es lebt heute in Japan ein sehr angesehener Bogenschütze, dem es noch nie gegeben war, ins Schwarze zu treffen, selbst nicht am hellen Tag."

Die vier Dünste des Chaos, vom Norden,
Osten,
Westen,
und Süden, begaben sich,
Chaos zu besuchen.

Er behandelte alle vier sehr freundlich, und als sie ihn wieder zu verlassen gedachten, überlegten sie selbviert, wie sie ihm wohl seine Gastfreundschaft vergelten könnten.

Da sie bemerkt hatten, daß sein Körper jener

Öffnungen

entbehrte, die ein jeder von ihnen hatte (

Augen,

Nase,

Mund,

Ohren,

etc.

)beschlossen sie, ihn an jedem folgenden Tag mit einer Öffnung zu versehen.

Am Ende des siebten Tages starb ***C h a o s***.

Dann und wann gerate ich an einen Artikel über jenen Steingarten in Japan, der nur eine Sandfläche ist, auf der ein paar Steine liegen. Der Autor, gleich welcher, begibt dich dran, entweder zu vermuten, daß die Stellung der Steine im Raum einem geometrischen Plan folge, der die Schönheit, die man gewahrt, verursacht; oder bloße Vermutung genügt ihm nicht, und er zeichnet Diagramme auf und vollführt eine detaillierte Analyse.

Als ich Ashihara, den japanischen Musik- und Tanzkritiker kennenlernte (dessen Vorname mir gerade nicht einfällt), äußerte ich, daß ich dächte, jene Steine könnten in jenem Raum wo immer auch sich befinden, und daß ich bezweifelte, ihre Beziehung zueinander wäre eine geplante; vielmehr wäre die Leere des Sands von einer Art, die Steine an jedem Punkt darinnen tragen könne.

Ashihara hatte mir bereits ein Geschenk gegeben, einige Tischmatten; nun aber bat er mich, einen Moment zu warten, während er sein Hotel betrat.

Er kam wieder und schenkte mir die Kravatte, die ich jetzt trage.

In Polen oder irgend dort herum ging einst ein alter Rebbe durch ein Gewitter von einem Dorf zum anderen.

Seine Gesundheit war schlecht. Er war blind, — von Wunden bedeckt. Aller Jammer Hiobs war sein. Als er über etwas stolperte, fiel er in den Schlamm. Mit Mühe hob er sich wieder auf die Beine; dann reckte er die Arme gen Himmel und rief:

„Gelobt sei Gott!

Der Satan ist auf Erden und macht seine Arbeit wunderschön!"

29'00''

Morris Graves besaß in Seattle immer einen alten Ford.

Er hatte die Sitze herausgenommen und dafür Tisch und Stühle hineingestellt, sodaß das Auto einem kleinen möblierten Zimmer glich, mit Büchern darin, einer Vase voll Blumen und so fort.

Eines Tages fuhr er vor eine Imbißstube,

parkte,

öffnete die Tür zur Straße,

entrollte auf dem Bürgersteig einen roten Läufer.

Dann betrat er den Läufer,

ging ins Restaurant

und bestellte eine Frikadelle.

Derweilen sammelte sich eine Menge, die erwartete, etwas Seltsames würde sich ereignen. ***Aber***

alles, was Graves tat, war,

seine Frikadelle zu essen,

die Rechnung zu begleichen,

wieder ins Auto zu steigen,

den Teppich zusammenzurollen ***und*** fortzufahren.

30'00''

'00'' One evening when I was still living at Grand St. & Monroe, Isamu Noguchi came to visit me. There was nothing in the room (no furniture, no paintings). The floor was covered, wall to wall, with cocoa matting. The windows had no curtains, no drapes. Isamu Noguchi said, "An old shoe would look beautiful in this room." 1'00''

'00'' You probably know the one about the two monks, but I'll tell it anyway. They were walking along one day when they came to a stream where a young lady was waiting, hoping that someone would help her across. Without hesitating, one of the monks picked her up and carried her across, putting her down safely on the other side. The two monks continued walking along, and after some time the second one, unable to restrain himself, said to the first, "You know we're not allowed to touch women; why did you carry that woman across the stream?" The first monk replied: "Put her down. I did two hours ago." 2'00''

'00'' Once when several of us were driving up to Boston, we stopped at a roadside restaurant for lunch. There was a table near a corner window where we could all look out and see a pond. People were swimming and diving. There were special arrangements for sliding into the water. Inside the restaurant was a jukebox. Somebody put a dime in. I noticed that the music that came out accompanied the swimmers, though they didn't hear it. 3'00''

'00'' One day when the windows were open Christian Wolff played one of his pieces at the piano. Sounds of traffic, boat horns, were heard not only during the silences in the music, but, being louder, were more easily heard than the piano sounds themselves. Afterwards someone asked Christian Wolff to play the piece again with the windows closed. Christian Wolff said he'd be glad to, but that it wasn't really necessary, since the sounds of the environment were in no sense an interruption of those of the music. 4'00''

'00'' One evening I was walking along Hollywood Boulevard, nothing much to do. I stopped and looked in the window of a stationary shop. A mechanized pen was suspended in space in such a way that as a mechanized roll of paper passed by it, the pen went through the motions of the same penmanship exercises I had learned as a child in the third grade. Centrally placed in the window was an advertisement explaining the mechanical reasons for the perfection of the operation of the suspended mechanical pen. I was fascinated for everything was going wrong. The pen was tearing the paper in shreds and spattering ink all over the window and on the advertisement which nevertheless remained legible. 5'00''

'00'' It was after I got to Boston that I went into the anechoic chamber at Harvard University. Anybody who knows me knows this story. I am constantly telling it. Anyway, in that silent room I heard two sounds: one high and one low. Afterward I asked the engineer in charge why, if the room was so silent, I had heard two sounds. He said, "Describe them." I did. He said, "The high one was your nervous system in operation. The low one was your blood in circulation." 6'00''

6'00'' Years ago in Chicago I was asked to accompany two dancers who were providing entertainment at a business womens' dance party given in a hall of the YWCA. After the entertainment the jukebox was turned on so everybody could dance: there was no orchestra (they were saving money). However, the goings-on became very expensive. One of the arms in the jukebox moved a selected record on to the turntable. The playing arm moved to an extraordinarily elevated position. After a slight pause it came down rapidly and heavily on the record — smashing it. Another arm came into the situation and removed the debris. The first arm moved another selected record on to the turntable. The playing arm moved up again, paused, came down quickly, smashing the record. The debris was removed by the third arm. And so on. And meanwhile all the flashing colored lights associated with jukeboxes worked perfectly, making the whole scene glamorous. 7'00''

7'00'' After he finished translating into German the first lecture I gave at Darmstadt, Christian Wolff said, "The stories at the end are very good. But they'll probably say you're naive. I do hope you can explode that idea." 8'00''

8'00'' Down in Greensboro, North Carolina, David Tudor and I gave an interesting program. We played five pieces three times each. They were the Klavierstück XI by Karlheinz Stockhausen, Christian Wolff's Duo for Pianists, Morton Feldman's Intermission No. 6, Earle Brown's Four Systems and my Variations. All of these pieces are composed in various ways that have in common indeterminacy of performance. Each performance is unique, as interesting to the composers and performers as to the audience. Everyone in fact, that is, becomes a listener. I explained all this to the audience before the musical program began. I pointed out that one is accustomed to thinking of a piece of music as an object suitable for understanding and subsequent evaluation, but that here the situation was quite other. These pieces, I said, are not objects but processes essentially purposeless. Naturally then I had to explain the purpose of having something be purposeless. I said the sounds were just sounds and that if they weren't just sounds that we would (I was of course using the editorial we) — we would do something about it in the next composition. I said that since the sounds were sounds this gave people hearing them the chance to be people, centered within themselves where they actually are, not off artificially in the distance as they are accustomed to be, trying to figure out what is being said by some artist by means of sounds. Finally I said that the purpose of this purposeless music would be achieved if people learned to listen; that when they listened they might discover that they preferred the sounds of everyday life to the ones they would presently hear in the musical program; that that was alright as far as I was concerned. 9'00''

'00'' However to come back to my story: a girl in the college there came backstage afterwards and told me that something marvelous had happened. I said, "What?" She said: "One of the music-majors is thinking for the first time in her life." Then at dinner (it was an afternoon concert) the Head of the Music Department told me that as he was leaving the concert hall, three of his students called, saying, "Come over here." He went over. "What is it?" he said. One of the girls said, "Listen." 10'00''

0'00'' During that Greensboro concert, David Tudor and I got a little mixed up. He began to play one piece and I began to play a completely different one. I stopped, since he is the pianist he is, and I just sat there listening. 11'00''

1'00'' When I told David Tudor that this talk on indeterminacy was nothing but a series of stories, he said, "Don't fail to put in some benedictions." I said, "What in heaven's name do you mean by benedictions?" "Blessings," he said. "What blessings," I said: "God bless you everyone?" "Yes," he said, "like they say in the Sutras: 'This is not idle talk, but the highest of truths'." 12'00''

2'00'' There was an American from Seattle who went to Japan to buy screens. He went to a monastary where he had heard there were very special ones and managed to get an interview with the abbott who, however, didn't say a word during the entire time they were together. Through an interpreter, the American made known his desires but received no comment of any kind from the abbott. However, very early the next morning, he received a telephone call from the abbott himself who turned out to speak perfect English and who said that the American could not only have the screen he wanted for a certain price, but that, furthermore, the monastary possessed an old iron gate that he could also purchase. The American said, "But what on earth will I do with an old iron gate?" "I am sure you could sell it to a star in Hollywood," the abbott replied. 13'00''

3'00'' We've now played the Winter Music quite a number of times. I haven't kept count. When we first played it, the silences seemed very long and the sounds seemed really separated in space, not obstructing one another. Up in Stockholm, however, when we played it at the opera as an interlude in the dance program given by Merce Cunningham and Carolyn Brown, I noticed that it had become melodic. Christian Wolff prophesized this to me years ago. He said — we were walking along talking — he said: "No matter what we do it ends by being melodic." As for as I am concerned this happened to Webern years ago. Karlheinz Stockhausen told me the other day in Copenhagen, "I demand two things from a composer: invention and that he astonish me." 14'00''

14'00" Two monks came to a stream. One was Hindu; the other Zen. The Indian began to cross the stream by walking on the surface of the water. The Japanese became excited and called to him to come back. "What's the matter?" the Indian said. The Zen monk said, "That's not the way to cross a stream. Follow me." He led him to a place where the water was shallow and they waded across. 15'00"

15'00" Another monk was walking along when he came to a lady who was sitting by the path weeping. "What's the matter," he said. She said, sobbing, "I have lost my only child." He hit her over the head, and said, "There, that'll give you something to cry about." 16'00"

16'00" In America when I was setting out to write the orchestral parts of my recent Concert for Piano and Orchestra which we performed Sept. 19th in Köln, I visited each player, found out what he could do with his instruments, discovered with him other possibilities, and then subjected all these findings to chance operations, ending up with a part that was quite indeterminate of its performance. After a general rehearsal, during which the musicians heard the result of their several actions, some of them, not all, introduced in the actual performance sounds of a nature not found in my notations, characterized for the most part by their intentions which had become foolish and unprofessional. In Köln hoping to avoid this unfortunate state of affairs, I worked with each musician individually and the general rehearsal was silent. (I should let you know that the conductor has no score but has only his own part. So that, though he effects the other performers, he does not control them.) Well, anyway, the result was in some cases just as unprofessional in Köln as in New York. I must find a way to let people be free without their becoming foolish. So that their freedom will make them noble. How will I do this? That is the question. 17'00"

17'00" Question or not (that is to say whether what I will do will answer the situation) my problems have become social rather than musical. Was that what Sri Ramakrishna meant when he said to the disciple who asked him whether he should give up music and follow him, "By no means. Remain a musician. Music is a means of rapid transportation to life everlasting."? And in a lecture I gave in Illinois I added: to life period. 18'00"

18'00" People are always saying that the East is the East and the West is the West and you have to keep from mixing them up. When I first began to study Oriental philosophy I also worried about whether it was mine to study. I don't worry anymore about that. At Darmstadt I was talking about the reason back of pulverization and fragmentation: for instance, using syllables instead of words in a vocal text, letters instead of syllables. I said: "We take things apart in order that they may become the Buddha." "And if that seems too Oriental an idea for you," I said, "Remember the early Christian Gnostic statement: Split the stick and there is Jesus." 19'00"

19'00" Well, since Darmstadt, I've written two pieces: one in the course of a fifteen minute TV program in Köln. The other is Music Walk written during two hours in Stockholm. Neither piece uses chance operations. The indeterminacy in the case of Music Walk is such that I cannot predict at all what will happen until we perform it, David Tudor and I, in Düsseldorf on the 14th. Chance operations are not necessary when the actions that are made are unknowing. Music Walk consists of 9 sheets of paper having points and one without any. A smaller transparent plastic rectangle having 5 widely spaced parallel lines is placed over these in any position, bringing some of the points out of potentiality into activity. The lines are ambiguous referring to 5 different categories of sound in any order. Additional small plastic squares are provided having 5 non-parallel lines which may or may not be used to make further determinations regarding the nature of the sounds to be produced. Playing positions are several: at the keyboard, at the back of the piano, at a radio. One moves at any time from one to another of these positions, changing thereby the reference of the points to the parallel lines. 20'00"

20'00" Kwang-Tse points out that a beautiful woman who gives pleasure to men serves only to frighten the fish when she jumps in the water. 21'00"

21'00" Once when I was to give a talk at Columbia Teachers College, I asked Joseph Campbell whether I should say something (I forget now what it was I was thinking of saying). He said, "Where is the should?" 22'00"

22'00" Have you ever noticed how you read a newspaper? Jumping around, leaving articles unread, or only partially read, turning here and there. Not at all the way one reads Bach in public, but precisely the way one reads in public Duo II for Pianists by Christian Wolff. 23'00"

23'00" A Chinaman(Kwang-Tse tells) went to sleep and dreamt he was a butterfly. Later when he awoke, he asked himself, "Am I a butterfly dreaming that I am a man?" 24'00"

24'00" An Eskimo lady who couldn't speak or understand a word of English was once offered transportation to the United States plus five hundred dollars providing she would accompany a corpse that was being sent back to America for burial. She accepted. On her arrival she looked about and noticed that people who went into the Railway Station left the city and she never saw them again. Apparently they travelled someplace else. She also noticed that before leaving they went to the ticket window, said something to the salesman, and got a ticket. She stood in line, listened carefully to what the person in front of her said to the ticket salesman, repeated what that person said and then travelled wherever he travelled. In this way she moved about the country from one city to another. After some time her money was running out and she decided to settle down in the next city she came to, to find employment, and to live there the rest of her life. But when she came to this decision, she was in a small town in Wisconsin from which no one that day was travelling. However, in the course of her travels she had picked up a bit of English. So, finally, she went to the ticket window and said to the man there, "Where would you go if you were going?" He named a small town in Ohio where she lives to this day. 25'00"

25'00" Four years ago I wds talking with Hidekazu Yoshida. We were on the train from Donaueschingen to Köln. I mentioned the book by Herrigel called Zen in the Art of Archery. (The melodramatic climax of this book concerns an archer's hitting the bull's eye though he did so in total darkness.) Yoshida told me there was one thing the author failed to point out, that is: there lives in Japan at the present time a highly esteemed archer who has never yet been able to hit the bull's eye even in broad daylight. 26'00"

26'00" The four Mists of Chaos, the North, the East, the West and the South, went to visit Chaos himself. He treated them all very kindly and when they were thinking of leaving they consulted among themselves how they might repay his hospitality. Since they had noticed that he had no holes in his body, as they each had (eyes, nose, mouth, ears, etc.), they decided each day to provide him with an opening. At the end of 7 days Chaos died. 27'00"

27'00" Now and then I come across an article on that rock garden in Japan where there's just a space of sand and a few rocks in it. The author, no matter who he is, sets out either to suggest that the position of the rocks in the space follows some geometrical plan productive of the beauty one observes, or not satisfied with mere suggestion, he makes diagrams and detailed analyses. So when I met Ashihara, the Japanese music and dance critic (his first name escapes me now), I told him that I thought those stones could have been anywhere in that space, that I doubted whether their relationship was a planned one, that the emptiness of the sand was such that it could support stones at any points in it. Ashihara had already given me a present, some table mats, but then he asked me to wait a moment while he went into his hotel. He came out and gave me the tie I am now wearing. 28'00"

28'00" An old Rabbi in Poland or some place thereabouts was walking in a thunderstorm from one village to another. His health was poor. He was blind, — covered with sores. All the afflictions of Job were his. Stumbling over something he fell in the mud. Pulling himself up with difficulty, he raised his hands towards heaven and cried out, "Praise God! The Devil is on Earth and doing his work beautifully!" 29'00"

29'00" Morris Graves used to have an old Ford in Seattle. He had removed all the seats and put in a table and chairs so that the car was like a small furnished room with books, a vase with flowers and so forth. One day he drove up to a luncheonette, parked, opened the door on the street side, unrolled a red carpet across the sidewalk. Then he walked on the carpet, went in and ordered a hamburger. Meanwhile a crowd gathered, expecting something strange to happen. However, all Graves did was eat the hamburger, pay his bill, get back in the car, roll up the carpet, and drive off. 30'00"

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*Translated by Margaret Shenfield
†Translated by Ruth Koenig

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1964 Dec. B.A. Music

MALLARME AND SERIALIST THOUGHT

HANS RUDOLF ZELLER

> Mais celui-ci faisait impérieusement supposer tout un système de pensée rapportée à la poésie, traitée, exercée et reprise sans cesse *comme une oeuvre essentiellement infinie*, dont les oeuvres réalisées ou réalisables ne soient que les fragments, les essais, les études préparatoires.
>
> Paul Valéry, Variété III (1936)

Anyone who has, of recent years, closely followed the discussions about the basic aesthetic, linguistic and formal problems of serial music will already have encountered the name of the French poet Stéphane Mallarmé (1842-1898) in various connections. Leaving aside the purely journalistic attempts to bring present-day ideas of composition into the ambit of poetic thought, it is Pierre Boulez who has repeatedly pointed out the significance of certain aspects of Mallarmé's work in connection with present-day efforts to construct a new, obligatory *ars poetica* for music.[1] Although far from being blinded by sentiment, Boulez admires Mallarmé's work greatly and feels a very direct, personal response to it; for this reason his arguments are not affected by the scepticism which usually crops up whenever an attempt is made to draw definite conclusions from more or less apposite general parallels. It is, of course, not for a musical account of Mallarmé's work to distort it by referring only to the contemporary musical situation, and transforming Mallarmé, by means of a few tricks, into a hitherto little recognised predecessor of the 'serialists'. An investigation of this kind is only worthy of the name if it brings out definite points of contact, such as similar solutions to problems of poetic or compositional technique; consequently it is best to mistrust the analogies which seem only too obvious (as to basic aesthetic positions, for example), and, on the contrary, stress the difficulties of any such undertaking. In fact, the title of this article should really end with a question-mark.

In general terms, of course, the comparison is unexceptionable. The music conventionally known as 'serial' with its determined struggle to evolve an absolute language, new principles of formation and a more suitable conception of the musical work, has indeed more in common with Mallarmé's outlook than has contemporary literature, which is essentially preoccupied with reportage. But it is in 'translating' Mallarmé's message that the most troublesome problems arise. On the one hand, the instinctive, naive conception of music and literature as two regions of artistic activity separated by a glass partition makes Mallarmé's relevance difficult to understand in musical terms. On the other hand any position which diverges from the customary idea of the relationship between poet and composer introduces a new difficulty. Although

[1] Thus the article entitled 'Recherches maintenant' published in the *Nouvelle Revue Francaise* formulates the same question that is taken up again here; it too rejects the inadmissible obliteration of boundaries. It is noteworthy that this previous reference to Mallarmé (and Joyce) ushered in a criticism of the formal concepts and principles of formation which had hitherto governed European music and had always been accepted unquestioningly; Boulez saw indications of their antitypes in Webern and, even more so, Debussy. It is not for this short study to show how many crucial pieces of knowledge Boulez owes to Debussy's late works. On the connections between the aesthetic ideas of Debussy and Mallarmé, particularly the question of the important 'maeutic' role of Far Eastern art and music, cf. W. Danckert, *Claude Debussy*, Berlin, 1950, p. 130 ff.

he uses a different linguistic system the composer of today is no longer interested only in the finished poetic product (as something that can be 'set'). He is just as interested in the poet's way of working, the system, the rules of play according to which the poet 'moves', his instruments, his methods: in short, the principles of his *ars poetica*. This demands a proper appreciation of the existing differences of language. Are they so intense that they will immediately wreck any attempt to communicate on specific poetic points? And if this is not the case, at what point can a particularly fruitful exchange of ideas be instigated?

At first sight, accepting the fact of 'language differences' seems to occasion an unnecessary intensification of the difficulty. Of course we have resisted the temptation to envisage the spiritual relationship which is to be noted between the poet of the second half of the nineteenth century and the musicians of the first half of the twentieth as a convergence of two tendencies, although this could be supported by a certain amount of evidence: the 'musicalisation' of poetic language resolutely pursued by Mallarmé would correspond to the 'delinguification' of music which began, with such vehemence, shortly after his death. On the other hand, accentuating the obvious diversities would remain a sterile pursuit if it did not lead, on closer examination, to the comparable ways of reacting which are only expressed symptomatically in the tendencies, and if the fact that the languages are different implied that their constitution were completely different – so much so that, for example, at a moment when the one language, as a system, was taking to irregularity and consequently getting into a crisis which posed those who spoke it the most difficult problems, the other one being compared with it was unquestionably at the disposal of those who used it. Obviously, then, we shall probably not be misled into the wrong views so much by misunderstanding the irreducible diversity of the linguistic systems (which are nevertheless unified to the extent that they are both languages) as by misunderstanding their different conditions, their independent stages of development. But at the same time the range of the problem broadens: it now embraces not only languages of different types (as communication systems or the 'material' of aesthetic structures), but rather, to an equal extent, the particular situation of those which are, in an exceptional way, 'directed' toward their material, so much so that certain designs could never be carried out without satisfying the material's demands; and conversely, mutations of material that the ear cannot miss, or language crises, demand new conceptions. Perhaps this can be seen more clearly in the musical language than in the poetic language. Since the disintegration of tonality (whose other face, not noticed until recently, was the disintegration of classical metre as the first, negative expression of a changed conception of musical time), it has been in a permanent crisis.

The tonal language became a dead language. Its 'monuments' are still accessible to the penetrating intelligence, but its repertoire of means – however assiduously refined and extended – no longer enables the composer to convey what he must convey as a man of the present. The history of the New Music shows how certain individual personalities reacted to this language emergency, resulting from an objective decline of language; it records the attempts at systems which are in the final analysis private, the many 'artificial' languages which owed their existence, basically, to the series of

works for which they were invented and their dissemination to the imitative urge of 'fellow-travellers'. What today, as the formulation of the classical serial principle, still appears to be in the appendix to this 'language history', will perhaps in the future constitute its central chapter, describing the exciting event in detail and showing how a true musical *characteristica universalis* was begun, at least, as a clear-cut, firm project, out of the artificial language of the New Music which was the most consistent, because it was most suited to its material, although inadequately 'formalised'. At the moment this universal language is still at the stage of being put into practice. Composition is synonymous with language criticism which is constantly testing its elements and the schemes of its systemisation. The composer can no longer think only of himself! If, giving way to a blind yearning for the riches said to have vanished he should try to free himself from this huge burden, he would attain nothing but a position of heroic egoism; for the sake of a deceptive self-confirmation he would be accepting impoverishment and putting up with corruption.

But can the poet, on the other hand, ever get into such a conflict between the subjective will to express and the objective demands of the material? In his work does he have to reflect specially on his language? Is it not the illusory security with which he governs its vocabulary and syntax which make him into a poet? Is he able to alter the language in substance, apart from enriching and differentiating linguistic expression? Must he first construct it? And finally is there any event in modern literature comparable with the decline of tonality? Of course, in this connection words like 'language crisis', 'language criticism' and 'meta-language'* will take on a different sound. But they may hardly be avoided if we are to show where irrevocable turning-points occur in the field of modern literature and, specifically, in the province of lyric poetry. The basic turning-point concerned an express thematisation of language as the first and only 'subject' of poetic writing. That which is not formulated has no existence; that which is already 'there' needs no formulation. This was to be a first step towards the standpoint from whence came the key position Mallarmé adopted for modern poetry – which, in its most essential manifestations, is an exploration of the limits of language. Another step derives from Mallarmé's dictum, which has long since become a cliché, that poems are made not of ideas but of words. What happens to these words, which are 'the same words the ordinary man reads every morning in the newspaper', but which he 'no longer understands' if he comes across them in a poem by Mallarmé? They are 'transcribed by a poet'. That is, their everyday function, which is to describe something, communicate something, is systematically nullified, and Mallarmé calls this process of changing the function of everyday words 'transposition'. The fact that it is achieved is not a result of the words themselves but of the position assigned to them in a selected system of arrangement (whose choice is, in its turn, dependent on the present situation of the poet and poetry in general). Consequently a word does not acquire *one* new meaning, but a whole new meaning-boundary, according to how many dimensions of

* TRANSLATOR'S NOTE: It should be borne in mind that in this essay Mr. Zeller does not use the term 'meta-language' in the usual sense, to mean a poetic language which has nothing in common with any previously known language, poetic or non-poetic.

'poetic space' are effective on the basis of certain decisions. So Mallarmé could take as the real theme of a sonnet one word whose meaning was evidently unknown to him, which had to be 'agreed on' afterwards. Thus transposition necessarily demands a structural design; it will not remain a postulate. As something which is (for the moment) static, it is a 'structure' (which the reader will have to 'continue'). The principles of the arrangement are called the line or sentence. Through the line (the Alexandrine!) Mallarmé knows himself to be linked with tradition, while at the same time, by building up his own syntactical system, he is making a definite break with tradition.

These few brief notes must suffice to explain what may be meant by 'language crisis' in this context. Seen from the viewpoint of everyday language and official language (which are inescapably committed to communication and hence to the criterion of non-ambiguity) poetic language is in a state of crisis. It is no longer the superstructure of the prose language, its ultimate possible intensification (from which it can profit in its turn), but rather something completely different, a language *within* language, whose sentences can no more be transformed into other sentences in this language than they can be translated into any of the current foreign languages. In both cases the reproduction of one dimension (for example the 'meaning') would be paid for by the falsification of another (e.g., the sound). If in ordinary language even silence is still 'eloquent', not understood exactly as pure non-speech, dumbness, in the 'meta-language' speech does not break out from silence to release something which may be grasped and handed on. The pure sentence does not have an 'answer', a 'solution'. It *is*, or it has *said something* – and, as this unique sentence-form, passes into oblivion; either the goal has been reached, or *another* sentence must point out a new direction. However, one is now back on the ground of established language, handling a highly complicated instrument which is nevertheless afflicted by the stigma of inadequacy. The situation of the poet (and the logician) is characterised by losing confidence in the rules of its manipulation, seeing through its imperfection, without being deceived as to its complexity. Since this instrumental facet of language has been revealed—problematical as it is—on the basis of a comparison with a more comprehensive concept of language, the criticism now beginning can define the limits of its validity. But this demands an intensive study of language, beginning with its elements, passing by way of their simplest combinations on to the system, for its word-equipment also goes to build up the 'meta-language'. However, this does not establish itself (nor is it 'able to be learned'), it remains a project in suspense – the stages of its realisation are not marked out, and only that which has *become* reality, the poetic fact, tells us anything about it. That is to say: the poet must always aim at the whole. And the lines of his 'thought-picture' will stand out more sharply, the more thoroughly he analyses and 'decomposes' their forms, rules and conventions. 'The good writer is the one who buries a word a day'. The positive correlative of this apparently negative criticism is represented by the demand for the pure sentence: absolute indistinguishability of 'form' and 'content'.

If one sees communication-language and 'meta-language' in this dynamic relationship it becomes plain to what extent an examination of the writer's situation

oriented round the linguistic concept of language (2) betrays its most inherent interests if it starts from the (unproved) assertion that even the most advanced writers have not been able to change the (so-called) 'infra-structure' of their language, and infers firm foundations where in fact the end of all security has to be faced and naive agreement with the raw material has long since disappeared. Now if a linguist did not cling to the criterion of 'change' (a secondary criterion in this case), but instead went to the texts themselves (with their variants) to find out to what extent the poet 'irradiates' that so-called infra-structure, a certain page of sketches for Mallarmé's *Igitur*, in which the pairs 'l'heure' – 'le heurt', 'echo' – 'ego', 'plus' – 'plu', represent a test-series, as it were, would be bound to remind him very much of examples in the standard works of linguistics. Pursuing his researches further, he would find in Mallarmé's biography and list of works several mentions of his intended study of linguistics, planned 'in the hope that this particular effort will not be without influence on the whole language apparatus, for which my nervous illness seems to have been specially intended' (letter written in 1870). Later, he thought of applying himself to oriental and semitic language studies in particular. The result of all these enterprises was the comprehensive work on *Les Mots Anglais*. Here again the reproach of dilettantism, justified from the standpoint of modern linguistics, might cause the exemplary significance of Mallarmé's work in this field to be forgotten. On the contrary ('after Joyce and E. E. Cummings') this work would only find an adequate interpretation in the simple supposition that the contemporary writer can no more overlook a study of phonetics and phonology than the composer ('after Webern') can overlook those of acoustics and the information-theory.

After this necessarily brief correction of an excessively undifferentiated conception of the poet's relation to his material, there is no need to make a special refutation of the objection (which springs from it) to the fact that musicians quote Mallarmé as a precedent. The question is no longer whether there is, in general, sufficient grounds for an imaginary dialogue between the poet Stéphane Mallarmé and contemporary composers, but on what subject it starts up on its own, as it were, because it concerns both sides with equal intensity and forces us to compare the results of their deliberations. But before this subject can be gone into we must recall the prehistory of the dialogue which we have been leading up to on the present occasion. In fact this dialogue will only continue an intellectual encounter which can be reconstructed, although it was hardly able to take place along one of the customary paths (for which reason there can be no question of direct influences). For it was not until the complete works of Anton Webern were made available – the most significant expression of the desire to purify and renew the musical language – that the entrance to Mallarmé's store of themes, which was concealed within it, was revealed. If a few indications could make plain the intimate link existing at a time of unparalleled language-confusion between the ideas on lyrical language held by the poet and by the composer (who was at the same time the only equally gifted 'translator' of that poet) it would provide a model and depth-dimension for all that follows.

Mallarmé and Webern were lyric writers. The exclusiveness with which they

[2] Cf. Nicolas Ruwet's article 'Contradictions within the Serial Language' on p. 65 of this book. In it language is conceived primarily as a communication-system, a social institution.

grasped at this form of existence as a last chance of purely artistic perfection of form gave the word 'lyric writer' a completely new ring. Since then it has been an anachronism to connect the lyricist with a rhetoric used to serve an urge to communicate, or, on the other hand, with the moist lips that indicate an introversion too flabby to be shaped in any way. The modern lyric poet no longer encounters this resigned *separateness* which nevertheless does not give up wanting to appear separate. For he is already on the outside fringe areas of the real; he could not resist the pressure of the linguistic 'elementary particles' for a moment, unless he was in command of the strategy and technique necessary to encircle and link them, unless he had made up his mind to the hardest of work, to construction. It has become imperative to be clear as to their methods, and this is only felt to be a disability by those for whom speculation as to some divine gifts or other, flight into the safe port of timelessness, is still a possible alternative. Both Mallarmé's and Webern's poems show this kind of renunciation from a position of strength. It is no accident that the metaphors used again and again in studies of the subject to describe Mallarmé's forms, such as 'strings of pearls', 'constellations', 'crystalline structures', 'diamonds', etc., but also 'mathematical formulae', 'calculations', etc., are equally applicable to Webern's. Taken together they all stand for one central concept: structure. To Mallarmé its ultimate elements, significant in themselves, were the twenty-six letters of the alphabet (or rather the number of phonemes in the French phonological system), to Webern they were the intervals that can be composed from the twelve notes of the tempered scale. Studies of compositions from each of Webern's creative periods have shown that the two-note, three-note and four-note motifs whose recurrence is particularly striking must be considered as the smallest structural units of Webern's syntax [3]. Let us relate this to a parallel discovery in Mallarmé: the noteworthy prominence given to monosyllabic words (such as *or, nu; pli, vol; laps, legs*) in both poetry and prose. This concentration on compact word-nuclei which cannot be stripped down any further and which 'perforate' the catchy song with a kind of metallic knocking, like a hammered staccato, and give it such unsuspected powers of impressing itself, may perhaps have derived its energy from the concept of an original language, an *Ursprache*, whose equipment Mallarmé supposed to be composed of monosyllabic words (consonants conveying meaning accompanied by indeterminate vowels). On the formal plane this corresponds to his preference for the sonnet, which was to be a 'block', a 'crystal cube', or a 'totality word', made up of single words. This 'passion for the sonnet' too is reminiscent of Webern's important predilection for the canon.

But the way in which the actual constants are embodied in the work of these two lyric writers is more important than this kind of more or less valid juxtaposition of the characteristics of their structure-technique. With Webern, it was not only the idea of the structure founded on itself which finally worked its way into musicians' consciousness but also, apart from that, a fitting conception of what before had been called composition. It emerges clearly in the pattern of Webern's complete oeuvre. After the 29 instrumental pieces of op. 5–7 and 9–11, the venture of including words

[3] Cf. Herbert Eimert, 'A Change of Focus', *Die Reihe*, II, p. 32; and Henri Pousseur, 'Outline of a Method', *Die Reihe*, III, p. 54.

begun in op. 8 and taken up again in op. 12 and in seven more works (always with varying combinations) represents a real experiment. The position won in the instrumental field could be either consolidated or undermined by concessions to the 'natural' data of the singing voice. However, in instrumentalising the voice, transforming the significance of the sound of the words into musical relationships (instead of interpreting their 'poetic content'), he managed to objectivise the structure; in the instrumental pieces this was still occasionally tinged with subjectivism and so could be taken (and misunderstood) as aphorism, miniature or psychogram. (On the plane of the problem concerning structure and traditional instrumental or vocal forms, this complementary pattern recurs, in a more confined area and with swifter alternation, in the series of works beginning with op. 20). From the standpoint of current compositional practice linguistic forms were captured in a new way, with compositional means, and their phonetic components became components of the musical structure. For Webern the trans-structurisation of the word, its transformation into sonic relationships, was at the very centre of his compositional work (which demanded an incomparably heightened sensitivity towards the sounds of words). And it was Mallarmé's vision of a way of writing which would be in the spirit of music, his intuitive grasp of the fact that words and music originally belonged together [4] which, from a certain period of his career, made his work take the form of the destruction (justified by its productiveness) of the theory of literature which had been accepted up to that time. Compared with what he demanded, the thing which before and since Mallarmé has been praised as 'word-music' proves to be simple imitation. For the euphony of a linguistic figure can at most form the point of departure for a closer examination, whose results it should in no way prejudice. This is especially so if it is only stressed as a noteworthy feature and put forward with half an eye on its ever successful, but highly questionable appeal to readers' superficial musicality, possibly to make one forget the lack of structure. If a structure is also (or wholly) distinguished by its euphony, this would be, on the whole, a sign of its absolute fragility; formal weakness would be very ephemerally transfigured in the ecstatic rush of sound. On the other hand, Mallarmé was strict in his insistence on euphony as a *sine qua non* of all poetic writing. To him music was not a metaphor behind which lay concealed a sphere constantly held out as a lure by the poet but ultimately unattainable; it was, rather, an exact description of the constructive law which had to govern all prose and verse composition, in all their dimensions, and which distinguished his word-music from any other. The restless striving to equal the musician was supplanted by a silent certainty of having found the elements of a music only the poet could write. An essential trait of this music is that its semantic ambiguity becomes a fundamental criterion of the poetic text; from now on interpreting a poem is like describing a musical composition. So if Mallarmé's halfway kingdom is beyond popular literature, as it is beyond music as a note-craft, he nevertheless did not cut the communications to these fields any more than he sought to reconcile the two merely externally (on the contrary, whether consciously or not, he was thinking of a time when they were not recognised as separate territories – and also of a time when this division would once again disappear...)

[4] Developed almost programmatically in the lecture 'La Musique et les lettres'. Cf. Stéphane Mallarmé, *Oeuvres Complètes* (Bibliothèque de la Pléiade), Paris, 1951, p. 633.

His interest in the music of his period (by no means confined to Wagner's) increased with the years. For by constantly comparing it with musical reality he could make his own design more precise and consider what consequences the composition he had just heard might have for his own 'trade'. A glance at the music-interpreted poem *Un coup de dés jamais n'abolira le hasard* (1897) will suggest what mental work the poet Mallarmé required of Mallarmé the concert-goer.

The sensual aspect of his idea cannot be adequately appreciated either from the angle of pure literature or from that of pure music – much less to what it was leading the way. The rapidly increasing suspicion of the 'only-literature' party that the poet could only solve problems of language and forms by resorting to musical means is apparently confirmed by the composer's acquiescence. In reality the idea of composition, as it is always envisaged, soon proves to be merely absurd (which is moreover the best proof of the independence, as well as the disquieting novelty, even the revolutionary quality of Mallarmé's conception). Both reactions relate to a question validly formulated for the first time in the *Coup de dés* – that of notation; its significance is still always underestimated. In the history of modern poetry-notation which still remains to be written the *Coup de dés* would be revealed as both a climax and a turning point. It was the fruit of decades of endeavours to establish the elementary bases of writing, in the form of a meditation on the problem of typography, the proportion of black (type) to white (blank areas, the role of the pause, etc.). No other work in modern poetry reflects the situation of the literary artist more clearly (having to 'create himself in front of the paper'); no other work keeps more aloof from the usual type of diction, or has more to offer for the poet's attention. The reader's feeling of being present at the 'creation of language' (as Valéry put it) is due to the fact that the typography changes from page to page, with the white being transformed into a kind of stage. But this feeling could give way to the thought that the 'play' is bought at the cost of an extreme 'specification' of the lyric language, that Mallarmé had unconsciously taken as his basis the spatial concept that was developed some twenty years after his death in the picture-theory in Wittgenstein's *Tractatus Logico-Philosophicus*. But what is presented to the reader as a graphic-spatial configuration of what the text 'expresses' is just as much a representation as an instruction that it should be realised purely complex type-picture is characterised is revealed, on further reading, as a totality that symbolic incidents are established spatially and that the modes of their 'temporalisation' are established. The spatial simultaneity by means of which the complex type-picture is characterised is revealed, on further reading, as a totality of dimensions which can in their turn be analysed separately and in isolation. If poetic work moves basically within the four dimensions (in the semiotic sense) – visual, audial, syntactical and semantic – the criteria which emerge as dominant, essential for reading, are that of the type-picture as a complex; those of the reading tempo and reading direction, that of the vocal register used (three regions are distinguished – low, normal and high); and that of the pause (Boulez has already drawn attention, indirectly, to the fact that its structural function is comparable with that of Webern's rests). ([5]) If Mallarmé compared this many-layered notation to that of

[5] Cf. Pierre Boulez, 'The Threshold', *Die Reihe*, II, p. 40.

a score, he was no doubt acknowledging a model that had fascinated him. But this analogy is only necessary while this work continues to be classed with the unique experiments which seem to reject every 'evaluation' just because they have succeeded so perfectly. This classification of the *Coup de dés*, undoubtedly justifiable from the standpoint of the history of literature, makes the unique dwindle into an isolated exception, wipes out the traces of the utopian design which alone would be worth the trouble of following. But if it unites, in rudimentary form, all the methods of a modern type of poetry-notation, then the close similarity of this notation to musical notation is revealed in a new light; there would then be the possibility of designing, with purely poetic means, an integral, multidimensional poetry whose 'respiratory centre' would have to be a new conception of metre – outside the classical conception, but also outside the 'free rhythm' conception.

Consequently the project of an 'abstract' (that is, in reality, concrete) literature undeniably involves a continuous coming-to-terms with the contemporary music of the time, and moreover in its most radical forms. The fact that such a literature still does not exist as a clearly outlined, unified area, that to be able to give any idea of it one has again and again to refer to its great forerunners and a few daring outsiders, must be put down largely to the way we determinedly cling to a common concept of language which remains immovably situated in traditional classical logic at the very point when it is leading, with wearisome intransigence, *ad absurdum* and (as in surrealism, for example) being transformed into anti-logic. It is surely time for a systematic study of language to be made with the aid of philosophy and general linguistics, thus finally paving the way to a genuinely poetic concept of language, if the writings on the thematics and structure of the 'Book' (found among Mallarmé's literary remains and recently published by Jacques Scherer ([6]), together with a commentary by him) are not to become merely an interesting and inexhaustible subject for study and discussion. In the letter of 1870 quoted above, Mallarmé himself indicated the close link betwen linguistic and formal studies: 'In addition to all that, the work of my heart and my loneliness is gradually building up. I can already see its structure in outline: in reality the other, parallel toil (*labeur*) is nothing but the scholarly background to it.' Now that it is published, this superficially incomplete collection of notes for this main work, first mentioned in letters in 1866 and in its deepest intention a counterpart to the ancient Chinese book of oracles I Ching, makes the poems known hitherto appear to be merely unique preliminary exercises for this total, absolute Book, while the multidimensional structure-poem *Un Coup de dés* looks like its first emanation. (The metaphysics of the Book have to be left out here). After all that has been said about Mallarmé's productive relationship with music, the first question to arise is bound to be what traces music has left on the design for the 'book of books'. The answer to this question takes us to the heart of the present musical situation. For it soon became clear that compositions by Stockhausen, Boulez and Pousseur (which, as it happens, were given their first performances as Mallarmé's collection of papers was published – so that the composers could have known nothing of them – and in which the permutation-

[6] Cf. Jacques Scherer, *Le 'Livre' de Mallarmé* (Premières recherches sur des documents inédits, preface by H. Mondor), Paris, 1957.

principle was also extended to the formal structure through the 'activation' of the performer) accord to an astonishing extent with certain designs for structures in the Book, more particularly with the principle of the Book itself. Thus the nearness of Mallarmé's writing and thinking to music corresponds to a 'parallel process' in serial music, apparently so remote from literature, so strictly autonomous: what Mallarmé intended was put into practice quite independently in the medium of the serial language. This gives us the ideal theme for a dialogue between contemporary musicians and the author of—'Faune' and the 'Hérodiade'. It will of course have to confine itself to a comparison between the formal structure of the Book, on the one hand, and the new musical form-structure, on the other, but, with its necessary bracketing together of abstract literature and serial music, perhaps this attempt at a musically determined account outside the scope of purely retrospective, historical-type studies, could help a little to overcome the concept-laziness of literary thought.

Before the individual structure-schemes or manifestations of the Book which stand out in the posthumous manuscript can be presented in turn, we must take a brief look at the role of the reader for whom it was supposed to be intended. In itself the change in the significance of his function has a certain similarity with the extension of competence granted to the musical performer (as a prerequisite for 'realising' a deliberately ambiguous form-conception). Although this sudden change was sufficiently motivated by compositional experience and the tendencies immanent in serial music, it must have been a surprise at first. More than any other modern music serial music gained the reputation of not being written for the performer and not at all for the listener. The same thing is persistently maintained of (the most) modern lyric poetry. Because it does not make an appeal to the reader, *i.e.* 'speak' to him directly, it by no means follows that the poet is not thinking of him; in this connection admittedly the image of the reader is determined by the spirit of the writing. As Hugo Friedrich says [7]: 'Mallarmé has in mind a reader who is "open" to "multiple understanding".' [8] In fact his poetry stimulates him to continue the unfinished creative act which takes place in it by a creative act of his own, which avoids a static conclusion just as the poem avoids it. The infinite potentiality within which this language moves extends to the reader only in so far as it incites him to an equally infinite potentiality of interpretation. It is not so much that the reader should solve the enigma as that he himself should enter into the enigmatic state where he *feels* solutions, but does not draw them prematurely, and indeed may think of possible interpretations of the poem which may never have been in the poet's plan. The rigorous formal compactness and purity of this kind of poetry does not bind down the reader in any way; on the contrary it gives him extensive elbow-room in which he can move freely. Mallarmé's reader is, in the musical sense, both listener and performer of 'this solitary concert of silence which communicates itself to the mind during reading'. He does not merely read the text; he reads for reading's sake. Mallarmé may have been thinking of this ideal reader when he wrote the foreword to *Un coup de dés*, in which he acquaints him with the 'performance technique' of this 'piece'. And indeed the reader's freedom has been immeasurably

[7] Cf. Hugo Friedrich, 'Die Struktur der modernen Lyrik', rde, vol. 25, Hamburg, 3rd ed., 1959, p. 92. These sentences are taken from a major chapter on Mallarmé. Further bibliographical notes on p. 207.

[8] *Oeuvres complètes*, p. 283.

increased, owing to the fact that new dimensions have been brought into play. So long as he has a varied 'touch-technique', a highly developed 'feeling for time', etc., every 'interpretation' built up by himself or others, along the lines of the general 'guide': *Un coup de dés* (+ one blank page) *jamais* (+ five pages) *n'abolira* (+ seven pages) *le hasard* (+ four pages) – the guide which both characterises and holds together the four parts of the work – will be a unique 'manifestation' of this one poem, which will not be able to be reproduced again in that form. On the other hand, the reader of the Book would have reached the very highest level of freedom in relation to the Work. No guide (much less the conventional page-sequence regulated by numbering) would have helped him and shown him which way to go. He would, rather, have been authorised to knot together his own guide-rope from various threads – that is, the guide characteristic of that particular reading. Take sheet 99 of the Mallarmé manuscript as an illustration of what the reader would have met with: the first and last pages (of a text) are written on a sheet folded double; in other words the points of entry and departure are fixed. The link between the two consists of six movable sheets whose respective content is conceived and established in such a way that each grouping of these inserted sheets which is obtained (by means of permutation) can link both 'points'; each interpretation will be a meaningful one, according to the language of the Book and its rules. That this task was not intended for any chance person out of the whole mass of possible readers will cause no surprise after what has just been said about Mallarmé's reader. Nor would the Book have revealed itself in the same way to every reader. We can see this from a brief outline of the three stages of the Book-process.

First it is conceived as a geometrical body whose proportions are derived from the 'books' made up of the mobile sections, superimposed or presented side by side. The external measurements of the volumes and of the whole complex, the length, breadth and height of the book when lying down or standing up are to correspond, inside, to the number of lines on a page, its length, and the size of the spaces between lines. But this three-dimensional spatial structure, which Mallarmé called the 'block', is only the *visual* model for a non-visual, multidimensional, poetic space which would be accessible only to the poet in a sort of vision. The opaque spatial simultaneity has to be developed in a sequence of time, in a series of readings which should fulfil no other purpose than that of 'showing the scientific relationships (between a selected grouping of the block)' and 'establishing identities' (sheet 41) through a 'two plus two that undermines and wears out the objects in the name of a central purity'. For this reason Mallarmé did not dwell on the details of the block for long but turned his attention almost exclusively to planning readings. For reading no longer meant working one's way progressively through a book in one direction; it was now, rather, a question of taking in the whole by means of suddenly grasping and realising one of its possibilities. To this extent a manifestation of the Book is time-conditioned, while the forms of other books remain untouched by time. The transformable Book can take on different appearances at different times, without ever losing its identity. The readings are the process which give it its identity. But so that this 'productive' reading could proceed with regularity, the great unknown factor, the reader, had at last to be taken into account and to become

a factor in the book's structure. Naturally the man in the street was not to be invited to the readings, which were to take place within the framework of 'meetings' – only a small élite familiar with Mallarmé's work and equal to all his requirements. Mallarmé himself wanted to take the roles both of the omniscient 'Operator' who directs the 'performances' of the Book, and of the 'plain reader' – both the conductor and the performer at the same time. Since the programmes for these meetings also represent the structural schemes of the individual forms of the Book, it is possible to reconstruct the formation-process if we take a look at the modalities of the reading.

The first thing to be reckoned is the quantities which figure in these plans: the number of sections (and/or pages) in the fragment to be interpreted, and (or generally only) the scope of the structure to be formed; the number of readers taking part, the number of readings and meetings to take place, the number of seats, the price of a seat, the length of time which the readings were to take, the length of the meeting and the number of readings a day and a year. They are not in fact shown in full on any of the sheets but nevertheless none of them should be neglected, strictly speaking, because each can be relevant structurally. Thus, for example, a performance once over of a fragment consisting of twenty half-sections (at one franc), multiplied by the number of twelve readings (also the number of the double seats) proves to be the design of a four-part large-scale form consisting of 480 fictive half-sections (=3,840 pages); and each half of a section is composed of three permutations of the actual section-elements (sheet 170). Thus the Book does not emerge as an entity only after the last section has been read; each section represents a complete book which needs no continuation and yet contains within itself the nucleus of more books. They are all aspects of the one Book, and it would have become plain during the readings that it had several, indeed an infinite number, all distinct from each other, although never remaining merely juxtaposed, without any connection. Collectively, they would be the Book. But in the case of each individual one it must be felt that it *is* ('que c'est cela').

Afterwards an account of what was constituted by this 'activating' reading within a predetermined time could be published. The publication, the third phase in the process of forming the Book, was, on the one hand, to enable wider circles to have a share in the Book, and, on the other, to serve those who had taken part in the meetings as a sort of memory-aid or 'study score'. Accordingly Mallarmé's calculations also include information as to the number of printed and blank pages (for advertising purposes), the number of sections and volumes, and moreover of editions, and the price of the edition, the selling price of the individual copies, the author's royalty and the bookseller's profit. Once again it must be pointed out that these quantities can similarly be significant structurally, in that, for example, financial considerations provide the motivation for putting on a series of readings and so for producing a manifestation of the Book.

These three phases of the formation-process always occur in super-imposition in the schemes and calculations in Mallarmé's manuscript. If they appear separately it is sometimes possible to deduce the missing ones and by comparing the result obtained with other sketch-plans, to establish relationships between sheets which at

first sight seemed to have nothing in common. Constant comparisons of this sort suggest what would have happened at the reading of the thing these juxtaposed fragments seem to be about. The Book exists.

Of these three phases of the Book, the meeting – or performance – phase must automatically arouse the particular interest of anybody who is looking for an informative comparison between the formation-process of the Book and that of the musical forms permuted in groups. For within the framework of the meetings the movable elements of the Book were to be formed into structures, if not with the active participation of the audience, at least in relation to its possible size, correlated with the number of people in it. But before more can be said about the modalities of the readings and their programmes, I beg leave to take a glance at the programmes for movable musical architectures, and the changed role of the performer.

Even from a purely superficial standpoint these programmes are greatly different from what was previously understood by a musical score. But this might be taken as an indication that questions of form became questions of notation and that, conversely, the solving of problems of notation-technique, which emerge from the broadened conception of musical time, can influence new formal types directly. (To recall Mallarmé: the 'fact that typographical presentation approached to a ritual' contributed to the genesis of the structure-poem *Un coup de dés*, which can no longer be classed with any of the traditional literary forms, and for the Book too various 'notations' were contemplated). So it is to be expected that each composition, whether its form-sections are interchangeable or not, will have its own 'physiognomy' not only with regard to its genuine sign-system, which is only valid for that composition, but rather with regard to the way it opens out in the two dimensions of the paper's surface. This tendency shows in its most impressively pronounced form in the two outstanding paradigms of the new formation-principle, Boulez' third piano sonata and Stockhausen's Klavierstück XI. The actual *appearance* of the notes in the Klavierstück XI reveals the concept of a 'directionless time-field' which underlies its structure (in parallel fashion this is 'spatialised' in the third piano sonata by means of the drawing of the central formant 'constellation'). What appears to be scattered over the page, without order or direction, must in fact contain the possibility of being co-ordinated, if one passes from the external manifestation of the composition to its 'internal' formal structure, and as a complex it must be provided with a rule if indeed its sonic realisation is to be meaningfully accomplished. This describes the two stages of the composition-process of a form which is ambiguous in substance. Although the methods developed by individual composers may differ from each other to a greater or lesser degree, it should nevertheless be possible to elucidate this division of labour by reference to the composition of Klavierstück XI (on the basis of the part standing for the whole).

The leading formal idea aimed to pin down a number of note-groups of various sizes, only partially arranged for the time being, whose succession was not based on any predetermination, and each of which was to be continued in one of the others – and to establish them in such a way that with each arrangement (interpretation) the groups' internal characteristics changed with their changing sequence. The groups themselves, the extent to which each of these groups can be altered by the preceding

one and the lack of connection between all the groups could be indicated by means of the notation and spatial dispersal. After the conclusion of the writing-down stage the conditions were created for the groups to be related. In the meanwhile nothing had yet been said as to the possible ways of opening and closing a performance, the modes of relating, and above all, the meaning and use of the notations and descriptions employed alongside the traditional signs. An explanation prefaced to the piece gives the player the necessary information and on the strength of it he is able to adapt the general and specific performance-indications. At the beginning and later in the realisation the performer may be enticed into preferring certain groups; the general performance-instruction will commit him to the lack of premeditation of the beginning and linking. Since each group needs another one for its more precise characterisation, this performance-direction must also determine the way the first group of a performance should be played. Further performance-directions indicate different ways of relating or concern the instructions to be noted when a group is reached for the second time. Finally there is a direction establishing the last group. Thus the performer is in possession of the keys to the work, as it were; by applying the rules of play either simultaneously or successively he opens the work up and puts together one of its possible configurations. The 'classical' performer had to subordinate himself to a work which was, basically, written *against* him. He satisfied its overwhelming demands by forgetting his own ambitions and considering everything that was not expressly permitted as forbidden. However, this concept of interpretation could only continue to stand as long as it had its correlative in the reality of composition. Once it came into conflict with it, because the fulfilment of one of its central points – the greatest possible accuracy of reproduction – failed to capture the musical content entirely, then the composer had to look for some way of solving the dilemma which now faced the performer. Giving performance the same status as composition meant, in the final analysis, taking account of its natural limitations in the compositional planning, but also releasing the performer from his inferior position and making him a close collaborator who, by means of precisely formulated instructions (rules of play), and without having to punish himself or extend his province without authority, contributes his share to the realisation of *one* project, which of course he always envisages as a whole.

If the rules of play are performance-indications for the performer, they also describe the formal layout of a work which can no longer be elucidated by means of a scheme which would only be valid for one of its performances. Although this can be seen particularly unequivocally in Klavierstück XI, it is true of all forms based on the permutation-principle. (Cf. the rules of play of Boulez' third piano sonata, the ones generally applicable to the five formants of varying scope, and the specific ones for each of them.)

In this manuscript Mallarmé anticipates the concept of performance briefly outlined above, which means composing a form out of structure-blocks according to rules and therefore *forming* – not just reproducing or interpreting a text with different nuances of interpretation. For example one of the projects proposed in it runs: 'Ten different interpretations with one copy of the text' (sheet 107, also 108-111). But what were the rules to be respected by the reader in this 'structure-creating' way of reading?

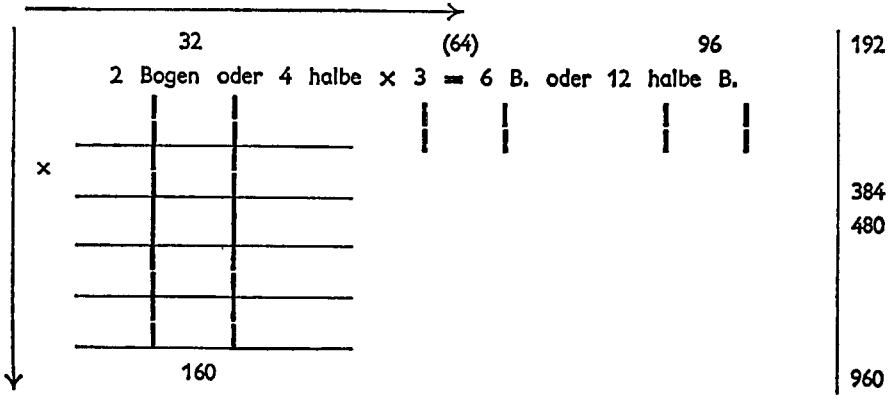
Mallarmé himself called the Book a 'mechanism'. It was to be the Operator's job to prepare to put the thing in motion, to get it going and to supervise it. The book-apparatus would have presented itself to the audience at the meeting in the form of six diagonally placed boxes, each containing five book-sections. On sheet 193 Mallarmé describes how he means to use this apparatus: 'He (the Operator) has a number of sections at this time, equal to half the seats in the auditorium, let us say six, and just as the seats are double, so each section is divided into two half-sections, of which one is the inside. Each half-section has eight pages. He combines the three sections by exchanging the inside half-section of one with the inside of another, say the first two, the two second and the two third . . .' One can readily imagine that the Operator would take one section out of each of the three boxes of the upper or lower half of the diagonal. Each of them belongs to a different work of the one Book, presents a different typographical picture, has its own 'theme'. Moreover each can be halved. They form (sheet 200) 'a whole consisting of two sections, 6 half-sections . . .', and a 'new way of reading which is presented simultaneously' shows that 'there are links between them, even if of the most remote', and moreover 'that these three co-operative works (*concurrents*) are identical'. This reading too takes place successively, but, through the device of the exchange between two sections, the reading itself determines what should follow what. It can begin anywhere and is subject to no direction-pressure. It must, of course, demonstrate that the material it is dealing with, which is apparently diverse, in fact belongs together in origin. Mallarmé expresses the attitude which should govern the reader in these collations as follows: 'It will be seen whether there is something or nothing'. The above example illustrates this. After the inner half-sections have been exchanged with each other the operation which reveals the identity of each pair of half-sections can begin. If it succeeds with all three pairs of sections, then the Book is proved to be real. What previously seemed to be a collection of loose leaves now presents itself as a richly articulated structure. Nevertheless the sections remain movable; a second series of operations will expose another aspect of the same group, thereby proving by example that the first was not some accidental product, but that the Book admits of at least two interpretations which are both of equal value in the light of the one and only reality, Book, and only differ with respect to their temporal displacement. The one whole is reflected in several forms, and apparently splits up, but it is in the formation-process that this fragmentation is at once established and suspended again. The supreme rule of play, which guides this constant closing up of the constantly re-opening Book, is: that at least two fragments of the Book, whether sections or section-ensembles, must be collated with each other, and this must be repeated. One single section does not count:

It cannot be 1
It must be 2. proof and
It can be 4 repetition
and 8

runs the note to a structure-sketch on sheet 168. The reading is a sequence of regulated operations. In his calculations Mallarmé tries to organise the book structures according to this principle of paired co-ordination.

Let us therefore select another elementary example. Sheet 159 envisages: '2 sec-

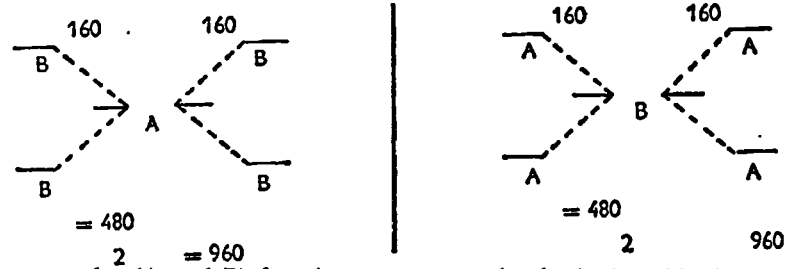
tions . . . once separate, exchange their inner half-sections, the same takes place with two other sections, which exchange their outer half-sections. The exchange is complete and requires 4 sections – say, 64 pages of 32+32, 2 sections+2 sections'. As in all his calculations, indirectly at any rate, Mallarmé bases his ideas on the section (equals 16 pages) for 'only the section counts, constitutes a unit; the section and the line' (sheet 190). (Sheet 98 is interesting in this connection; on it he wonders 'You have the page, as for the syllable? – The long word made up of syllables – of pages; 2 lines 24 syllables, 2 sections 12 pages'). In reality four half-sections would be enough to carry out the above exchange-scheme. After the exchange of the inner ones the first operation-series would be faced with $(\frac{1}{2}A+\frac{1}{2}B)+(\frac{1}{2}B+\frac{1}{2}A)$ and after the exchange of the outer ones the second would be $(\frac{1}{2}B+\frac{1}{2}A)+(\frac{1}{2}A+\frac{1}{2}B)$. However, this observation may remain, in itself, academic. Since each section was to be balanced by a seat in the auditorium, it is necessary to use a plan which comprises the same number of sections as there are people taking part in the reading. Here, for example, is an extract from sheet 136 (to be compared with sheets 36, 143 and 144):



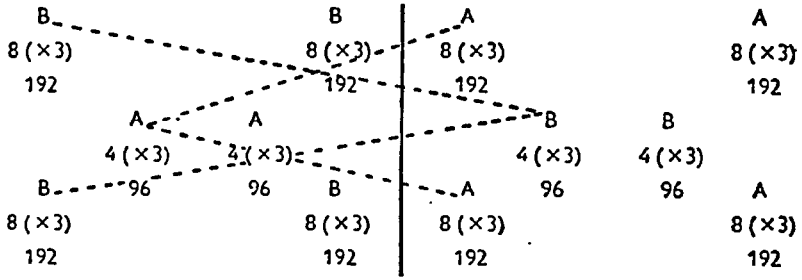
This is the pure Book-scheme. The two sections are to be multiplied, as can be seen, first by 3 (horizontal line) and then by 5 (vertical line) which produces 5+96 pages horizontally, reading from top to bottom and 3×160 vertically, reading from right to left. If one assigns one seat to each section, then 30 persons would have spread out 2 sections over thirty (by varying the arrangement 14 times). But Mallarmé planned to invite no more than 24 to a meeting, sometimes indeed only 10. If one reckons in eighth-sections, one can even imagine the first six-section group (equals 96 pages) of the diagram, produced by 24 operations. If on the other hand, one allows each reader one section, then they amount to 24 fictive sections (equals 384 pages). Now two sections are a minimum quantum for an operation, a micro-structure of the Book. The boxes were to hold thirty (equals 480 pages) altogether, of which however half were apparently to be the other half reversed. Applying the basic-operation-rule to a 'sample' of 240 pages produces the following fours-group, (240+240')+(240"+240"'). If each reader operates with this quantum the number of pages would eventually reach 23,040 (plus Mallarmé's copy=24,000). By thus multiplying the number of pages of a sample to be formed, by another Book-dimension (e.g. the number of people at the meeting) one arrives at general 'operation-norms' which, quite generally, amount to the number of the pages which are produced by the repetition of the same text (in varying orders), over and above the unavoidable minimum of reduplication. The same operation-norm can be fulfilled by repeating samples of varying size, and the repetition-degree of a micro-structure of the Book will conform to it; only after its fulfilment will it 'appear spatially'. The partial operation-norm can mean the use of the basic-operation rule.

Let us return to the aforementioned sheet 159. There too Mallarmé triples the two-section group and then describes the operations to be effected with them: 'I take one of the tripled sections from each of the numbers I – or corresponding to two poems each of which here constitute a fragment of 96 (pages), and proceed in this way with all three; I juxtapose them – then the same thing must be carried out in reverse, that is, by beginning and ending the other way round, so as to get the other double fragment of 96 – making 384 altogether'. Thus in the Book-scheme the first two series are occupied by sections. Mallarmé seems to reckon in double sections, which is why two are always collated together. When all three are covered the '*opération inverse*' begins: both section-series are reflected in the vertical line. Two poems of 96 produce a two-part whole of 384 pages. As a special form of exchange, inversion joins the operation-rules already formulated.

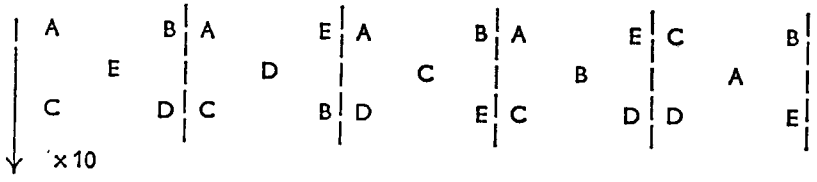
Following this there should figure a series of macro-structures of the Book, and an attempt would be made to decide, by reference to the basis of the operation and its norm, on the way the sections should be divided up in the meetings, so as to be able to follow up their formation better. Sheet 140 (like 161) shows this scheme:



Again two samples (A and B) function as an operation-basis, but this time each comprises 160 pages. But the partial operation-norm is 960 for both complexes, no doubt in order to guarantee the fourfold aspect on a large scale. The 160-page sections to be inserted are thus to be tripled and the 480 pages this produces are to be doubled. How this would work out in practice is perhaps easier to understand if one envisages the whole in terms of its division into half-sections:



The first complex would thus be: 192B (64)+192B (64)+ 96A (32)+96A (32)+192B +192B. In this one-fifth of fragment A(160), whose other four-fifths appear peripherally in the second complex, would always constitute the centre; it would be at the same time the end of the first part and, after it had been repeated, the beginning of the second part. Since both formations (with two readings each per formation) were to be composed ten times, the general operation-norm would have amounted to 9,600. On the bottom half of the sheet, however, Mallarmé pushes it up to 48,000, or five times the original figure. The note added reveals the motif: '5 genres – each of which takes the centre and extends itself round four others'. Taking this rule of operation into account, the reading plan just expounded would look like this:



Another note says that these five constellations of five years were to be formed in twenty readings, with the order being changed ten times. With 24 participants per reading, each would have had 96 pages, but the twenty-fifth (Mallarmé himself) would have had 96×26; but this would only have been true on the premise that the composition of the circle would have been renewed each time. If the 24 remained 'on their own', then the Operator's task would have fallen to each of them. There is unfortunately no indication of the time within which Mallarmé intended to carry out this programme.

The scheme of a book-structure which has been reconstructed here seems worth closer examination. Mallarmé's operation-rule 'five genres, each of which takes the centre and extends itself round four others' was applied on the paper, which means that only one possible arrangement presents itself to the eye. This may serve to illustrate the formal function of the operation-rules more clearly, and via a comparison with the formant-groupings established by a rule of play in Boulez' 3rd piano sonata (of necessity in both cases these statements apply exclusively to the formants and do not take into account the internal fluctuation of the groups of part-sections, which in their turn are regulated by performance-directions). Boulez' rule of play has the effect of limiting the permutations, by keeping four formants away from the central third position, for which reason the number of possible permutations only amounts to 24, instead of 120. Moreover the only formant 'constellation' – the one which has to come in the middle – is in any case distinguished by being much longer than the others. With Mallarmé, on the other hand, each genre should comprise 192 pages, for a preliminary differentiation would affect the 'centralisation-effect'. The operation-rule has the effect of arranging the permutations. Expressed in another way, this means: no genre may include the centre more than once within a series of

five performances. The 120 possible permutations are thus divided up in 5 groups of 5 elements, each of which represents 24 possibilities:

I	II	III	IV	V
C D A B D	A E B D C	B D C E A	C E D A B	D A E C B
3 4 1 2 5	1 5 2 4 3	2 4 3 5 1	3 5 4 1 2	4 1 5 3 2

This would be the simplest arrangement of the central genres, still in the sequence A B C D E. The change is brought about by altering the position of the four flanking ones. But if the sequence of the middle parts always remains constant, a dominant, predictable result could easily develop after a few series of interpretations, endangering the autarchy of the individual groups of 5. So if one takes the 'central element' as the particular characteristic of a constellation, e.g. A, as that of constellation I, there emerge new possibilities of permutation – the 120 possible arrangements of constellations I – V. The preparation of the schemes for the performance-cycles to be brought about could thus result from three different approaches. 1. 24 constellations of 5 with an unaltered sequence of the 'central elements' A B C D E. 2. Along with the internal permutations, 24 external permutations of the five complexes (I–V), with a remainder of 96 left unused. 3. A distribution of the 24 internal permutations among the 120 external ones, by transferring the genre-disposition of a permutation of 5 complexes to the next one(s). Now, Mallarmé obviously did not plan to exhaust all the possibilities, but used the operation-norm to limit to ten the number of repetitions of a complete performance.

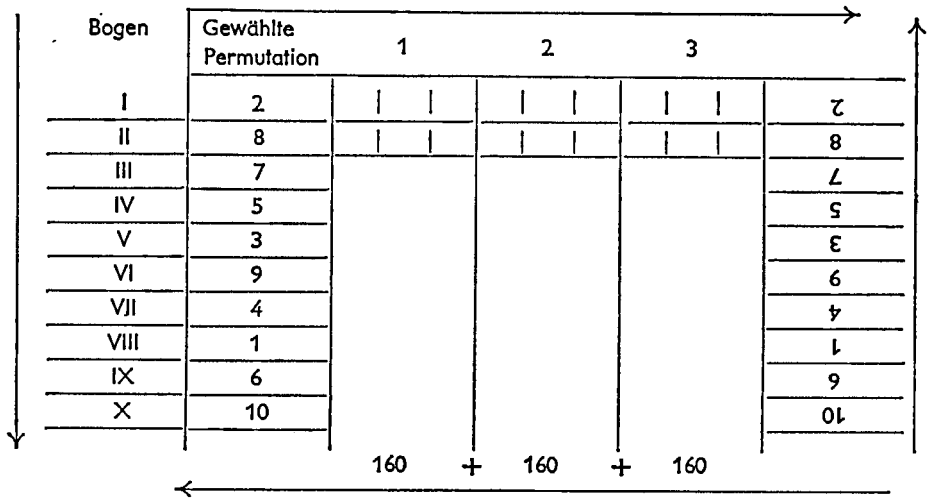
From these fragmentary notes it may be concluded that here, in intention, is a noteworthy 'alternative' to Boulez' third sonata which it is quite within the musician's competence to achieve.

But what is the significance of the tripling of sections practised in the previous example? To obtain information about this let us adduce a scheme which goes further into the distribution of the sections. According to sheet 93, Mallarmé planned to 'obtenir en 3 fois le développement 480 – identique à soi ou déployé en sens inverse 960'. The operation basis of ten sections should consequently be tripled again: 160×3. Not all of them together, however, but as the appended calculations show, each separate section on its own:

I × 3, II × 3, III × 3, . . . X × 3; X × 3, . . . III × 3, II × 3, I × 3

Elsewhere there is a note: '3 concurrents'. Since the 24 people at the reading could be divided into 8 groups of 3, it suggests the conclusion that the tripling of the ten sections (together with their reduplication) was to be extended to such a group. This seems to be indicated in sheet 157: '. . . the same section three times, with regard to the voice, intonation – up to+10'. Reading one text-fragment in different ways would in itself have been enough to make the same thing appear different. The meaning of a word-constellation would have changed along with its articulation, and in this case the term 'different readings' (i.e. versions) is to be taken literally. (Mallarmé even intended to have this close link between text and 'accent' in his prose. According to the reports of various contemporaries who had attended his readings, his phrasing

immediately banished the apparent obscurity of his prose and revealed a clearly constructed pattern of thought). Of 24 participants three would be active; each would collate one section with another (fundamental operations) until finally there would be 480 pages (instead of 160). Then the inverse operation would begin.

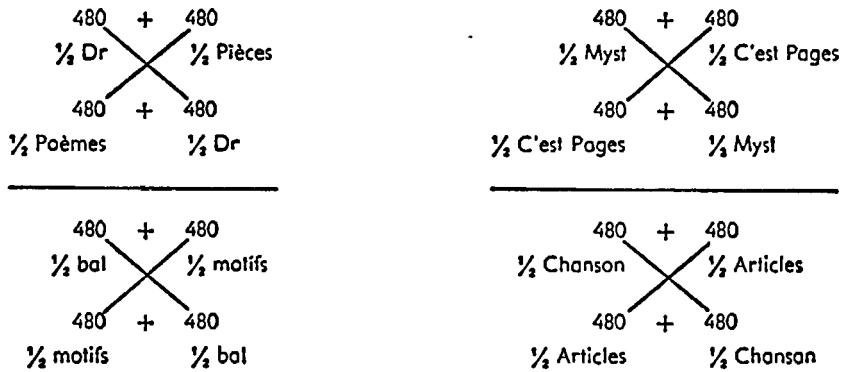


The sequence of the sections could be regulated by one of the possible permutations of these ten elements. Despite the general plan, each reader would remain free to exchange the half-sections of the two sections with each other. The scheme says nothing about this but merely shows what it is possible to do, hence leaving him scope to make a free decision.

In connection with the general character of the meetings and the structure formed in them Mallarmé explicitly observes: 'Each meeting or each piece is a game, a fragmentary performance, but it is satisfied with this'. This also applies to a large extent to the interpretations of multi-polar musical forms. Each one is indeed fragmentary, since only some of the bricks are used in the building, but for this very reason it reveals a piece from a particular perspective which the performer lays out according to the guidance of the rules of play. The form 'actualised' is bound up with the situation of the moment, with the performer's power of action and reaction, his 'happy touch'. In modelling one of the infinite number of configuration-possibilities, he demonstrates what is possible for him in this situation. But the specific 'time-volume' of the piece itself (in Stockhausen's terminology called its 'field-structure') becomes plainer if two or more of its performances can be compared with each other (cf. the corresponding performance-indication in Klavierstück XI).

With regard to the form-producing performance of one manifestation of the Book, the repetition of the same thing in a different pattern is the supreme law, valid for both the micro- and the macro-structure. In the last example the repetition (retrograde development of the ten sections) was restricted by the application of the basic operation rule. Mallarmé does not leave the other repetitions to chance or free choice, but plans them, which in this case leads to the remaining seven groups of

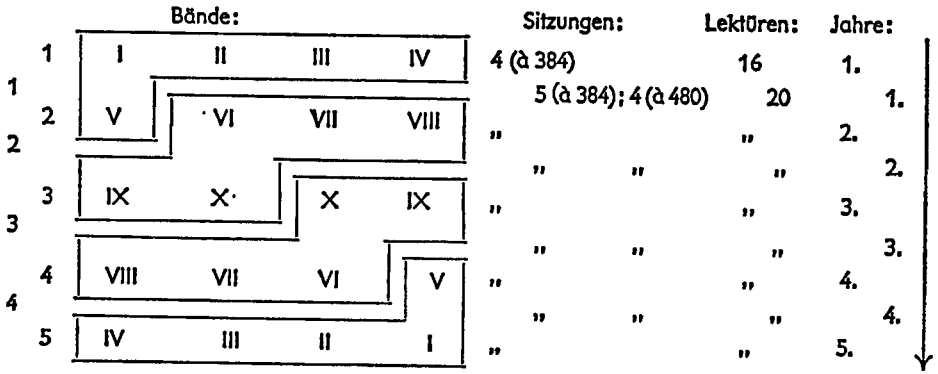
three readers being drawn into the formation-process (at least symbolically). If, before, each of the three readers operated with section-pairs of a permutation of the ten sections and their inversions, 320 pages altogether, this figure multiplied by 24 gives us an operation-norm of 7,680 or, in other words 8 repetitions of the operation-quantum of 960, for each of which no doubt a new permutation of the operation-basis would have been begun. This can be seen from Sheet 163 which moreover reveals the same disposition of sections as sheet 93. Again '3 concurrents', the multiplication of a pair of sections, is prescribed, and again 5×96 (×2) pages should be read, rather than 3×160. As in 93 Mallarmé 'hides' (sheet 158) the 'real' ten sections and their inversions in sixty imaginary ones which would only be together spatially at the end of the first series of meetings, as published sections. The same with the eight forms of the whole complex which were to be produced. To characterise them more precisely over and above what the individual operation-quanta proclaim, let us quote sheet 137 whose computations largely agree with those of sheet 163 (but on which, in addition, a literary genre is associated with each partial operation-norm (960) (for the Book, as the substance of all literature, is not to be confined within one of its genres). The entire complex of works would have comprised two large sections of 3,840 pages each. 'Drama', 'pieces', 'ball' and 'themes' would have been characteristic of the first, and 'mystery', 'pages', 'chanson' and 'articles' characteristic of the second. Mallarmé therefore drew up the following schemes:



The diagonals which cross each other link halves of the same genres (with the exception of the first formation, in which 'pieces' is put in in place of the second half of 'poems'). Although from the calculations (not given here) it is not possible to see plainly how many sections Mallarmé had contemplated using as the operation-basis, it may be assumed that it was, again, ten. Then eight permutations and inversions would have been read, and they would finally have combined to form a whole composed of four parts. And this grouping of four was reflected in each of the parts, in that each was composed of four halves of two section-permutations, half of one genre always being collated with half another; e.g., ½ Dr (permutation 1) +½ Pièces (permutation 2); ½ Poèmes (permutation 2)+½ Dr (permutation 1). Thus the exchange is not confined to the particles of the sample (sections and half-sec-

tions); it should also take place between the resultant parts of the form, in order to guarantee their close dovetailing and reciprocal penetration.

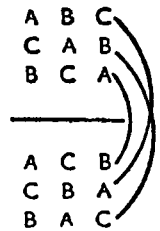
It becomes clear that carrying out a project of this scope would have demanded a lengthy period of time, quite apart from the fact that the conception of the work, with which the autonomy of its parts was inextricably involved, in itself excluded any uninterrupted continuation of the meetings. So in thinking of the macro-form Mallarmé planned not in days or weeks but in years, and endeavoured to find a harmonious division for the meetings. If one compares leaves of the manuscript on which the general operation norm of 7,680 is aimed at but which also indicate (either wholly or in part) the period of time, number of meetings and readings, one finds a performance-time of four or five years. This hesitation between four and five can perhaps be explained by reference to the two possible ways of putting into practice the operation-norm of 7,680. For it is not only a multiple of 320 and 480 but, equally, of 384: 7,680=384×20. The relevant project is on sheet 92: '20 volumes each of 384 (pages) – in four parts, say 5:5 (384×5=1,920) or one piece×2=3,840 (pages) or 10×384. There are only two of them – which produce two pieces the first time in one performance and two pieces the second time in the other. The same text twice . . . the 384 are as complete samples or 96×4'. This would make four groups to each of six sections with which the 24 participants (divided, according to sheet 127, into four groups of six for this cycle of meetings) were to operate. After the conclusion of the four readings (equals one meeting) one volume would have emerged; there were to be four meetings per year (within two days). If we arrange these according to volumes, readings, meetings and year, we get the following diagram:



The first possibility of interpretation would consist of viewing this total-structure made up of twenty volumes as one book or one drama (in five acts) and realising the one or the other by means of a reading or performance. But if on the other hand one identifies it as a tetralogy or a book in four books, each book or play comprising four volumes or acts of 384 pages, their production could be completed after four years. But in reality the four books and the tetralogy are present in the five volumes or acts of the first year. For instead of touching the operation-norm of 1,920, in the course of five meetings with twenty-fold readings (ten collations of two groups of six sections), this could be achieved in four, thus revealing a third possi-

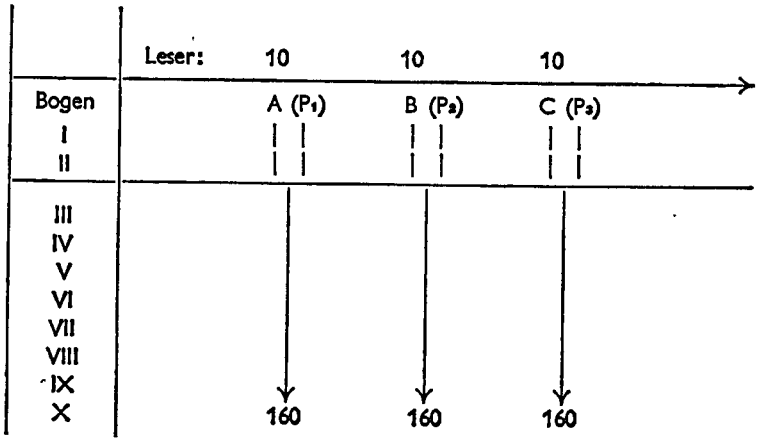
bility of interpretation. That is, the four groups of six of the operation-basis of 384 may be increased by one (as emerges from a detailed examination on sheet 92), if for example, a group of six participants repeats one of the A B C D groups, thus forming the variants d and e, say, out of D. However, raising the number of groups from four to five reduces the number of group-formations from five to four and the number of meetings accordingly; on the other hand, the number of groups and readings necessary to fulfil the operation-norm of 1,920 would remain constant. They represent the common denominator, as it were, over which are to be placed the plans resulting from the operation-basis of 24 and from the ten sections. Production within an area defined by norms always proves to be reduction and vice versa. If a five-fold aspect is worked out a four-fold one is still latent in it; if the latter comes into the field of vision then it is always against the background of a five-fold one. Forming always means at the same time bearing in mind the transformation-potentialities of the thing formed (at least, it means this from the Operator's point of view).

Besides this structural model of the book which crystallises very clearly from the wealth of sketches and is characterised by an operation-norm of 7,680 (480 sections), if we put together a series of leaves in the manuscript which all have the general operation-norm of 5,760 (360 sections), there emerges a new concept of the work. For the most part ten sections function as the operation-basis and the three 'samples' A, B and C, are obtained from them (by permuting three times). The schematisation of these three groups according to their six possible permutations was carried out on sheet 76:

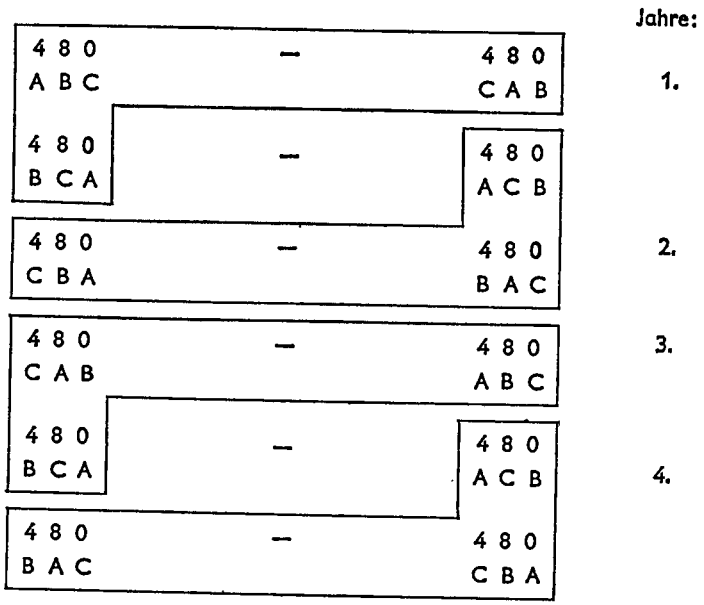


(Elsewhere Mallarmé replaces this scheme with the general rule of operation: each of the three changes its position to become the centre *once*). Each of the three ensembles below the line is the inversion of one above the line (see the brackets drawn by Mallarmé). A formation made up of three ensembles represents 1,440 pages or a complete performance interpretation, to be achieved by ninety participants in nine readings a year (three on each of three days).

Thus the plan of readings for one day, for example, would present the following picture:



On sheet 182 (from which these details are taken) Mallarmé multiplies the ninety sections of one year by four, getting the operation-norm of 360 (5,760 pages). (Another version of the same note specifies 240 pages, or three groups, A, B and C, of eighty each which, when multiplied by the number of participants (24) once again gives the operation-norm of 5,760). In the course of a period of four years a four-part complex of works would have been formed:



This in its turn divides into two parts, the second of which (operation-norm+2,880) represents an inverse repetition of the first. Whereas the dialectic between four and five characterised the macro-form composed of twenty presumptive volumes, here

we have a dialectic between three and four. For three form-parts made up of four ensembles of three can equally be identified, in place of the four made up of three ensembles, which again leads to the operation-quantum of 1,920. Just as in the reading-stint of the first day the threefold formation of the year can already be seen in essence, so after four days (the fourth in the second year) the twelve ensembles-of-three of the four years are visible. The fourth day of reading concludes the formation of four ensembles-of-three and also begins the 'structurisation' of the three three's of the second year, which, despite the fact that they are fitted into the plan of the four years, nevertheless constitute an autonomous whole on their own. Thus after four years there are either 4×3 ensembles-of-three, or 3×4 ensembles-of-three, and both are at the same time a whole composed of twelve ensembles-of-three. But the formation-process only appears to be concluded; like a stone thrown into water the project makes wider and wider rings. The twelve ensembles-of-three of the four years now compose the nucleus substance (analogous to the twelve groups at the end of the fourth day of reading); the first day of reading in the fourth year proves to be just as ambiguous as that of the second. (Like a latter-day Janus, the god of time, the Operator looks both back and forward, into the past and the future). This day paves the way for the final phase of the cycle of twelve ensembles-of-three, but at the same time there begins a new one of thirty-six ensembles-of-three altogether. This may be effected by putting the task for a year, or an ensemble-of-three, in the above scheme, instead of the group of three belonging to one day. Once again we get 12 complexes, whose germ-cell is still the 12 formations-of-three which in their turn grew out of the four ensembles-of-three of the first year(*).

It will already have been noticed that by substituting four and five for the two numbers three and four one can link up with the tetralogy scheme mentioned above (operation-norm 3,840); it is hardly necessary to work this out in detail(10).

The construction of the absolute Book is a game. However unequivocally all the lines of Mallarmé's lyrical speculations finally converge on this one project, however meaningfully the efforts of certain post-Mallarmé poets fit into its framework, the theories of language and poetry will still have to solve myriad problems before Mallarmé's Book can be put into practice in the sphere of literature (transcending

[9] The 'growth' of this form can be expressed mathematically (after G. Frohnmüller):

$$N(x) = 3\, f^1(x) \,.4\, f^2(x)$$
$$= 3 \left[\frac{n+1}{2}\right] .4 \left[\frac{n}{2}\right]$$

[x] = largest whole number $x = n$
$x = n + \varepsilon$, where n = whole number (number of years) and $0 \leq \varepsilon < 1$

$$f^1 = \frac{n+1}{2} \text{ and}$$

$$f^2 = \frac{n}{2}$$ can be represented graphically (monotone rising step-functions)

[10] Bearing in mind the sketchy representation of the separate structure-designs and the significance of number in Mallarmé's plans (which is not derived from an obscure number-magic) it is easy to see what there is against any interpretation which seeks, as it were, to give the Book's possibilities a definite number (as in Gustav René Hocke's 'Manierismus in der Literatur', rde, vol. 82/3, Hamburg, 1959, p. 51 ff.). Moreover, note that this number (3,628,000=10), whose most outstanding strong point is that in the tradition of occultism it plays a role very favourable to the performer, does not occur once in Mallarmé's manuscript (a fact which Hocke deliberately conceals), but rather in J. Scherer's commentary (cf. the section 'Grandeur et Servitude d'Analyse combinatoire', p. 87) which attempts to demonstrate and estimate the range of possibilities, from a relatively simple example (in which the sum total of all possible permutations of ten sections emerges as 9,864,100=11+2!+10!). Hocke's presentation of the Book is to Mallarmé's Book what this one example, passed off as the whole, is to the multiplicity and diversity of Mallarmé's structural designs.

it). In the meanwhile the sections which have been so much spoken of, are reserved for musical notation-signs alone; when their white will have to assert itself against the black of the characters cannot, naturally, be exactly calculated in advance. Nevertheless there is much to suggest that it will not be up to a *single* author to achieve this. From several remarks of Mallarmé's it is easy to see how much he felt the powerlessness of the individual to realise this vision; measuring up to it laid such demands on his powers that he was constantly haunted by doubts as to whether it was possible for the sketches to be appreciated later. Mallarmé was more than 60 years ahead of his time, and it was not until that period had elapsed that composers were able to formulate the idea of a musical form which was no longer given one pre-determined meaning. Rarely had a poet lived more resolutely for the future; rarely had the posthumous manuscript of an artist in language and form (whose influence may be traced in everything of importance that was created in the language medium after his time) exerted a more imperious pressure towards concentration, collective co-operation in a superindividual task. One of the inaugurators of modern literature disavows, as it were, the various 'partial' interpretations which have been given of his work in the course of time by showing up that literature and with it the whole tradition (both the tradition with which it associates itself and the tradition it tries in vain to reject) as a special instance of a literature that was originally much more universal. It is no mere catch-phrase to call Mallarmé the poet of the beginning. However, what was to be begun was not proclaimed sensationally in manifestos but privately wrested from a not very pleasant professional life and put in sufficiently concrete form, despite a certain delaying action, for it perhaps to be 'manifested' one day in some form. The fact that this 'beginning again' is seen in terms of a thoroughly radical trans-organisation of every phrase of the book-process will only seem monstrous and bureaucratic to those who cannot see anything more in the book than an aesthetic object produced by one author for a certain number of subjects isolated from each other, and so zealously take away from the totality of manifold relationships whose interplay it first constitutes. The above attempt, too, was bound, willy nilly, to be guilty of such abstraction. The functions of the reader (expressed in the various rules of formation) were the central point of interest, as were the individual possibilities for fulfilling the 'bulk' operation-norms with regard to the fragments of the Book. Applying the basic operation-rule (as the establishment of the elemental way of relating) to the partial operation-norms (as the indices of pure quantities which add up to the general operation-norm) led, when certain additional operation-rules were taken into account, to certain manifestations of the Book. (And what 'type' they are to be classed with is, accordingly, not defined by the general operation-norm, but rather by the extent of the partial operation-quanta, which in turn is defined by the character of the operation rules which have also to be noted). Thus two aspects always govern the examination of the form-production: one concerned the forming and its modes, the other its result (as being able to be established in a visual scheme), that is, the structure of what is formed in each case; and both take place, moreover, in a constant parallel action to the formation-process and structure of the musical permutation-forms. It emerges that this interplay of operation-rules enables Mallarmé to take over traditional form-concepts ('tetralogy') comparable with the 'substructure' of ancient form-models in the formants of Boulez'

third sonata). However, all the forms of the Book always remain 'open', provisional; only from time to time one of the possibilities it holds in its nucleus is realised, the superiority of the possible over the real is not affected. The macro-structures developed in the time-dimension 'grow' according to certain laws which can be formulated mathematically (the example of the macro-structure last quoted demonstrates this particularly forcibly).

The two-track quality of the approach drew attention to the fundamental meaning of time, with regard to the formation of the macro-structures of the Book. Unlike the timeless book as a concept, the macro-structures have a performance-time, that is, the time the reader (Operator) needs to constitute them, to 'mature' them. The 'duration' of a manifestation (micro- or macro-structure, or reading or series of readings) of the Book depends on the duration of the procedure of the readers taking part in it and this in turn is dependent on the number of readers. The *group* of readers is itself part of the Book inasmuch as they do not assimulate it individually but, while thinking they grasp it, are, rather, grasped by it, by means of the reading-modalities, and from the first are governed by the law of the Book. They accept the rules of play, without which it would be no more possible to play this intellectual game than to play any card game. This complete identification of the readers with the book-structure may well be one of the most fascinating aspects of Mallarmé's manuscript. For the first paradigms of a musical form-construction based on the permutation-principle were conceived for one or (like, for example, Pousseur's *Mobile*) two performers. If pieces for an ensemble (or indeed several) had not already been under construction (as may be supposed) Mallarmé's example must surely have inspired them formally, the more so since the composer can after all refer back to the body of experience collected in connection with the various realisations of the solo pieces[11].

Before ending all these reflections, temporarily, with a final point, one more fundamental question must be aired. It is less concerned with the legitimacy of the whole undertaking than with the methods used to carry it out. It is true that a collection of notes, hurriedly jotted down and never intended by the author to be published in this form, has been distorted, that an attempt has been made to read a 'system' into fragments? It is true that the sheets have simply been twisted and turned until they produced the mosaic whose design comes from contemporary composers? In the face of such scepticism it would sound like a mere conventional phrase if one pointed to the constantly envisaged aim of gathering the method from the thing itself. Finally it too would come into its own if the posthumous manuscript were a treatise

[11] Little of all this, admittedly, is to be traced in Bo Nilsson's *Zwanzig Gruppen* for three performers. This emerges clearly as soon as one compares the curiously confused and fragmentary performance indications (which at first give the impression that the piece is written for *one* performer, and give no answer whatever to important questions of co-ordination) with the Stockhausen model, which this only matches in the spatial division of the groups. If Nilsson had not long since proved to be an imaginative composer (recently in his piano piece *Quantitäten*), one would be tempted to suppose that he had misunderstood the new formal principle to mean that the indication of any formal idea was to be radically suppressed. If this were so, composing would really be confined to putting forward groups whose further fortunes would be entirely in the hands of others. But this would be a complete reversal of the meaning of all the efforts of today. Composition would degenerate into uncontrolled improvisation. How far he is determined to prevent this relapse into another variety of performer-neglect will be seen from the significance the composer attributes to the rules of the game, whether he sees them only as useful explanations or rather as a continuation of the composing-process using other means, and devotes just as much care and deliberation to their formulation as to all the quantitative statements of the score. In short, whether he leaves the major part to chance. From the precision and simplicity of the rules one will be able to judge to what extent he has discussed his formal idea not only with himself but first with his performer(s), how greatly his composition differs from all the others constructed on the same principle.

on the book surviving in fragmentary form. But Mallarmé ventured further. In view of the meaningfulness and the wealth of relationships of the whole, which can hardly be overlooked, the fact that the actual making of the Book never got beyond a certain phase is irrelevant. Of course both can only be experienced by operating the sheets, and the above attempt is nothing more than a collection of such operations, carried out according to Mallarmé's rules of play.

The future will show whether the work on the Book itself can be taken up again and 'continued', out of similar motives, with (at the same time) differently accentuated motivation corresponding to the altered situation. As far as the present is concerned, the question is, rather, whether at least some contemporaries are able to fulfil, approximately, the attitude which Mallarmé transcribed in the words: 'Je suis, moi, fidèle au livre' (sheet 35). It cannot be documented by a single performance whose unavoidable tendency to exclusiveness, to sticking statically by what has once been secured, would only be neutralised if another performance, constituted by operating the elements of the Book, cancelled out the previous one – so as to make the Book appear in its own right. According to its structure, it is this multiform, complex movement of the performance which never really becomes static. For the Book, like 'Book-formed music' could be headed by a sentence from sheet 181 'Un livre ne commence ni ne finit: tout au plus fait-il semblant'.

BROUILLARDS – TENDENCIES IN DEBUSSY

DIETER SCHNEBEL

In this piece, No. 1 of Debussy's Preludes, there is: no theme, no development; no traditional form; no counterpoint, but no so-called harmony either; neither 'melody' nor 'accompaniment'; no main and subsidiary voices; neither definitely diatonic tonality nor chromatic tonality. Is there any tonality at all? Nothing which is reminiscent of contemporaries such as Schoenberg or Mahler.

What we do find is a 'sound chemistry' whose processes replace the traditional constructions.

So it is a question of processes. That is, the single element is not to be subordinated, as a part, to a dominant unit (for example, a certain note of a certain length as the first component of a theme made up of a number of similar components). The single element is, rather, a stage, and therefore something existing in its own right, independent. The process is seen in the sequence of such stages. So it is important to recognise both the single element in itself and the larger entities which result from sequences of such single elements.

Stage 1 of *Brouillards*:

A chord of C', E' and G', *pp*, *léger* and *la main gauche un peu en valeur sur la main droite:* carefully pointed setting in motion of several vibration-processes (few overtones). Dies away fairly quickly, medium duration. In this dying away B flat', G flat', E flat' and D flat' are played one after another, even more softly and carefully; the interval between striking each note is one fifth of the duration of the whole sound; rapid dying away.

In other words, two superimposed constructions whose movement (frequency sequence) is, in the one case, neutral in direction (notes struck simultaneously) and in the other (R.H.) articulates a falling movement.

Stage 2:

Another 3-note chord, B, D', and F' in the L.H. with in the R.H., A flat', F flat', D flat' and B flat, one after another. Form and performance-indication as in Stage 1.

Structural unity of Stages 1 and 2. Together the two stages make up a falling movement.

Stages 3 and 4 repeat Stages 1 and 2. Consolidation of the form-type. Stages 1 – 4 represent the first formal unit. Movements in general: down – up – down – (up). Dynamics (according to traditional conception of beats) $> < > <$.

Bar 2 introduces a new formal unit.

The new stage (5), bar 2, first quaver, shows a new structure. L.H. alone, sequence of two three-note chords. Short time-values, performance as before, upward movement $<$.

Stage 6:

In the L.H. another sequence of two three-note chords, short time-values, downward movement $>$. R.H. two very short time-values in successive notes each one-third of the time-value of a three-note chord, dying away quickly and with a marked falling movement. Again the general tendency is downwards.

Stages 5 and 6 (repeated in stages 7 and 8) form another structural unit. L.H., a sequence of 3-note chords, movement up-down, dynamics < >. R.H. first a fairly long interval before entering at the beginning of the structure, the beginning considerably higher than the L.H., strong downward movement in two curves. Very short time-values.

In other words, two more interconnecting patterns. That of the L.H. has a rising and falling movement – in fact the movements balance each other, as there is a positive and a negative movement. Pronounced falling movement in the R.H.

Relation of Structure II (bar 2) to Structure I (bar 1): L.H. shorter time-values, more movement, movement-direction and dynamics negative in 1. R.H.: an expansion, as it were, of the first note-gap of the half-structure, and hence a compression of the single pattern, shorter time-values. Once again, a falling movement but in wider interval-leaps.

The process from Structure I to Structure II: on the one hand, stabilisation – the movement-tendencies of the L.H. become prominent; repetitions. On the other hand, a markedly single-minded direction – in the R.H. intensification of falling movements: heightening of speed by means of shortening the time-values.

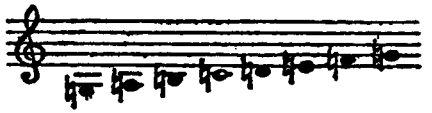
Stages 9/10 repeat Stages 1/2. The stabilising tendency seems to want to take over completely and establish itself – completion of a period. But in Stage 11 the general falling movement of Stages 1 and 2 is carried further. It reaches its goal in Stage 12 and then stagnates (Stages 13-17). In the R.H., once again there are shorter time-values (sextuplets – demisemiquavers). For the first time a brake is put on the pronounced falling movement. So the whole thing looks like this:

This phase, a first comprehensive structure, now looks like a fairly complete formation. At first it has a pronounced upward movement (bars 1/2) then a downward one. The upward points in bar 2 are neutralised by the downward ones in bar 4. Within the unified structure bar 2 represents a short disturbance, which also has an effect on bar 4 (R.H. in Stages 13, 15 and 17). Out of it the piece develops further – bars 5 and 6 are formed from it.

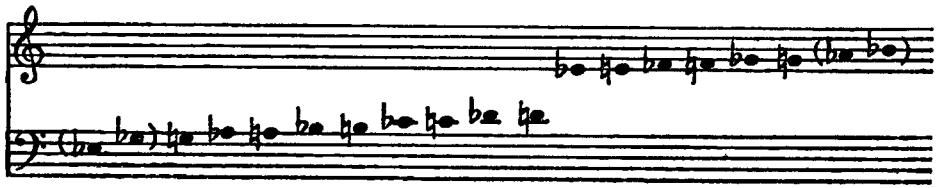
The material of this first structural entity seems to stand in opposition to the arrangement of the whole. In this the concern is with the movement of note-surges, since single notes only stand out as the goal of a movement-phase; this however does not give them precedence. The L.H. part stresses tonality and consequently the hierarchy of notes (the 'tonic', C, and the 'dominant', G). But as a *tonal* phase this chain of 3-note chords would be a bad phase. Now, one does not hear it as such:

one does not feel the urge from one chord to the next which was characteristic of the harmony of the period – but rather a static row of 'note-patches' co-existing side by side, whose sequence nevertheless produces movement. Does this mean there is no tonality? Or another tonality?

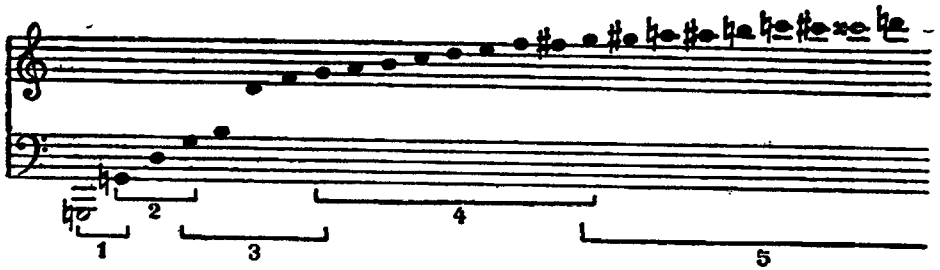
The material of these bars (L.H.) is:



The notes of the R.H. produce the impression of being a complement (see the ligatures which indicate that the notes in the R.H. are added to those in the L.H.). With their addition a second row emerges:



It is noticeable that the first row of material offers the material of the 4th octave of upper partials above G, the second the material of the 5th octave – apart from the notes that cannot be produced on the piano.



The lower octaves too are borne in mind. The choice of 3-note chords in the L.H. stresses the characteristic quality of the partials of the 3rd octave, the predominance of 5th's stresses that of the partials of the 2nd octave.

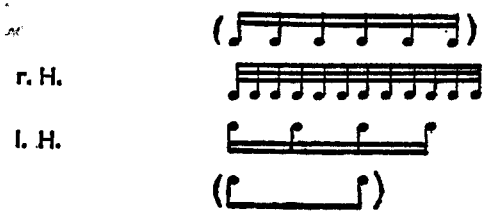
These various fields of upper partials are compressed into the region of about one octave, so that one has to think of the keynotes as one to four octaves lower. They would be G or possibly C in each case.

The material can also be considered as a reservoir (compressed into one octave) of the various octaves of lower partials, although there is less evidence for this. In that case it would be questionable whether G and C were the 'keynotes'. One would have to think of them as being in the higher octaves.

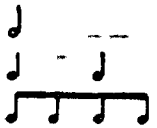
There are also 'partials' to be seen in the rhythmic sphere.

'Overtones':
Bar 1 (the same as bar 3): L.H. first 'overtone', R.H. fifth 'overtone'.
Frequences:

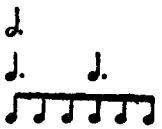
Bar 2 (the same as bar 4): L.H. second 'overtone', R.H. sixth 'overtone', implicit 1 and 3.
Frequencies:



Thus the material is a frequency-spectrum ranging from the first to the sixth overtone, the fourth being left out (it appears in bar 29).
'Undertones':
Bars 1/2: first, second and fourth 'undertone'.
Frequencies:



Bars 3/4: third and sixth 'undertone'.
Frequencies:



Here again a spectrum ranging from the first to the sixth 'partial', with the fifth 'undertone' omitted (it appears in bars 30/31, in the rhythmicisation of the D major 3-note chord). This rhythmic composition of overtones and undertones differs from the organisation of the tones in not omitting the keynotes, but also fills up the frequency-spectrum.
This is what emerges:
Debussy composes the 'partials'. He juxtaposes selections from spectra of partials. The result is formant-composition, composed timbre-change, the organisation of sound-movements. Debussy is tending towards composition with sounds.

There is another important point. On the one hand keynotes are left out. On the other, the remote partials come into prominence. In this way the composer stresses the 'atonal' parts of the sound-spectrum, which make the sound change into a tone-mixture, even noise. In the rhythmic sphere too – in which previously the octave limits had been used almost exclusively as frequencies – the other frequencies are also included. (While in the sphere of micro-time and macro-time the dissonant phases come into prominance, the scale of intensity of the partials is inverted).

The urge towards noise makes itself felt in the first bars: Stages 1 and 2 each offer chromatic totals extending over a fifth. Thus they contain a series of directly related frequencies, and the result is a kind of illuminated noise. As they do throughout the work, the sounds of this piece tend towards opacity – *brouillards*, in fact. The fact that the keynotes are left out adds to this. While in the tonal system they form the basis of chords and rhythms, they now become only an aura.

This tendency towards noise, or away from the keynote, leads to the break-up of the tonal method of composition. Of course, its relics are still apparent – for example, in the 'modulation' from the tonic to the dominant in bars 1 – 4. But at the same time the process stimulates one to hear differently – transformation of sound-colour and sound-movement. Not until one looks at the piece as a whole, does the abandonment of modulation in the traditional sense – indeed of tonality altogether – really emerge.

The arrangement of the whole piece attempts to abandon traditional form. The harmonic disposition makes this clear. If one considers the material of bars 1 – 4 not as before, but as divided between the hands, the L.H. proves to contain the material of the 4th overtone-octave of C or G, but the R.H. that of F sharp or C sharp. So as imaginary keynotes we get C and F sharp or G and C sharp (which can also be heard in the frequency-clusters of the combination-notes). Thus these combination-notes form the 'atonal' interval of the tritone. In the tone-colour changes during the course of the piece, those of the partials of the F sharp – C sharp field are stressed at some times, while those of the C – G field are stressed at others. In bars 1 – 4 the C – G field is prominent. Bars 5 – 9: transition. Bars 10 – 17: F sharp – C sharp field. Bars 18 – 30: C sharp – F sharp field. Bars 31 – 35: more remote partials from both fields. Bars 38 – 42: C sharp field. Bars 43 – 46: C field. Bars 47 – 52: not clear. So in the course of the whole there is a steady flowing away of sounds – *brouillards*, but no longer any formal scheme.

These, then, are the tendencies shown by Debussy: composition with musical elements to form sound-structures – sound-movements, tone-masses, etc. – as a method. Moreover he uses regions of the material which until then had been largely taboo – noise-type frequency-structures in the micro-time and macro-time field, a functional instead of a purely decorative organisation of intensities. And finally their break-up of traditional forms.

What is the goal of all this? Sound composition, which tries to combine sound-elements into superior units – indeed units of any kind. Since these are no longer to be understood as individual elements, 'statistical categories' become valid; these units are characterised statistically according to direction, density, speed, etc. It is no

accident that in a lecture entitled *Webern and Debussy*, Stockhausen has pointed out examples of 'statistical form-criteria' in a work of Debussy's (*Jeux*). And it is no accident that such criteria can serve the conception of electronic music – the realisation of the sound-composition to which Debussy's conception looks forward.

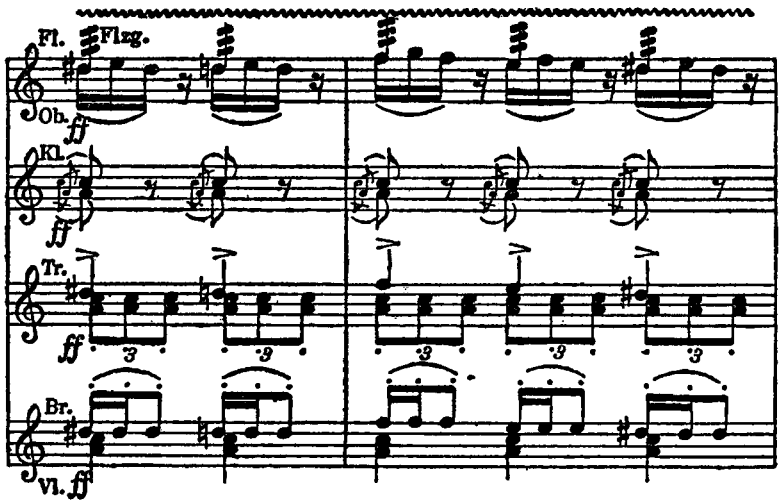
Debussy forged his compositional method by, broadly speaking, breaking the chord-chain of traditional music. The chords dissolved into their component parts and he organised them to make certain sound-bodies out of which he formed sequences and so produced form.

By way of tailpiece, let us take a look at the proceedings of some other great composers, contemporaries of Debussy's who, like him, had to start from the stage of composition reached in *Tristan*; this will give us a synopsis of his and others' procedures and enable us to name his opposite poles. With regard to the above-mentioned traditional chain of chords, the normal procedure was to develop its horizontal and vertical moments further, until it burst of its own accord. Schoenberg led the way and obviously took the greatest step forward, but paid the price of destroying the concept of music as implied by the chord chain. Mahler's experiences were as far away from the main-stream as Debussy's, though on the opposite side. Like Debussy he reorganised traditional harmony internally; but he broke up its most intimate line-structure horizontally. Let me demonstrate this briefly from the beginning of the *Lied von der Erde*.

The whole thing is based on a simple melodic line – a simple fourth-motif

This is polyphonised and, as it were, split up into layers. First on the upbeat to bar 2, by the E" being hinted at from below; then in the upbeat to bar 3 by a horn figure, and finally by the transformation of the E" in bars 3/4. The horns appear to take the lead – to be the main voice; but in bar 2 the E" on the oboes and clarinets is dominant. In bars 3/4 these instruments are joined by flutes and strings. Moreover a kind of timbre-melody

T. 3 T. 4



emerges. The line playing round E" in bar 3/4 is again polyphonised internally: each instrument has a specific rhythm – Fl. , Ob. , Kl. , Tr. and , Br. and a specific sound-form – flute *Flatterzunge*, oboes *legato*, trumpets *staccato* or *marcato*, viola *saltando* . Moreover here again the noise element is prominent in both the micro-field and the macro-field of time-arrangement.

The consequences in Mahler are similar to those in Debussy: traditional modes of thought like melody, accompaniment, theme, etc., lose their meaning; and the traditional form-schemes are equally unsuited to this kind of music. Here again the composer pushed forward to frequency-structures which had previously been taboo; and Mahler too freed dynamics from their decorative role. But the tendencies of Mahler's music are different. It does not aim towards vertically arranged units, like Debussy's music, but towards horizontal units: lines that stretch out in time and can be superimposed without losing their independence. However this implies a tendency toward spatial division of sound-bodies – space-music.

These two opposite poles, Debussy and Mahler, had little immediate effect on musical history. That is to say: their proceedings were not understood and so (like Webern at a later date) they were denied disciples to recognise their achievements and build on them. But the tendencies of their music are being fulfilled today – much of Debussy's work is reminiscent of electronic music, and much of Mahler's is reminiscent of the new orchestral space-music. So at least these two outsiders, whose music looked so far forward, are getting the justice that the course of history seemed at first to deny them.

KARLHEINZ STOCKHAUSEN

MUSIC AND SPEECH *

1955/56 saw the first performances of three pieces of new music which combined in various ways sung speech and instrumental or electronic sounds:

Pierre Boulez: "Le Marteau sans Maître".
A cycle of 9 pieces to three poems by René Char, for contralto, bass flute, viola, guitar, vibraphone, xylorimba, percussion.

Luigi Nono: "Il Canto Sospeso".
A cycle of 9 pieces using extracts from letters written by members of the resistance movement, for soprano, contralto and tenor soloists, mixed choir and orchestra.

Karlheinz Stockhausen: "Gesang der Jünglinge".
Electronic music to Daniel 3, 57–66.

A closer examination of the relationship of speech and music in these three works may prove illuminating.

Boulez selected poems of a contemporary; typically surrealist art-form of speech. He grouped purely instrumental pieces around the vocal ones as 'avant', 'après' or 'commentaire':

I Avant "L'Artisanat Furieux"

II Commentaire de "Bourreaux de Solitude"

III "L'Artisanat Furieux"
La roulotte rouge au bord du clou
Et cadavre dans le panier
Et chevaux de labours dans le fer à cheval
Je rêve la tête sur la pointe de mon couteau le Pérou

IV Commentaire 2 de "Bourreaux de Solitude"

V "Bel édifice et les pressentiments", version première
J'écoute marcher dans mes jambes
La mer morte vagues par-dessus tête
Enfant la jetée-promenade sauvage
Homme l'illusion imitée
Des yeux purs dans les bois
Cherchent en pleurant la tête habitable

VI "Bourreaux de Solitude"
Le pas s'est éloigné le marcheur s'est tu
Sur le cadran de l'Imitation
Le Balancier lance sa charge de granit réflexe

VII Après "L'Artisanat Furieux"

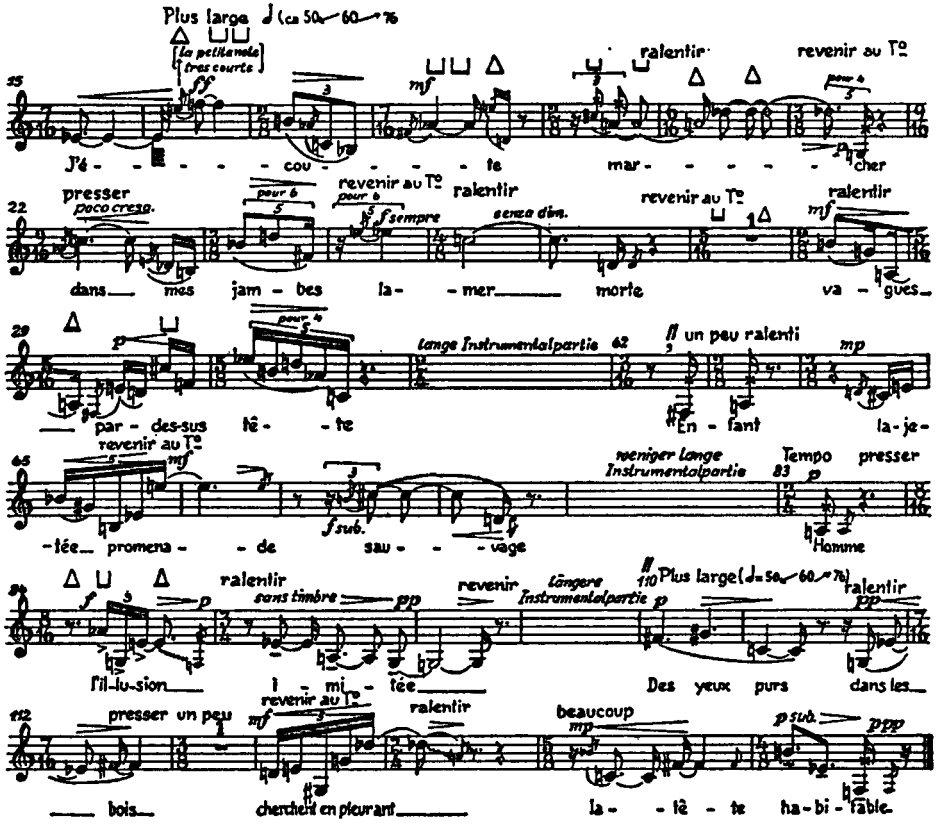
VIII Commentaire 3 de "Bourreaux de Solitude"

* This article was the basis for a paper read at the Darmstadt Summer School in 1959.

IX "Bel édifice et les pressentiments", double
J'écoute marcher dans mes jambes
La mer morte vagues par-dessus tête
Enfant la jetée-promenade sauvage
Homme l'illusion imitée
Des yeux purs dans les bois
Cherchent en pleurant la tête habitable

In each case, the contralto is combined with at least one of the instruments (bass flute in III) able to produce reasonably similar durations and intensity curves (bass flute and viola) so as not to extend the simple contrast between voice and instruments to the rhythmic, dynamic and pitch structure as well. In the pieces with text, III, V, VI, IX, the order of the words in the poems is composed quite according to their literary form (taking into consideration the form of the lines, unaltered syntactic order and arrangement in the lines, no repetition of words, etc.). The comprehension of the words is not affected by the use of instruments; it is rather intensified, and accentuation (loud-soft) and metre (long and short syllables) enhance the rhythmic and metric structure of the poem.

Example 1:

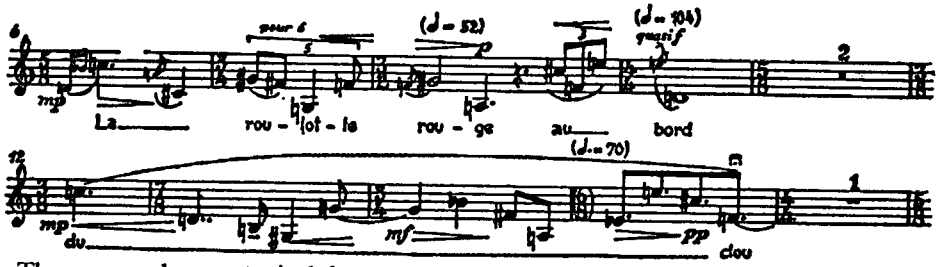


The composer exploits the written poem's virtual possibilities of being able to be read in various ways, in order to interpret within his sphere of arrangement (fixed pitches, durations, intensities, and selected instrumentation) a pre-formed literary 'object' of art.

Let us compare the natural flow of speech in example 1 (alterations of accentuation, length of syllables and vocal pitch when speaking) with the melody. These are lines from 'Bel édifice et les pressentiments' (V), as melismatic (at the beginning) and also syllabic (further on) setting of the words to music occur here (see the reversed sequence in IX).

The syllabic setting throughout VI demonstrates complete agreement of the articulation of speech and music. Even a strongly melismatic treatment of the words as in 'Artisanat furieux' never disturbs the syntactic logic.

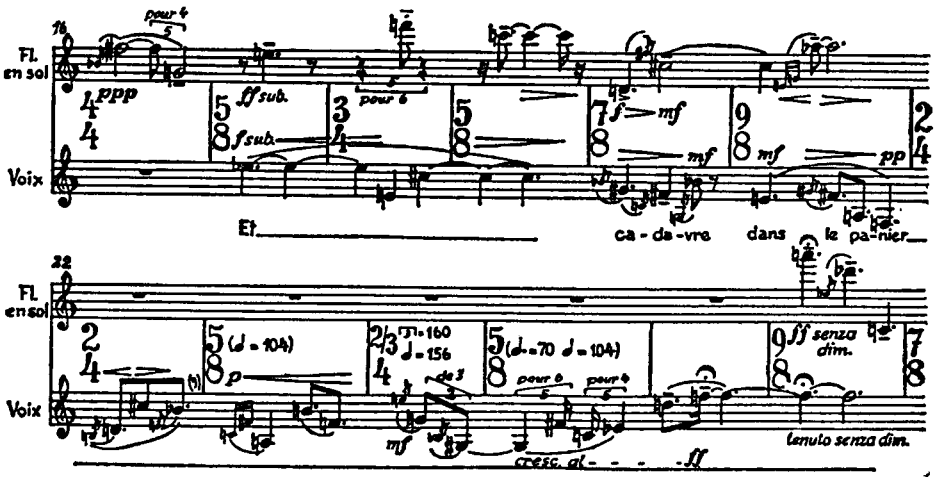
Example 2:



These examples are typical for the support of the formal structure of the text by music. Let us see how the semantic sphere – the 'meaning' – is treated. (The following quotations are to a great extent also valid for the whole work).

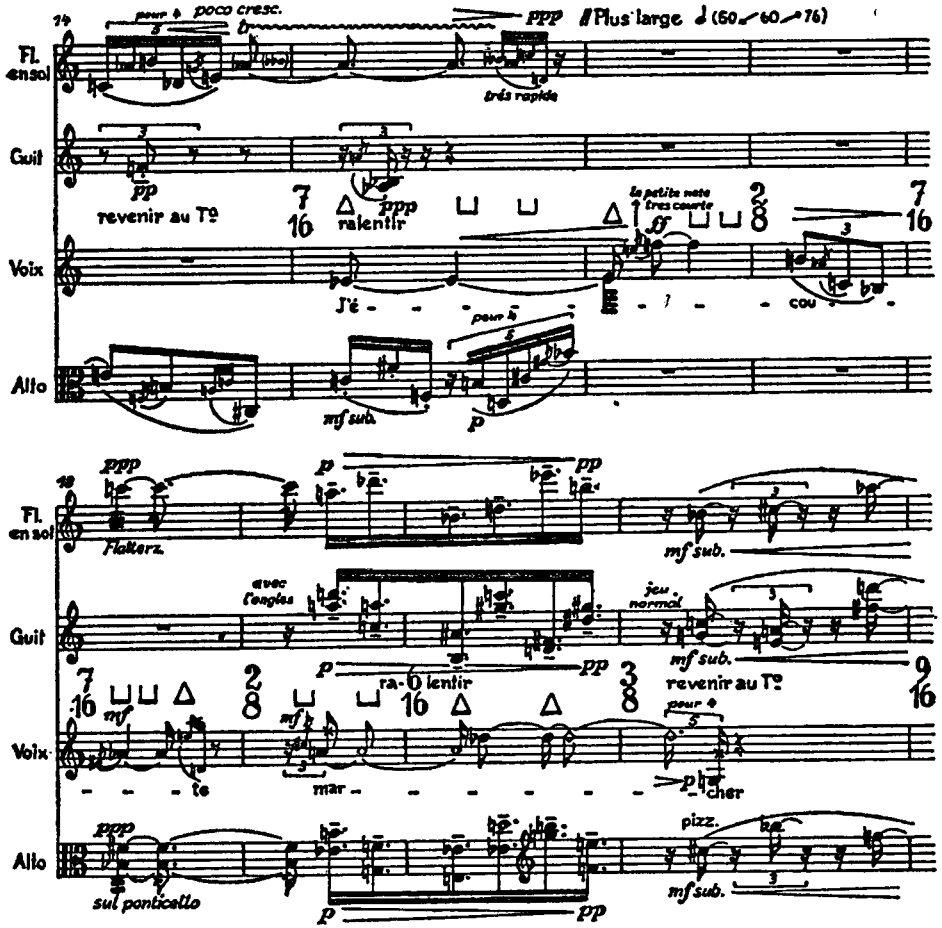
First a clear interpretation of the literary sense of 'Corpse in the basket' (III, bar 17 f.): after long, soft, legato groups (continuation of example 2) the melody is suddenly shattered (cadavre); a short pause, small, tortuous groups of notes (panier):

Example 3:



Another example shows how the instruments contribute to the interpretation of the literal sense (see V, bar 15 f.): 'I' (remains alone, ff, after a dense structure) 'hear' (dim. pause: flute flutter-tongue and viola tremolo sul ponticello) 'walking' (six rhythmic evenly-decelerated five-note chords, piano dim., continued with pauses, three more four-note chords, mf sub. crescendo, revenir au tempo):

Example 4:



A third method of interpretation in the semantic sphere is purely symbolic. Example: the 12th tone of a series as 'clou' (see example 2, bars 12–15).

Where the treatment of the text is more phonetic, the vocal part resembles the realistic way of speaking – 'quasi parlando' (V, bars 62, 83) and becomes similar to speech in parts (IX, bars 15–17). The other extreme, that of singing through closed lips, thereby becoming a speechless instrument, also occurs in IX (compare IX, bar 10 f.).

The vocal composition, then, always clarifies the phonological structure of the French text in syllable, word and phrase and, to a great extent, the semantic sphere of the words; and finally it keeps exactly to the form of the poem. Variations of the formal division consist of variously emphasising caesurae of the text: 'La roulotte rouge 𝄾 au bord 𝄽 𝄿 du clou 𝄽 Et cadavre dans le panier 𝄽 ' etc.; in V, first a strophe (two lines) – for a long time no text – first line of the next strophe – not so long without voice – second line of the second strophe – for a long time no voice – last strophe; in VI, half a line – half a line/no voice for a long time/second line with short pause after the half-line/not so long without voice/third line 'Le Balancier'/ longer without voice/'lance sa charge de granit réflexe/; compare also the division of the lines in IX.

Under these conditions the phonetic properties of speech can hardly be exploited for composition unless whole groups of words are set first as vocal delivery, then as elevated language and finally as colloquial speech. A strictly musical usage of the phonemes according to their acoustically distinct properties would destroy the structure of the so precisely pre-formed text and also, naturally, to a great extent, the sense of the words – especially if the phonemes as elements were manipulated in the sense of a serial composition, as we find them in the instrumental structure of the work. It is therefore evidently necessary for the listener to comprehend the sung words as French language and to hear the added music in this context; this does not go for the instrumental parts when they are called 'commentaires'.

The musical treatment of the text, keeping close to speech, results in four clearly-distinguishable categories:

1. parlando (almost identical with colloquial speech; 'tone' and speed intimated – 'libre');
2. quasi parlando (moving curve of the pitch, duration of syllables and intensity fixed);
3. syllabic song (all parameters proportionally exactly fixed);
4. melismatic song (the musical parameters become dominant; more tones than syllables).

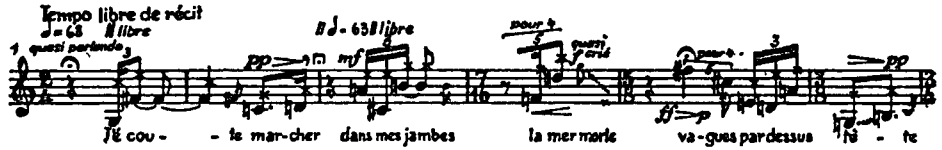
The voice makes use of a fifth category without altering the timbre (which defines to a great extent relevance in speech) and thus closely approaches the bass flute and viola: the singer sings without opening her mouth (here I should like to state that Nono, in his 'Canto sospeso', differentiated this vocal form in four ways in the transition from speech to music: bocca chiusa, quasi aperto, normale and aperto – all still without 'speech', i.e. without alteration of the timbre of the sounds).

In 'Le Marteau', the fifth vocal form, 'bouche fermée', leads abruptly to the sphere of pure music. This would not be absolutely necessary, however, as controlled degrees between 'coherent speech' and 'coherent structure of the sounds' could form this step from 'comprehension of speech' to 'comprehension of music' more continuously without further ado – we shall speak of this presently.

We shall demonstrate how the five degrees between speech and song are functionally employed to articulate the form of the ninth piece. The individual methods are familiar to us from the Vienna School, where they possessed dramatic significance, expressive function in crying, speaking, singing, 'Sprechgesang'; some parts were

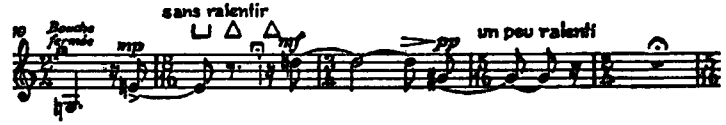
dramatised in this way (one only has to think of Alban Berg's opera 'Wozzeck'). Boulez constructed the ninth piece of 'Le Marteau' in the following way. The first vocal melody is 'quasi parlando' for the words 'j'écoute marcher dans mes jambes la mer morte'; this section ends 'quasi crié' with a glissando at the word 'morte', immediately followed by the only normally sung tone, fortissimo, and softly fading Sprechgesang for the words 'vagues par dessus tête:

Example 5:



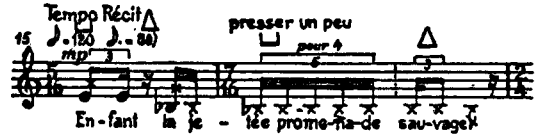
Then comes the sequence sung without opening the mouth – 'bouche fermée':

Example 6:



The third vocal sequence is delivered 'parlando – libre' – relatively freely spoken in rhythm and pitch:

Example 7:

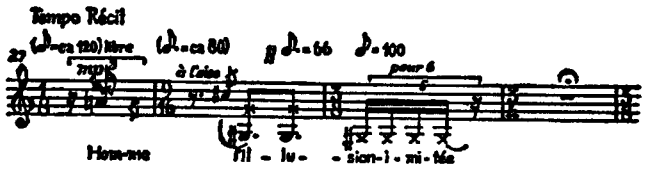


Again 'bouche fermée' is called for:

Example 8:

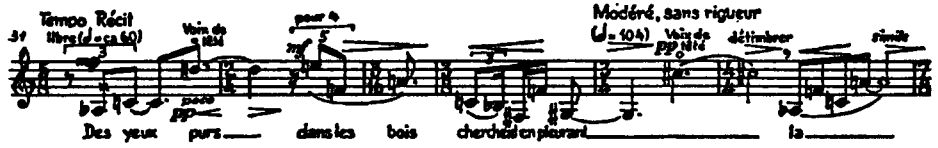
The fifth vocal sequence is delivered as the third, 'parlando – libre':

Example 9:



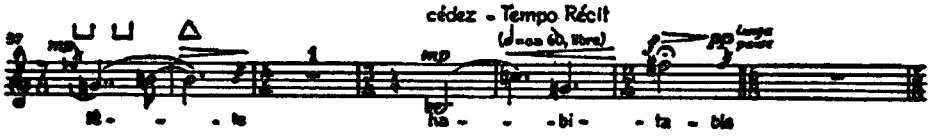
A syllabic sequence follows: 'pure eyes search weeping in the woods'; and Boulez instructs the singer to use head-tones for the words 'pure' and 'weeping':

Example 10:



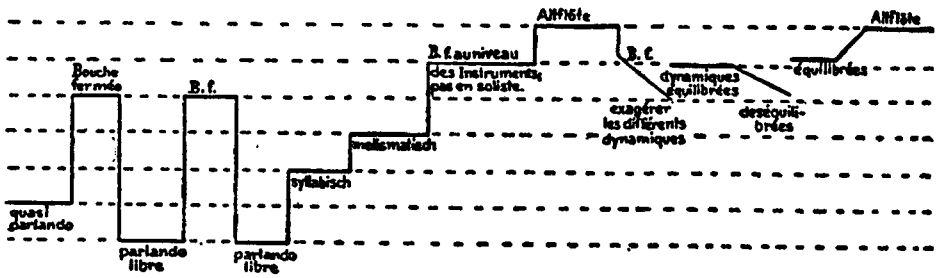
The vocal line becomes melismatic at the instructions 'soundless' and 'simple':

Example 11:



Now the vocal part ceases for some time. Only the instruments play meanderingly, short, hurried groups, drawn-out tones, an isolated trill or a few sharply struck notes from the xylophone. Then the singer must again sing through closed lips, 'au niveau des instruments' (at the same level as the instruments), the vocal part is taken over by the bass flute which has been silent up to this point. Twice, where gongs are unexpectedly heard and the voice calls back, the score calls for the singer to exaggerate the various dynamics and at another place to level them. For some time the instruments and the voice should be out of balance with each other; then the voice is called upon to balance itself with the other instruments. The bass flute remains alone, enveloped by beating gongs. Here there is no longer any point in discussing speech and music; one should rather talk of the transition from speech to music. Here is the formal conception of the ninth piece:

Example 12:



Because the music of 'Le Marteau' goes so deeply into the text of the poems, because the music supplies the poems with an extremely elevated delivery, it refers to them to a high degree, to their form as poetry, to their message, their images. These poems do not possess an unequivocal meaning as does a statement of facts: they 'mean' themselves as 'poems', as forms of high artifice. And Boulez's music interprets this meaning incredibly well.

For his composition 'Il Canto Sospeso', LUIGI NONO chose extracts from farewell letters of political prisoners condemned to death ('Lettere di condannati a morte della resistenza europea', published by Giulio Einaudi, Turin). He set them in six out of nine sections of the 'Canto' in Italian, with alternating combinations of soloists, choir and orchestra:

I Orchestra

II A capella choir

„. . . muoio per un mondo che splenderà con luce tanto forte con tale bellezza che il mio stesso sacrificio non è nulla. Per esso sono morti milioni di uomini sulle barricate e in guerra. Muoio per la giustizia. Le nostre idee vinceranno . . ."

'. . . I am dying for a world which will shine with such a strong light and with such beauty that my sacrifice is nothing. Millions of men have died for it on the barricades and in war. I am dying for justice. Our ideas will conquer . . .'

III Solo soprano, contralto, tenor and orchestra

„. . . **mi portano a Kessariani** per l'esecuzione insieme a altri sette. Muoio per la libertà e per la patria . . ."

'. . . they are bringing me to Kessariani to be executed with seven others. I am dying for freedom and for the fatherland . . .'

„. . . oggi ci fucileranno. Moriamo da uomini per la patria. Siate degni di noi . . ."

'. . . they will shoot us today. We shall die as men for the fatherland. Be worthy of us . . .'

„. . . m'impiccheranno nella piazza perchè sono patriota. Tuo figlio se ne va, non sentirà le campane della libertà . . ."

'. . . they will hang me in the square, because I am a patriot. Your son departs, he will not hear the bells of freedom . . .'

IV Orchestra

V Solo tenor and orchestra

„... se il cielo fosse carta e tutti i mari del mondo inchiostro non potrei descrivervi le mie sofferenze e tutto ciò che vedo intorno a me. Dico addio a tutti e piango ..."

'... If the sky were made up of paper, and all the sea of ink, I could not describe to you my sufferings and everything I see around me. I say farewell to all, and weep ...'

VI Choir and orchestra

„... le porte s'aprono. Eccoli i nostri assassini. Vestiti di nero. Ci cacciano dalla sinagoga. Com'è duro dire addio per sempre alla vita così bella!"

'... the doors are opening. Here are our murderers, dressed in black. They are hounding us out of the synagogue. How hard it is to say goodbye for ever to such a beautiful life!'

VII Solo soprano, female choir and orchestra

„... addio mamma, tua figlia Liubka se ne va nell'umida terra ..."

'... farewell, Mother, your daughter, Liubka, is going to the damp soil ...'

VIII Orchestra

IX Choir and timpani

„... non ho paura della morte ..."

'... I am not afraid of death ...'

„... sarò calmo e tranquillo di fronte al plotone di esecuzione. Sono così tranquilli coloro che ci hanno condannato?..."

'... I shall be calm and peaceful at the command of execution. Are those who have condemned us also so calm? ...'

„... vado con la fede in una vita migliore per voi ..."

'... I go with the belief in a better life for you ...'

Compared with the poems of 'Le Marteau', these texts can be treated formally much more freely. However, they present the composer with a different problem: all the extracts do not contain isolated words, exclamations, images for the poetical effect; they contain calm, complete sentences, logical connections of sentences in colloquial language; they communicate whole trains of thought which can, when set, be either respected or effaced. As the meaning is quite fixed, however, syllables or words could be taken as serial elements to an even smaller extent than in the 'Marteau'.

In certain pieces in the 'Canto', Nono composed the text as if to withdraw it from the public eye where it has no place. The composer was deeply moved by these letters; musical reasons were not the only ones to lead him to set them to music. In sections II, VI, IX and in parts of III, he turns speech into sounds, noises. The texts are not delivered, but rather concealed in such a regardlessly strict and dense musical form that they are hardly comprehensible when performed.

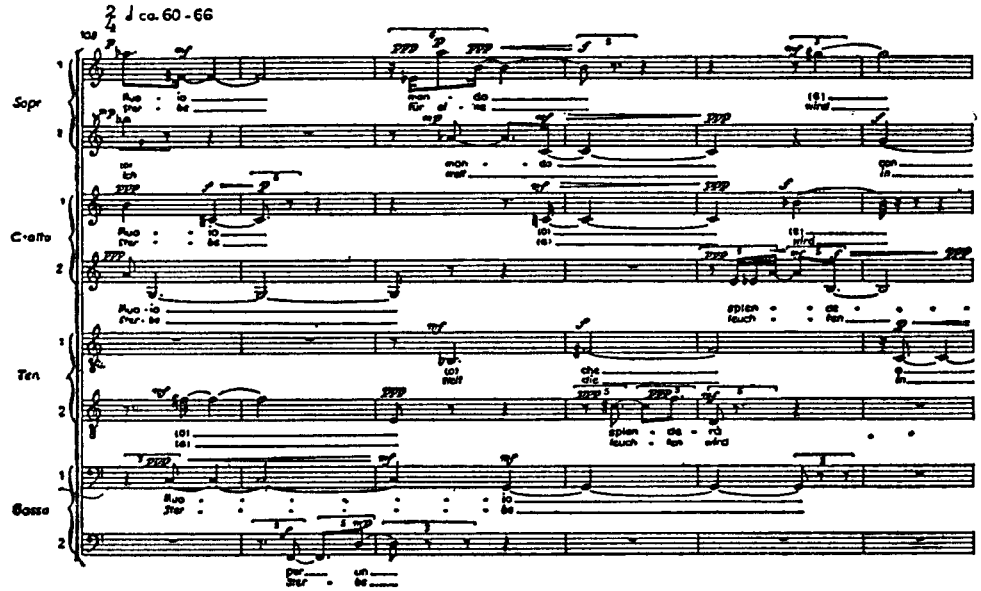
Why, then, texts at all, and why these texts?

Here is an explanation. When setting certain parts of the letters about which one should be particularly ashamed that they had to be written, the musician assumes the attitude only of the composer who had previously selected the letters: he does not interpret, he does not comment. He rather reduces speech to its sounds and makes music with them. Permutations of vowel-sounds, a, ä, e, i, o, u; serial structure.

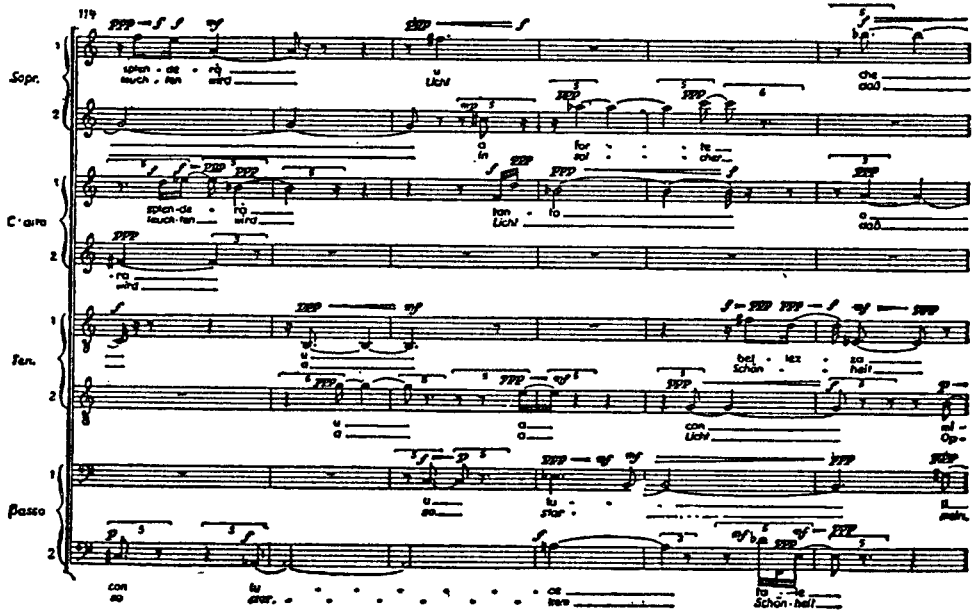
Should he not have chosen texts so rich in meaning in the first place, but rather sounds? At least for the sections where only the phonetic properties of speech are are dealt with?

Let us consider the entire composition. Some sections (II, VI, IX) go so far as to break up the sense; others (V, VII) quote, even clarify the text just as in 'Le Marteau'. We can therefore keep to the idea, just mentioned, that the composer consciously 'expelled' the meaning from certain parts of the texts; only the vocal line remains. This is not possible with meaningless syllables. The sense of speech can only be banished to a vocal structure when the listener can know, or feel, or check that he is not supposed to understand some particular thing – in this context – and that this particular thing is apparently not so important at the moment of hearing this music. It is not for nothing that a few fragmentary syllables flash out of the heaving sounds here and there in II. The listener feels he has understood them without, however, their having resulted in larger coherent passages*.

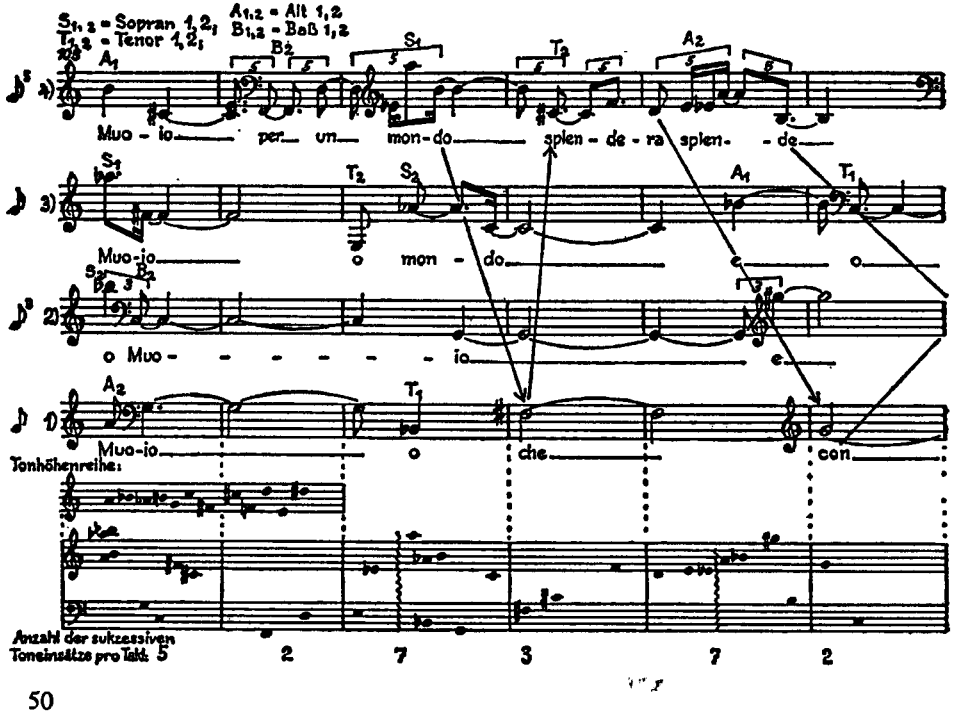
Example 13:

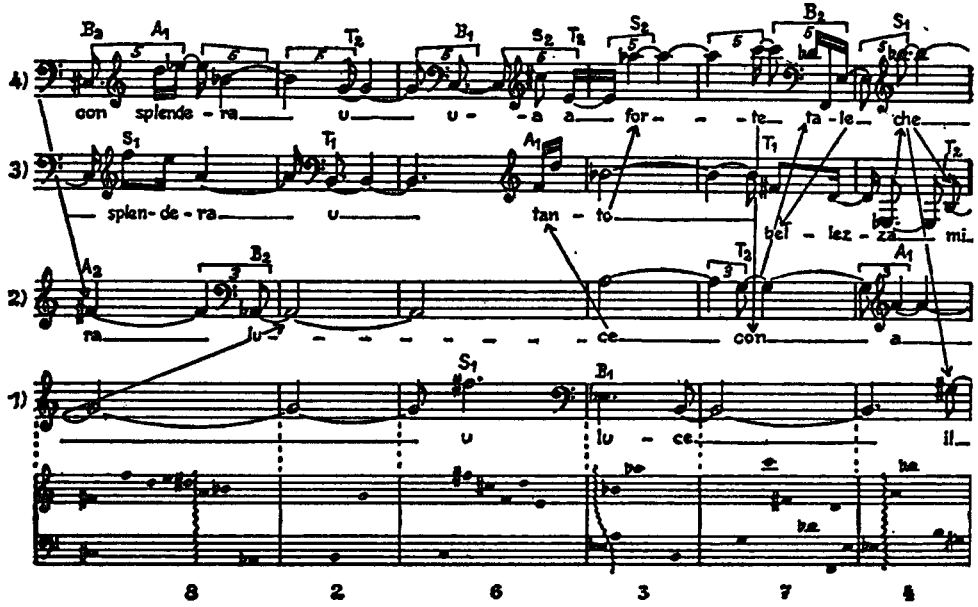


* Soon after the publication of this interpretation, Nono informed me that it was incorrect and misleading, and that he had had neither a phonetic treatment of the text nor more or less differentiated degrees of comprehensibility of the words in mind when setting the text – not even with respect to a possible repression of the sense of these farewell letters, and if I could interpret a quasi-serial vocal structure into II, it was a mere coincidence. The reader must therefore not take my reflections and analyses as being demonstrations of Nono's composition, but rather of my own – demonstrated on the work of another composer.



Example 14:





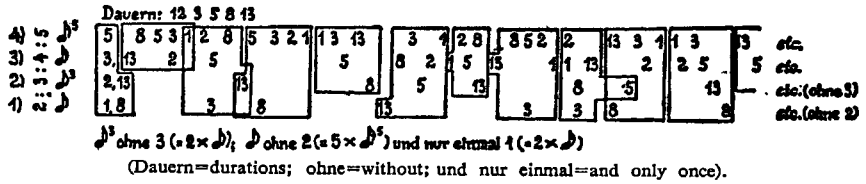
The same problem crops up in the polyphonic choral style of Machaut or Gesualdo. Of course, here the difference is that the familiar mass and other liturgical texts were used. It was essential to be dealing only with these sacred texts and no others, and it was really not at all important whether a word be heard or not. This is naturally not possible in the 'Canto'.

I shall now demonstrate how Nono makes music out of speech in No. II for a capella choir; the first 12 bars suffice as an example to show the essentials (example 13). The whole piece is a continuously four-layered movement. The individual layers progress without pause; their characteristic difference is based on the speed-proportion 2 : 3 : 4 : 5, i.e. one layer has ♪ as smallest unit, the next ♪³, the third ♪ and the fourth ♪³. In this way, only a few tones commence simultaneously, and it is not difficult to reconstruct the layers from the notation.

This is not so when hearing the piece. The four time-layers are irregularly distributed among eight choral parts (4×2). For example, the first soprano has 2 tones from layer three, then 3 tones from layer four, then 1 tone from layer two, 3 tones from layer three, 1 tone from layer one, etc. The particles in a part are separated by rests. This is possible because four layers without rests can be distributed among elght voices, and so, on the average, enough time remains in each voice – when all are used to the same extent – to keep the particles of the layers apart by means of rests. This is why the listener hardly perceives the four-layered conception; especially because one duration is now sometimes used for two simultaneous tones, thus giving the impression that the number of voices is increasing. Moreover, the crossing of the parts provides to a certain extent for the blurring of the quadruple counterpoint. Compare example 13 with example 14.

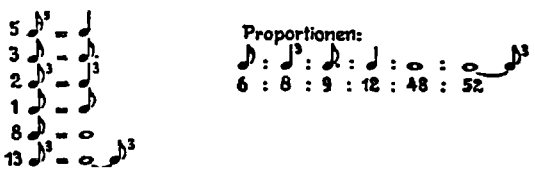
To determine the durations, Nono uses a series of six factors which can be multiplied with the four unit values: 1 2 3 5 8 13×♪ or ♪³ or ♪ or ♪⁵. These six factors are used throughout the notation from layer to layer, but not in the individual layers as a series. The duration unit with which each factor is multiplied depends on two conditions: first, a statistical – equal distribution of the factors must be achieved – and secondly, that the four layers must always carry on together.

Example 15:



(Dauern=durations; ohne=without; und nur einmal=and only once).

The first complex of six, then, has the duration:



(Proportionen=proportions).

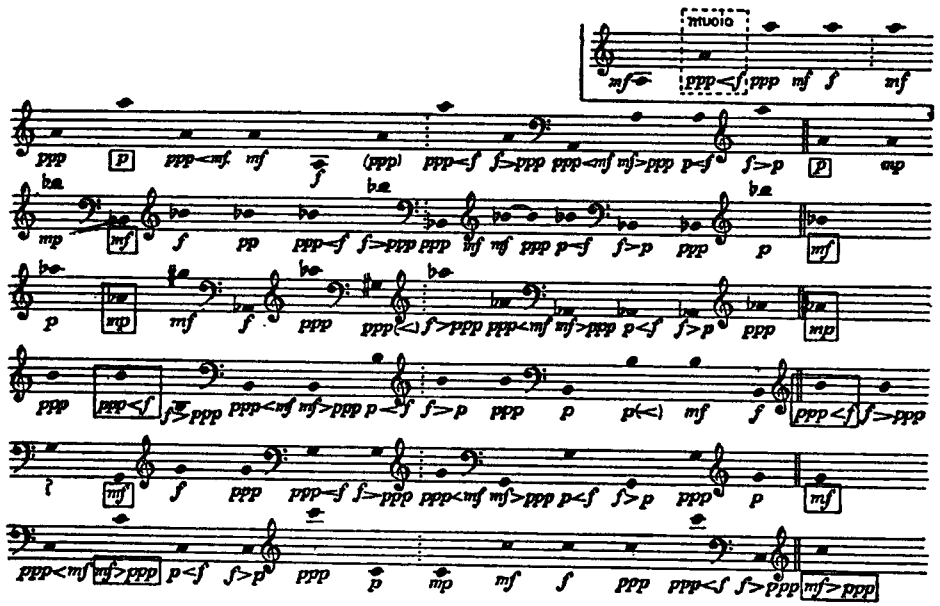
Thus fewer durations occur in the layers with longer unit-values than in those with shorter unit-values. Besides this, there are repetitions in the individual layers (cf. example 14).

The time-proportions of the phases from one sound to the next which are effectively heard are only perceived, however, according to the distribution of the frequency of their occurrence: recurrences of the attacks alternate quite regularly from bar to bar with the mean values 7–2. This is an automatic result of the selected rhythmic system.

The pitch structure continuously employs the same series, and the distribution of the registers must adapt itself to whichever voice is free and this voice's natural register, as well as to a feasible distribution of the lower and upper 'peak'-tones (progression in steps). For this, see the diagram of the pitch series under the four layers in example 14.

The structure of the dynamic values is doubly determined, as is frequently the case in serial composition. It is first linked with the pitches, each of the 12 chromatic pitch values receiving a different intensity whenever it recurs. In the same way, there are also 12 different forms of intensity arising from 5 basic intensities (ppp, p, mp, mf, f). The dynamic values for the recurring first six pitches of the basic series are (compare the beginnings with example 13):

Example 16:



Furthermore, the intensities are arranged continuously from one tone to the next in groups of six, like pitches and durations (here, the permutation must obey the first direction of example 16):

Takt 108 *p, mp, ppp, mf, ppp<mf, f>p;*
Takt 109 *f, mp, ppp, p, mf, ppp<f;*
Takt 110 *mp* (S_2), *mf, mf>ppp, f, ppp;*
Takt 111 *ppp* (T_2), *mf, ppp<mf, f, f>ppp, p<f* (Takt 6, T_1);
Takt 112 *mf* (S_1), *f, p, ppp, ppp<f, f* (>);
Takt 114 *f* (S_1), *f>ppp, mf, ppp, f, ppp<mf;*
Takt 115/16 *ppp* (T_2), *f>p, ppp<f, mp, f* (>) *ppp, ppp<mf;*
Takt 117 *ppp<mf* (B_1), *f, ppp<f, ppp, mf>ppp, f>ppp* (Takt 118, T_1);
Takt 118 *ppp* (S_2), *ppp<f* (T_2), *mf, ppp* (<), *mf>ppp* (B_2), *f>ppp* (Takt 119, S_1);
Takt 118/19 *ppp<f* (T_1), *mf>ppp, ppp, p<f, f>ppp, p;*
Takt 120 *ppp<mf* (T_1), *f* (B_2), *mf>ppp, f>ppp, p<f* (121), *ppp<f; etc.*

(Takt=bar).

We are dealing, then, with an autonomous musical serial structure in all parameters. This structure has not apparently felt itself in the least bound to the text up to now because it had had quite different intentions from the very beginning: it is true that the text runs throughout the piece with the words in the prescribed order, and that

it is hereby arranged almost exclusively in the quintuplet-layer with the most attacks (see example 15); the flow of the text, however, falters at individual syllables or words, repeats them ('mondo' twice, 'splendera' four times and others).

In general, the syllables are distributed among the longer and shorter durations in such a way that certain vowel-sounds (always alternating – at first successively) occur at the longer values and thus begin to predominate. Furthermore, the other three layers now support only these vowel centres; they add either just the single vowel-sounds or the syllable with the respectively pre-dominating vowel-sound (see bars 108–109 [o:], bar 112 [e:], bars 115/16 [u:], bar 116 [a:] etc.). In the second section of our example (from bar 116 to ca. 120) the vowel-sounds are polyphonically mixed, and the vowel zones then chiefly follow each other again. If one listens carefully, one discovers a serial structure of vowel-sounds, and the transformation of the meaning of the speech into musical meaning, previously mentioned, becomes clear.

Takt 108/109	[o:]	muo$_1$- io$_1$
" 110	[ɔ:]	mon - do, con
" 111	[ɛ:]	splen-(dera)
" 112/13	[e:]	-de-
" 114	[a:]	- ra
" 115/16	[u:]	lu-
Takt 116	[a:]	tan-
" 117	[u:]	lu -
" ↓	[e:]	ce, te
" ↓	[o:]	- -to
" 118	[ɔ:]	for -, con
" ↓	[ɛ:]	bellez -
Takt 119	[a:]	ta -; -za
"	[e:]	- le, che
" 120	[i:][u]	mi -, sacrifi-, il
" 121/22	[o:]	-cio, non (o)
" 123	[ɛ:]	é
" 124	[u:]	nul-
Takt 124/25	[a:]	- la
"	[i:]	l (-e)

etc.

(Takt=bar).

Throughout the piece, the serial sound-structure relies on the vowels of the text; the permutations therefore result from the arrangement of the vowels in the text, and in the rows of 6 vowels, every single vowel is exchanged for another (for example, in the third series [i] occurs for the first time instead of [ɔ]). Compare examples 13 and 14.

It is thus important when performing the piece to bring out this structure of the vowel-sounds and not to deliver the [n], for instance, in syllables such as mon-, con, tan- until just before the next syllable or before the end of the tone: mo – ndo, co – n, ta – nto (how stupid to have printed a German translation in the score!).

When the text is treated so phonetically, and the parameters of sound constructed so strictly, there is little scope for emphasising the long and short syllables of

articulated speech by making use of longer and shorter durations of the tones. The same applies to the relationships of accentuated and unaccentuated syllables in the word (Italian pronunciation nearly always couples emphasis and length). One and the same word can thus be accentuated in quite different ways, according to the intensity and durations with which the individual syllables coincide; and this results in sequences of accentuation which are similar to speech as well as being quite opposed to it.

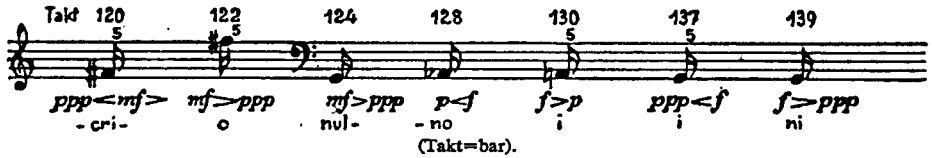
Takt 112 (A_2)	Takt 111 (T_2)	Takt 114 (A_1)
splen - de - ra	splen - de - ra	splen - de - ra
pp<mf f>ppp	*ppp—— mf*	*f f>ppp*

Takt 110 (S_2)	Takt 118 (T_1)	Takt 117 (B_1)	Takt 120
mon - do	bel - lez - za	lu - - ce	sa - cri - - fi - cio
mp - mf	*f>ppp<mf mf>*	*ppp<mf mf*	*p - ppp<mf ppp p<mf*

Takt 124			
S_2	A_1	A_2	B_1
nul - la	nul- - la	nul - la	nul - - la
ppp - mf	*mf>ppp ppp<mf*	*mf - ppp*	*mf>ppp, p<f mf>ppp*

(Takt=bar).

The independent treatment of the parameters of duration and intensity resulted in extreme combinations; the text must keep to the structure even more closely, in face of the danger that it will not be sung according to the score:



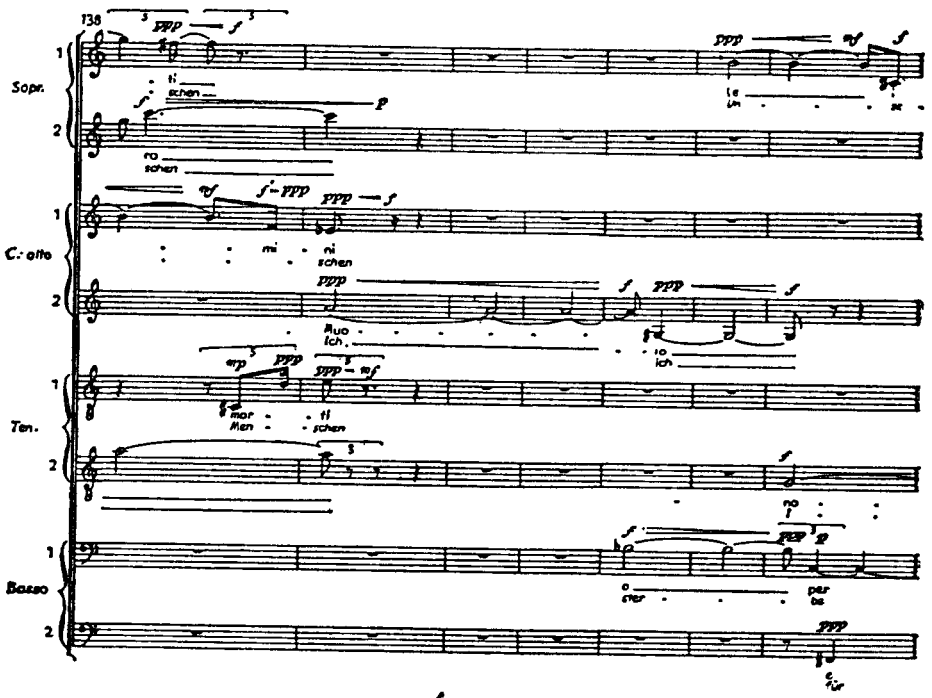
(Takt=bar).

However, shortly before the end of No. II – in the last line of the text 'muoio' – the structure described up to this point is shattered: the regular course of the four-layered counterpoint is cut off – in the middle of the serial context – the second contralto part remains alone with the initial tone of the basic series in the same register as at the beginning, a^1, with the extreme form of the intensity-series, ppp<f and with the longest time value: $^{13}/_8$. This unification of all the extreme values of the parameters (including the initial vowel [o:]) cannot be coincidental, for every single instruction follows the widely-branched paths of serial contexts; this can be especially clearly seen in the table of dynamics in example 16. We must assume, rather, that the determination of the entire serial course of No. II resulted from this point (example 17).

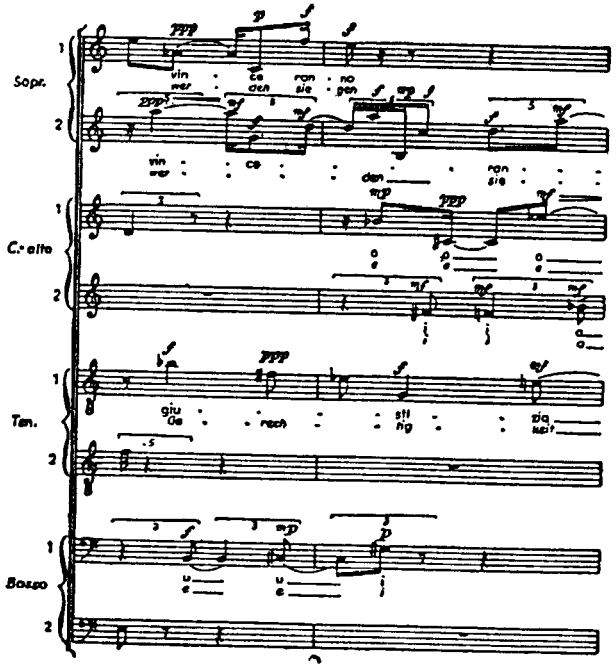
Then the layers begin again, one after the other, and form a symmetrical final structure; as an example, here are the time-values of the -layer:

$$\frac{13\ 8\ 5\ 3\ 2\ 1}{8} \,\Big|\, \frac{1\ 2\ 3\ 5\ 8\ 13}{8} \,\|$$

Example 17:



Example 18:



The densities of the commencements of the tones are correspondingly arranged – bar for bar – (this is possible because of the new beginning of the rythmic layers): 'muoio' 1-0-0/ /2-1-4-3-9-14-4-4-1-1-0-0-0/ /commencements per bar (bars 142 – 157). The centre of this finale is very significant. The composer interprets the text directly here for the first and only time in the whole of No. II (after 'muoio') and applies the rhythm in such a way that the word 'vinceranno' combines the many short tones and large leaps: 'our ideas will conquer . . .' (example 18).

The 'Song of the Holy Children' is a sequence of acclamations from the Apocrypha to the Book of Daniel – to a great extent, then, general knowledge. The composition GESANG DER JÜNGLINGE is based on the German version which is recited after the Mass (there are several customary translations of the same Latin text which have often been used for selections of words and syllables). Here are the lines which yielded the material:

O all ye works of the Lord, praise (exalt) ye the Lord above all for ever.	Preiset (Jubelt) den(m) Herrn, ihr Werke alle des Herrn – lobt ihn und über alles erhebt ihn in Ewigkeit.
–	
O ye angels of the Lord, praise ye the Lord – O ye heavens praise ye the Lord.	Preiset den Herrn, ihr Engel des Herrn – preiset den Herrn ihr Himmel droben.
O all ye waters that be above the heaven, praise ye the Lord; all ye hosts of the Lord, praise ye the Lord.	Preiset den Herrn, ihr Wasser alle, die über den Himmeln sind – preiset den Herrn, ihr Scharen alle des Herrn.
O ye sun and moon, praise ye the Lord; O ye stars of heaven, praise ye the Lord.	Preiset den Herrn, Sonne und Mond – preiset den Herrn, des Himmels Sterne.
O every shower and dew, praise ye the Lord; O all ye winds, praise ye the Lord.	Preiset den Herrn, aller Regen und Tau – preiset den Herrn, alle Winde.
O ye fire and heat, praise ye the Lord; O ye cold and hard winter, praise ye the Lord.	Preiset den Herrn, Feuer und Sommersglut – preiset den Herrn, Kälte und starrer Winter.
O ye dews and storms and rain, praise ye the Lord; O ye ice and frost, praise ye the Lord.	Preiset den Herrn, Tau und des Regens Fall – preiset den Herrn, Eis und Frost.
O ye hoar-frost and snow, praise ye the Lord; O ye nights and days, praise ye the Lord.	Preiset den Herrn, Reif und Schnee – preiset den Herrn, Nächte und Tage.
O ye light and darkness, praise ye the Lord; O ye lightning and clouds, praise ye the Lord.	Preiset den Herrn, Licht und Dunkel – preiset den Herrn, Blitze und Wolken.

These are 9 verses of the song of praise, which contains 11 more verses in the usual translations. (According to the context, I employed 'Jubelt' [exalt] instead of 'Preiset' [praise]).

We have primarily to do with three words in the text (preiset den Herrn) which are frequently repeated and in connection with which all kinds of things are ennumerated. Obviously, this ennumeration can be continued at will or be broken off after

the first line. The lines and words can also be permutated without altering the actual meaning: 'alle Werke' ('all ye works'). The text can therefore be especially well integrated in purely musical structural arrangements (especially permutational-serial ones) without affecting the literary form, its message or other aspects. 'Jünglinge' reminds us of general knowledge: if the word 'preiset' (praise') occurs at one moment and the word 'Herrn' ('Lord') at another – or vice versa – the listener is reminded of a word-connection which he has always known: the words are memorised, and here we are primarily concerned with the fact *that* and *how* they are memorised, and the details of the content are of secondary importance; the concentration is directed upon the sacredness; speech becomes ritual. In the composition, sung tones must be blended with electronically-produced ones to form a mutual sound-continuum: the will of the selected musical arrangement determines how fast, how long, how loud, how soft, how dense, how intricate the tones must be, how great and small the proportions of pitch and timbre must be in which the tones are audible. This was not so difficult for the regulation of durations, intensity and pitch, as each word and syllable could be separately recorded on tape with exactly controlled parameters (generator-tones for orientation, as many attempts as needed for each articulation), and because even finer corrections could be made when transforming the material further (scales of frequency, intensity and durations up to 42 steps in the ratio 1 : 2 in the 'octave'). It would not have been possible to achieve the desired fusion with discontinuous sound sources such as, for example, with instruments (especially with respect to the 'timbre'). In order to employ the most complex phonetic structure of speech in terms of serial composition, many different steps are necessary between the individual examples of a given phonetic system (in this case, German) so that regular timbre-scales can be chosen from a continuum (for instance, steps from one vowel to another, from vowel to half-consonants, to consonants, etc.); this is only, if at all, possible with electronically-produced sounds. This can be equally-well formulated the other way round: in a selected scale of electronically-produced sounds, single steps are replaced by sung speech-sounds. We only have a homogeneous sound-family if sung sounds sound at certain places like electronic sounds, electronic sounds like sung ones. In order to achieve the greatest possible homogeneity (as far as individual articulation and 'personality-formants' are concerned), a twelve-year-old boy sang all the necessary sounds, syllables, words and at times groups of words, too, which we recorded on tape and transformed, employing various methods of orientation as to pitch, duration, intensity and articulation of timbre. The extremes, then, of the scale we were seeking to make are: sound-vowel <—> consonant-noise; in the sound-range between [u] and [i], the darkest and brightest tones; in the sound-noise opposition between purely harmonic spectra and aleatoric noise-bands: in the noise-range between ch and s (unvoiced) darkest and brightest tones.

According to the 'colour'-continuum, the composition was based on the idea of a 'speech-continuum': at certain points in the composition, sung groups of words become comprehensible speech-symbols, words; at others they remain pure sound-qualities, sound-symbols; between these extremes there are various degrees of comprehensibility of the word. These are brought about either by the degree of permutation of the words in the sentence, syllables in the word, phonemes in the syllable,

or by blending one form of speech with speech-or sound-elements foreign to the context (jubilt; Son-synthetic sound-ne. Of course this leads to new word-connections not contained in the text: Schneewind, Eisglut, Feuerreif, etc. [snowwind, iceheat, firefrost]). The context of the sounds therefore also influences to a particular degree the comprehensibility of the speech (for example, degrees of spatial effects by means of artificial echo, degrees of intensity, of the density of simultaneous or successive events, etc.).

The intention, therefore, is, by selecting individual steps from a sound-word continuum, to let 'speech' proceed from the composition. It is not the case that the comprehensibility of speech is always brought about by a sudden transformation from the 'meaningless' sound to speech – one only has to recall 'indistinct' speaking, 'listening with half an ear', 'didn't quite catch'; on the contrary, it is possible to have a continuous transition from listening to comprehension. It can be said that the more the sound-aspect dominates in a structure, the more typical of music it is; the more the word-motivic aspect dominates (sound-connections with a fixed meaning), the more typical of speech it is; and speech can approach music, music can approach speech up to the point of dissolution of the boundaries between sound and meaning.

If a listener does not understand the German words, he can still appreciate the structural function of the 'series of degrees of comprehensibility',because it is coupled with a series of gradual transformations of sequences of sung sounds; the degrees of transformation become increasingly similar to the sound-connections of non-vocal character and finally become interchangeable with electronic sounds. In this way, something unequivocally perceived as 'sung' is at the same time 'çomprehensible to the highest degree'; the term 'comprehensibility' is, then, both semantically and sound-phonetically differentiated.

My article, 'Actualia' (in the first volume of 'die Reihe') shows how syllables or words are composed with the help of. purely musical formal laws (permutation, group formations); in it, the selected elements were also stated as being variously complex oscillation structures between the sinus tone and white noise. In this work, the number and combination of the employed sound-elements change from one formal overall structure to the next – according to the largest projection of the time-series. The following table shows how, for instance, the distribution of recurrences and proportion of elements in the plan for the last overall structure of the piece are transformed from sinus tones to sung chords; the element-groups A – W stand for a corresponding number of time-sections of various length; each element occurs – statistically viewed – equally often in the overall structure:

Abbreviations:

SK = sinus complexes (showers of sinus tones with defined frequency, duration and intensity in very complex rhythmic micro-structure);
IK = impulse complexes (showers of impulses as SK);
LS = sounds and syllables;
R = noise filtered to about 2% wide (in cps);
I = single impulses;
SV = synthetic vowel sounds (spectra rich in overtones in various formant-combinations);

RO = noise filtered 1–6 octaves wide;
IO = showers of impulses of statistically fixed density, filtered 1–6 octaves wide;
IA = single impulses in chords (in each case, pitches of used scales);
RA = chords from 2% (in cps) wide noise bands (middle pitches according to the scale);
S (A)= sinus tone chords (or mixtures in unharmonic types of scales, sounds as boundary case in harmonic scales);
GA = sung chords (combined sung sounds).

Methods of analytic phonetics (vowels – sinus sounds; consonants – bands of noise; plosives – impulses; various hybrid forms) were made use of for the system of the scale of sound-elements (arrangement of the sounds in the synthetic sound-family).

Table:

A	–	SK										
B	–	„	JK									
C	–	„	„	LS								
D	–	„	„	„	R							
E	–	„	„	„	„	!						
F	–	„	„	„	„	„	SV					
G	–	„	„	„	„	„	„	RO				
H	–	„	„	„	„	„	„	„	IO			
I	–	„	„	„	„	„	„	„	„	IA		
J	–	„	„	„	„	„	„	„	„	„	RA	
K	–	„	„	„	„	„	„	„	„	„	„	SA
L	–	„	„	„	„	„	„	„	„	„	„	„ GA
M	–		„	„	„	„	„	„	„	„	„	„ „
N	–			„	„	„	„	„	„	„	„	„ „
O	–				„	„	„	„	„	„	„	„ „
P	–					„	„	„	„	„	„	„ „
Q	–						„	„	„	„	„	„ „
R	–							„	„	„	„	„ „
S	–								„	„	„	„ „
T	–									„	„	„ „
U	–										„	„ „
V	–											„ „
W	–											„

This continuous change of elements was divided into four rows of related tendency in the piece:

	A	E	I	M	Q	U	→
→	B	F	J	P	T	(X)	→x
→	C	G	K	O	S	W	→
→	D	H	L	N	R	V	

—>(*Receives a structure with special definition resulting from the total plan of the work).

The elements thus selected are permutationally used to form groups in each partial structure defined in time; there are signs in the time-structure to show where alterations are necessary. The alterations behave in their turn – being subjected to a temporal arrangement – according to groups (in one time-field, for example, groups

from 1–4 elements, in the following 1–6, etc.). Now, in this structure there are four group-forms: the groups are either singly, uniformly differentiated (for example, 3 IK, 2 LS, 4 R, 1 SK) or they are all uniform, the various elements, however, indicating the endings (for example, 2 SV, GA/4 SV, R/IK/SV, 1/3 SV, LS/ etc.); or the groups are in themselves varied, the endings, however, the same; or they are individually uniform and a fixed element always indicates the group-endings. It is obvious that no opposition is formed between speech-sounds and the other sound-elements, but that they rather function according to their position in the defined sound scale. A group of 2 and more LS provides the opportunity of forming syllables and words which can be made use of according to the degree of comprehensibility (which depends on the respective structure-duration).

The acoustic use of LS conforms (previously fixed pitch, duration and intensity excepted) to degrees of a series of internally structural distribution of the dark-bright-vowel aspect or the voice-unvoiced-consonant aspect; always, however, considering the fact that such degrees are to be checked with the selected elements of speech. It is best to show a sequence of phonemes which were produced for a partial structure; the phonetic transcription symbols in parentheses indicate the attitude adopted in selecting the syllables. In these examples, either the pitch was to be sustained on the phonemes with [ ] (and half or full consonant phonemes before or after the vowel in the syllable were treated as extremely short attacks or decays), or the articulation used the longest part of each duration for the voiced consonant (w-erk, [tu] j-), or the unvoiced consonant was emphasised by means of the duration (Sch-a, [Rei] f-), or the accentuation (werk); various forms thereby also changed; the same vowels, various attacking phonemes, etc. Four groups of six follow:

Vokale		stimmhafte Kons.[1]		stimmlose Kons.		Verschlußlaute (hart - weich)	
ju-	[u]	tuj	[j:]	-wig	[ç]	jep	[p]
bell	[a]	ult	[l:]	Preis	[s]	Lob	[b]
dem	[e]	-ren, dem	[n,m:]	Reif	[f]	Werk	[k]
Herrn	[ɛ]	Her-	[r:]	-belt	[t']lang	Tag	[g]
all	[a]	Wer-	[v:]	-ze	[t͡s]	preist	[t]kurz
ihr	[i]	-set	[z:]	Scha-	[ʃ]	Wind	[d]

1) entgegen dem Sprachgebrauch wurden diese stimmhaften Konsonanten oft in starker Dehnung verwendet.

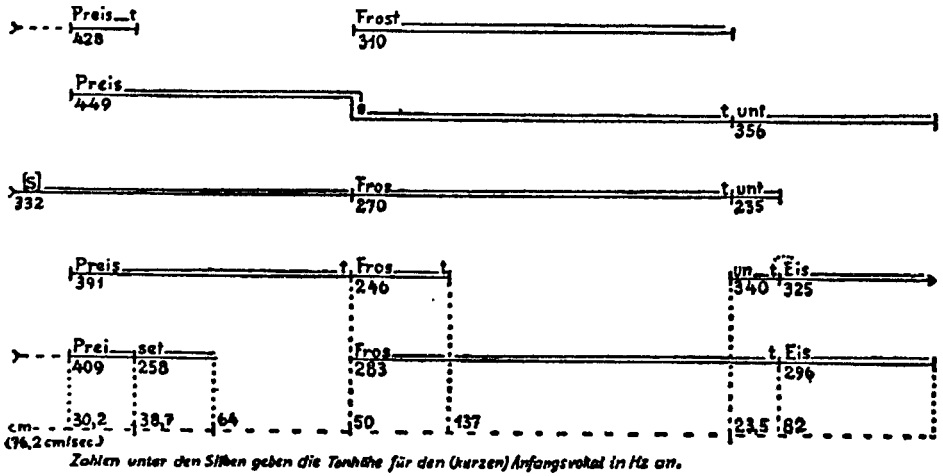
(Vokale=vowels; stimmhafte Kons.=voiced consonants (1); stimmlose Kons.=unvoiced consonants; Verschlu laute (hart-weich)=final sounds (hard soft).

1 Contrary to linguistic usage, these voiced consonants are often considerably prolonged.

The employed forms of the text were especially exploited in structures with the same vowel: [ai] dipthong in Reif, preist, Eis, -keit; or [ɛ] in Werk, Herrn, Näch-, gen, -ren, des, -set, -kel, -len, -ken; such groups were completed, if necessary, with meaningless syllables (see above example, ult, jeb, tuj).

Another example follows for the less usual case of the accentuated consonant structure ('noise'). In connections with noise-elements, an LS-structure occurs consisting mainly of s- and t- phonemes (unvoiced consonants), produced in such a way

that the articulation, the prescribed pitch having first been sung as shortly as possible, proceeds to the consonant and fills the prescribed duration with it, hereby also differentiating the frequency register of consonants: highs, s, middle s, low s, etc. Large time-units receive a consonant structure by means of various unsimultaneous attacks and endings of the articulation, in simultaneous layers. Here is, then, an example for s, t:

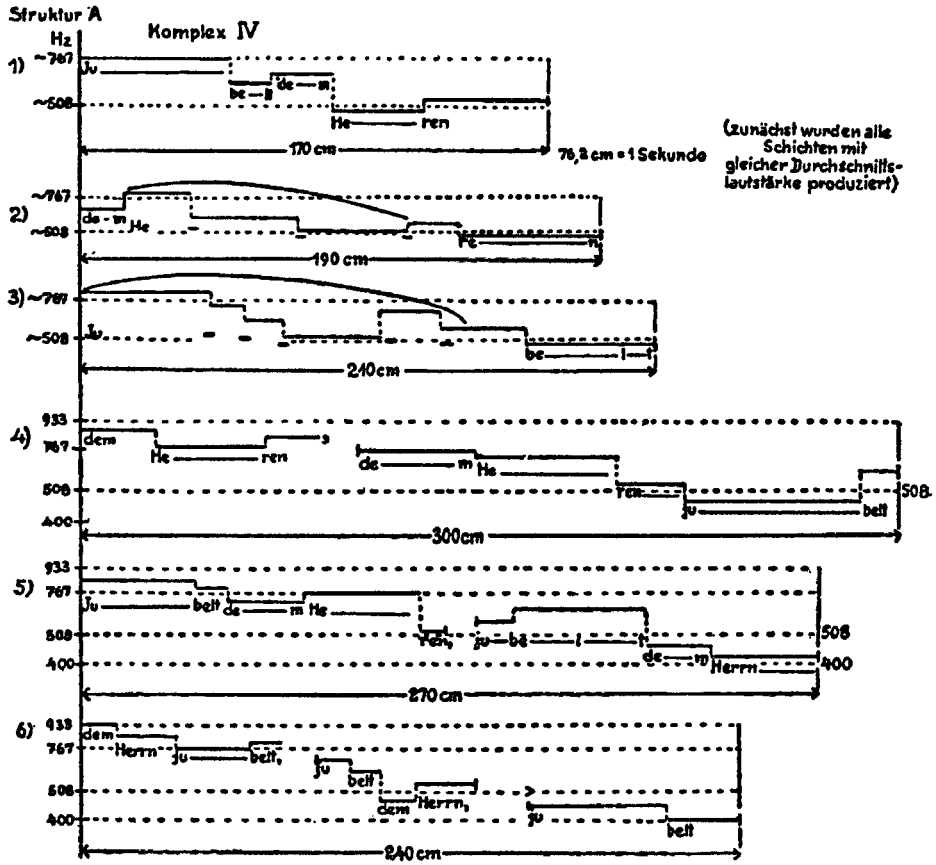


Zahlen unter den Silben geben die Tonhöhe für den (kurzen) Anfangsvokal in Hz an.

(Numbers under the syllables indicate the pitch for the (short) initial vowel in cps.).

This LS-complex lasts about 6 seconds; it is simultaneously connected with R- and I-groups and proceeds imperceptibly into a complex of coloured noise [s] and [t]. A structure consisting mainly of [ʃ], [f], [s] and [c] consonants, which are completed with sounds from Sch(nee), (Rei)f, (prei)st, (Nä)ch-(te).

Although the previous examples were based on phonetic elements, discretely determined in their parameters by means of the composition, there is a second type of treatment of speech based directly on and referring to statistic structural ideas. The statistic structure was achieved as follows. In a particular complex, A IV for example, the following were serially defined: the number of 6 layers, the number of syllables per layer, 5–10, the total duration of the individual layers (in cm. at a tape-speed of 76,2 cm/sec.). The relative distribution of time and the direction of the pitch for the syllable sequences, the width of the frequency band and total movement direction of the complex (933 : 767 cps to 508 : 400 cps), as well as the dominant, on the average, phonetic structure ([u], [ ], [ɛ], [e]). Diagrams and models prepared on tape (with approximate pitch and duration data) were then used to aid the boy to sing the various layers, and the best results were superimposed. The 6 diagrams to which the boy sang look like this (one must imagine them simultaneously intermingled in the 'synchronisation' which followed later):



(Struktur A=structure A; Komplex IV=complex IV; Sekunde=second).
(At first all the layers were produced with equal average volume intensity).

Such complexes were again dynamically regulated (⌒, ⌒, ⌒, ⌒), reverberated, synchronised with others, etc. They could now be distinguished according to the average density (as product of the number of layers, average number of syllables per layer and average length of the layers), and according to the average intensity and type of spatial presentation – spatial depth, from far to near or vice versa; spatial direction of the source of sound in the auditorium and also the direction of the movement in space (rotation to the left or right, spatial diagonal movements, etc.: loud-speakers set up round the listeners) – and they can be regulated in the degree of comprehensibility of speech.

Many steps between the extreme forms of the sound structure indicated here occur in series of hybrid types.

These few points – which canot be supplemented with 'examples from the score' as the 'score' is a combination of written instructions for the production and synchronisation plans for the 5 groups of loudspeakers, and only contains indirect data about the sound phenomena – may give an approximate idea of how the problem of speech and music was tackled in 'Gesang der Jünglinge'. The basic conception may have become clear: first of all, to arrange everything separate into as smooth a continuum as possible, and then to extricate the diversities from this continuum and compose with them.

CONTRADICTIONS WITHIN THE SERIAL LANGUAGE

NICOLAS RUWET

I imagine that every attentive listener must have been struck by a contradiction inherent in a great deal of post-Webern serial music. In the composer's plan this music is basically very intricate, but as soon as it is performed it appears unsubtle.

(This of course does not apply to certain works, such as Boulez' *Marteau sans Maitre* or Stockhausen's *Zeitmasse*).

On the one hand this music appears to be very complicated in principle; it is exceedingly difficult to perform, and is labelled with non-decorative titles like *Polyphonies*, *Structures*, *Kontra-Punkte*, which suggest a highly developed method of working. The composers tend to invoke all that is complex and strict in musical tradition – the isorhythmic motets of Machault and Dufay, the *Art of Fugue*, Beethoven's last quartets, *Jeux* and the *Etudes pour Piano*. In the numerous commentaries with which they launch their works they lay much stress on structural problems, underline their desire for strictness and complexity, reveal the complicated schemes and the lengthy preparations which lie behind the writing of the work. To such an extent that traditionalist critics attack this method and, as we all know, accuse it of excessive cerebralism, of thinking in systems.

When it is performed, on the other hand, this music strikes anyone who listens to it without any preconceived idea as astonishingly simplistic. And however often you hear it, however familiar you are with the language of Webern and Debussy, it is still difficult to perceive anything but a sequence of sonic eruptions, a succession of moments which seek to convey something never before heard but only succeed in cancelling each other out. This swift succession of sound-blocks, these continual changes of pitch, and minimal rhythmic changes end by creating a very static music which falls quite flat; nothing ever happens in it. It proves to be amazingly lacking in incident, apart from the completely elemental and basic incidents which are more like the cataclysms of nature than historical events. In short, it does not succeed in building up a pattern of growth.

Of course it is not without a certain primordial emotionality, a certain purely natural beauty: in themselves the sounds are often very beautiful. But this music, acceptable as background sound, as ornament, does not succeed in evolving a self-determining language. Everything happens often, as though this music was falling back into the 'distinctionless' stage of pure nature, as though it had given up trying to build up a language, a dynamically organised whole.

How has this come about? What is the explanation of such a disparity between the proclaimed aims and the reality of the work? And what is the explanation of the fact that a type of music which (like that of its great predecessors, to which it refers) aims to be a language, a '*Weltanschauung*', is just good enough to furnish the undifferentiated background sound for our daily existence.

In the final analysis, to answer this question would be to write the history of modern music. At the same time it would demand the solution of certain fundamental aesthetic and sociological problems. In this article I can only sketch a first

attempt at a solution, and try to show how the problem must be posed if one is to have any prospect of solving it.

To start with, it need not be specially emphasised that we would not be satisfied by simply accepting (in place of an explanation) the reproach which critics have most often flung at this music – excessive cerebralism, intellectualism, lack of spontaneity – if only because this would mean falling back into the same error from which the composers themselves suffer, and confusing the musical reality with the ideological programmes put forward in the commentaries which surround it.

On the other hand, one should not be too eager to accept interpretations of a sociological kind. The fact that the flourishing of music at the beginning of the twentieth century coincided with the culmination of imperialism and the decadence of the one with the decline of the other should not lead us to draw conclusions that leave out of consideration the separateness of the two phenomena and moreover prevent us from understanding the nature of the link that does exist between the two events. As Claude Lévi-Strauss [1] has demonstrated, not until the grammar of each separate field (language, kinship system, economy, arts, etc.) has been worked out down to the last detail, will it be possible to describe more precisely how the various fields influenced each other reciprocally in a particular situation of this kind.

I have just used the word 'grammar', and the term 'language' has cropped up several times. This brings us to the real problem. On one point there can be no disagreement with the serial musicians who so often speak of the musical language: the central problem facing the composer of today is still primarily not a sociological or psychological problem, or even an aesthetic problem, but a linguistic one. The tonal system is dead. The problem is to find another system.

But instead of reproaching the composers for systematic thought, I would stress the fact that they have not displayed *enough* system. That is, they have not made themselves sufficiently clear about what it means to say that music is a language. In other words, I think their fundamental mistake and foreseeable downfall spring from the fact that they have not taken into account the limitations of the potentiality of a thing like language (in the most general sense of the concept). And neglecting these has prevented them from founding a language. So we must begin from this point.

Music is language. This means to say that it is one of many communication systems by means of which men exchange meanings and values. In order to work and be efficient it must obey rules which in a general way make the functioning of a communication system possible.

Here we must draw a basic distinction between the two main forms in which men can enter into relations with each other. On the one hand there are the links which lie on either side of language: shouts, looks, caresses, etc. There are undoubtedly great riches here, an inexhaustible variety – but it is a cornucopia without order, differentiation or explicitness.

On the other hand, there are the differentiated, articulate systems: myths, rites,

[1] 'Style must be understood by itself, the grammar of style must be elaborated independently of the grammar of social institutions, such as kinship or technology or economics, and it is not between the raw materials that the correspondence can be found, but only between the systematised forms, which should first be abstracted on the different levels'. Claude Lévi-Strauss in Sol Tax, Voegelin, etc. An Appraisal of Anthropology Today, Chicago, 1953, p. 62.

languages, arts, kinship and economic systems. Systems in which totalities of articulate meanings are expressed in a complex way but which also imply certain limitations and exclusions at the same time.

Obviously this is a very schematic distinction, but it seems to me important in that certain theoreticians of serial music take no account of it. When, for example, Henri Pousseur [2] speaks of the inexhaustible wealth of noises, as compared with the relative poverty of the notes chosen by traditional music, it is as though he were to try to place the rich variety of a baby's babbling (which includes every possible, imaginable sound the human organ is capable of producing) above the poverty of the phonological systems of, say, French or Chinese. Or as though he should compare the restrictions which human kinship-systems put on love, with the variety and freedom of an anthropoid ape's love-life. But the baby's babbling means nothing, and the love-life of the ape is completely anarchic – no social attitude is built on it. In the same way the inexhaustible wealth of noises cannot be transformed into a musical system as they stand.[3] So music must be relegated to the second category – that of articulate systems – and the question is: what rules govern these systems? Can we work out what they must be?

Theoretically the answer to this question must be sought in the science of communication systems in general, semiotics. But as yet semiotics only exists as a project, and for lack of it the best we can do is to turn to the most progressive and strict of all the 'humanities', linguistics.

In this connection, the example of Claude Lévi-Strauss' ethnology, with its wide scope, is encouraging – the more so since the founders of modern linguistics were well aware of the general significance of their discoveries.[4] Now, which of the doctrines of linguistics can be of use in the matter we are dealing with?

To begin with, it provides us with two very important and useful concepts: to put some order into the limitless variety of linguistic phenomena, they are considered from two complementary viewpoints, that of language (*langue*) and that of speech (*parole*).

Let me dwell on this for a moment, for this division is likely to be of further help, in fact, to clarify the concept of the time-dimension in music which has been much discussed recently.

This quotation from a work by a linguist, Troubetzkoi, will serve as a point of departure [5]: 'Every time one person says something to another, an "act of speech" takes place. This speech-act is always concrete, always takes place at one particular time and in one particular place. It presupposes one particular speaker (a "speaking subject" or "sender") one particular person spoken to (a "receiver") and one particular message transmitted, to which the act refers. All these three elements –

[2] Cf. 'Musique électronique, musique sérielle' in *Cahiers Musicaux*, 12th March, 1957, etg., p. 50 and *passim*.

[3] Cf. for example Claude Lévi-Strauss, *Les Structure Elémentaires de la Parenté*, particularly Chapter VII, 'L'illusion archaique', pp. 120, 121.

[4] Cf. for example Ferdinand de Saussure, *Cours de Linguistique Générale*, p. 35: 'If we want to discover the nature of language we must first recognise what it has in common with all other systems of the same order . . .': Also N.S. Troubetzkoi, *Principes de Phonologie*, p. 69: 'Above all we must introduce certain concepts which are of crucial importance not only to phonological opposition-systems but to opposition-systems of every kind'.

[5] *Principes de Phonologie*, pp. 1–3.

sender, receiver and content – vary from one act to the next. But an act also demands something else: for the "receiver" to understand the "sender", both must understand the same language and it is a necessary condition of every speech-act that there must exist a language which is alive in the consciousness of all the members of a language-community. Unlike the speech-act, which is always unique, language, or the language-structure, is essentially something general and constant. The language-structure exists in the consciousness of every member of a given language-community, and countless concrete speech-acts are based on it. On the other hand, the only justification of the language-structure's existence is that it makes speech-acts possible, and it only exists in so far as it is "realised" in concrete speech-acts. Without concrete speech-acts the language-structure would not exist. In other words, the speech-act and the language-structure each demand the other. They are inextricably bound up with each other and must be considered as the two sides of the same phenomenon – "language".

In the sphere of time this distinction between language and speech corresponds with the distinction between an 'irreversible time' (that of speech) and a 'reversible time' (that of language). ([6])

If we try to apply these ideas to music, we come up against a difficulty. What do the three elements of which speech is composed – subject ('sender'), listener ('receiver') and content (thing spoken) correspond to in the realm of music, since music does not deal with any objects outside itself?

But in reality this difficulty is not crucial: it disappears if, accepting that music is a language that signifies itself, we decide to consider these three things as being, in a certain way, inherent in music. Let us take a simple example, such as a two-part invention by Bach: here, once again, are the two sides of the dialogue, the two voices, the things they say – varying motifs – and the system (tonal, the rules of counterpoint, etc.). This is only a simple example, but any music could be viewed in this light.

This is exactly what I propose to do. When Henri Pousseur speaks of the 'project for a radical and unchecked irreversibility of musical growth' or Boulez speaks of the 'project for a totally asymmetrical music', they are only confusing the two levels, or rather, confining language (as expression) to only one of its aspects, 'speech'.

Using these concepts would undoubtedly clarify a certain number of individual ideas, such as those of the chord and the sound-block. Serial composers consider the sound-block as the opposite of the chord, whereas I am of the opinion that a chord is always a sound-block at the same time: If one speaks of a 'chord' (that is, of a system, a network of relationships) one is thinking on the level of language, if one speaks of a sound-block, one is thinking on that of speech. The same is true of the concept of the 'reprise'. I recall a lecture given by Michel Philippot some years ago in Royaumont. Pleading the need for continual novelty, Philippot reproached Webern for having introduced a reprise into his symphony op. 21. To which, if I remember rightly, André Souris replied that, since music is continually, irrevocably moving forward in time, a reprise can never be considered as nothing but a simple repetition. In music, he said, A is never the same as A'. I would say that on the level

[6] These terms come from Claude Lévi-Strauss.

of language, the system, A *is* the same as A', but on the level of speech it is not. But these two aspects are mutually implicit. That is to say, the repetition of A in the form of A' can only be felt as different within the dynamics of a work because A and A' are identical on the level of language. Only when things are identical at the language level can differences develop at the speech level, so that a movement, a growth, emerges.

If one tried to create absolutely irreversible music, one would in reality extinguish this movement. And the extent to which serial music tends towards this irreversibility – without of course ever achieving it, which is impossible by definition – is undoubtedly one of the causes of its monotony, its unsubtle character. This is only a 'summary indictment'; it must be developed further.

I shall now turn to another point and approach it by quoting again from Troubetzkoi: 'As the language-structure is made up of rules or norms, it differs from the speech-act in being a system, or rather several partial systems. The grammatical categories make up a grammatical system, the semantic categories various semantic systems. All these systems are of course balanced out, so that all the parts hold together, complete each other, and relate to each other'.([7])

Elsewhere Troubetzkoi writes: 'Since language is a system, there must be a close link between the grammatical and phonological structure of the language. Only a limited number of phonological systems can be linked with one grammatical structure'.([8])

Let us pause for a moment. Language is, then, a system of systems: and you will agree that the same could be said of the musical language. Now is the moment to return to a question which may seem a little obsolete today, but which still deserves closer examination, considering its theoretical implications. It is the well-known question of how far the serial principle extends to the various components of music (rhythm, intensity, modes of attack, timbres).

What does it really mean if the serial principle is generally applied in this way?

It means looking at the relationships between the various partial systems from a parallelistic standpoint, that is, according to the most primitive scheme there is. It means believing that the self-same principle governs each partial, separately handled, system. But the truth is that in a musical system, as in a linguistic or kinship system, the various secondary systems are normally arranged in much more complex relationships, in dialectical relationships of mutual implication, complementariness, compensation, etc.

The fact that these relationships have been considered exclusively in a parallelistic way, at least theoretically, and in practice also in many works, has had serious consequences, Serialism is tending to create a certain uniformity – a uniformity which is, moreover, the justification of its existence. Indeed, it was introduced to keep alive a certain unity, even a certain uniformity, after the collapse of the system of tonal relations in the musical language.

But this very uniformity at the level of the system of pitch implied completely different principles at the other levels, if a really rich and varied language was to be

[7] *Principes de Phonologie*, p. 3.
[8] *Principes de Phonologie*, XXVII.

evolved. And this is moreover what happened with Webern. I am thinking now of 'timbre'-melody, mirror-image, all the elements promoting symmetry and balance which play such a large part in his work. Conversely, the general extension of the serial principle must lead to the general extension of uniformity, which indeed occurred as early as 1950 in a work which had a profound influence on serial composers, Messiaen's *Mode de Valeurs et d'Intensités.* ([9])

Thus on the one hand the various partial systems are all taken from the one principle applying to the work, and on the other the various partial systems are seen as separated again. As Boulez says, 'the component parts are isolated'. In fact this is just another way of losing sight of the reciprocal implications, which can lead to new contradictions. Basically it could be said that any one duration-system can only be linked with particular pitch-systems, timbre-systems, etc., and vice versa. In a work like Stockhausen's Klavierstücke I-IV there are undoubtedly contradictions between the extremely subtle duration-proportions on the one hand and the continual changes of pitch on the other. They cause the continuity to be perpetually shattered; this shattering develops a rhythmic power of its own and tries to work against the perception of these subtle distinctions of duration.([10])

So far I have dealt only with general concepts. But structural linguistics is of great interest just because, unlike the majority of 'humanities', it has got beyond the stage of generalities. The emergence of phonology enabled it to point to specific systems, and describe and explain their functioning with exactitude. Thus it was able to draw up a chart of the phonological systems of a large number of languages and deduce general laws from it.([11])

It is worth dwelling on these phonological systems for a little longer. They make up the 'infra-structure' of the language, so to speak, and are composed of elements which have no meaning in themselves, but are essential to make meanings clear.

To begin with, it is clear that every language selects only a small number of the sounds the human voice can make; these then assume a functional significance within their language-system. Moreover – and here we come up against the distinction between language and speech again – we emit innumerable different sounds when we speak, though the majority of these distinctions are not appreciated as such. For example, I can pronounce the *a* in *pat* with greater or lesser clarity, harder or softer; but these differences are meaningless from a linguistic point of view, so long as the *a* is distinguishable from an *o* as in *pot*, for example, (this is what makes *pat* and *pot* into two different words with different meanings).

[9] Perhaps this will throw some light on Schoenberg's procedure after setting up the row. In returning to the classical forms Schoenberg testified to something he had dimly recognised: the necessity to compensate for the uniformity of the row by drawing on other principles.

[10] We have only touched on a very extensive problem which has already been the subject of a discussion between Pierre Boulez and Boris de Schloezer (cf. P. Boulez, 'Auprès et loin' in *Cahiers J. L. Barrault*, II, 1954, and Boris de Schloezer, 'Retour à Descartes' in *Nouvelle N.R.F.*, June 1955). This problem demanded further close study, possibly following the example of the researches into structure in various fields. Apart from works by linguists, the following should be mentioned: Claude Lévi-Strauss, 'La notion de structure en ethnologie' in *Anthropologie Structural* (1958) and, in connection with music, the works of C. Brailoiu.

[11] It should be remembered that phonology, unlike phonetics (the physiological-scientific study of the sounds of speech from acoustic and articulatory points of view) is the study of the sounds of language in so far as these are elements of a linguistic structure. Incidentally musicians should have an interest in working out a similar scheme of distinctions, as soon as they tackle the problems connected with electronic music. However, they would be wrong to imagine that technique and language are identical. The emergence of new instrumental possibilities is only one – perhaps necessary, but not all-sufficient – prerequisite for the emergence of a new language.

In this way every language is based, in the final analysis, on a phonological system made up of a limited number of elements which themselves have no value but only attain value by being contrasted with other elements. Hence the phonological system is a system of contrasts, relationships, and consequently it builds up a certain structure and hierarchy.

We are now dealing with concepts essential to the communication-system. It may be said that, basically, as soon as an exchange of differentiated values and meanings takes place between men, it demands the existence of a system composed of a limited number of elements distinguished from one another by certain features. To which it may be added that the constant distinctions between the elements are a necessary condition of the functioning of such a system as an instrument of communication.

Now to deal in turn with a few linguistic concepts which could have equivalents in music.

First there are the correlative concepts: 'phonological (or distinctive) opposition', 'phoneme', and 'optional variant'. Take, for instance, two pairs of words in English: 'so' and 'see', 'pose' and 'peas'. In each case the two words differ from each other because one has an o-vowel and the other an ee-vowel. Therefore the linguist would say that in English *o* and *ee* constitute a phonological distinction, in that they can serve to differentiate between the meanings of both words in each pair.

The terms of an opposition are called phonemes. As we saw above in connection with the distinction between language and speech, these phonemes can be embodied in the speech-acts in many different ways, which is of no importance linguistically, so long as the terms of the oppositions do not become confused; these are called the 'optional variants of a single phoneme'. Thus in English, French and German, etc., O and I or P and B constitute definite distinctions, but the gutteral R and the lingual R are only optional variants of the same phoneme. The reason for this is that in these languages there is not one pair of words which is differentiated only by the use of a guttural or lingual R. Therefore from a linguistic point of view the distinction between the two R's is not valid.([12])

The concept of the 'basis of comparison' is important in connection with the two sides of a distinctive opposition. 'An opposition demands not only features which distinguish the two parts of it, but also features which are common to both parts. Such features may be called the basis of comparison. Two things which have no basis of comparison, not one feature in common (like, for example, an inkwell and free-will) do not form an opposition ([13]).' Thus for instance the basis of comparison in the P - B opposition is that both are bilabial plosives.

Finally there is the concept of the 'safety margin (*marge de sécurité*) ([14]). We

[12] In connection with all this, cf. Troubetzkoi, *Principes de Phonologie*, p. 33 ff. We must stress two things especially: 1. that a large number of the phonological oppositions are relative to individual languages; in French and English, for example R and L are phonological opposites (road, load, rot, lot, rung, lung) while difference in the pitch of sounds are meaningless. In Japanese, on the other hand, R and L are not in a position to form a phonological opposition – they are variants of the same phoneme – but differences in musical pitch are used to differentiate meanings. 2. Each language admits only a small number of phonemes. The phonological system of Burmese, quoted by Troubetzkoi as being particularly rich, nevertheless contains only 61 consonants and 51 vowels. The majority of systems are based on no more than two or three dozen oppositions.

[13] Troubetzkoi, op. cit., p. 69.

[14] This term was coined chiefly by André Martinet. Cf. his *Economie des changments phonétiques. Traité de phonologie diachronique* (1956).

know that in speech a great number of variants of the same phoneme can occur. But it has been discovered that language tries to maintain certain barriers between the various variants of various phonemes, with the aim of avoiding confusion as much as possible and guaranteeing the maximum consistency.

Before we go a step further and examine whether these concepts can possibly be applied to music – one last parenthesis. If one starts comparing the different arts (for example, with regard to the problems with which each of them is confronted today) one point often remains unclarified, which would become much clearer if it were formulated anew. For simplicity's sake, let us take a comparison between music and literature.

We have already seen that, in so far as it represents an instrument of communication, every art is based on a definite system, an 'infra-structure'. This infra-structure is, broadly speaking, already laid down for literature, whereas music has to create one for itself. With literature the infra-structure (phonological system, morphology, vocabulary, syntax) is entirely built on the foundation of everyday speech. At the instant when the writer – Joyce, say, or Mallarmé – starts writing he does not have to worry about this infra-structure, which is outside his sphere of influence to a large extent. This is absolutely true of the phonological system and hardly less so of morphology, syntax and vocabulary. It is noteworthy that the boldest attempts to do anything along these lines – say, in Joyce's *Finnegan's Wake* – had absolutely no effect on the infra-structure and confined themselves to a mere elaboration or manipulation of what may be called the superstructure of language.

In other words: in so far as this infra-structure of spoken language is laid down, outside the writer's sphere of influence, communication is to a large extent assured and the writer has a solid basis to build on, so that he is freer at the superstructure level. He can concentrate on the quest for complexity, on examinations of form, and so on.[15]

The musician is in a completely different sort of situation. Music forges its own infra-structure, and we are living through a historical era when that infra-structure is being called in question. If the above exposition can be extended to another field, it could be said that present-day music is in a position comparable to that of a language which within a few decades has been deprived of its entire system of phonological oppositions; it is open to the chaos that such a situation threatens.

So the musician finds himself in a difficult position. He is always having to tackle, simultaneously, problems on the levels both of language and of style. Of course, this analogy must be handled with a certain caution; above all the question of 'complexity' has quite a different meaning for the composer from the one it has for the writer. Hence the forced, misplaced quality of the various invocations to Mallarmé which often occur in Boulez' theoretical writings. For this is a problem of a completely different type.

With these reservations, let us try to see what *can* be got out of applying the above concepts to music. It should not be difficult to find substitutes for these concepts in musical terms.

Take an example from the pitch-system – say the scale of C major in the tonal

[15] The barriers he comes up against are of a psychological and sociological, rather than a linguistic, order.

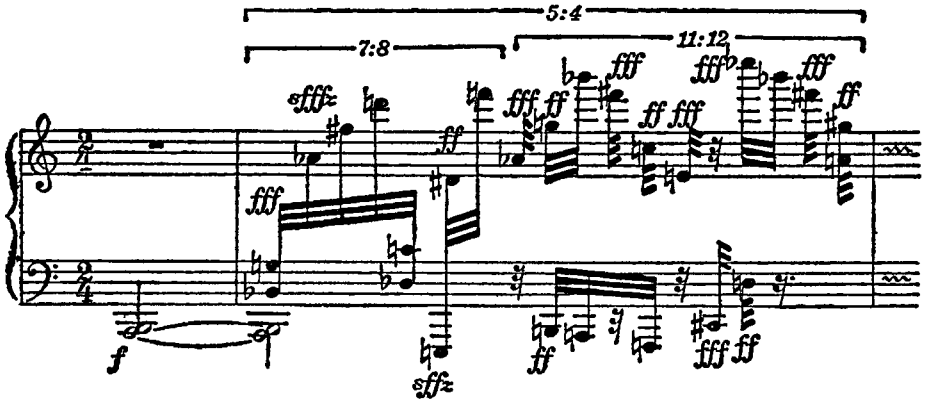
system. I would say that E and E flat, A and A flat, B and B flat are distinctive oppositions in that the presence of one or other of them is sufficient to alter the meaning of the tonal structure completely.

On the other hand, according to Brailoiu's studies, it would seem that in systems like the pentatonic and pre-pentatonic certain oppositions which seem to belong to the same type must be considered as the causes of either optional or combinatory variants of the same unit.[16]

There is just one important thing to be noted here: on the level of language the phonemes, or elements which serve to distinguish meanings, have no meaning in themselves. So we must draw a distinction between two different planes – that of phonemes and that of morphemes. But in music there is only one plane: the elements and the groups which these elements serve to distinguish partake of the same nature.[17]

Now, with these concepts to support us, let us turn to serial music itself. My examples are taken from Stockhausen's Klavierstücke I-IV. [18] First of all there are simply too many intentional oppositions, and on every level. The fact that there are too many oppositions results first in contrasts between elements which are too closely related for the safety margin to be sufficient: the distinctions between these elements appear optional.

Let us select an example from the angle of rhythms and intensities. In bar 6 of the first piece there is a note-sequence that juts out vigorously; it is in very quick values and *fortissimo*. It is written in 2/4, which is at first divided into five parts. The two first parts fill seven equal note-lengths (all written in demisemiquavers).



One demisemiquaver in the first subsection equals $^{2}/_{35}$ of the total duration of the note-sequence; in the second subsection one demisemiquaver equals $^{3}/_{55}$.

[16] Cf. Constantin Brailoiu, 'Sur une mélodie russe' in *Musique Russe*, collected edition, vol. II. P.U.F., 1953, passim. On the concept of combinatory variants, which lack of space has prevented me from defining, cf. Troubetzkoi, op. cit., p. 50.

[17] For a better understanding of the differences and similarities between music, language and other systems of relationships, a resumption of the discussion between Jacobson, Lévi-Strauss and Martinet published in *An Appraisal of Anthropology Today*, would be particularly useful. Cf. p. 283 ff.: 'On the cultural equivalent of the phoneme'.

[18] This is a particularly blatant example. I must repeat that these criticisms do not apply to certain recent works by Boulez and Stockhausen.

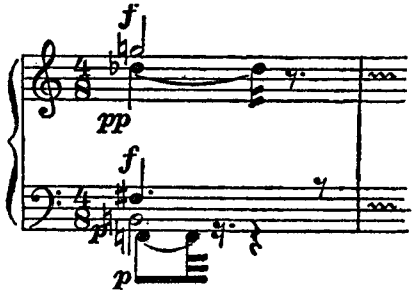
Since the whole thing takes place at a very quick tempo and *fortissimo*, at the changes of pitch which cover the whole range of the keyboard, the relationship between the two values is not perceived as the basis of a real distinctive opposition. At most one is aware of an *accelerando* extending throughout the whole sequence.

Moreover the differences in intensity do not coincide with the differences in duration, and in addition the safety margin is very narrow – a consequence of the arrangement of the intensities used: *ff*, *sffz*, *fff*, *sfffz*. And the result of all this is that the listener is barely aware of anything but a barrage of rather undifferentiated drum-fire.

On the other hand, there are oppositions whose two halves are too remote for any clear basis of comparison to emerge.[19] This applies to rhythm and the lack of any rhythmic periodicities which could provide some points of reference. But if very long values alternate with very short ones, it can happen that the listener does not perceive the exact relationship between the two. He only grasps more or less long, or more or less short, values.

Similarly (to take the question of pitch) it is questionable whether – once every hierarchy of a modal or tonal type has been destroyed and on the other hand changes of register are used without the economy or indeed the rigorism of Webern – the listener is still clearly aware of differentiated relationships between the intervals, at least from time to time, or whether he only hears more or less high or low timbres.

Once again, a relatively simple example from the Klavierstücke. Take the sound-block in bar 24 of the second piece:



It seems to me that on the whole this may be described as follows:

1. The listener perceives (a) the nuance-opposition between F sharp and G" plus *forte* on the one hand, and the rest (plus *pianissimo*) and (b) the fact that G" plus *forte* lasts longer than the rest.

2. On the other hand I doubt whether (a) even if this opposition can be effected by the performer, the listener will recognise it as significant; and (b) certain duration-distinctions (between F sharp and D flat) are valid.

There are contradictions between the various systems: the distinctions of intensity

[19] This is sufficient to show why the music of someone like John Cage – which, however one looks at it, should not be confused with the works of Stockhausen or Boulez – does not represent a language.

do not coincide with the duration-distinctions, which in this particular case adds to the difficulty of appreciating the whole as a differentiated entity.

Finally, this sound-block itself seems to be an optional variant of something fairly undifferentiated that could have been written in a different way. It follows that as soon as the desired relationships are not perceived music has entered the region of the undistinguishable – the kingdom of the 'more or less'. The relationships which can still be perceived are too rough, too summary, to constitute a language.

What conclusions can be drawn from these observations? For the time being – none. This exposé is much too brief and summary to be able to lay claim to any final conclusions. I prefer to suggest a line of research. The study of music must be systematically collated with linguistics and anthropology. On the basis of the principles indicated here a study must be made of a certain number of very different musical systems, in order to evolve a general science of music in due course. We have not yet reached this point.

Above all else Webern's oeuvre must be studied afresh. Hitherto every study of his work has approached it from a biased point of view, if I may so call it, even those which have undoubtedly contributed a great deal to our understanding of him. Webern has been seen as the creator of a new world and commentators have been inclined to attribute significance only to those parts of it which seemed to herald serial compositions, treating the rest as 'a survival from the past'. But this so-called 'survival' and the forward-looking aspects are two sides of an ordered whole, whose significance will only be made plain when its structure is examined without any ideological prejudices, from a purely synchronic point of view.

After Webern has been studied afresh in this way it will undoubtedly be easier to see how much his sensitive feeling for the problems mentioned marks him off from the musicians who succeeded him.

Finally I will venture on one – completely hypothetical – attempt at interpretation. Once again an analogy with linguistics gives us a lead. After linguists had demonstrated the variety and relativity of language-systems, they finally observed not only that certain formal principles were valid in all languages but that certain significant phonological oppositions also recur in every system. In this connection I would refer to an article by the linguist Jakobson, quoted in French in the appendix to the French edition of Troubetzkoi's *Principes* and entitled 'Les lois phoniques du langage enfantin et leur place dans la phonologie générale' (the phonic laws of the speech of children and their place in general phonology). Jakobson points out that certain oppositions recur in every language and for that very reason form the basis of the phonological systems. Moreover when children are learning to speak these oppositions always make their appearance in one particular order, always the same.[20]

[20] First there is the opposition between the most 'open' vowel, A on the one hand, and the most 'consonantal', the labials, on the other. Then the child makes sure of the difference between A, I and U (the 'minimum vowel system') and between the labial, oral and nasal consonants.

In general it seems to be the case that certain phonemes occur more commonly than others – not because they are easier or more 'natural' to utter, but because they reveal certain structural peculiarities which make them particularly suitable for language-treatment.([21])

One may well wonder whether, in the same way, certain pitch-intervals and rhythmic structures lend themselves more readily than others to the discovery of form-developments which are both differentiated and clear; only a study of music in general can give us the answer to this.

If this were so, the difficulties encountered by serial composers would be explained by the fact that, after depriving themselves of the simplest and most easily grasped types of relationships, they could escape chaos only by taking extraordinary precautions. This would explain Webern's brevity and economy: they would be due less to a quest for asceticism than to his attempts to come to grips with an unsafe, tricky system.

In this way it would become clear that it is not a question of judging the serial system by the light of the 'laws of nature', but only appreciating that its structural potentialities are limited and may already have been exhausted by Webern and a few exceptional works like *Le Marteau sans Maitre*.

[October 1958]

[21] On this subject, cf. Martinet, *Economie des changements phonétiques* with the concepts: 'good' and 'bad' system.

MUSIC, FORM AND PRACTICE

(an attempt to reconcile some contradictions)

HENRI POUSSEUR

No enquiry into the essence of the musical language can hope to make any progress unless it aims at more general, more basic criteria than the concepts usually associated with this language. It seems impossible to throw light on the meaning, origin and further development of a form (whether it be an elementary harmonic formula, the scheme which guides the complete working out of a whole series of pieces, or more particularly the work as integrally present) without paying some attention to the social conditions to which the form refers, and without evoking the relationships it creates between the individuals participating in the practice of music, and hence in bringing the form to life. An example will make this clear. As we are still most familiar with tonal music (at least of the *fully defined* musical systems), we will run less risk of making mistakes if we take tonal music as our example. So let us try directly to determine the ideology which governs the formation of tonal music (or which is consummated in it), the social structure with which among other things this ideology links tonal music (and which tonal music helps to 'materialise'). As will be seen, this will give us the least disputable reasons for its development and its progressive disintegration.

There is already need for a definition of terms: in dealing with the tonal language I am not thinking of any one work, and even less of what gives a work its unique, incomparable character (which makes it an undoubted masterpiece and constitutes its attraction for us). I am only thinking of what is *common* to the works of one age, the reservoir of current formulae. Accordingly I am aiming to determine the central, dominant image, the collective 'etymon' which polarises the ideological and linguistic stock-in-trade of this age, without perhaps ever being embodied, absolutely, in any one work (in addition it always needs a strange element, however small, the remains of an earlier ideological tendency or the seed of a future element, or one which is strictly individual and cannot be traced back to a collective dimension of the usual type).

This means to say that it seems possible to define the fundamental intention of classical thinking (and not only this but also musical thinking) as the projection of a representation (if not indeed a construction) of an individualistic, optimistic world, which for both reasons was a rationalistic world. Each formula governing the construction of many tonal works – on whatever level, in whatever dimension – expresses this one central tendency. Take, for instance, the perfect cadence. We are placed in a state of balance and presented with a carefully weighed form of the relationship between the things perceived; this in its turn is directly assimilated into the balance of our own consciousness, in such a way that it produces it and becomes its abode. Then suddenly this perfect 'harmony' is shattered and we are jerked into a state of crisis – a crisis of the relationships between us and things, a crisis of the central function that we thought we exercised amongst them. But this crisis is so constituted that it brings with itself the possibility of its being overcome.

Moreover, we already know how – by means of what new change – it can be settled. Of necessity we want this corrective development to occur. This continuously stimulated desire produces the tension and dynamic of tonal music. In short, after every possible digression (these only heighten the desire still further and make its satisfaction still more imperative) we are really brought to the point we longed for, and return to the balance of the beginning. It feels – even if only for a brief moment – more than ever like the fixed point of convergence.

The first thing to strike one is this: the balance and harmony presented to us are fictive phenomena; they would not exist in a non-human world. If I play a chord of the dominant seventh, it is obvious (although I may be tempted to imagine something of the sort) that *it does not resolve itself on its own.* These phenomena thus become reality only in a human, *social* world. Because human beings carry out certain processes which are necessary to make the things develop in this way, aural perception can use the ways mapped out. Here then, is a first, very easily grasped link between a certain musical form and the practical application that brings it to life.

From this we could conclude that tonal music helps to give society a harmonious structure, since within its sphere of influence individuals work together in such a way as to fulfil each other's wishes. But let us examine whether everything is really based on reciprocity, as it would appear. Why do musicians, above all executants, carry out the processes outlined above? To begin with, in the musical life of today the muscician is under two compulsions: the 'how' of the music is prescribed for him in a score written by the composer; and a concert-promoter (who himself only represents the public by whose tastes he must always be guided in some way) directs him to follow these indications in return for a fee. The performer – and he could, to advantage, be replaced by any well-oiled automaton; certain modern devices like the radio and gramophone, not to mention the juke-box, are not far from achieving this – is, above all, sacrificed to the will of the public, whose motives are not difficult to understand in view of the satisfaction they derive from it. The performer appears to be, to an equal extent, the composer's subordinate, but the latter's position is more equivocal. In so far as he is a contemporary (but remember that he is, by definition, a composer of tonal music), his actions too are motivated by the fact that he accommodates himself to a lucrative goal, a commission. The fact that he is not conscious of this state of affairs does not alter the case; we know how closely related the unconscious and the guilty conscience are. But was this also true of the composers of the past, those of the real tonal period? Did they not compose tonal works and build up the tonal language before they respected it (or nullified it) and for non-mercenary reasons? Could not a similar question be asked about the performers of this period?

First of all, it must be remembered that performers and composers were frequently no more than 'the prince's lackeys', as they have appropriately been called. In respecting the established language they were showing their master the respect owing to him and also conforming to the scheme described above (even when they secretly cheated it). The only difference was that the public of this pre-democracy era consisted of only a tiny number of people (but it is not an important distinction: the extent to which the public of today continues to give the orders in this way makes it into a princely patron, however democratic it may be).

Of course the system had its constructive stage of development. The musicians, often composers and performers at the same time, built it up not so much because the overriding authority, the prince, had commanded it, (unless indirectly, through the ideological pressure of the age) as out of the deepest personal conviction. This is only a superficial summing-up of a historical situation which would take a long time to disentangle. By and large it would be true to say that the formation of the tonal language was one of the offshoots of the formation of bourgeois individualism. At first it was a revolutionary opposition to the hierarchic, theocratic structure of feudalism (which had its own forms of musical expression, musical practice); then it was split by the Reformation and domesticated by the Counter-Reformation. At last it too solidified into a system (after the quest for personal *freedom* had been destroyed by a thirst for individual *authority*) and the basis of that alienation which the most clear-sighted thinkers tried to overcome.[1] From the moment when it completely stopped being constructive, every act of creative liberation was directed *against* this system. Mozart and after him Beethoven no longer conformed to it entirely; if the one dangerously distorted the elemental, metrical or harmonic rules of the language and the other went far in breaking up the schemes recognised as large-scale forms, was not this because above all they refused to submit servilely to a current system of oppression from then on? Is not this attack their way of making a determined contribution to the transformation of the world? And was it not accompanied by typical, non-musical manifestations? This refusal to conform to a social structure founded on unbridled individualism – expressed in its purest form in the exploitation of man by man – is justified even in terms of individualism: first and foremost they proclaimed their individual freedom against the subjugating demands of other individuals arbitrarily governing society. At that time this was the only possible way: for more than a century the crisis, which became even plainer, would always take the form of a crisis of individualism exalted to a high degree. There were to be continual reversals of the classical relationship of master and man, which would give rise to an increasingly marked lack of balance, and increasingly pernicious oppositions. Composers refused to bow to the demands of the public; and so their language became more and more hermetic. Unfortunately the public proved less ready to follow along the trail disdainfully laid for it by the composers. Conscious of what was happening to it, it finally reacted with violent impatience and repulsion against something it saw as opposed to it (viewed in this light the scandals over the *Sacre du Printemps* and certain works by Schoenberg are to a certain extent manifestations of obvious discernment). Although at a disadvantage because of their middle position, even the performers tried to work against the trend for their benefit. And then came the farces staged by virtuosi and conductors which finally robbed musical communication of the last shred of credibility which might have remained to it.

[1] This apparently superficial description of the actual musical language could be linked up with analyses in purely musical terms, but there is no room for this here. Perhaps the reader will think them out for himself.

This general state of conflict explains most precisely the famous breach or *gulf* which characterises 'musical life' during the first half of the century and which, as we all know, is still far from being bridged. Every work, every individual language of modern (or at least pre-Webern) music can be examined and interpreted from this angle. When, for example, Milhaud superimposes several melodic lines – in themselves very uncomplicated, but in different keys – he is expressing the musicians' refusal to go on working according to a synchronisation-scheme indispensable for the 'requisite' harmonic links. Of course this refusal is expressed symbolically: in reality the musicians, the performers, did not reject anything (except when they consciously consented to what they were made to say): they would always adapt themselves to the exact instructions on the paper. It was, rather, the composer who refused to go on making them say something he felt to be a fraud. Nevertheless it may have been thought (consciously or not – that is a secondary question) that it was essential for certain ingredients of the fraud (in individual parts, for example) to be retained in the interests of the manifesto's comprehensibility.

Viennese atonality provides another example of a 'criticism of the language' of this kind. It revolutionised the language's harmonic foundation, but allowed the contrapuntal, thematic, melodic and rhythmic systems deriving from it to remain in existence. In this way it revealed the alienation on which the whole structure was based. Once again certain layers of the heritage (of meanings) had to be preserved for practical reasons. Getting rid of *all* the manifestations of the old rhetoric at one blow would not have had such a power of provocation. In testifying to a *radical* originality, the forms disclosed would no longer have appeared to be distorted music, both offensive and offended against, but musical nothingness, total absurdity, not really worthy of notice.

Because he had dared to do this, Webern was even excluded from polemics, that last vestige of communication, and plunged into total isolation. Individualism had reached its zenith; the ivory tower seemed to be complete. Since, however, every bridge to the *ancien régime* had been burned, when people had become aware of its unsuitability, there was no way of breaking the vicious circle in which modern music was grinding itself to death, but by accepting and bearing this extreme isolation and apparent solipsism.

In reality Webern had already conquered classical individualism on the level of language. And it was this very fact which isolated him from a society which still enjoyed it. For his work to be revealed as the way out of this conflict all that was necessary was for society to gain access to the forms of meaning he created.

Above all the concept of time, the relationship of the consciousness to it, were definitely altered by Webern. Classical society thought of time as cyclical, always capable of coming round again; it thought of it as the transitory inflection of a perfect harmonious space. The keyword of this *intelligible* duration was necessity raised to the status of the highest good. From the French Revolution onwards this relationship began to be reversed. In the course of Romanticism, Post-Romanticism and Expressionism the – optimistic – conception of time gradually became more and more pessimistic. Time changed from *goal* into *destiny*. Necessity remained; but it no longer ruled for the benefit of the single individual (the artist

was becoming increasingly conscious of being 'maudit'). It no longer set up the consciousness as the highest good, as some kind of immutable harmony. Space itself, in which this harmony could have established itself, was caught up by the movement and drawn into the progressive, irrevocable decline. Admittedly, people still believed in a sort of golden age, which seemed to shine out at the beginning of time; it was this very nostalgia, the passionate desire to return to that time that made the age even more explosive. But these ideas went hand in hand with an increasingly strong realisation that the object of this passionate desire was unreal and that what had been lost was irreplaceable.

For his part Webern began by wiping out nostalgia and at the same time bade farewell to Expressionism. This is the meaning of his early works. Though time might run on perpetually, he paused and collected his thoughts. After spending a little longer meditating on time, which flees, and the past, which gets further away and disappears in the distance, he turned his attention to the *vacuum* which this departure leaves behind, and this second period of concentration enabled him to make a volte-face to a certain extent. Since all nostalgia had been eradicated, he turned from then onwards to the future, to pure, unused possibilities, and to the many new points of departure. This is the significance which time seems to assume in his last works, which open up a new, free area for simultaneous musical co-operation.

It cannot be denied that Webern's musical successors took this time-conception into account even in works of doubtful merit. (In fact, some of them took the idea of an absolute will, which they thought they detected here, to such extremes that in killing the possibility of the past's surviving in the present, they also killed the possibility of any future whatever). But on the plane of the dialogue and the concept of the *work* he is responsible for any possible originality of theirs in the new conception of time.

In the practice of Classicism the work was dominant, as the image of absolute space, of the harmonious world towards which the consciousness was aiming, the whole system of interchange of ideas. Musicians, above all performers, acted purely as middle-men: their efforts, which almost amounted to a ritual, were intended only to bring to life this eternally pre-existent mental region, so as to give listeners access to it and enable them to sink themselves in the prevalent harmony. And the composer's task was not so very different, in that his activity too, consisted of 'e-voking' a *beauty* for which he was not responsible, with which he was inspired.

With Webern, on the other hand, the work does not exist outside its 'actualisation'. At the same time performers, as 'actualisers', gain considerably in stature. But they still fulfil a mediating function – in that their playing, prescribed for them by strictly fixed scores, brings to life global structures answering the imagination of the composer: they guarantee an exchange between the composer, Webern, and the audience. The work itself has now taken up middle position; it guarantees reciprocal communication between the two sides. Every time a work of Webern's is played, you bring your own message to it. Paradoxically, this message, which concerns the relative emptiness of time, the partial availability of the future, and the – qualified – freedom of the subjects it deals with, is still expressed in the old

totality of 'production ratios': the freedom conceded to performers is extremely limited. Nevertheless, in the most discontinuous works, those of his last period, you feel (hear) that the performers are there (much more than in tonal music, which seems to perform itself), that they produce tones and meanings which *they* define.

This status for the performer, which had been accepted *de facto* from time immemorial, had only to be recognised *de jure*, and (after tentative beginnings to which we will return later) there developed the venture which has resulted in incomplete movable scores, left open to the inspiration of the moment. In these the work regains its original status. But it is no longer *above* 'musical society'; it is *in the middle of it*. It is no longer perpetually-ready-made, but perpetually-to-be-made, to be continued – and moreover collectively. Instead of being merely a means of communicating (a message worked out beforehand), it is now also a means of *co-operation*, accessible to all the participants involved in it. The composer provides a general programme of action; the performer, raised to the rank of an operator, an 'actualiser', is the person mainly responsible for the act itself and its quality. As far as the audience itself is concerned, it exerts a certain pressure on the performer by its mere presence, and it can be considered as more strongly committed, playing a different role from that of a passive recipient.

It would not be going too far to assert that the most recent music is an experimental area. One area among others – modest, limited, but nevertheless real. In it a new human community is trying to define itself, to assume a form.

But it should be noted that this form is of a *specific* nature. The human relationships defined by music have the very precise appearance of the *sonic* relationships which music develops. The only way of acting 'musically' is to 'activate' audial forms (for they are always *active* forms) and then reflect on this unique performance.

Hence the quest for a new *grammar* now seems justifiable, if by grammar is meant a definition of certain constants (to the exclusion of all backward-looking hopes for the language to crystallise) – constants which still, after they have been completely totally purified, seem to be valid for the significant articulation of time, and which apparently could only be ignored at the cost of losing all hope of significance.

This kind of plan coincides with that put forward in Nicolas Ruwet's article in this book. Since I am responsible for its inclusion here, perhaps I will be best able to approach it and get to the heart of its thesis.

Nicolas Ruwet reproaches serial music for its 'unsubtle' character. But surely he runs the risk of having the reproach (taken literally) flung back at him, or rather at certain aspects of his exposé. Is there not something a little arbitrary about the contrast he draws between post-Webern works in general and a few specially favoured examples – that he himself is responsible for picking out? Surely he should first of all have compared the works in these two categories, tried to find out what distinguished one from the other, how, and moreover why, the composers were able to progress from one to the other, whether the course pursued by this development was not progressive and full of ramifications – all of which could be very instructive.

Is there not a certain number of transitional works which should be examined and which tend to be passed over – as we shall see – without being noticed. An examination of the paths followed by the new research would have enabled him to prognosticate about future development, within the balance of probabilities, and make the criticism into something more constructive. Among other things, it would also have prevented him from drawing certain over-hasty conclusions, as for example that the structural possibilities of the serial system may be already exhausted. On the contrary, it can be shown, on the basis of the most concrete and pertinent sentences in Ruwet's article that we are still at the beginning of any adequate exploration of the system, that its real errors, pointed out above, stem from a misapprehension of its true powers, and the superiority of certain recent works from the fact that they have appreciated these powers better.

Nobody now pretends that works of the so-called 'pointillist' period did not suffer from a certain lack of differentiation. The composers themselves were the first to acknowledge it some time ago. The most clear-sighted of them also tried to get past this elementary stage quickly and find new ways of writing suited to their profound aesthetic intentions (which are still perhaps best defined by the word 'serial'). With the aid of these tools it should be possible to provide the duration of a musical phase with a high degree of variability, to increase, renew and distribute its 'information-potential' in each of its successive moments, so that it is able to attract the listener's attention, directly and permanently. The first (intellectual) tool that these composers forged for themselves was the concept of the *group*, which was contrasted with the *point* of the first period. As we know, a group is characterised by its global qualities, common to all its elements; these qualities distinguish it *en bloc* from neighbouring groups. This makes it possible to depict structural relationships – no longer only between isolated tones, but on more important planes, and arranged in order of increasing importance. In fact related groups can in their turn build up even more extensive structures, which again combine together to form higher entities producing the 'total form' of the pieces; this is fairly *simply* arranged so as to remain easy to take in. This then is a structural method *par excellence*. It is still undoubtedly in a state of development, and we are far from having exhausted its resources or determined all the conditions of its effectiveness.

Even Stockhausen's *Klavierstücke* (those of the first book, from which Ruwet takes his examples) derived from this method up to a certain point – represent a first move in this direction. It seems surprising, in view of Ruwet's thesis, that he did not turn to No. 4 in this collection. Owing to the way in which it is composed it startles the perception with its undeniably 'pointillist' attitude and gives evidence of fairly limited variability of densities. This is why it is the piece which *forces* agreement least and which, more than any of the others, asks for the listener's voluntary act of comprehension, to be carried out with perseverance. There can be no doubt that this does not only bring out a purely negative quality. Be that as it may, the other pieces reveal different priorities.

When Ruwet asserts that the rapid note sequence in the first piece conveys no perceivable duration-proportions apart from a slight *accelerando* extending through

the whole sequence, and that, considering the very small difference between the dynamic markings, 'the listener is barely aware of anything but a barrage of rather undifferentiated drum-fire' – he does not seem to have seen that in essence this is not a reproach. For this is undoubtedly a *group*, and indeed one of the best stressed groups in this piece – one of the groups best distinguished from what is going on around it. Elsewhere the alternation of groups intended by the composer comes off less effectively, owing to the use of a whole series of *medium*, in-between characters which are less distinct from each other. From several points of view this group is characterised by the invariance of its elements – or, to be more precise, by two 'invariables', *intensity* and *speed*, whose slight variations – cancelled out moreover by the fatal irregularities of performance – may, for all practical purposes, be ignored. As for the duration-proportions between the demisemiquavers of the two subsections, here we are really dealing with the ratio 22 : 21 – two thirty-fifths of the total length of a group. This would be a difference in the region of one two-hundredth of a second – not only impossible to perform, but completely impossible to perceive.

One, could, of course, object to the fact that Stockhausen noted down such insignificant and unperformable differences so precisely, thus causing a certain conflict between the way he wrote and the result he was aiming at, and making life particularly difficult for the performer trying to play these pieces. The dynamics could have been globally notated by the use of *one single* description, possibly supplemented by accents on particular notes; the rhythm-notation could have been simplified if, for preference, the whole duration had been divided up into eighteen equal values, with, in certain cases, the addition of a weak *accelerando*. But this is being wise after the event. In reality one can only say that, at a time when serial thinking was still preoccupied by a 'pointillist' and purely quantitive conception, Stockhausen's creative powers of invention were a long way ahead of it – not only of its *means of notation*, but also its compositional tools, the *theoretical* supplementary constructions of its thought. He was gifted with a very sensitive 'compositorial awareness'; in his work this conflict produced a dialectical movement which tended to counteract it.

So it came about that in the second cycle of *Klavierstücke* Stockhausen abandoned the so-called 'irrational' sub-divisions entirely and the dynamic specifications for each note to a large extent. He systematically explored the possibilities of the *accelerando, rallentando, diminuendo* and *crescendo,* and the various combinations of these fluctuations. The way his ideas are adapted to the *direct* action of the performer, to his specific, not mechanical, abilities, should be of the greatest historical significance. It led him to develop the methods on which *Zeitmasse* is based; this is a work to which Ruwet – quite rightly – attributes a decisive importance, though once again without showing precisely why he does so.

But it is just because of the 'more-or-less' concept which he attacks in such a negative fashion, that the mutation to which we today owe the possibility of such works occurred: the groups of a structure are sufficiently characterised, distinguished from each other (their 'phonological opposition' is guaranteed by a large enough 'safety margin') to be effective *on the plane of the 'large-scale form'*) despite greater

or lesser internal variation. In *Zeitmasse* they are then used to guarantee constant renewal of interpretation, to keep an adequate dose of unpredictability in reserve for each performance and make it something more than the mere repetition of a past action – a *real* act, *related* to a whole series of past acts. The concept of the 'optional variant', which one may be tempted to introduce, is only acceptable if it is divested of its character of invalidity and if one assumes that in music (as in spoken language no doubt) there exist various levels of validity – more or less general or limited and variously presented.

Ruwet's criticism of the sound-block in the second piece can be tackled in the same way. There is no doubt that here too we are concerned with a way of writing which is too abstract, too general, imperfectly adapted to the materials it is capturing. Since the inequality of volume of the various registers of the piano is assumed, it is difficult to convey what is written in the score to the listener with exactitude. But if the aforesaid formation of melody-components is given to wind instruments, for example, all becomes easy to grasp. Once again there is a superfluity of perfectly valid examples in *Zeitmasse*.

I shall take this opportunity of pointing out the difference between a chord and a 'sound-block'. Though it may appear unimportant when one is only reading a score, it is very important for the appreciation of the actual sound. I would say that in a sound-block the individual components can no longer be analysed by the ear, whereas in the chord they remain completely distinguishable [2] (for various reasons, such as harmonic structure, texture, duration, etc.).

There are of course intermediate phenomena, ambivalent regions, and we often find something that begins as an impenetrable sound-block being progressively transformed by the mere length of the operation into a harmonic constellation whose structure can be determined.

Consequently perception (the actual perception which can vary from one performance to another and is dependent to a certain extent on the listener) must be recognised as the final criterion of any analysis or criticism. This perception (which is perhaps only predictable within certain limits) is a global phenomenon extending over every dimension, plane and capability at the same time, and the critic should never forget – or let the reader forget – that he is only picking out various considerations and planes in the interests of methodical study for the time being, without ever losing sight of the indivisible reality which it is the one aim of his investigation to *illuminate*.

This brings us to the heart of Ruwet's criticism, which is based on a clear distinction (on the plane of verbal communication, but there seems to be an inclination to extend it to music too) between language on the one hand and direct expression (shouts, sighs, looks, caresses, etc.) on the other. Ruwet even applies this contrast to language itself, describing language (i.e. the stock of conventional signs) and speech (concrete, temporal speech-acts) as 'the two sides of one phenomenon – language'. The additional distinctions to which this dualistic concept led Ruwet – symmetrical oppositions such as wealth and poverty, reversible and

[2] But perhaps the word 'chord' should be banished from serial terminology altogether and replaced by less harmonically loaded expressions. Cf.: Henri Pousseur: 'Webern und die Theorie' in *Darmstädter Beiträge*, I.

irreversible time – have been seen. I shall do no more than bring out the hypothetical character of such an analysis and elucidate this by means of a few questions. Does not spoken language, when it is being spoken, include all the resources of direct expression? Is it not the forces released from it which make each concrete speech-act into something other than the mechanical utilization of a realisable capital possessed by a so-called 'language' (which would be static and reversible)? Is it not these forces which form the *style* of every real speech-act, whether it comes from Baudelaire or the grocer down the street (the style which manifests itself at every level – that of the 'phoneme', by means of intonation and deformation, that of the word, by means of choice and occasional invention, that of the sentence by means of types of combinations, etc.)? If one rejects a strictly functional view of language, is not this stylistic aspect as valuable for the complete understanding of the message, for any real participation in the dialogue? The linguists seem to want to show due deference to 'validity' only in the semantic connotation – i.e. in the sphere of mechanical speech-activity. They can then only use the 'expressive' and 'appellative' aspects as allegedly 'optional' variants for ones found invalid. But does this not mean that they are working at the level of a largely debased and unbearably a-poetic language which perhaps does not exist at all in reality? Whatever may be true in individual cases, readers will appreciate the difficulties that must arise if these concepts are used – at any rate unaltered – to elucidate the musical language.

Neither in music nor in the spoken language does the concept of 'language' have the constancy which linguists, to all appearances, would like to ascribe to it (basing their argument on a purely synchronistic analysis: but in the main they seem to have overlooked this). In passing may I point out that music, like spoken language, admits of *real* partners. These are the 'musical subjects' – in the present-day musical world the composer, the various performers, the listeners, and even the concert-promoter could probably all be woven into this close-meshed network of human relationships. Whereas the voices of a Bach invention only form a dialogue in so far as they are the relics of a real polyphony for several performers who enter in turn into relationships with one another. As to what the participants in the conversation talk about, I will confine myself to the reflection that they do not speak *about* something (in the sense that this statement could be presented separately, on its own), but *say* something which would not exist without this saying. Is this completely false with regard to spoken language?

Because of its uniqueness, every 'speech-act' – as it were, the new interpretation of a score finished long before, an interpretation which always fails to conform, to a greater or lesser degree, to the norms of the established written language – every speech-act contributes a new element to language, retouches it. As soon as a 'speaking subject' dips into it he modifies it as a whole, while modifying the borrowed elements a little by representation and wear and tear. Thus the time in which language is set is not in reality reversible. To the extent to which it is really time it too appears to be regulated. Only the pace of its development is incomparably slower than that at which concrete speech-acts take place. The one is the lifetime of the individual, the other historical time, the time-span lived through by the collective

as such. We are dealing then, with two overlapping development-tempi, and there are constant transitions and interferences between the two. This exchange between two durations, one subjective (but itself considerably sub-divided and also comprising as many branches as subjects) and one inter-subjective, is the substance of the perpetual dialogue which is what language is; and without language there would be no conscious, and therefore no truly human, activity. In the first place it is the dialogue of individuals who are together physically and, in order to tell each other things, have to develop collective forms of meaning and constantly renew them so as to renew their ability to convey information. But it is also a dialogue on a much more extensive scale, between all individuals in space and time who share in a common heritage of significance, by devoting themselves entirely to bringing it to life, deploying it. The individuals who spoke before I did established the co-ordinates of my own speech; and the modest but nevertheless real modifications contributed by my speech to the collective store will enter the speech of those who follow me.

So if the temporal *irreversibility* of language was taken for granted, this by no means implies that irreversible time was conceived of as a blind duration, a succession of non-memorable moments. 'Pointillist' music seems to have inclined towards this ideal for a short time (and John Cage explicitly claims it for his work, which thus represents an extreme case of pointillism, a catexogenic pointillism). But it was soon realised that the discontinuity established in Webern, which people had tried to make generally applicable, was in fact only a prerequisite for the total liberation of the traditional thought-schemes, which would above all make possible a transition to a new form of commitment adapted to present-day conceptions of the world and *time*. This conception of time would be determined by our recognition of the essential ambiguity of human existence. If time is not irreversible in the sense that its moments are thoroughly foreign to each other, this is because the contemporaneous always recapitulates the past to a certain extent, brings it into play again, contains it within itself. As something that is nevertheless *behind* me, that I cannot see, it remains present in the present; it is not outside the world in which I have to exist and is still accessible to my movement. However, time *is* irreversible, in that there is no such thing as the absolute space which classical society tried to imagine. If I return to a place I have left it is never identical with what it was before. What has happened in the interval – including my movement (in which is rooted my freedom, which cannot therefore be absolute) – has also modified the place. Admittedly the speeds of the modifications can vary, and some can be practically negligible measured by our standards. Only who can guarantee us against sudden tempo-changes of something that we only control so imperfectly?

(The question of the *reprise*, raised by Ruwet, should also be considered from this angle. The following brief indication must suffice: classical thinking tried to demonstrate the possibility of a re-presentation of the same thing, even when it was aiming at *variation*, while the new music, even when it is recapitulating something that has gone before, is chiefly concerned to demonstrate the relationship between occurrences which cannot be shown to be identical. This, of course, needs to be debated in greater detail and illustrated with examples; here too, it would appear, the concept of the 'basis of comparison' could be of considerable help).

So, as can be seen from the above explanations, language must be understood as the *totality of speech-acts and the various relationships between them*. This totality is (permanently) located in time – or, to be more precise, it constantly *produces* time, influenced by two apparently contradictory tendencies. The one is conservative and aims at making permanent, at crystallising abstract, general signs. The other is creative and aims at creating anew, inventing concrete, unique and directly comprehensible signs. You can see to what extent this concept makes use of the basic ideas of an opposition between language and speech – which in itself is considered too static – in a modified form. From this standpoint speech becomes a true original phenomenon in its own right. And since non-interchangeable meaning springs from the differences, the *distance* between particular speech acts, language is consequently – as a living totality, as a totality of living speech-acts – a system. Moreover *this* is the system the linguists are talking about: but this system is always incomplete, always open to the future. The dynamic character it has is at the bottom of the relative, limited, but nevertheless incontrovertible liberty of the 'speaking subjects'; it is also a result of that liberty. It would be idle to look for precedence in one or other of the driving forces of this reciprocal justification: they are strictly simultaneous. In this respect the language-structure would be only one form, one level of possible relationships between speech-acts, the totality of the relationships which past, *sedimented* speech-acts keep up between themselves and with the present state of the consciousness. Considered in this way, it can serve as a (provisional) basis of comparison for real speech, an (imperfect) implement for further researches in the sphere of inexhaustible possibilities. But it will be readily apparent that there is nothing definitely normative about it.

For the important thing is to reveal a world (a totality of relationships between men and those of men to 'nature') by means of language and to bring about its existence – a world which will always surpass what it can formulate, which always impinges on us, as this transcendence (whose weight, however, seems to be negative, more like a vacuum), and which therefore will always stimulate new definitions.

This seems to dispose of the opposition between the 'poverty' of the linguistic systems on the one side and the 'wealth' of the unsystematised forms of expression on the other. If it is true that the 'real' can be selected and 'arranged' then it will be found that it only takes place with its *realisation*. Order is not sought for its own sake, any more than a selection is made on account of the specific virtues of self-denial. Both 'moments' only serve to create communication between men themselves and between men and the world, and this communication should be as alive and rich as possible.

The validity of the attempt made by electronic music to include all sound-phenomena in the sphere of music should not be called in question because the fundamental phonological laws are recognised. If, in order to penetrate into the consciousness with the maximum of plausibility, these 'raw materials' must first be *composed*, that is selected and arranged with a view to a certain effectiveness of the reciprocal elucidation, at least the arrangement-systems can today be considerably refined, so that they are capable of integrating 'all the sonic riches of the world'.

In connection with this last, one thing should always be borne in mind: there are only riches in the world in so far as we recognise them, they are always riches *to us*. But there is no recognition without definition – that is, language. If we stake our claim to 'all the sonic riches of the world' it is because we already contain them in a way, because we have already begun to assimilate them. The only remaining ambiguity resides in the fact that audial phenomena spring from several different levels of reality. For example the 'noises' which music has been trying to incorporate in its stock of raw materials, have hitherto belonged to the sphere of nature or everyday reality. But to the extent to which the project for their inclusion in musical expression is actually being put into practice (for we have some idea, if a vague one, of the modalities of this annexation) they are being freed from these naturalistic implications and are already subject to the power of original meaning – connections which are only to be grasped aurally. The acquisition took place under *musical* auspices.

This is to say: I do not deny that either this first stage (and all the following stages of the founding of a new and very comprehensive 'phonological' system appertaining to the present-day musical language) or the previous, contemporary and later stages of the formation of this actual language (in reality they are always contemporary with the treatment of the 'material') did not call for a highly methodical consideration of the conditions of their greatest effectiveness. In this connection Nicolas Ruwet's criticism remains the most valid and can give us valuable information, if first its ideological bases are discussed and made plain.

The conclusive criticism of the separation and afterwards independent (and *isomorphous)* treatment of the various dimensions of the note, the *parameter,* can be approved without further discussion. From the angle of this pertinent criticism, works such as *Le Marteau sans Maitre, Zeitmasse* and *Gruppen* attain the status of reference-values just because their composers had got past this analytical stage of serial theory, recognised the *methodological* value of parameter-analysis, and pledged themselves to the necessity of making a special study of the relationships which link the parameter structures. Perhaps an example from my own work (since one is most familiar with this) will show that composers have come to terms with this problem *consciously*.

The ninth (last but one) section of the *Mobile pour Deux Pianos* bears some similarity to Stockhausen's Klavierstück XI. Unlike the tenth section, which was relatively incompletely 'composed' (the 'composing' should be completed during the performance), but whose course is nevertheless indicated precisely, the structures in the ninth section are indicated in full, while there is greater freedom as to the course which brings them together.

Here let me describe exactly how the material is presented. Each pianist has in front of him a folding album consisting of three pages. On each page three structures are written, one above the other. First he has to play any one of the structures on the first page, then any one on the second, then any one on the third; then he must begin again and repeat the series of operations until the nine available structures have all been worked off. It is obligatory for one of the two pianists to begin and when he has reached a certain point in his first structure he gives the

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other pianist the sign to start; when this one has finished one he gets the starting signal from the other pianist to begin his own second structure, and so on. When the second pianist has reached his ninth structure he gives the first the signal to start the next section – the tenth and last, which he then begins himself.

In this ninth section I was faced by the following compositional problem. On the one hand, so that each choice of a structure should produce a meaning, each of the nine structures open to each piano should have its own physiognomy.(3) But on the other hand, since each structure may be superimposed on any one of six others on the other piano (three in the first part and three in the last part), it must be compatible with each of these, despite its difference of character. For example, at no time must one of the two pianos completely mask the playing of the other.

This problem of balance was solved in the following way. The character of the structures, their global character (to be made clear by the writing) was to be determined by five parameter-dimensions: height, dynamics, speed, density (number of notes struck at one time) and 'morphology' (the effective length of the notes, independent of the speed with which they follow one another: or, in other words, the kind of touch and pedal used). There were only two possible positions left for each of these parameters, on account of the 'safety margin', a *minimum* and a *maximum* (the low registers of the piano have more sonority than the high ones; they can last longer, so they were reckoned as the maximum for the pitch-arrangement), extreme positions; between them by and large the ratio 1:4. In addition it was decided that to three dimensions in the maximum there would always be two in the minimum: when, from one structure to another, a dimension changes from the maximum to the minimum, this 'energy loss' must be compensated for by a reverse modification to another dimension.(4)

In this way *ten* combinations are possible; since *nine* of them were needed, a different one of them was eliminated from each piano part. It was placed in the middle of the album of the other piano, while the eight common characters were variously distributed to each of them (in such a way that the partial overlapping of two identical characters was still possible, but this could not occur twice in succession).

In concrete terms; low single chords played *forte* will be *staccato* but they will be *tenuto* if *piano*. On the other hand low isolated notes are always *forte* and *tenuto*, and they are not repeated in the high register. They can only become *staccato* (=*secco*) provided that they multiply and form quick groups, for the rest they remain *forte*; the groups may only be played *con pedale* again if they assume the intensity *piano*. Changing over to the high register, these quick note-groups become *forte* again, while they continue to be *con pedale*; played secco, they are transformed into chord-groups (averaging four notes each), still *forte*, but if they should be played *piano* they are once again pedalled; on the other hand they may be played *secco* and *piano* provided that they transfer to the lower register. Finally, there are also single chords in the high register, but simultaneously *forte* and *tenuto*.

[3] The total form of the ninth section, which results from the totality of the successive choices, to a certain extent determines the way in which the pianists realise the tenth, whose text, as aforesaid, is left relatively hazy.

[4] Structures of different minima-maxima-proportions recur in other parts of the work, where they fulfil various functions, while they are founded on these nine more or less perceivable relationships.

It is easy to imagine these characters (which because of the 'safety margins' and 'bases of comparison' existing between them form real 'distinctive oppositions') can produce when they are superimposed: they always stand in the reciprocal relationship of *transparency* to each other.

Since this method reveals other, more general advantages, apart from its practical efficacy, exploited here in a movable dialogue, it can be generalised. The concept of *total energy* resulting from the various parameter positions could provide theoretical serial thought with a supplementary tenet not to be despised. Two main co-ordinates of variation could be defined: the one, horizontal, would only consist in the interparametric interchange of an invariable total energy (which is why approximately equivalent 'transformation-thresholds' will have to be established for all parameters, a completely direct evaluation!) The other one, vertical, would consist of modification of the total energy itself. Nevertheless the 'horizontal' co-ordinates can only be taken as an 'upright' if one is only working with two parameters. If there are three they must be thought of as 'two-dimensional' and a group of more than three parameters requires us to conceive of the musical development in areas of more than three dimensions. Within areas of this kind there are straight, diagonal, curved and other modifications, and it would be of the greatest interest to determine the *information-degree* of these various transformation-types, together with their combinations. Once again, of course, this is only possible on the basis of a *context* – that is, by taking into consideration the *temporal* sequence within which these transformations take place. Here a knowledge of electro-acoustics (briefly acoustics and the laws governing the formation of sound-waves) points the way to thought-patterns which could be of some use and which could also be included in a kind of generally applicable 'wave theory'.

If in the course of a note-sequence such a parameter changes position, if it strays from a maximum to a minimum and then returns to its original position, this is really a wave, and it can be treated like sound-waves, those swift variations in air-pressure. Several successive waves indicate certain relationships between them. The maxima and minima they attain are not necessarily identical. In the simplest case a symmetrical variation of the two extremes takes place; this can be defined as the *amplitude-modulation* of our wave-sequence and itself forms a new wave subordinate to comparative relationships above it. Or again the minima and maxima may vary independently; this would be the *middle-position*, the *zero-position* defined by them, which oscillates and occasions a new type of modulation. On the other hand, durations of the different waves can also vary, and this gives us a *frequency-modulation* which acts with the two aforementioned more or less structurised relationships. Finally, the modifications either progress continuously in both directions (sinoidal oscillations) or else consist of a sudden modification in one direction and a progressive compensation in the opposite one ('saw-tooth impulse'), or else occur as brusque, two-way modifications which interrupt a more or less long-lasting pause on the maximum and minimum ('rectangle-impulse'), or lastly form one of the numerous transitional conditions of simple models and can include minor changes, irregularities (which may be considered as partial oscillations of a basic oscillation). This fact about the modifications allows us to speak of a *spectral* or

phase-modulation, whose effective use at all levels of musical composition can easily be imagined.

Nevertheless the various modulations of which we have just written, and their interaction according to the definition given at the outset only affect one parameter-dimension. The various dimensions stand in the relationship of *inter-modulation* to each other – the relationship which led us to the concept of a 'resultant energy' which we developed above. Thus it is possible to define a *phase-coincidence* and a *phase-difference* between the modulations belonging to each parameter. We know what conclusions can be drawn from this in connection with the reciprocal strengthening or neutralising of energy. The result of this higher co-operation takes effect at every stage of the listening process, from the inner structure of the note to the large formations which make up the total form of a work – by way of the amplitude-modulation perceivable as such (the 'repeated notes' are only one of its special cases), the frequency-modulation or *speed* (most commonly as 'rectangle-oscillations') and all the stages of the alternation of groups and conceivably, possible groups of groups. Moreover we have seen that this co-operation (which becomes even more refined when the musical process is divided into several *polyphonic strata*, independent of each other and similarly intermodulated) takes place in an area of n dimensions. It can, therefore, be considered as the total *information-potential* characteristic of any given work.

I am quite sure that an analysis from this angle of works such as *Zeitmasse* and the *Marteau sans Maitre* would bring out some extremely remarkable – and frequently very different – phenomena. If carried out with sufficient discernment it would register the realities of perception most accurately. Moreover an analysis of 'pointillist' works based on this method would reveal the reasons for the *discrepancy* felt when they are performed. And if this type of analysis were applied to works of the *transition*, such as the second of Boulez' three first *Structures* or Stockhausen's *Kontrapunkte* it would finally show that the composers, by becoming increasingly aware of certain regularities of perception and adapting themselves to them better and better, paved the way to a kind of musical communication with more power to produce its effect – but without in the least abandoning the emancipation with which the creation of the original pointillist group had provided them.

I spoke of 'regularities', for in all probability it seems that the mechanisms that interplay when meaning is perceived can quite generally be considered as predictable. Admittedly they work together in a constantly varying manner, according to the 'constellation of subjects' to which they are adapted, but it seems possible to define certain constants. But it would be pointless to revive the old nature-*v.*-mind quarrel: another of the pairs of alternatives which deserves to be disposed of! Man never creates outside nature, *ex nihilo*, or even *against* it, but with reference to it – that is, it is owing to nature that he acts at all. But what he creates would not exist without him. Take an electric light: everything which goes to produce it is present in nature – electric energy, heat – or the mechanical energy which it produces, raw materials through which this production can be brought about, others by means of which energy can be stored, transmitted and transformed into light: all that had to be done was to select and process these elements to produce light. Only the combination leading to discovery had to be invented. In science and technology at least, invention and discovery seem to be strictly synonymous. Is not the same thing true in art? In order that important energies of this kind can actually make an effect on our perceptions is it necessary for us to do more than choose and combine those forms and materials which allow the energies to emerge? Here too the world in which we live already contains the potential riches which we have to call into existence, apparently by virtue of our vocation, although otherwise we would never even know that such treasures *could* exist.

This brings me to one final question raised by Nicolas Ruwet. He questions the validity of a comparison between present-day relationships in music and literature. Certain of my rectifications to his argument will already have given a glimpse of how I consider it possible to approach this comparison. Let us take this problem lower down. First of all, is it true that even a writer like Joyce did not have the slightest effect on the 'infra-structure' of spoken language? Does this mean the phonological structures on which the languages used by him are based? In itself does not the combining of various languages, the incessant introduction of rather unorthodox spellings which occasion two-sided or even many-sided ambiguity also effect a phonetic inter-fluence with an expressive or appellative function? It constitutes a grave risk to the content – distinguished as 'semantic' – of the aforesaid languages, while considerably narrowing down and resolutely damaging the famous 'safety margins' on which their (well named!) safety depends. By constantly drawing on onomatopoeia, by its real generalisation, does not Joyce attain a direct expression, a concrete meaning, which brings his language (a deliberate language, as pure, unique and unfragmented as it is possible for a language to be) close to contemporary musical discoveries – and indeed on every plane?

Even if one accepts the subordinate position of phonetics, whose insufficient powers of expression and flexibility Mallarmé explicitly bemoaned, surely there is in the latter a sort of higher onomatopoeia on the level of the sentence and compound forms which does not so much try to imitate existing noises or transcribe aurally phenomena which are perceived (in the narrow sense) with other senses, but rather uses its movement to give information about the movement by which we adapt ourselves to the world, by which we perceive it (this time in its broadest sense), that is, reduce it to a formula, give it a 'form-for-us'. On the plane of this operative dynamic, surely there are – if not parallels – at least true similarities, links; surely one can trace relationships with operations carried out with different materials and in another milieu. Surely Mallarmé opens up new territories, whose secret was also possessed by Debussy, and surrounds us with a silence also known to Webern. To the consciousness that evaluates them the various deeds of man are by no means partitioned off from each other so that it cannot grasp the fact that they are constantly reflecting each other. Here more than in any other matter, of course, one must beware of any schematising isomorphism. But with this reservation can we not – perhaps – base our greatest hopes for the art of today on communication of this sort between the different fields?

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METAMORPHOSES OF MUSICAL FORM

GYÖRGY LIGETI

A general new feeling for musical form seems to be emerging, despite the not inconsiderable idomatic differences in the works of the various 'serial' composers. It is irrelevant to consider whether this is the result of research into the serial ordering of the musical material, or whether the serial manipulations are themselves the consequence of the new idea of form. Technique and imagination influence one another in a constant interchange. Every artistic innovation in the craft of composition ferments the whole spiritual edifice, and every change in this edifice demands constant revision of compositional procedure.

Relations of this sort have always urged us on to metamorphoses in the way we work. The modifications of pitch, once seemingly insignificant, in the modal framework—at first a mere sharpening of individual leading-notes—led to the formation of functional harmony, together with the whole architecture of periodic forms and their specific world of expression. In the craft of composition this process led to techniques of modulation and development that undermined and finally ruined the periodic forms themselves, and the leading note—which had spawned the tonal system—then condemned it to extinction by annexing to itself more and more of the harmonic and melodic activity.

But the newly installed chromatic republic stood in need of its own legislation. The which having been supplied by Schönberg's 'composition with twelve notes related only to one another', the serial principle—originally set up only for the dimension of pitches—sought to spread itself over the totality of form. This led to the discrete quantification of all parameters, and the music became a product of superpositions of pre-fabricated arrangements. In this way the musical structure acquired a 'pointillistic' character.

Hard on the heels of the serial organization of durations, intensities and timbres, came the expansion of the method to cover more global categories like relationships of register and density, distribution of various types of movement and structure, and also the proportionalization of the whole formal sequence. Considerable adjustments in compositional planning now came into play: as the larger form-categories came under serial control, the serial ordering of the elementary parameters became looser and looser. A strict determination of these took second place in the total composition, and this again put a new complexion on the form: the concept of 'pointillism' was extended to embrace 'statistical fields' (1).

The serial arrangement of pitches, which had initiated the whole process, was the first thing sacrificed in this shift of emphasis (2). Disintegration had set in here even before the 'statistical' phase of serial technique, in fact during the period of composition with series of fixed elements.

Within this disintegration we can distinguish various 'destruction-types', as follows:

1. The individual character of the various serial arrangements fades as a result of

[1] Cf. Kh. Stockhausen '. . . how time passes . . .' Die Reihe 3, p. 10.

[2] Cf. Luciano Berio: 'Aspetti di artigianato formale', Incontri Musicali 1, Milan 1956, p. 62. Berio writes expressly of the 'superamento della sensazione di serie di altezze focali e di intervallo a favore di una sensazione di qualità sonore e di registro, considerando questi ultimi gli elementi attivi e determinanti della struttura formale'.

the superposition of several horizontal series, in which, wherever possible, common notes occur at the same pitch. Such interweaving obscures the single serial threads, (especially when all the parts are played on one instrument), and the resulting intervals have little or nothing to do with the original arrangement. Where such a procedure is coupled with series of durations the composer can hardly even retain an influence over the intervals that are to result, let alone determine them. They follow automatically from the type of procedure. In this way the pitch series loses its last remnant of function, paralysed by the emerging complex. This situation is especially typical for the early stages of integral-serial composition, particularly for the case of composers—Boulez amongst others—who tend to think in terms of horizontal layers([3]).

> Self-propagating automatisms of this kind evince a relation of indeterminacy, and the structural contexts are of necessity subject to this. For the degree of indeterminacy of the structure increases in proportion to the number of directives that are issued, and vice versa: in proportion as a composer worries about determining the result, he finds he can determine less and less about the order and relationships of the elements. It is essential to recognize this contradiction, if one is not to be entirely at the mercy of the arbitrary dictates of compositional 'craftsmanship', for it has its roots deep in the peculiar nature of the serial conception of musical material. When this is recognized, it is of course a personal matter for the composer how he regards the situation: should he allow the form to follow from pre-stabilized elements and schemes of organization, fully aware of the risk he runs of virtually allowing the result to slip through his fingers? Or should he take the other path and progress from a total vision into particularities, accepting as part of the bargain the fact that he will have to sacrifice any number of attractive and, in themselves, logically developed details?

2. The character of pitch-series is weakened by the increasing preference for homogeneous sequences of intervals, particularly the chromatic scale. Stockhausen in his 'Klavierstück 2', for example, instead of a fixed 12-note series, uses various permutations of the notes of sections of the chromatic scale.([4]) The basis of Nono's 'Il canto sospeso' is the series A, B-flat, A-flat, B, G, C, F-sharp, C-sharp, F, D, E, E-flat. At first glance this poses as an all-interval series, but it can be seen to consist of an interpolation of two sequences of semitones in contrary motion([5]). Finally, in his 'Cori di Didone', Nono has chosen the chromatic scale itself for his raw material; this is really no longer a series but simply a regulator to ensure an even distribution of the 12 notes. The vertical disposition of this material results in a piling up of neighbouring tones. It is no longer primarily the intervals that constitute the structure but relations of density, distribution of registers and various displacements in the building up and breaking down of the vertical complexes. From the point of view of 'traditional' 12-note composition, this technique would doubtless be regarded as an impoverishment. But seen in the light of the requirements of integral-serial composition, this accusation misses fire. Nono's attention is concentrated mainly on the construction and dismantling of piles of layers (which represents in a way a macroscopic projection of attack and decay processes that are not usually analysable by the human ear), and in this context a pitch-series, however artfully constructed, would have been no use to him at all—it would have gone astray and succumbed in a network of structures such as these.

3. The succession of notes becomes subject to a higher ruling, which has the prerogative of altering—to a greater or lesser degree—the original series of pitches. This state of affairs can be observed in Stockhausen's 'Gruppen für drei Orchester'. In this composition, the individual groups are characterized in various ways, among others by the specific ambitus of the sounds involved. The limits of the ambitus in each case are determined by a higher order series. The ambitus is a feature of the group as a whole, whereas the succession of pitches is executed discretely with the entry of each note; consequently the requirements of the pitch series are compelled to accommodate themselves to the larger, more comprehensive order. If the ambitus in question covers an octave or some larger span, the 12-note series is of course not threatened, because only the registers of the notes are influenced. But if a group is required to fit into a span of less than an octave, then the series suffers a compression; its elements tend towards identity with each other in proportion as the span is narrower. The original series can, it is true, be retained in its proportions if electronic means of sound-production are employed, or if intervals smaller than a semitone are available (as they are with instruments of the string family). But with even temperament (the division of the octave into twelve equal parts) the original series is inevitably destroyed.

4. The function of the pitch-series is grafted on to other parameters.F or example, in Pousseur's Quintet for clarinet, bass clarinet, piano, violin, and cello, the basic 12-note series—borrowed from Webern's Saxophone quartet Op 22 in homage—is shorn of its function simply by filling out each interval chromatically. The pitch-series has been transformed into a series of densities([6]).

5. Any pre-formation of pitches is completely abandoned in favour of serial depositions of a higher order. Among other things, this step enables us to reassert our sovereignty over intervallic relationships. This can be observed in Koenig's Wind Quintet, for instance. However paradoxical this state of affairs may seem, it is logical: the 12-note method, created for the purpose of allowing a compositional control over the intervals, has to be liquidated in order that the same control can be exercised in the changed situation.

Taken as a whole, this tendency (outlined in the above points) leads to an erosion of any intervallic profile. (The possibility mentioned in point 5 is an exception). Sequences of notes and vertical complexes of notes are for the most part indifferent in respect of the intervals of which they are composed. Concepts of 'consonance' and 'dissonance' can no longer be applied: tension and relaxation are surrendered to the statistical properties of form, e.g. relationships of register, the density and weave of the structure([7]).

Pousseur documents the growing impediment of the intervallic function by regarding major sevenths and minor ninths not as fixed relationships of pitch but as 'impure octaves'([8]). Note that the octave is taken as the comparative measure([9]). In the midst of the general erosion this interval seems the least affected. In any case, our sensibility regarding the octave is rather negative; the interval is generally shunned—a well-

[3] Cf. Gy. Ligeti: 'Pierre Boulez—Decision and automatism in Structure I a', Die Reihe 4, p. 36ff.

[4] See L. Nono: 'Zur Entwicklung der Serientechnik', Gravesaner Blätter, Mainz 1956, vol. 4, pp. 17-18.

[5] Cf. U. Unger: 'Luigi Nono', die Reihe 4, p. 12. A transposition of the same series serves as the basis of the 'Varianti'. (Cf. R. Kolisch: 'Nono's Varianti', Melos, Mainz, October 1957, p. 292 ff).

[6] See H. Pousseur: 'Outline of a Method', die Reihe 3, p. 50 ff.

[7] The tendency towards melodic and harmonic indifference has its roots firmly planted in 'traditional' twelve-note composition. See Th. W. Adorno: 'Philosophie der neuen Musik', Tübingen 1949, p. 49 ff.

[8] Cf. Pousseur, loc. cit., p. 54, and G. M. Koenig: 'Henri Pousseur', die Reihe 4, p. 23 f.

[9] The octave performs this special role already in Webern's music. H. Eimert points out that 'Webern achieves spatial tension by, so to speak, knocking in his acoustic objects right at the edge of the octave-gaps'. ('A Change of Focus', die Reihe 2, p. 34).

developed idiosyncrasy even in the days of traditional twelve-note composition[10]. There are several reasons for this: on the one hand, the discrepancy between the melodic breadth and reach of the octave and its high degree of harmonic fusibility—i.e. its lack of harmonic tension—is disturbing, and on the other hand the octave's overt relationship of overtone to fundamental advertises too plainly a tonal and hierarchical connection, and this makes it appear a foreign body in a context that is not tonal[11].

Sensitiveness on this point leads to the practice of fixing the register of individual recurring tones, and preferring unisons to octaves. Despite its close relationship to the octave, the prime position (unison) has completely different properties: it is free of the contradiction we mentioned between the harmonic and melodic dimension, and is free of tension in both directions; and because in itself the unison presents no overtone-relationships—apart from the spectra necessarily produced by specific instruments—it cannot be suspected of defaulting back into the tonal sphere.

In dense textures we are not so allergic to the octave; progressively less so as the texture becomes more and more difficult to 'hear through' (in the sense undergrowth is difficult to 'see through'). In a particularly complex pile-up it is hardly possible to distinguish the individual intervals; octaves cannot be recognized as an individual shape, and consequently no longer disturb us. This explains the use of octaves in the denser passages of Stockhausen's 'Gruppen', to take a familiar example.

Our decreasing sensitivity to intervals gives rise to a condition which, for want of a better word, we may call 'permeability'. This means that structures of different textures can run concurrently, penetrate each other and even merge into one another completely, whereby the horizontal and vertical density-relationships are altered, it is true, but it is a matter of indifference which intervals coincide in the thick of the fray.

Permeability has not in the past exerted any great influence on form; nevertheless it was not entirely unknown in earlier musical styles.

Palestrina's music had perhaps the lowest degree of permeability; simultaneous parts had to fit into each other in a manner prescribed by unequivocal laws. The high-degree determination of the various possibilities of combining intervals would not tolerate the slightest confusion in the structure, and as a consequence of this the handling of consonance and dissonance was most sensitive in that school[12].

The tonal music following this was also fairly impermeable, although much less than the harmony books intended for school use would have us believe. It is well known that the hierarchy of functional harmony permitted a certain freedom in the treatment of passing notes and suspensions occurring simultaneously since, as a consequence of cadential connexions, the attention was directed more towards the role of these subsidiary notes in relation to the harmony notes. Particularly where simultaneous parts are strongly contrasted in timbre—as voices and instruments, strings and wind, solo instrument and accompaniment—the music can well tolerate small harmonic impurities, and slight delays and anticipations in time. In such cases the intervals relinquish some of their sensitivity about conflicting with each other; the higher order

[10] See H. Jelinek: 'Anleitung zur Zwölftonkomposition I', Vienna 1952, p. 47 ff.

[11] Works in which the octave plays an important part in the construction, as in 'Nones' by Berio, do not weaken this assertion. The use of octaves is legitimized by over-emphasizing their role. (Cf. P. Santi: 'Luciano Berio', die Reihe 4, p. 99).

[12] See K. Jeppesen: 'The Style of Palestrina and the Dissonance' (2nd ed., London 1946).

regulator is more important, i.e. the functional progression of the harmony. This permeability increases considerably in more complex structures; there are places in Bach—in the Brandenburgs, notably the first Brandenburg, and in many choral works with instrumental accompaniment that is rich in figuration—where the functional interval-relationships are retained, but where the individuality of many single intervals is lost in the general harmonic field of the complex figurative texture.

This is only one of many historical examples. Similar points could be made with reference to the mediaeval motet composers, the heterophonic folk music of certain areas, the music of non-European cultures, the music of Debussy, and many other spheres.

Of necessity, serial structures possess a different sort of permeability; the historical state of the material is after all a different one. Statistical-serial regulation is however slightly reminiscent of traditional systems of control, as for instance the system of figured basses.

The high degree of permeability of many serial structures has decisive formal consequences:

1. It makes possible the mobility of individual shapes—this mobility is in direct proportion to the size of the field in question—and this effects a loosening of the temporal flow. For its part, this loosening now permits the simultaneous control of activity in various different tempi, as in Stockhausen's 'Zeitmasse' for five wind instruments.

2. The interpenetration of different structures gave rise to those specific forms that are concerned with the superposition of several layers that are different in quality. In electronic compositions such a method of construction is inspired by the technical conditions of the process of realization, i.e. the necessary procedure of producing individual contexts first and later synchronizing them. However, even the instrumental works of almost all serial composers show a tendency towards 'layer-composition'. The overlapping groups in Stockhausen's cited work for three orchestras[13] and many of Pousseur's methods[14] are examples chosen at random from a varied host. Koenig's 'Zwei Klavierstücke' are an example of the purest layer-composition; the form is completely ruled by this procedure. Separate layers of various different types of configuration are pressed together into a simultaneous activity, smelted together as it were by the uniform timbre of the piano. The final form is thus a product of interferences amongst the originally heterogeneous shapes. This method of work is related to that of weaving simultaneous series together, as, for example, in Boulez' 'Structures'. In this latter case, however, the individual layers were simply single horizontal threads of notes, whereas in the Koenig piece it is a matter of complex prefabricated textures, folded into each other according to a higher order plan.

High permeability and insensibility to intervals are even more essential features of the music of Cage and his circle, although this music proceeds from quite different points of departure. Cage has written pieces which can be played either on their own or together with other pieces. The separate pieces of music thus become layers of a larger whole, which, though more dense than its constituent parts, is yet not different

[13] Cf. Stockhausen, loc. cit., p. 24.

[14] The reader's attention is drawn to Pousseur's remarks (in the article already quoted) about 'Polyphonic density' as one of the compositional parameters. His Quintett is conceived almost entirely in layers. (Cf. loc. cit., p. 52).

in principle. The indifference of such structures—which are the result of chance manipulations—is closely related to the indifference of the automatic products of early serial music.

This indifference shows a tendency to spread beyond interval relationships to other musical dimensions. Now that hierarchical connections have been destroyed, regular metrical pulsations dispensed with, and durations, degrees of loudness, and timbres have been turned over to the tender mercies of serial distribution, it becomes increasingly difficult to achieve contrast. A flattening-out process has begun to absorb the whole musical form. The more integral the preformation of serial connections, the greater the entropy of the resulting structures; for—in accordance with the relation of indeterminacy mentioned earlier—the result of knitting together separate chains of connexions falls victim to automatism, in proportion to the degree of predetermination.

Let us take an illuminating analogy: playing with plasticine. The distinct lumps of the various colours gradually become dispersed the more you knead the stuff; the result is a conglomeration in which patches of the colours can still be distinguished, whereas the whole is characterized by lack of contrast. Knead on, and the little patches of colour disappear in their turn, and give place to a uniform grey. This flattening-out process cannot be reversed. Similar symptoms can be discerned in elementary serial compositions. The postulation of series means, here, that each element should be used with equal frequency and should be given equal importance. This leads irresistably to an increase of entropy. The finer the network of operations with pre-ordered material, the higher the degree of levelling-out in the result. Total, consistent application of the serial principle negates, in the end, serialism itself. There is really no basic difference between the results of automatism and the products of chance; total determinacy comes to be identical with total indeterminacy. This is the place to seek the parallelism (mentioned earlier) between integral-serial music and music governed by chance (John Cage). The following is characteristic of both types: pause—event—pause—event—pause, etc.([15]); naturally the events are variously structured and the pauses have different durations but the more differentiated the individual events and caesuras, the more evident becomes the levelling-out process in the result. This is a consequence of the fact that increased differentiation in the separate moments is only possible at the expense of the differentiation of the whole.

At the same time however there are tendencies at work in opposition to the levelling-out process that we have been describing. They result from the dissolution of the elementary serial organizations, which stands in direct and mutual relation to the levelling-out process. The primitive stage to which composition is relegated by automatism will only be supported by musicians who succumb to the fetish of total integration, and debase musical form to a simple arithmetical game, thus preparing the way for an imitative academicism that is certainly no better than the traditional sort. Adorno's negative diagnosis may well apply to such musicians (but not to the élite who pursue their thoughts further([16])).

It is only possible to take adequate measures against the levelling-out process when predetermination and chance are kept within bounds, i.e. when the highest possible

[15] However it is perhaps noteworthy that the pauses in Cage's music are generally longer than those in serial structures.

[16] See Adorno: 'Das Altern der Neuen Musik' (The ageing of new music), which appeared in the book 'Dissonanzen', Göttingen 1956, p. 102 ff.

degree of order is sought by means of decisions made by the composer in the process of composition. This is the only way in which a composer can work out individual, unconfused characters, and write music that is not content with the cheap function of being a more or less pleasant wallpaper-pattern in sound.

The possibilities of organizing such an order and defining such musical characters are available where the weight of serial composition has been shifted onto the global categories that we mentioned earlier. The total form is serially guided, but the individual moments are, within given limits, left to the composer's discretion([17]). 'Musical office-work'([18]) is thus thrust back into its proper place, where it fulfils its function in general planning. It ensures a control of the emerging form in its general shape, but raises no claims to being the work itself. The formal function of this sort of serial 'programming'([19]) corresponds approximately to the modulations, cadential progressions and connected methods of articulation in tonal music. But here the planning is non-centralized and non-hierarchical (as opposed to the case of tonal music) and the controlling directives enjoy equal rights and even distribution in the determination of the form. The network of serial connections stands in the same relation to the form as do the genes in the chromosomes to the emerging organism.

When such a procedure is adopted, the compositional labour divides into two successive phases:

1. Serial preformation of the global determining factors.
2. Filling out by detailed decisions the network of possibilities that is the result of the first phase([20]). The desired characters can be worked out by postulating or avoiding certain specific constellations([21]).

A form conceived in this way, free of the rigid static quality of automatic products, can be handled with great flexibility, and this makes possible the composition of transitions. An example: in his 'Gruppen' Stockhausen was in a position to compose, besides passages of homogeneous instrumentation—passages for strings alone, brass alone, percussion alone—passages of various degrees and mixtures, in which the transition from one dominant timbre to another was never a linear transition but always a transition proceeding by serial dosages. Stockhausen succeeded—with his specific ranges or ambituses, his statistical mobility-resultants and his group-densities—in typically characterizing the individual regions of his composition. These typical characteristics counteracted the otherwise general effect of the pulverization of the durations and thus maintained and articulated the form.

[17] Several composers have given expression to these ideas in their theoretical articles, and despite their differences in orientation, they show remarkable unanimity. See the quoted articles by Stockhausen and Pousseur in die Reihe 3, and also 'Alea' by Boulez, which appeared in the 'Darmstädter Beiträge zur neuen Musik', Mainz 1958, p. 44 ff.

[18] We are indebted to Antoine Goléa for this term.

[19] H. Eimert: 'The composer's freedom of choice', die Reihe 3, p. 7.

[20] Cf. Pousseur, loc. cit., p. 67, second paragraph.

[21] This idea is similar to one developed by Boulez in his article 'Alea'. However I cannot agree with his intention of making the network of possibilities submit to a method of 'guided chance'. Any latitude achieved by the loosening of the network should not be thrown open to chance but submitted to further, ordered decisions, as I said before, with the aim of reducing the entropy of the structure to a relative minimum. It is a deceptive fallacy that the design of the resulting form can be left to the interpreter in the form of 'freedom'—as is the case for example in Stockhausen's 'Klavierstück XI' and Boulez' Third Piano Sonata. The interpreter is given a set of more or less finished building blocks, and finds himself in a confusing position: he is supposed to be helping with the composition, but cannot escape from the circle of possible permutations that has been circumscribed by the composer. All possible 'interpretations' have in fact been envisaged by the composer—and if not, then so much the worse for the overall form. In any case there is no genuine freedom of interpretation, simply a manifold *ossia* form (however much Boulez would like to defend himself against this view in his article).

The lay-out of the broad fields of distribution was such that it allowed the one-movement piece to extend to a length of over twenty minutes—a non-thematic construction can hardly expect to bridge a longer time-span than this.

This sort of higher-command serial planning was also responsible for those zones where specific intervals dominate, in Stockhausen's second cycle of piano pieces, in Pousseur's piano pieces and in Koenig's Wind Quintet. This recapture of the field of intervallic composition is by no means a regression; the intervals are not used hierarchically, they conscientiously abhor any tonal function and are used simply as group-characteristics, similar to densities and types of movement. When, in one of the pieces mentioned, a particular interval appears particularly prominent, it happens statistically, i.e. in every moment it is quite possible for other intervals to put in an appearance, but one interval simply occurs more often than the others and thus provides a specific tag for the group as a whole.

There is one question that can hardly be avoided when discussing this 'freer' phase of serial composition: if the serial determinations have been removed to the sphere of global categories of form, and only lay vague claim to the control of individual moments, why then must we have serial manipulations at all? Wouldn't it be possible to leave the form completely to the discretion of an unrestricted imagination, both in its general flow and in all its details?

The falseness of such freedom can be demonstrated by pointing out the atavism of pieces that are actually composed in this way. In our present situation it seems that the only way to ensure an economy in the use of material and a continuing sensibility towards such questionable factors as repetition and periodicity is to provide a pre-formed network of choices and limitations. Paradoxically, it is possible to compose more freely in this way than one can when one's imagination is totally unrestricted([22]). It is difficult to predict what metamorphoses in the method of composition the future holds in store for us, and many aspects appear in a different light to different composers. Not only are we the captives of our historical constellation, but our conceptions of this constellation differ widely.

Nevertheless, it is surely permissible to indicate various tendencies that are possibly coming to the fore:

1. The weave of serial pre-stabilization seems to show further signs of loosening up. It seems even to approach a state of fluidity, in that the relation between the pre-formed plan of control and the form that proceeds from it is no longer fixed and unequivocal; the musical realization seems rather to have a constant feed-back effect on the control plan itself. The serial draft loses in this way its quality of being a binding pre-formation, but remains valid in so far as its elastic contours are retained. A method of composition —and with it, a form—will only free itself from automatism and dependence on home-made material, when at every moment the composer has the possibility of taking a decision that will alter the future course of the piece entirely([23]). The degree of surprise in structures such as these would be very high indeed. Something unpredictable might appear and suddenly capsize the form. The form's integrity could only be preserved if the 'surprises' were not inorganic, not merely external disturbances, however. Such heterogeneous happenings should have the faculty of influencing each other back and forth, thus making it possible for gradual transformations to take place as well as sudden mutations([24]).

2. Serial manipulation particularly of durations leads to certain internal contradictions which make it seem necessary to deviate considerably from the serial order. The problem is, that the longer a duration-interval is, the more dominating its effect, for in the series and all structures proceeding out of it only one shortest duration is available to counter-balance the longest. The longer durations take up a larger proportion of the total time taken by the series or structure than do the short ones, and the longer the long durations are, the more obviously is this the case. This is the cause of the generally slow average tempo that characterizes most pieces conceived in a serial way([25]). The fact that the longer durations dominate destroys the 'non-hierarchicalism' that serial organization is trying to establish. Various means have been adopted in an attempt to counteract this undesirable situation:

(a) Splitting up the serially pre-ordained intervals of duration. (In this way Boulez enlivened the rigid time-organization of his 'Structure 1 b', for example, by shoring up the serial technique with Messiaen's method of 'rhythmic cells'. Stockhausen practised a method of sub-dividing the fundamental durations according to various combinations of harmonic 'formants'([26]).

(b) Destruction of the original serial duration-proportions by means of a superposition of several layers with varied disposition of the durations. (This was mentioned earlier in connection with 'layer-composition'.)

(c) Alteration of the duration-proportions by means of a control-system of higher-order time-relationships, or 'tempi'. (This method has been very widely used and can be observed in the work of almost all serial composers).

(d) Substitution of serially ordered changes of speed for some or all of the fixed durations. (This procedure, mentioned earlier in connection with Stockhausen's 'Zeitmasse', is one of the most fruitful fermenting agents in the loosening-up of serial rigidity. It not only encourages a departure from a state of rigidity, it also enables the technical peculiarities of the various instruments to be functionally exploited. The fact that variations of speed cannot be so precisely determined as fixed duration-proportions means that interpreters have to react directly during the performance, and the live music experiences an inrush of warmth and subjectivity([27]).)

Since all these methods inescapably result in the destruction of the original fixed pre-determination of the durations, and since they do this in a round-about way *via*

[22] 'The very freedom which he sought becomes chaotic and if it is not limited all work loses its point'. (P. Boulez: 'At the ends of fruitful land', die Reihe I, p. 29).

[23] The beginnings of this method can be found in Pousseur's concept of 'checking'. (See Pousseur loc. cit. particularly p. 47).

[24] I attempted to realize a similar formal idea in the first part of my orchestral piece 'Apparitions'.

[25] An analogous case is demonstrated by Stockhausen in connection with sub-harmonic series of durations (loc. cit., p. 13). The argument holds good, however, for all sorts of series of fixed time-intervals, so long as the elements have not been split up.

[26] Stockhausen, loc. cit., p. 17.

[27] This nourishment may be very salutary, but the consequences should be regarded critically. An uncomfortable situation arises because the measurable is being pushed further and further towards the 'estimable' (using the word in its literal sense), for either the performance no longer corresponds with the notated text, or else the composer—for the sake of this correspondence—introduces something vague into the notation of his music. Thence it is but a short step to a notation that no longer directly describes what the sound should be, but merely indicates—in a sort of tablature—what actions the player should execute. Such a metamorphosis of musical notation is bound to have an effect on the substance of the music; the form is in danger of being degraded from its status as a plan of sonorous contexts and situations to that of motoric activities, and we call this a degradation because these actions had originally as their sole function the production of sound. The music is then a by-product, and less important for the player than the motoric aspect of sound-production, while for the audience the visual experience (watching the actions) is the more important. From the music's point of view this seems like a devaluation, but it can be very effective aesthetically if it is understood to represent a shift into another artistic sphere. This art-form approaches that of pantomime.

higher-order control-systems etc., the question suggests itself whether one shouldn't take hold of the elementary duration-relationships themselves, and instead of practising corrective therapy, transfer the moulding of the temporal flow of the form directly into the composer's hand. This step would necessarily break through the serial postulate of equal frequency of occurrence for all duration-values. Irregular distribution of the elements on a statistical basis could then take the place of fixed series.

For example, in the first part of my orchestral piece 'Apparitions' I used a repertoire of durations (intervals of entry) with values attached to each element such that the product of each duration-value and the number of times that it occurred in the whole structure was a constant. By this means an equilibrium of intervals of entry was achieved: the shorter a particular duration-interval, the more frequently it appeared in the context, and so many short durations were used for every long one that the sum of the short ones equalled that of the long. Later this repertoire could be used directly, by means of an adequately chosen—serial—dosage, for the composition of the horizontal density-relationships. And this without recourse to higher-order tempi or superposition of layers and their automatic consequences([28]).

It must be admitted, however, despite the fact that by this means we have succeeded in excluding another rudimentary trace of a hierarchical system, that the essential nature of the serial principle itself has here been called in question. But, as mentioned earlier, the serial principle has already been called in question, irrespective of the case just cited. 'Serial Music' is doomed to the same fate as all previous sorts of music: at birth it already harboured the seeds of its own dissolution.

3. The function of shaping the form, which was once restricted to individual melodic lines, motifs or chordal shapes, has been handed over in serial music to more complex categories, such as Groups, Structures or Textures([29]), and, because of this, the way these are woven now takes over a very eminent role in the compositional design. It is possible to distinguish various 'aggregate-conditions' of the material. One can see most clearly how such conditions articulate the form in compositions where the diverse types of 'weave' are accompanied by considerable differences in timbre and density, and are thus even more clearly differentiated. In Stockhausen's 'Gruppen', for example, the backbone of the form is given by contrasted types—hacked, pulverized, melted, highly condensed—and their gradual transformations and mixtures one with another. In this method of composition it is vitally important to pay attention to the available degrees of permeability. The two extreme types enjoy exceptionally good mutual permeability: a dense, gelatinous, soft and sensitive material can be penetrated *ad libitum* by sharp, hacked splinters. Their mutual indifference is so great that the layers can get considerably 'out' in time, and enjoy fields of inexactitude of considerable

[28] In my electronic piece 'Articulation' I used a similar principle of distribution, with the following difference however: here, the product of the individual duration values and their frequency of occurrence was not a constant, but changed according to the different kinds of texture that are used in the piece. The result is that the specific average density varies from texture to texture. Obviously one can set up numerous other statistics of distribution, depending on the specific ideas one has about the work one is composing,

[29] With the word 'structure' I intend to refer to a differentiated kind of material in which the separate parts can be discerned, a construction that can be regarded as the product of the inter-relationships between these separate parts or details. The word 'texture', on the other hand, refers to a more homogeneous, less articulated complex, in which the constituent elements can hardly be discerned. The difference between the two words can be characterized thus: A structure can be analysed in terms of its components; a texture is better described in terms of its global, statistical features.

latitude. It is this peculiarity that enables the three orchestras to play together despite the fact that they are widely separated in space: the points of entry for each orchestra are generally fixed, but in the further course of a group the orchestras can diverge to a greater or lesser degree, without any damaging effect on the general result ([30]). 'Soft' materials are less permeable when combined with each other, and there are places in Stockhausen's 'Gruppen' of an opaque complexity beyond compare.

In my electronic piece 'Articulation' the aspect that occupied me most was the composition of the mutual effects exercised by these 'aggregate-conditions' on one another. First I chose types with various group-characteristics and various types of internal organization, as: grainy, friable, fibrous, slimy, sticky and compact materials. An investigation of the relative permeability of these characters indicated which could be mixed and which resisted mixture. The serial ordering of such behaviour-characteristics served as a basis for the erection of the form. In the detail-work I attempted to obtain contrast between the types of material and between the modes of amalgamation, whereas the over-all plan was a gradual, irreversible progress from the heterogeneous disposition at the beginning to the complete mixture and interpenetration of the contrasted characters at the end.

A compositional method that concentrates mainly on conditions of the material inevitably brings with it associations with visual and tactile sensations. Here we have an unambiguous case of that 'pseudo-morphosis to painting' described by Adorno in connection with the music of Debussy and Stravinsky([31]). Electronic music necessitates a relation between the composer and his work that decidedly favours this condition: the production of directly sounding material that can be heard over and over without the slightest variation once it has been realized, brings pieces composed in this way into the neighbourhood of the products of the plastic arts. 'The composer is simultaneously the performer . . . In that he has a direct control over the quality of the realization, the musician takes on a function similar to that of the painter'([32]).

> Indeed, the pseudo-morphosis of painting to music is equally observable. It is present in the half-abstract art of Paul Klee, and is particularly pronounced in non-objective works, primarily in the non-geometrical abstract painters working today. Situations that were previously regarded as the specific property of the musical sphere are now being presented visually. One remarkable fact is that painting and music come closer and closer together the more they regard themselves as 'autonomous' and think they are producing 'pure forms'.([33])

However, besides these associations, there is another important factor in the current musical situation which is also responsible for the pseudo-morphosis to painting, and that is the seeming conversion of temporal relations into spatial ones([34]). The course of the form is no longer experienced as a 'process of congestion and relaxation, but as a juxtaposition of colours and surfaces, just as in a picture. The succession of events is a mere exposition of something that in its nature is simultaneous; in this way, in

[30] Cf. Stockhausen loc. cit., p. 25 f.

[31] In 'Die Philosophie der Neuen Musik', p. 125-126 of the quoted edition.

[32] Boulez, loc. cit. in die Reihe 1, p. 19.

[33] The closest point of contact between music and painting is manifest in those compositions by Earle Brown that can be viewed equally well as pictures. In the case of a musical interpretation the time-axis is interchangeable with the vertical axis of density (or intensity) and pitch. (Cf. H. K. Metzger: 'Just who is growing old?' Die Reihe 4, p. 73).

[34] Adorno exposes the origins of this tendency; they are detectable in Debussy and Stravinsky, yes, even in Wagner (loc. cit, p.p 123-125).

fact, one's glance wanders over the canvas of a painting'([35]). As opposed to this, the individual moments of hierarchic-tonal music were not restricted to maintaining their mere 'presence', they also included the 'just past' and at the same time pointed forward to the immediate 'future'. That they were able to do this was a consequence of the —historically conditioned—'cadential' successive ordering of the harmonies. The music was, thanks to this faculty for embracing the immediate future, able to negotiate points, as it were, and even fork off into several parallel lines of events, but the formal course of the music was limited to a single direction of movement in time. The onward flow of the music was further protected by the generally even pulse of the music's metre. If unexpected events did occur—as for instance interrupted cadences or sudden modulations—they would immediately be confronted in the hurrying imagination of the listener with the hoped for and expected, not experienced as any hesitation in the flow of time, but rather as a diversion or branching off, always of course in the same direction as the general current. This sort of successivity gave an aura of logic to the tonal forms, hence their 'similarity to language'.

Schönberg, despite his radically new filling-out of musical substance, was concerned to preserve the empty shell of the developing forms, and in this way he considerably delayed the process which we shall refer to as the 'spatialization of the flow of time'([36]). But this process could no longer be held back when all the remains of the hierarchical forms had disappeared. Webern's music brought about the projection of the time-flow into an imaginary space by means of the interchangeability of the temporal directions, provoked by the constant reciprocity of the motivic shapes and their retrogrades (it seems here to be a matter of indifference which is regarded as the original shape). This projection was further strengthened by the 'grouping round a central axis, which implies a conception of the time-continuum as 'space'([37])', and by the fusion of the successive and the simultaneous in a unifying structure. However, this 'space' is not yet quite 'timeless', even though its unfolding in time can no longer be compared with the flow of the developing forms. Webern's structures seem, if not to move forward in one direction, at least to circle continuously in their illusory space, driven by the strength of the intervallic tensions and shifting accents.

In the rigidity of Messiaen's *Étude* 'Mode de valeurs et d'intensités' even this remnant of dynamism is banished. Integral-serial composition was born under the sign of the totally static; there are few pieces in which this application is so extensively executed as in the Sonata for two pianos by Goeyvaerts—the earliest example of total-serial music—or in Boulez' 'Structure I a', for example([38]). This music is like hanging carpets of mighty oriental quietness, because the forces that drive on the flow of the form have been de-activated([39]).

[35] Adorno loc. cit., p. 123. Cf. also Koenig Die Reihe 4, pp. 14-15. Koenig there indicates the fundamental difference between the space of the plastic arts and the—imaginary—space of music: in painting and sculpture space is a given physical condition, whereas in music the illusion of space is produced only by the passage of time.

[36] The fact that many of our present musical avant-garde—amongst them Boulez—consider Debussy more 'topical' than Schönberg, although the musical idiom of the former in its totality belongs to an earlier historical phase than does that of the latter, can be explained by just this tendency towards spatialization of time, which is much more manifest in Debussy than in Schönberg (Cf. Boulez: 'The Threshold', Die Reihe 2, p. 40).

[37] Eimert: 'A Change of Focus', die Reihe 2, p. 35.

[38] 'Rigidity' and 'static' are not meant as negative categories at all. Complete stillness may seem strange to one who is exclusively conditioned by our Western tradition, but this can form no basis for a value-judgement.

[39] There is nothing so very strange about the fact that Cage arrives at a similarly static result by means of a procedure that is apparently diametrically opposed to it, namely chance manipulations. It merely backs up everything we said earlier about the correspondence between totally organized and totally unorganized composition and their common tendency towards non-differentiation. Incidentally Cage's relations with things oriental seems much less mannered than similar attitudes in European composers, although in his case too it is an importation.

There are other tendencies in the shaping of time that do not paralyse the flow of time itself, but do succeed in completely dissociating it. In the literary or pictorial field they can be seen to correspond with the manipulation and interpolation of events (and thoughts) in Joyce's 'Ulysses', or with the 'temporalization' of space in Picasso's 'simultanistic' paintings. The musical-historical roots of these tendencies can be traced as far back as Beethoven, as for example in the remarkable coda to the first movement of the piano sonata 'les Adieux', where the phrase of horn-notes and the echoes of this phrase slide into one another, closer and closer. The simultaneous presentation of things that are only expected in succession—in this case the dominant and the tonic—has the effect of a sudden, bewildering entanglement in the flow of time; at least it does in the tonal forms, in which—as is well known—the successivity of the harmonic functions is strictly regulated. The famous premature entry of the horn before the reprise in the first movement of the Eroica is a similar example; the horn strikes up the theme in the tonic, while in the accompaniment the flow of the cadence demands that the dominant hold sway. This mixture of functions, so violently shocking in a well-ordered tonal context, has been generalized by Stravinsky in his technique of *montage* and made to seem quite tame. This represents a loss of strength; nevertheless, the constant iridescence of this sort of cloven time—which forces one to hear the harmonic connections 'crooked'—is what gives Stravinsky's idiom its particular magic.

The cleaving of the music's flow as in Stravinsky and Milhaud, the simultaneous presentation of different metres as in Mozart's 'Don Giovanni', and the simple experience of the street sounds of a great city or the acoustic conglomeration of an international harbour zone—all these are absorbed in the concept of multi-layer sequences of events like those manifested in the works of Cage and Stockhausen (particularly in 'Zeitmasse' and 'Gruppen'). The effect of harmonic cross-reference and cross-incidence, which was earlier the essential part of the procedure, is now almost entirely lost, owing to the de-sensibilization of the intervals; however, the ear can still follow the diverging streams of movement. But, no matter how daring and complex the temporal action in the pieces we have mentioned, they cannot escape a certain internal problem: As a result of the high degree of permeability, the various sequences of events tend to melt into one another, and their original variety is resolved into a high unity; the various different interfering tempi become simply relationships of density, and the virtual space that is the result mercilessly gobbles up any individual 'time-measures' [Zeit-Masse]([40]). And yet these pieces of Stockhausen's owe some of their peculiar fascination to this balancing-act, performed on a line on the one side of which speed has to be qualified as density, and on the other, time is after all still time, although at the same time it is also pseudo-space([41]).

Spatialization and dissociation are not the only tendencies that Time has to put up

[40] If you observe the behaviour of vehicles in a fairly deserted street, you can distinguish their individual speeds and directions. If the traffic increases by an considerable amount, our capacity to register the individual actions decreases by the same amount. There is ant-like activity in the details, but the whole—regarded as a whole—is motionless.

[41] The progressive spatialization of time could be one of the reasons that led composers—particularly Cage and Stockhausen—to transfer the imaginary space of formal matters into a real space, by distributing instrumental groups or loudspeakers around the concert hall. This traditional procedure handed down from the Venetian early baroque thus acquires a new function.

with in present-day music. In the dialectic of musical form, forces and efforts appear that strive in the diametrically opposite direction. Today, more than ever before, composers are concerning themselves with micro-relationships in sound; indeed they force themselves upon any composer who turns in the direction of electronic music. And it is a result of this concern if composers realize more and more that real integral reversibility contradicts the character of the world of sound. Only a narrow peripheral area of the world of sound can support a process of being run backwards without sustaining considerable damage; i.e. structures that consist merely of stationary sounds. All other sound phenomena—e.g. all instrumental and vocal sounds without exception—have their beginnings and ends irrevocably marked by their respective entry and decay-processes. A retrogression can only apply to the sequence of sounds, never to the sounds themselves. Run a magnetic tape backwards and it soon becomes clear how unrecognizably the micro-structure of the sounds has changed. Admittedly, such matters are on a different plane from spatialization through reversibility, which is after all only imaginary, whereas the irreversibility of sounds is a matter of hard fact. However, experience gained while working with micro-relationships is likely to have an effect on our broader ideas about form; in fact this could be one reason why unmodified retrograde formations seem to have been avoided in most recent music. The individual sound itself has been recognized as a kernel of musical form, by reason of its entry and decay processes (really it is a complete, though tiny, autarchic form), and it can serve as a possible archetype for structural sequences ([42]) and even for broader constructions. Crystal formations in the manner of Webern can no longer be reconciled with such a feeling for form. This means that, despite all talk of the illusion of space, there is a tendency once more to allow time to flow in one direction only; finally of course this must lead to a dismantling of the spatialization itself. The recapture of the time-dimension receives strong support from the idiosyncrasy that forbids repetitions and symmetries of all kinds, and also from the general fragility of the musical material that is the result of that idiosyncrasy. The increasing allergy against all constellations that have been heard before signifies the radical exclusion of *ostinati*, and makes the appearance of any openly periodic shape or formal feature quite insupportable.

Thus was founded a situation in which one is forced to design every particular differently from all the others, to write every little bit of music as if one had to think everything out right from the start, as if there were not even any sounds, but one had to create them first so as to be able to manipulate them, 'like a writer who has to provide himself with a special vocabulary and syntax for every sentence he writes'([43]). Whether the directionally orientated forms that emerge as a result are to be regarded as regressive because of their affinity with the discarded tonal ones, or not, must remain an open question.

Now, hardly has the dismantling of the tendency towards spatialization begun than it pokes its head up again on another level; in accordance with the principle of shift and expansion the rejection of all repetitions leads us to extrapolate from internal structural relationships onto the work as a whole, and then to set about preventing the unaltered reappearance of this, the work as a whole, in its turn. This is the aspect

[42] Compare this with our remarks about Nono's method of composition on page 6.

[43] Adorno, loc. cit., p. 69. Surely it was this realization that drove composers into the realm of electronic sound-production.

needed to complete the emergence of those 'free' forms that have to be assembled by the interpreter (we mentioned them already at an earlier juncture). These works, supplied by the composer in component parts together with instructions for assembly, have to chalk up a deficit on the side of the detail-work for every credit they achieve as a whole; i.e. in giving the overall form the chance to be different each time it is heard, the separate parts have to be made interchangeable, which means that the unequivocal direction of flow is lost, and entropy increases. The various interpretations of such a work are like flash-photos of a Calder mobile: changes are manifested only indirectly, since each performance is merely a momentary incarnation of the manifold possibilities of the form. It seems to me it would be much more worthwhile to try and achieve a compositional design of the *process* of change.

November-December 1958

AMANCIO WILLIAMS' SPACE THEATRE

URSULA BURGHARDT-KAGEL

Amancio Williams, architect, was born in Buenos Aires in 1913. Shortly after completing his studies at the university for architecture and urbanism in the city of his birth, Williams devoted himself to researching new methods concerned with town planning, architecture and sculpture. His executed works and numerous projects bear witness to his need to free himself from the traditional view of architectonic expression, and identify himself with the principles of the 'Charte d'Athènes'.

In his sketch for an 'auditorium for plastic theatre and sound in space' Amancio Williams attempted to achieve the same loudness level for every individual in the audience. He proceeded from the method of the architect Lyon, which had been used in the Salle Pleyel, Paris, and in the theatre in Helsingborg. The basic idea is to compensate—by means of a quantity of reflected sound proportional to the distance of the listener from the sound source—for the softest sound-signal that each listener can receive.

Lyon took into consideration the vertical section of an auditorium in reckoning the quantity of sound to reach each member of the audience, and used it as a basis for achieving an even distribution of sound. However, he restricted himself to considering only the waves reflected from the back of the stage, and therefore solved only a part of the problem.

Williams was inspired by this method in 1941, but in his sketch he took into account also the ceiling of the stage, and the walls of the auditorium and stage. As he developed his own ideas he came to the conclusion that an even distribution of sound could only be achieved if the auditorium took a form substantially different from the traditional concert hall. To bring reflected sound to various points in the auditorium, Williams had recourse in his first sketches to a series of compensatory surfaces above the stage for the purpose of obtaining favourable angles of reflexion and thus making possible an even distribution of the sound.

In this project he proposed various profiles for an auditorium. They form the basis of his last design, in which Lyon's method has been transposed from a two-dimensional surface to a three-dimensional space. A few figures from Williams' last design follow.

Figure 1 shows the free-standing interior for the presentation of dance or theatre

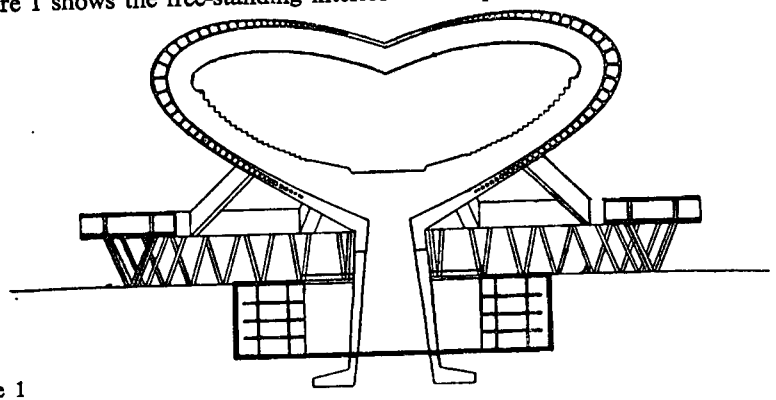


Figure 1

performances, sounds in space or pictures in space. The profile of the auditorium effects the reflexion of all sound waves that circle round a symmetrical axis. The result is an arch of even reflexions that reinforce the sound and permit the desired distribution of sound; the amount of sound received by the individual listener is proportional to his distance from the sound-source.

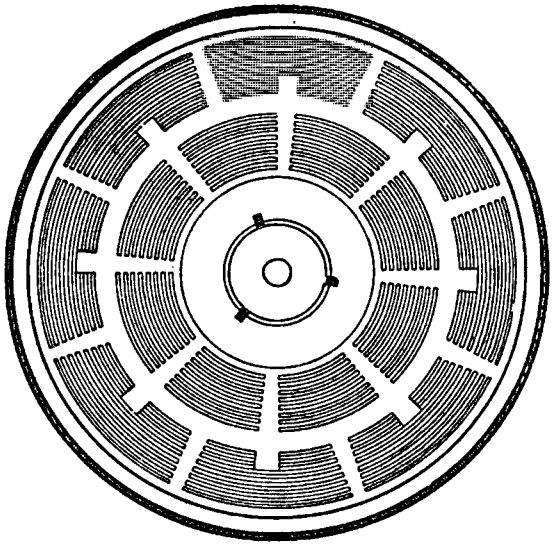


Figure 2

The audience sits in sixteen concentric rows (see Figure 2), which can accommodate 4,000 people; however, there is room for 6,000. Williams says that the second figure is the maximum for an acoustic event in a closed space, intended to be experienced under ideal conditions. An auditorium for a larger number of people would require such a large volume of space that the requirement of even distribution of sound could no longer be satisfied.

In the 'acoustic studies' (Figures a-f) he shows the directions of the reflected waves with various dispositions of sound waves:

(a) The reflecting surface of the ceiling and the sloping surfaces of the orchestra platform; also the absorption area in the curve where the seats for the audience are placed.

(b) The two reflexions of the reflexions occurring in the sloping surfaces at the sides.

(c) Reflexion of the waves that hit the ceiling, proceeding from a central sound source.

(d) Reflexion of waves, proceeding from two sound sources on the edge of the central podium, in their respective ceiling arches.

(e) Sound sources as in (d); shown here is the reflexion in their respective opposite ceiling arches.

(f) Shows all possible points of arrival of waves originating from any point on the central podium.

Figures 3 and 4 show the model. The public can reach the promenade gallery that surrounds the auditorium by means of ramps leading up from the garden. Among other things this gallery accommodates the refreshment rooms, exhibition rooms, wardrobes, cloakrooms and entrances to the theatre.

Between the inner auditorium and the shell are passages for the use of the actors and performers; by means of these they can reach any point in the performing space. Thus performers and public form a unity; the division between stage and audience accommodation is dissolved by the availability of new, communal actions.

Williams made some sketches for plastic and musical performances in space. Figures g-k are graphic representations of these:

(g) Triangle (surface or prism) and line execute various movements. Both elements can change colour and are mobile in three dimensions.

(h) Three apparatuses similar to the projection methods in use in Planetariums. The play of lights and forms in various colours and combinations, independently mobile in the auditorium.

(i) Ten platforms connected by ramps for musical or theatrical performances. Some of these surfaces can be transparent, and they are distributed in such a way that the performers are visible to everybody in the audience.

(j-k) Two platforms with steel supports and connected by spiral or curving ramps. The lower line indicates the orchestra or chorus.

This project was accepted by the architect Clive Entwistle in his town plan for Park Crescent, London, and the town of Aycliff. In November 1955 it was intended to execute the project in Washington, U.S.A.

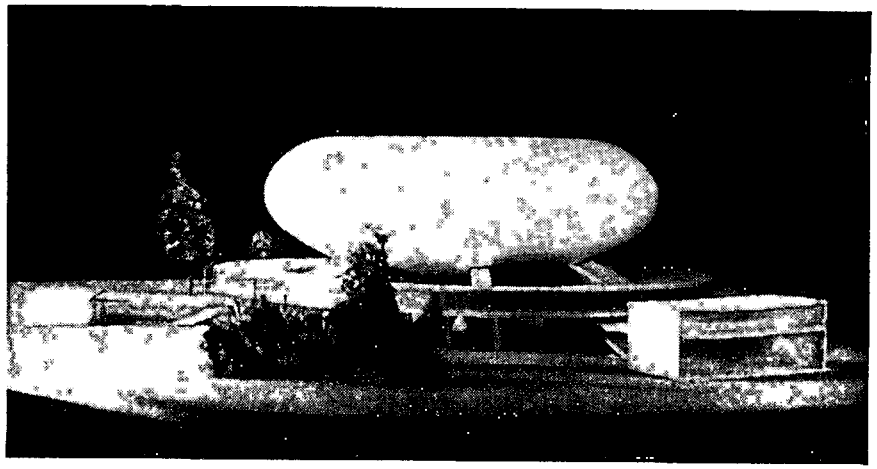
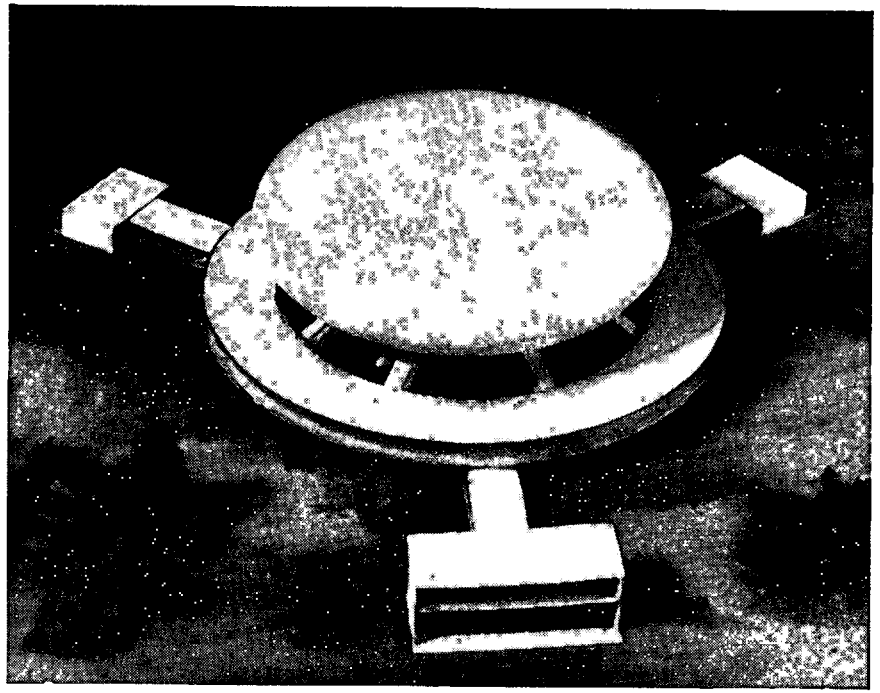


Figure 3



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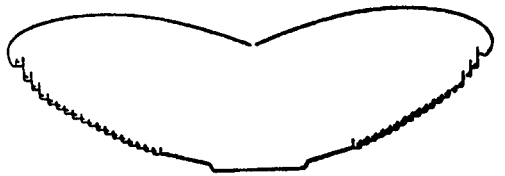


Figure a

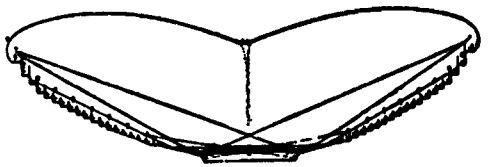


Figure b

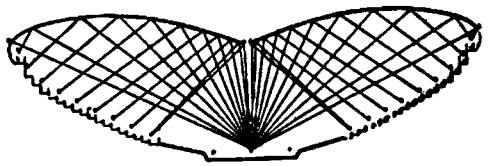


Figure c

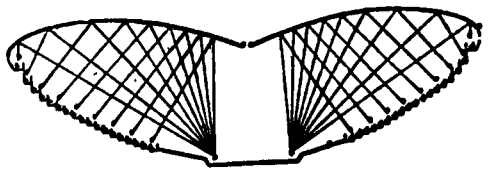


Figure d

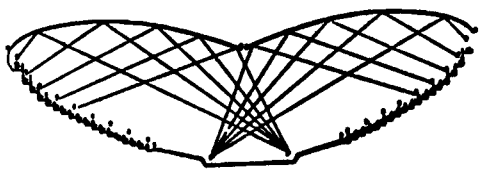


Figure e

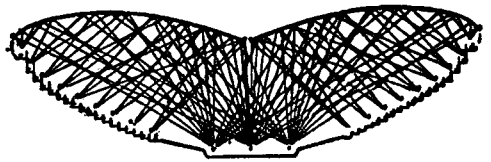


Figure f

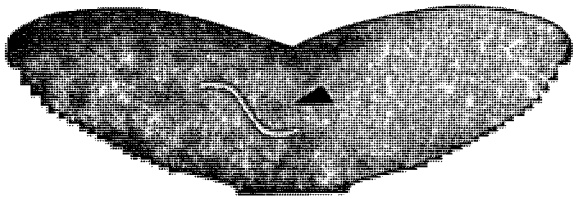


Figure g

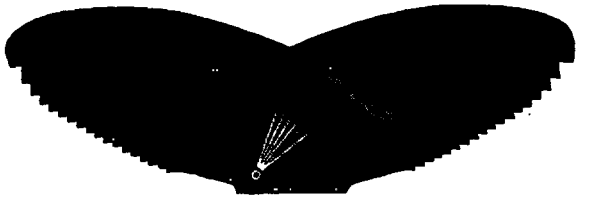


Figure h

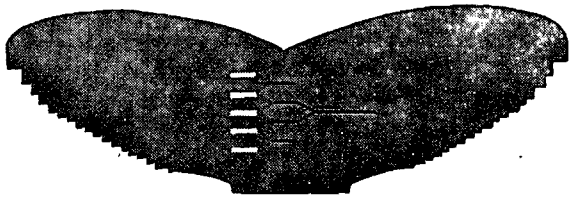


Figure i

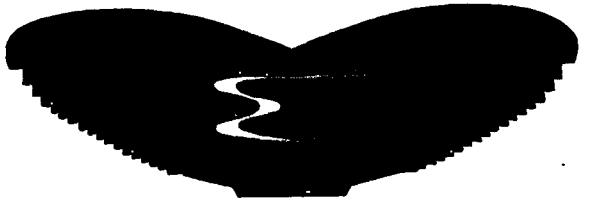


Figure j

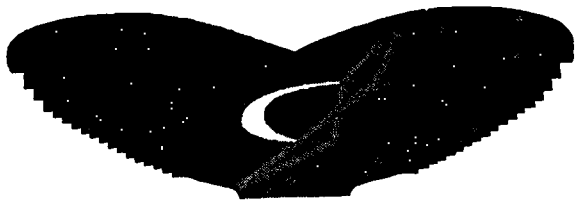


Figure k

ON FORM

CHRISTIAN WOLFF

Form in music could be taken as a length of programme time.

This is clearest in the work of John Cage of the last four or five years. No distinction is made between the sounds of a 'work' and sounds in general, prior to, simultaneous with, or following the work. Art—music—and nature are not thought of as separated. Music is allowed no privileges over sound. Yet the work is quite distinct. It can be timed and tends to use sounds not always generally heard and in combinations not generally common. But its distinctiveness implies no exclusiveness. The work tends to be at once itself and quite perspicuous (cf. painting on glass and constellations).

A piece as it starts and stops is indicated by the actions of its performers (even when no sounds are scored at all). Form is a theatrical event of a certain length, and the length itself may be unpredictable.

At one remove from the event the form of a piece is reduced to a score, instructions for performers. It is a question of what should go on for how long, a matter of boundaries before an event: boundaries which the event tends to annihilate or obscure.

Take, for example, what John Cage found long ago and called a rhythmic structure: a sequence of proportions which fix time lengths and are expressed both in small for phrases (e.g. 2, 5, ¼, 1, 3, 11, 2½ seconds) and in large for the parts of the total structure of a piece (thus seven sections 49½, 123¾, 6 3/16, 74¼, 272¼ and 61 7/8 seconds long, i.e. 2×(2+5+¼+1+3+11+2½); 5×(2+5+¼+1+3+11+2½); etc.). The sum of the phrase lengths, 24¾, is, then, the square root of the total length of the piece, 602 3/16 seconds. A frame subdivided according to proportions chosen either deliberately or at random, in any case arbitrary as frame, is taken as given. Any criteria for characterizing its subdivisions are possible.

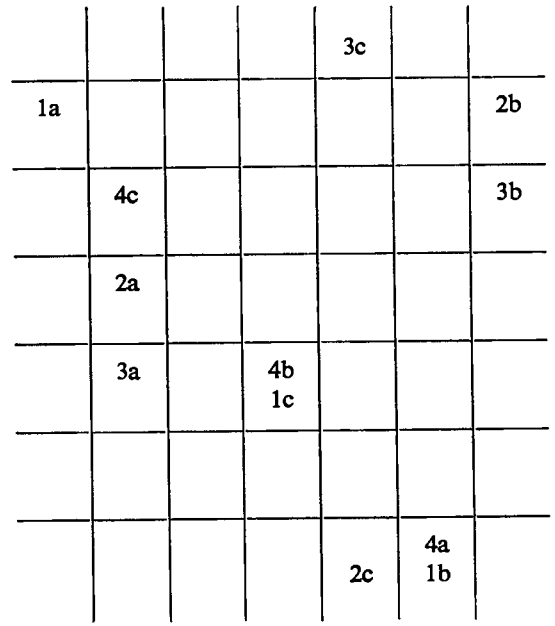
This sequence of lengths may be multiplied through to make a square like the following:

4	10	½	2	6	22	5	(2×2, 2×5, 2×¼, 2×1 etc.)
10	25	1¼	5	15	55	12½	
½	1¼	1/16	¼	¾	2¾	⅝	
2	5	¼	1	3	11	2½	
6	15	¾	3	9	33	7½	
22	55	2¾	11	33	121	27½	
5	12½	⅝	2½	7½	27½	6¼	

(The square as it stands has certain properties, for instance, the possibility of a unique series of lengths on the diagonal from the upper left hand corner to lower right, i.e. from beginning through centre to end—4, 25, 1/16, 1, 9, 121, 6¼—and the symmetrical spacing of one repetition of each of the remaining lengths—thus the horizontal sequence beginning with 4=the vertical column beginning with 4; the horizontal sequence beginning with 10=the vertical column beginning with 10; etc.)

To begin to define these subdivisions of lengths one might next take a second square having a number of elements (subdivisions) equivalent to the first, namely 49. On this

second square continuities—in space, discontinuous from a linear point of view—can be indicated by recurrent 'moves'. For example:



There are three continuities here—a, b, c—of four elements each (1-4). Each continuity makes the same move which can be described as: 1 (1a starts anywhere); 2: two spaces down from 1 and one over to the right; 3: one down from 2; 4: two down from 3 and four to the right. The second and third continuities (b, c) repeat the move overlapping at the beginning, that is, 1b starts in the same space as 4a, 1c as 4b. Since the square in its two dimensions can't accommodate all moves thus repeated, its limits at top, bottom and sides are considered continuous, bottom to top and side to side. Thus the first part of the move (two spaces down and one over to the right) in the second continuity (b), from 1b to 2b, must proceed to the top of its vertical column and from there move down two spaces and then over to the right. Similarly, from 3b to 4b one can go down two (as from 3a to 4a), but must then go to the other side of the horizontal line of spaces in order to move four to the right.

The three continuities made on one move can be characterized in any number of ways, i.e. can be used as references to whatever aspects of sound one wishes to compose. And while characterizing them individually, one may also indicate that they all belong to one move by criteria applicable to all of them together. For example, if they are differentiated by having each a particular pitch gamut, they may be related by sharing a common tempo, or timbre or dynamic configuration.

A whole structure would have a number of moves, each in turn separately charac-

terized, perhaps of various numbers of elements (the move described above had four) and repeated for various numbers of times (three above). For instance:

6h	5e	7h		3c	10k	
1a				11k		2b
7g 5h 12k	4c				6g	3b
8j	2a		6f	9j	7f 5g	
	3a		4b 1c		10j	
	6e		7e 5f	11j		
12j 8k				2c 9k	4a 1b	

Now there are three moves (1-4 [as just described], 5-7, 8-12), repeated respectively three times (a,b,c), four times (e,f,g,h) and twice (j,k). Parts of different moves may intersect, as at the beginning of the third line $\binom{7g}{5h}$ 12k). And spaces in the square may be left blank, which means they will be silent.

Having thus fixed locations for criteria of sound or its absence, one can fix the extent of these locations, their possible durations, by applying the square of lengths we first described. Superimposing the two squares gives 6h in 4 seconds, 5e in 10, 7h in ½, silence for 2, and so on.

Yet the disposition of the material in a given amount of time can be quite variable. If the element 6h refers one to a given source or gamut of pitches (or timbre or dynamics) and the move in which 6h occurs (5-7) involves a given tempo or configuration of durations, both the move and its particular continuity could still be expressed by just one sound. That sound, to be sure, might come at the beginning of the 4-second length and 5e could start at the beginning of the following 10-second length marking off 4 seconds. Articulating all the structural lengths, then, can indicate a minimal order.

But even this order is not entirely fixed, and the form, originating as a frame or system of frames, is not necessarily closed. Silence, for one, introduces ambiguities. Within the space of 10 seconds, for instance, there may be 3½ seconds of continuous silence. But this theoretically contained, i.e., structurally subordinate, amount of silence cannot be distinguished from the 2 seconds of silence which makes up a discrete structural unit.

Further, this order can be elaborated by superimposing different readings of the squares of durations and of elements. Use, say, the square of elements as given (6h, 5e, 7h, etc.) but combine it with the square of lengths beginning with 5, at the end of the

first line, and continuing with 12½, ⅝, 2½, etc., i.e., read this square turned over on one side. Simultaneously, then, in a second 'voice', use, conversely, the square of lengths as given (4, 10, ½, 2, etc.) but combine it with the square of elements read as though turned on its side (silence, 2b, 3b, silence, etc.). Superimposing these two sets of readings or 'voices' one then gets (time lengths are given first, before the colon, element indications second, after it):

5:6h 12½:5e ⅝-7h 2½:0 etc.
4:0 10:2b ½:3b 2:0 6:0

The relationship of the voices is, in a general way, like that of the voices of a canon in so far as every reference to an element and every time length is found first in one voice and then in the other, though the repetitions are not continuously from the same to the other, nor at equal distances, and they are variously combined, e.g., 5e is first located in 12½ seconds and then in 22, 4 seconds is first characterized by silence and then by 12j+8k. Imitation is at geometrical intervals, in space, so to speak, rather than in linear continuities.

Such superpositions make possible a greater degree of internal liveliness, a greater elaboration of particulars. Moves intersecting and voices overlapping can obscure structural outlines and produce meetings or events that are disengaged from them to become simply themselves. Then, a structure that seems closed by a square of time lengths may also be dissolved by including a zero in the sequence of the time lengths' proportions (e.g., 2½, 1, 0, 2 . . .). The zero I take to mean no time at all, that is, no measurable time, that is, any time at all, which the performer takes as he will at each performance. Also, one may take fixed lengths to represent space, leaving the speed of procedure through the space to determinants other than the criteria which gave the lengths (cf. John Cage's *Music of Changes* or the use of a page of score as a structural unit, e.g. in Cage's *Music for Piano* or Earle Brown's 25 *Pages*).

So far form, or rather the making of a score, has been taken as a matter of what (this only generally) goes on for how long, and the simultaneity of varying structural lengths having various kinds of material within them. The succession of lengths has been assumed fixed and predictable before a performance. Karlheinz Stockhausen's *Klavierstuck XI* introduced the notion of a variable, unpredictable continuity of structural sections, variably characterized according to the sequence in which they happen to appear, and an indeterminacy of the total length of a piece at any particular performance. Beginning with that idea my *Duo for pianists II* makes a counterpoint of two sequences of structural units each indeterminate before any performance. Each of the two pianists makes his particular continuity of structural units (they total 15 and are from 1/16 to 42½ seconds long) and is dependent for the successive choice of what units to play not, as in Stockhausen, upon a straying eye, but upon what he has heard. Ten kinds of sounds (e.g., highest octave *ff*, pizzicato in the middle register, 11 seconds of silence) as heard from one piano are cues to the units which the other will play, and vice versa. A given cue may refer to one unit or to a set of alternatives (two or three). A unit may be played any number of times during a performance, depending on how often it is cued. One unit or pair of units needs no cue and so can be used to start the piece and to return to during the piece when one has either not heard or missed a cue. Once the piece has begun there should be no pause between units, that is, one must

always be doing something (including the observation of silence) which is indicated by the score: after playing one unit one must play whatever next one is referred to by the cue last heard before the unit one is playing has ended. There is no cue for ending the piece; the performers agree on a total duration.

The material in the various units also can be variably performed. Time is given in seconds, or in one case as zero (see above), and what one is to play in a given length is characterized with varying completeness, allowing the performer varying degrees of free choices. For example: (cue: 5 seconds of silence)

$$1\tfrac{1}{4}\text{:0 (i.e. silence)/ } \tfrac{1}{4}\text{: 3a 2b/ } \tfrac{1}{8}\text{:0/ 4:ppp f/ 1:pizz 1a}+\tfrac{1}{4}\text{, 3,}\tfrac{1}{10}\text{/ 31: 1e/.}$$

The first number gives seconds. Within $\frac{1}{4}$ second one must first play 3 notes from a pitch source 'a' (in which there are, say, 4 pitches), in any higher or lower octave than the one in which they appear originally (this is indicated by $\begin{matrix}x\text{-}\\ x\text{-}\end{matrix}$). Any three of the four available pitches can be chosen, or one can be chosen and repeated three times, or two, one of which is played twice. With these one must play two notes from source 'b' (which has, say, 6 pitches in it). How these five pitches are disposed—singly or in chords, their dynamics, and their individual durations—is left to the performer, who must, however, act within $\frac{1}{4}$ second. Where *ppp* and *f* are indicated the specific requirements are two notes and these dynamics; the rest is left to the performer. $+\frac{1}{4}$, 3, $\frac{1}{10}$ means that the notes should have one or more of these durations. One need of course in no repetition of this sequence choose or play the material in the same way.

The idea is to allow for precise actions under variously indeterminate conditions. One may have $\frac{1}{4}$ second to play 9 variously specified notes or 35 seconds in which to play one of one's choosing. Both fluidity and exactness of performance are possible. And no structural whole or totality is calculated either specifically or generally in terms of probabilities or statistics. The score makes no finished object, at best hopelessly fragile or brittle. There are only parts which can be at once transparent and distinct.

Returning, finally, to the notion of form as a matter of what goes on for how long, an inconsistency may have been noticed: the durations of the lengths in the square of durations described earlier bore no particular relation to the durations of individual sounds within those lengths. The form as a sequence of structural lengths bore no precise relation to the material chosen for use in the form. Form and material are taken as separate for the purposes of composition. That form, as a structure indicated on a score, can be derived out of the nature of the sound material is, I think, illusory. So, conversely, a piece is not played to exhibit its composed structure. Form as structure is simply a matter of technique. The tendency to identify form and material, what is intended and what is given (cf. 'art' and 'nature'), implies the elimination of all expressive intentions: which might be salutary. But it is practically impossible. If one refers form to what is scored then it will never be exactly represented in a given performance. In any case a kind of solipsism is implied. In making a piece initial, completely arbitrary choices are inevitable, e.g., choices of instruments, timing, performers. On the one hand, one is in an automatically open situation. Whatever one does there will

be unpredictable interferences (e.g., circumstances of performance, misunderstanding). On the other hand, no matter how open a procedure one adopts, whether 'naturally' (in as complete accordance with the nature of one's material as possible) or by chance (in accordance with the nature of events left to themselves), a degree of circumscription, itself characteristic, will still be necessary. So, for example, in John Cage's *Music for Piano* the making of the score seems as free from determination as possible, namely the fixing of pitches and their spacing by marking the imperfections that happen to be on a blank piece of paper. Yet the result is characteristic, less of the material (which is in any case graphic or visual and not acoustic) than of Cage who by inventing or choosing this method and its application to one or more pianos has brought it about that only certain pitches and noises, of certain timbres, will appear, only singly or in flurries, in more or less isolated points. And, recalling the simplest view of form with which we began, namely as a theatrical event, it is by definition not a 'natural' event. It might be natural only if it were private. The alternative attending a full acceptance of the equivalence of form and material is, in the end, no longer to write, or perform music: a perfectly valid possibility still leaving much available for the ears to focus attention on.

TRANSLATION-ROTATION

MAURICIO KAGEL

Form='nature morte'(1)

Crisis seems to be a *status quo* in musical form (the confusion of concepts is already classic: crisis instead of renewal), and now we are beginning to take account of new compositional principles that have a large penchant in the direction of graphic solutions, thereby overstepping the properties of the usual notation. If one chooses to regard these graphic representations as merely an extension of musical semiography, one is ignoring the desire for unknown projections of the invention—which surely is what inspires these new symbols and methods. The metamorphosis of musical language in the last sixty years enjoined a direct adaptation of the way of writing; this is no longer a matter for argument, but the relationship is the other way round today: the development of particular notations implies a latent development in the musical language. This stage is often rejected on account of the systematic separation of the point of departure (the idea) from the final effect (the notation) in a composition; this effort of ours—schematic introduction to the principles of a theory of musical translation and rotation—will surely bolster up any rationalized objection to the idea, but the following exposition of the theory has been undertaken for other reasons.

The fact that the structure of a piece of music can find an analogy in the visual representation only makes wider the gaps between idea, representation and realization. Composing today is no longer a matter of a subjective attitude to an objective form; the correspondence of forms and methods is to be found in the subject—the sound-object remains as the only object. Interpretation is thus a department of composition, both in its manifestation in performance as the extension of the idea, and also when an interpretative treatment of the material is demanded by the perspectives of infinite possible points of combination in the internal articulation of the form.

In composition interpretation stands in a reciprocal relation with decision; the steps between the two take the form of a codex—consisting of a language of stimuli and signals *ad hoc*—on the same level as the organization of pitches or intensities.

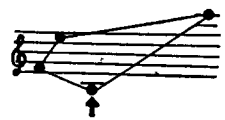
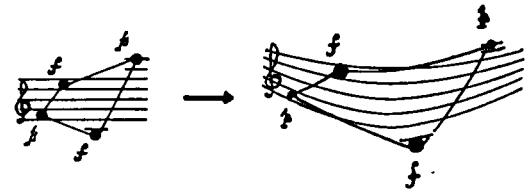
> The perception of the musical form of some works is only possible through the active interpretation (in the sense of a synthesis) on the part of the instrumentalists, and not through a merely passive interpretation (in the sense of an analysis). The act of hearing is then inseparable from the form, just as a formant is inseparable from the sound (of which it is part). The 'timbre' of forms such as these is dependent on characteristics of the interpretation, and in the interpretative *enchaînement* of the various sections.

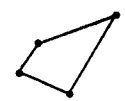
Forms that allow of manifold interpretation require manifold (multivalent) material; an ambiguity of form could not be achieved without a directly corresponding ambiguity in the material. The inclusion of interpretation as a constitutive concept in composition tallies with the pre-requisite that one should be in a position to harness all the attributes of form in every respect—this is one of the few mental *ostinati* that has been preserved in present-day composition.

The graduation of interpretation in the broad area between the possible and the utopian will have no mean part to play in the problems concerned with the presentation

and design of musical passages by geometrical means. Naturally, a technical process must be found which can provide an insight into the investigation of the function and effect of translating and rotating.

Rising or falling as directions in a series of notes are components of a geometry in two dimensions; connecting lines between the combined directions of several notes create surfaces that can be articulated temporally and dynamically. For example, this

'figure' can be extended; a delay on the B could have the following effect  , and if dynamics are added, a dimension is gained which causes a spatial accentuation in the figure: 

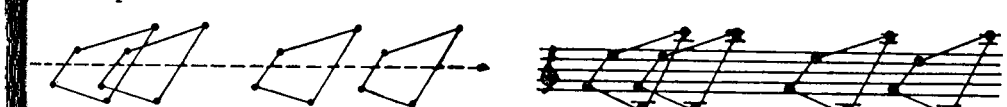
If we investigate the figure divorced from the musical stave  the earlier distance between the notes is no longer an expression of a temporal sequence; the perimeter, accentuated by four dots, is free of any temporal function and therefore cannot force any directional movement on our attention.

The isolation of the figure from its complementary relationship to a musical process serves for an experiment. There is now no temporal sequence from left to right to fix the orientation of the figure, so movement becomes possible if one refers the figure to a musical parameter (for example, pitch).

The following is the result of the application of two simple *categories of movement:*

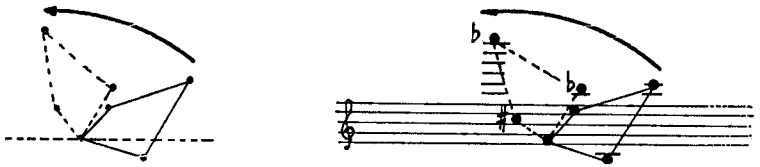
I. *Translation* as a simple, straight-line shift of two (or more) similar (or dissimilar) forms along one or more constant or variable axes:

Example 1



II. *Rotation* as a circular shift around one centre of motion (axis) in the figure in question:

Example 2



For the presentation of a translation or rotation at least two stages in the shift are necessary.

The application of these categories of movement in the sphere of music is quite conceivable. The combinations of spatio-temporal movement that appear require a definition of the following concepts:

.) *Dots* are notes that determine the outline of a virtual figure (surface). (Note-dots refer to pitches; time-dots refer to durations and intervals of entry; space-dots refer to intensities and spatial movements).

.) *Basic shape* is the virtual figure determined by the dots. This it is that can be shifted from an original position to other positions by means of the processes we are describing.

.) *Derived shape* is a shape that varies from the basic shape in its position in relation to a common axis (i.e. not a repetition of the basic shape as in the simple translation with a constant axis—see 'translation').

.) *Identity* will be used to describe the correspondence of the basic shape with itself—in graphic terms, a congruence of the two outlines; in time it should be understood as the reappearance of the original constellation (constellation of pitches or whatever the dots stood for in their original position).

.) *Period* means a cycle of shifts that returns to identity.

.) *Regular shift* is a shift that does not alter the virtual outline of the basic shape. It is expressed by the finite positions of a single category of movement(2).

.) *Discontinuous shift* is a shift where the interval between the original position and the final position is not expressed in time. In this case, what is shown is the effect on the basic shape of only one moment of movement, i.e. an irregular, static alteration(3).

.) *Successive shift* is a shift where the basic shape and the derived shape follow one another separately.

.) *Compound shift* is a shift where the relationship between the basic shape and the derived shape is visible in the graphic presentation, but the two form a unity when translated into acoustic terms(4).

We will meet these nine expressions again in the course of our exposition of straight-line and circular shifts in their application to basic shapes of pitches, durations and timbres.

Translation

The shifting of note-dots provides us with an opportunity to regard the concepts of *repetition* and *transposition* from a new point of view. In the following examples a repetition is a special case of a translation with a constant axis, and a transposition is a special case of a translation with a variable axis. This is the result of the fact that in translation we always take into account the relationships of the surfaces (graphically speaking) or times (acoustically speaking) of two shapes, whereas in the usual concept of repetition, the time (intervals of entry) is not taken into account(5).

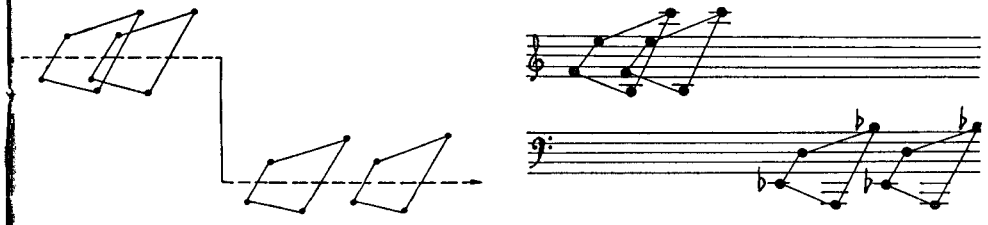
Examples for two similar and two dissimilar shapes in two stages:

Similar shapes

(a) constant axis (see example 1)

(b) variable axis:

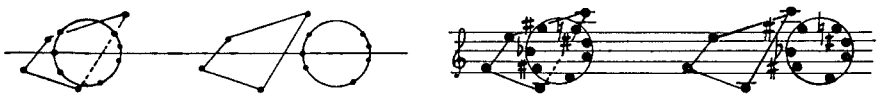
Example 3



Dissimilar shapes

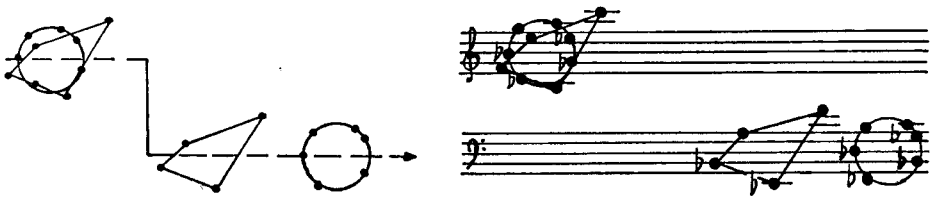
(a) common constant axis:

Example 4



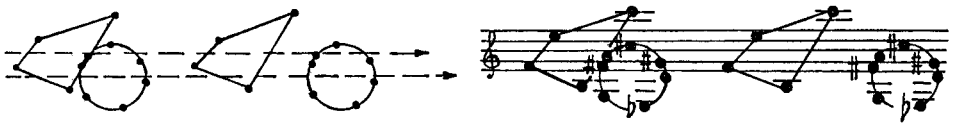
(b) common variable axis:

Example 5



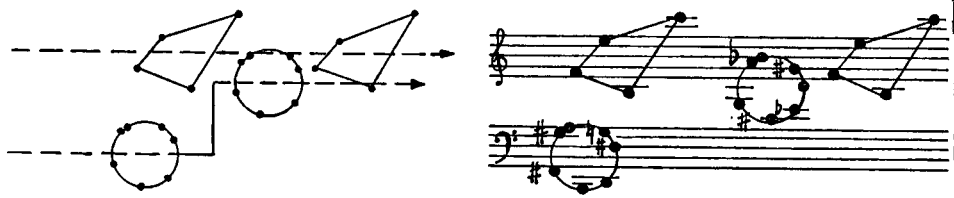
(c) different constant axes:

Example 6



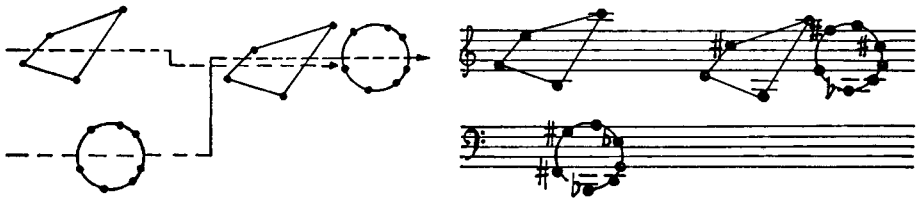
(d) different axes, the one constant, the other variable:

Example 7



(e) different axes; both variable:

Example 8



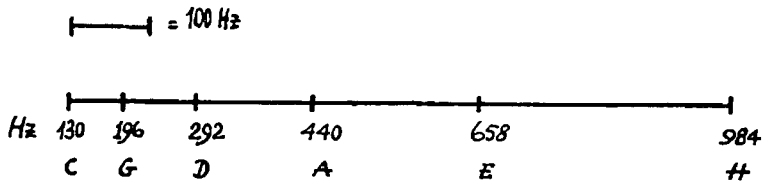
(c) (d) (e) for dissimilar shapes are also applicable to similar shapes, as long as these are made clearly distinguishable by the use, for example, of different timbres. If not, the translation of two similar shapes on different axes is effectively the same as a translation of one shape on a variable axis.

Rotation

1. *Note-dots* (frequencies)(6)

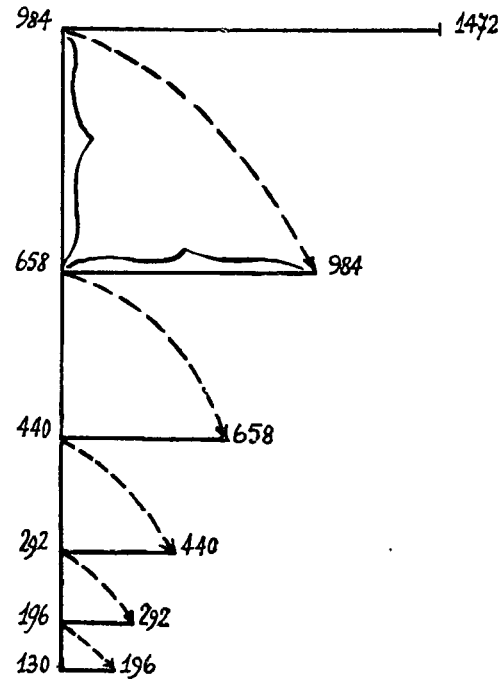
Example 9 shows a series of fifths expressed in frequency cycles per second (cps); [*translator's note:* in the examples the abbreviation Hz (Herz) is used instead of cps]. The frequency intervals are given on a linear scale; they get progressively larger in the proportion 2:3. The series of fifths begins at 130 cps (C below middle C; the numbers have been rounded off according to even temperament $\sqrt[12]{2}$).

Example 9



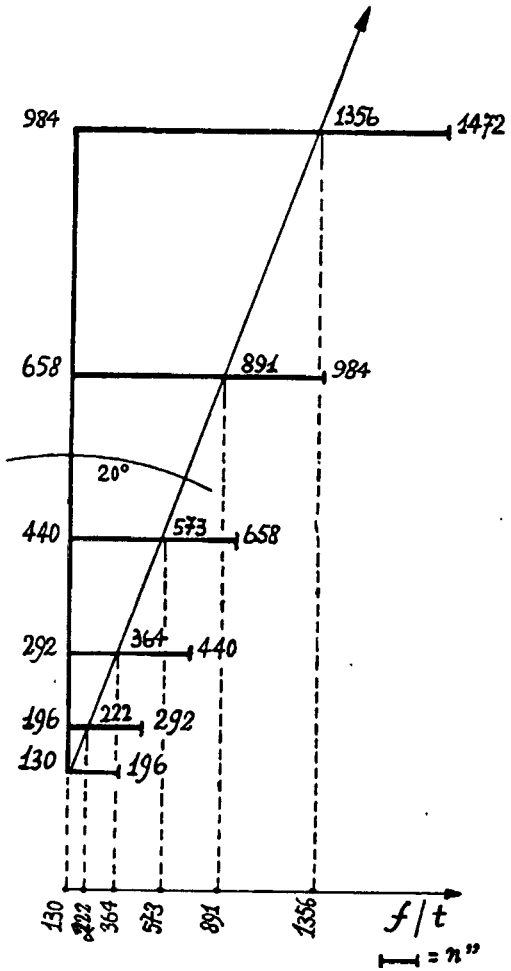
In example 10 the series of intervals is presented vertically, and the intervals themselves are projected onto horizontals; thus each interval forms a right-angle with arms of equal length. These angles form a co-ordinate system of which the abscissa and the ordinate both represent frequencies. The abscissa is a continuous frequency scale, whereas the ordinates are projections of this scale.

Example 10



If we draw a vector from 130 cps so that it makes an angle of 20° with the abscissa, the points at which the vector intersects the ordinates indicate frequencies (see example 11). A new series of frequencies is produced if we drop perpendiculars from the points of intersection onto a horizontal line f. If we go further and interpret f as a time-axis t, we can read off the duration for each frequency. The original series of fifths has been transformed into a derived series of frequencies that no longer has a single interval as a modulo. The first interval is now a major sixth, and the following intervals get smaller and smaller. The greater the angle between the abscissa and the vector, the larger the derived intervals become. The greatest possible angle in example 11 is 55°; with a greater angle the vector will no longer intersect the frequency lines above 292 cps.

Example 11



The vertex of the angle can occur at other frequencies (e.g. 440 cps, 984 cps, etc.); but the largest variation is obtained by drawing the vector so that it takes a new angle at every point of intersection with an ordinate. This is shown in example 12.

In order to do this we have to determine the series of angles; the proportion 2:3 is chosen as the constant interval of the scale:

1	2	3	4	5	6	7	8	9	10
30°	45°	67.5°	101.2°	151.8°	227.8°	341.7°	152.5°	48.7°	73°

The following series is the one used in example 12:

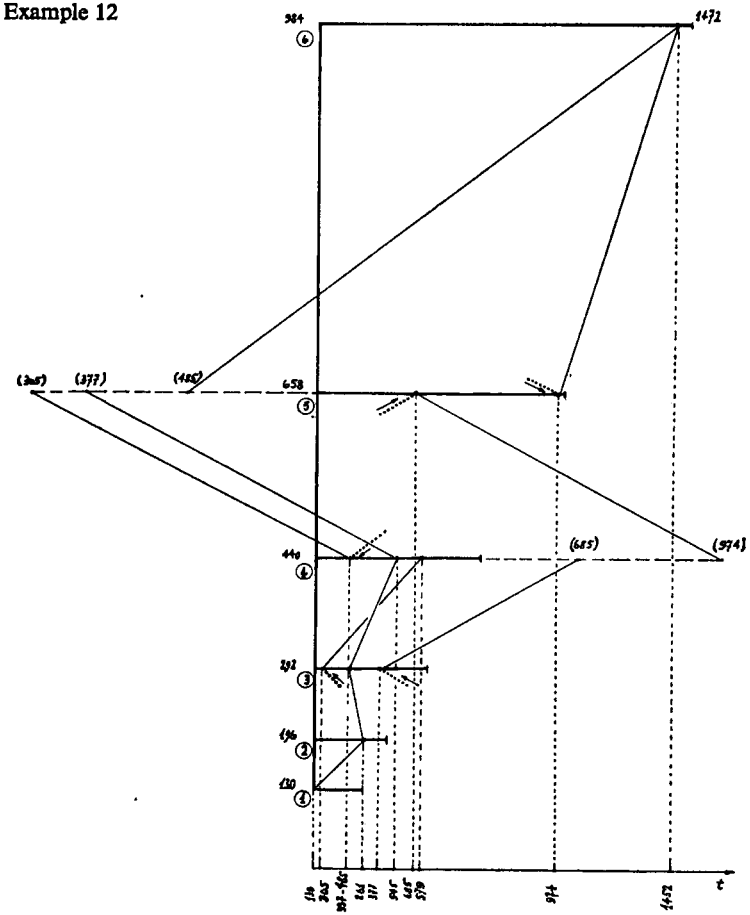
2	4	3	5	1	7	10	6	8	9
45°	101.2°	67.5°	151.8°	30°	341.7°	73°	227.8°	152.5°	48.7°

The vector has always to reach a point of intersection that lies on an ordinate. However, if the vector—because of its angle—cannot intersect an ordinate, then the

latter is extended as far as is necessary to provide a point of intersection. The extension can take place in both directions—towards the higher or lower frequencies. If the ordinates determined by the series of fifths are extended, a larger range is covered by the frequency scale. The frequencies of the intersections that lie on extended ordinates are transported on to the ordinates that contain these frequencies in their original length. (For example, a vector that starts from 545 cps on the fourth ordinate with an angle of 151.8° intersects the fifth ordinate in extension to the left. The resulting frequency—377 cps—is transported onto the third ordinate, and a new vector is drawn from that point with the defined angle, etc.).

The new series of frequencies is no longer a rising one as in example 11; the series of angles that is applied determines the tendency of the derived frequencies: rising, falling, or alternating. The series of frequencies in time is also dependent on the series of angles, if one understands the intervals between the frequencies that are ordered horizontally as delays (=intervals) of entry: wider angles correspond to shorter delays of entry and acuter angles to longer delays of entry.

Example 12



In a first interpretation, reading from left to right, we get the following series of frequencies:

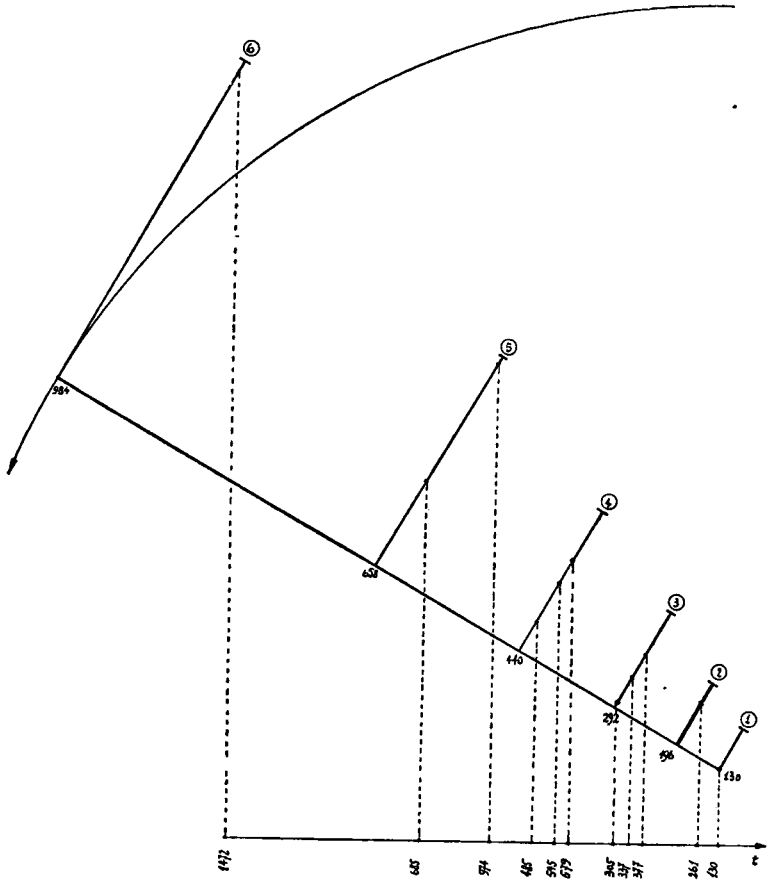
			4							
Ordinates	1	3	3	2	3	4	5	4	5	6
Frequencies	130	305	485	261	377	545	685	579	974	1452
			337							

A second interpretation of example 12 for frequencies is given by the sequence of intersections on the ordinates 1-6; the series of frequencies is then:

Ordinates	1	2	3	4	3	5	5	6	4	3	4
Frequencies	130	261	337	545	377	685	974	1472	485	305	579

One can get a corresponding series of delays of entry if one interprets the frequency scale from example 11 as a t-scale in which the largest interval receives the longest entry delay. However, it is more favourable to define time intervals and frequency intervals by *different* rules of combination. If one applies the delay of entry of the first interpretation of example 12 to the second interpretation of the same example, one

Example 13



obtains new combinations; the sum of the delays of entry will then always be larger than in the second interpretation.

We will now take the frequencies obtained from the intersections of the vectors and the ordinates in example 12 as a basic series. We will permutate this basic series by means of rotation. We take the abscissa (the continuous scale of frequencies) as the axis, and 130 cps as the turning point. In example 13 the axis is rotated to the left by 60°, and perpendiculars are drawn from the frequency points to the ordinate.

The remarkable transformation in this example is not only the new ordering of the frequencies, but also the alteration in the corresponding sequence of intervals of entry. As a consequence of example 13 we can formulate the following axioms for the rotation of note-dots (frequencies):

1. A note-dot-system that is connected with a horizontal by perpendiculars determines a *rotative basic shape.*
2. The original position (identity) of the rotative basic shape is at 0°.
3. The intervals between the note-dots are given by perpendiculars dropped from the note-dots to a horizontal outside the area of rotation.
4. The horizontal is the straight line for reading off the successive intervals between the note-dots.
5. The intervals between the note-dots on the straight line are altered by turning the rotative basic shape.
6. The distance between two note-dots determines the interval of entry between them.

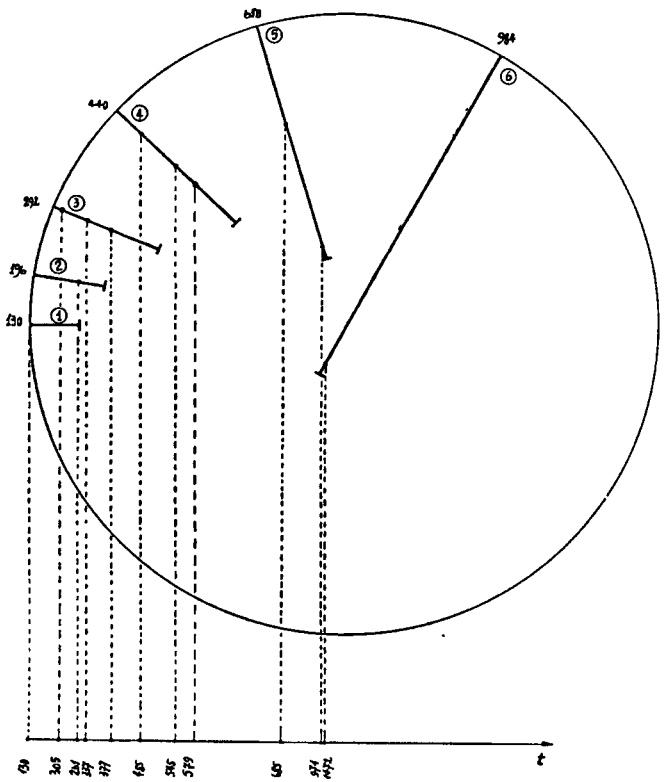
The preceding axioms will also be applicable to the points of the rotative basic shape when they have other references (time-dots and space-dots). In example 14 the continuous scale of frequencies is not a straight line but a circle. What were previously the ordinates are now sections of radii of the circle. Choose any frequency area as representing the circumference of the circle (e.g. 1640 cps), and each degree is then 1/360th of this frequency area (in example 14: 1640 cps/360°=4.55 cps/°). The length of the section of the radius shall be equal to the frequency interval on the continuous scale of the circle (e.g. increasing in the proportion 2:3). The new distances between the frequencies can then be read off again on a horizontal.

The rotative basic shape in this example offers a larger range of possibilities for transformation and combination than the one in example 13. The circle encloses a virtual 'frequency area'. Any point in this area can be joined by a radius or the continuation of one, and in this way a certain ambiguity is provided by the simultaneous presence of two interpretations. If every radius is extended to become a diameter, only the higher of the two frequencies can be raised; the lower frequency reaches the value of the higher frequency:

130 ⟶ 1640
3150 ⟵ 1640

Maximal ambiguity is achieved at the centre of the circle: there, each radius reaches a different frequency.

Example 14



II. *Time-dots* (delays of entry)

A series of delays of entry within a total length t is to be rotated round a defined centre. The axis of rotation (t) is identical with the straight line on which the time-dots are located; each dot describes a circle around z.

The 'speed' of the rotation is determined by:

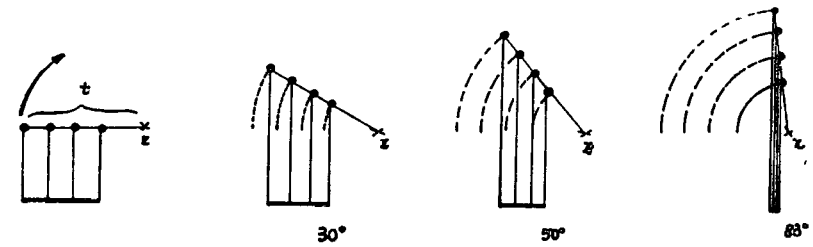
(a) the number of positions occupied by the axis,

(b) the angles formed by the axis in its various positions and its original position at 0°.

According to the nature of the instrument for which the diagram is to be interpreted, the delays of entry result in pauses (e.g. for percussion instruments), identity of duration and delay of entry, or overlapping (for brass and strings, etc.).

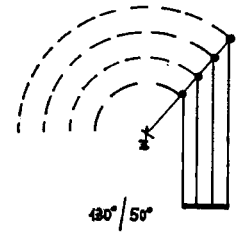
In example 15 three angles of rotation are given—30°, 50° and 83°. Perpendiculars are dropped from the dots on the axis to a common straight line so as to provide transpositions of the total length t. Each of these transpositions alters the delays of entry in proportion to the angle of rotation:

Example 15



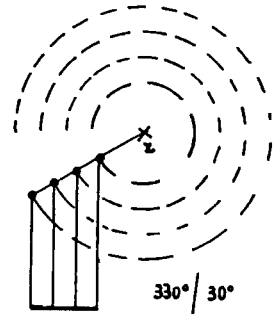
0° and 90° are the limits of the scale of transposition for the original length t; *derived length* (delay of entry) is the name we will give to a transposition. Between 91° and 180° we get the retrograde of the derived length (180°—83°=97°; 180°—50°=130°; etc.).

Example 16



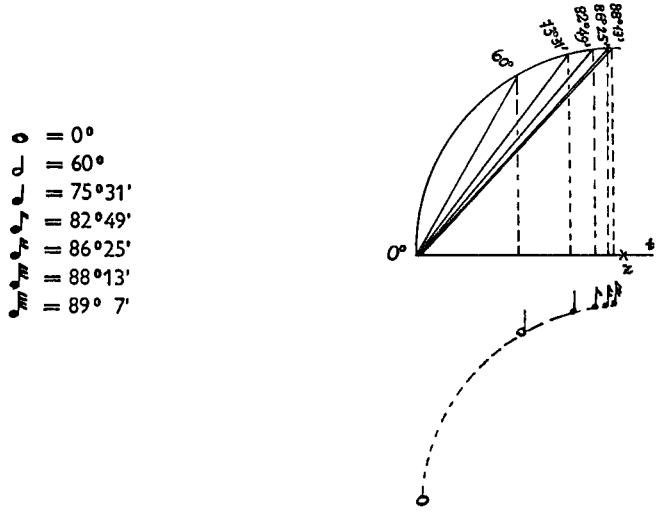
and between 181° and 360° we get a repetition of the transpositions from 1° to 180°.

Example 17



From 0° to 90° the original length is shortened. A derived scale of lengths can be formed with the angles of rotation; and it would also be possible to make a proportional scale of the lengths from 2:1 of the traditional notation:

Example 18

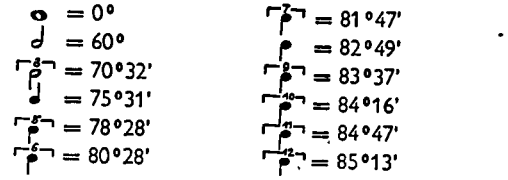


Here we have an unending series *converging* on 2 (infinite number of members with a complete number as sum):

$$1+\tfrac{1}{2}+\tfrac{1}{4}+\tfrac{1}{8}+\tfrac{1}{16}+\tfrac{1}{32}+\tfrac{1}{64}\ldots\longrightarrow 2$$

So, rotating through 90° we arrive at the length 0.

A *diverging* unending series: $1+\tfrac{1}{2}+\tfrac{1}{3}+\tfrac{1}{4}\ldots$, in which the sum of the members is larger than a pre-determined whole number, has the following equivalent in a scale of angles of rotation:



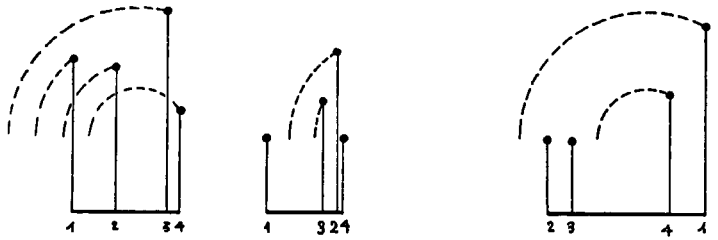
This converging unending series is a harmonic series, whose function—be it for frequencies, lengths, tempi or timbres—can be articulated by means of a system of angles of rotation.

But a system in which—by means of rotation—a series of intervals of entry is transposed only into smaller values results always in acceleration. Therefore it is necessary to combine the system of rotation with other processes such as will allow of an *increase* in the sum of the intervals of entry, in other words, deceleration. For this purpose we have to introduce different vectors with simultaneous rotation for each time-dot. In this process several speeds of rotation are superposed, and these prevent any *harmonic* transpositions of the original lengths (i.e. where the diminution of the delays of entry is proportional to the diminution of the total length). In example 19a we

observe the rotation of four time-dots with different angles of rotation. If we number the dots we can see that the original order has been permutated; the diminution of the delays of entry is not proportional to the diminution of the total length. In example 19b the rotation only affects the dots that lie between the two extremes; the total length is unaltered. In example 19c it is the outer time-dots that rotate, the others stay still, and the total length *has* changed. All these sorts of derived lengths will be referred to as *non-harmonic*, since the alteration of the original shape does *not* affect the relationship between the delays of entry and the total length *proportionally*.

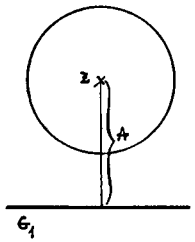
[In example 19a there is a mistake in the numbering; 1, 2, 3, 4 should read 2, 3, 1, 4].

Example 19



The application of different speeds of rotation for each individual time-dot means that the rotation of the series of dots is independent of a common vector serving as a single axis of rotation. Different angles of rotation automatically result in different axes of rotation. The speed of each individual dot can always be found out by the number of rotations or by the angle described by each point in its path from identity to identity. 90° cannot be regarded as the limit of the transpositions since retrogrades and repetitions at 0° and 360° can be avoided by means of different speeds in simultaneous rotation. This exclusion of a common vector makes it possible to use a process that results in an augmentation of the original lengths. If now, instead of the perpendiculars, we extend the vectors in all angles onto a common straight line G1 underneath the circle, we have abolished the limit that was given before by the distance between the outside dots (i.e. the diameter of the circle).

The augmentation of the sum of the lengths (delays of entry) on this straight line is determined by two factors:



(a) by the angle between the position 0° or 180° and any position between 180° and 360°: the smaller the angle, the longer the extension of the vector required to reach the straight line.

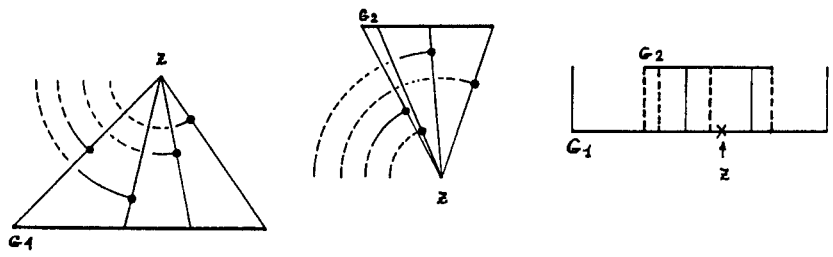
(b) by the distance A between z and the straight line: the longer this distance, the larger the sum of the delays of entry.

Extensions of vectors between 0° and 180° intersect a straight line G2 above the circle.

By overlapping two or more straight lines one can achieve a higher density of delays of entry. (It is not necessary to use all the dots that result from this overlapping procedure; higher density is achieved even when certain areas of the straight lines are 'filtered' or various individual dots are left out).

Example 20c shows the overlapping of G1 and G2 that results from the examples 20a and 20b:

Example 20



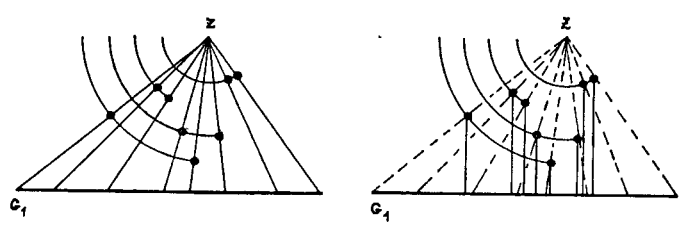
(a) (b) (c)

In example 21a we see how—with the application of different speeds for each time-dot of the original order—it is possible to co-ordinate two or more intersections (given by the various angle-positions) on a single straight line, without having recourse to a corresponding number of straight lines (though the tendency to diminution leads to 'strettas' of the original delays of entry when two or more 'harmonic' transpositions are overlapped). If diminution is the only result of a transposition, each entry delay has a characteristic effect; successive transpositions then only provide faster periodicities that are clearly perceptible in the overlap.

Different speeds of rotation for the individual time-dots allow us to compose larger or smaller 'density zones' in a single superposition, without repeating any characteristic interval. The density zones are dependent on whatever angles of rotation are applied, on the number of superpositions, and on the assimilation of the 'harmonic' transposition to these superpositions.

Example 21a shows two superpositions on the same straight line; example 21b shows the same with the delays of entry of the 'harmonic' transposition.

Example 21



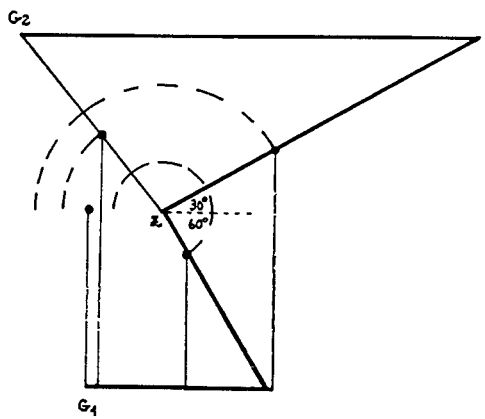
(a) (b)

The application of a straight line above as well as a straight line underneath produces symmetries similar to those in examples 15-17. There, the limits of the scale of transposition of the original length t were 0° and 90°; from 90° to 180° retrogrades of any of the transpositions reached in the derived lengths could occur. Since retrogrades can be avoided by means of different speeds, let us now follow the position of the angles in relation to the 0° position. Every dot determined by an angle whose one arm is drawn as a vector as far as G2, can be superposed on a dot on G1, when the same angle is mirrored symmetrically below the 0° position (e.g. 45°-315°).

To mirror dots that lie on the same straight line, a vector has to be extended as far as the opposite straight line; in this case the resulting angles are supplementary, i.e. they add up to 180°.

When the rotation position divides 90° into two unequal parts, the projection of dots onto a single common straight line can never produce a superposition. Example 22 shows two complementary angles (adding up to 90°) of 60° and 30°. The derived lengths have been drawn in:

Example 22



When the angles add up to 90° it is not necessary for the 0° position to be regarded as one of the two arms of the angle. The right-angle can be shifted; in this case the two arms of the angle have been extended as far as the straight line above and/or below the circle.

The fact that complementary angles are independent of the 0° position, permits us to use it as a module. (Two pairs of complementary angles make up two supplementary angles; the resulting retrogrades can only be avoided if every vector (arm of an angle) constitutes the axis of rotation for a different dot.)

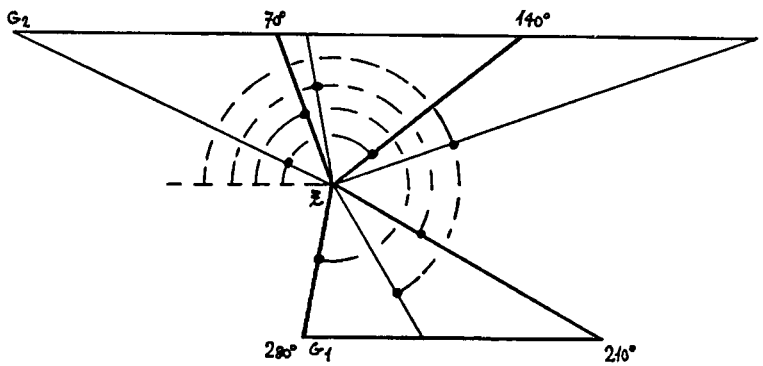
The principle of complementary angles can also be applied to pairs of angles that add up to less than 90°. The angles in question can be freshly defined for each process of rotation, thus enabling one to obtain a differentiated articulation of the lengths. The angle regarded as the sum will be referred to as the module-angle.

Having decided on a module-angle, its relationship to 90° and 180° must also be fixed; if the module-angle is contained *n* times in a complementary angle, retrogrades result (for example, 9×10°, 6×15°; 9×20°, 6×30°, etc.).

In example 23 the module-angle is 70°; it is made up of the following pairs of complementaries:

25° and 45°		10° and 60°		20° and 50°		30° and 40°
70°	+	70° (140)°	+	70° (210°)	+	70° (280°)

Example 23

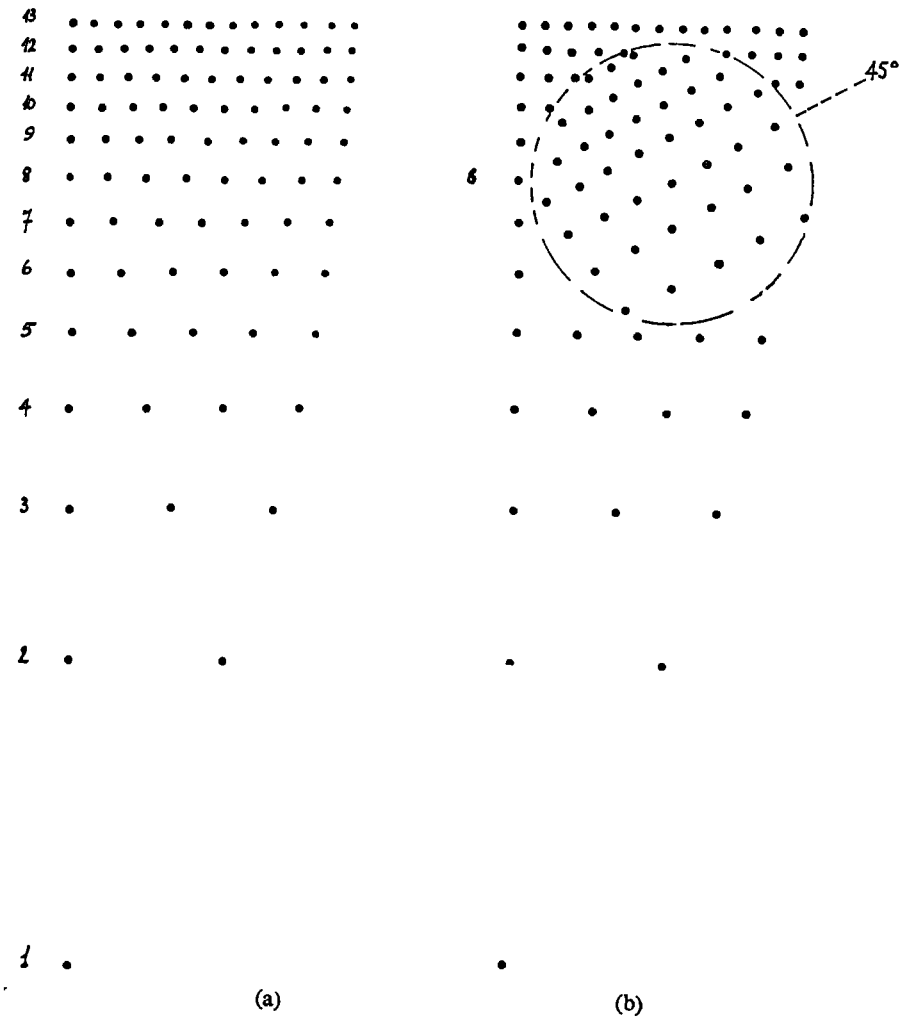


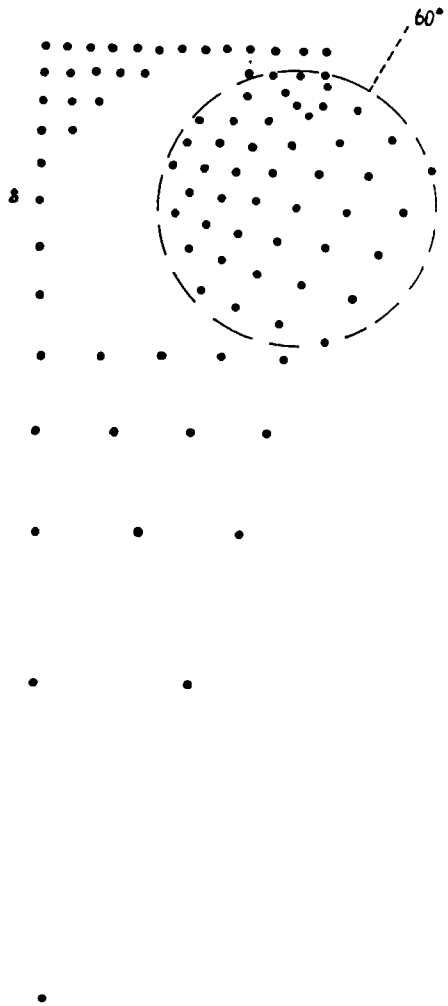
Apart from module-angles, one can also use certain proportions for the purpose of transforming a series of delays of entry (7). In a process of rotation, every angle corresponds to an interval of time. The number and size of the angles determine the changes in the delays of entry, which is why we have thought fit to provide the above sketches of the various possibilities for the articulation of these changes.

By means of translative and rotative procedures one can progress from fixed, determined time-dot-structures to constructional processes of quite a different sort, which then produce bendings, contractions and stretchings in a particular flow of time. Example 24a shows the paradigm phase of a time-spectrum with the formants 1 to 13 in (logarithmic) order. The space between two formants is equal to that between the individual dots of the lower of the two formants (as with the projection of the frequency abscissas in example 10). This concurrence of the single entry delay and the vertical distance between formants can be compared graphically with the presentation of the relationships of the harmonic series (or series of partials) in the realm of frequencies. When the distance between the formants is drawn as a constant, the formant rhythm in the vertical is no longer congruent with the structure of the time-spectrum (the time-dots of each formant are delays of entry with duration included, presented on an illusory surface). This mode of presentation enables one to rotate sections of this spectrum around a time-axis; this time the rotation does not provide any regular grid—it results in a surface with a certain density-gradient as a continuous acceleration.

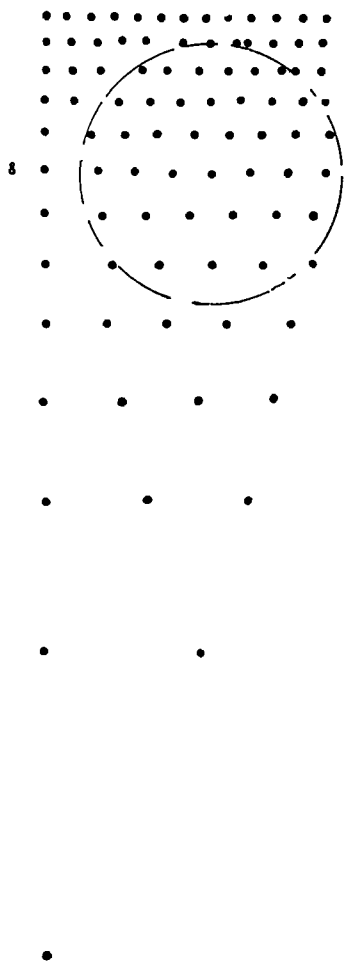
Example 24b shows a rotation through 30° of a circular area with its centre in the middle of the eighth formant. The area between the sixth and twelfth formants first accelerates the projected periodicity of the basic phase, and then slows it down. The interpenetration of two areas of a time-spectrum is shown in example 24c (coupling of straight line and circular shifts) and 24d (simple translation of the same area)(8).

Example 24





(c)



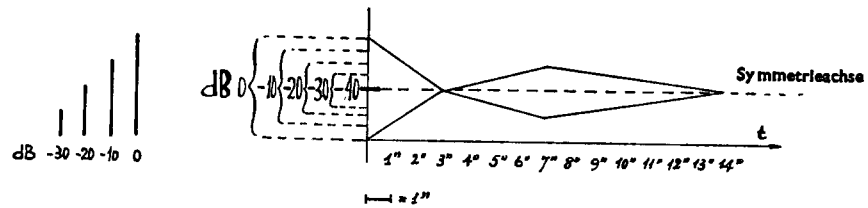
(d)

III. *Space-dots* (timbre)

Changes of timbre by rotation are best obtained by means of electro-acoustic processes. Partial tones and their amplitudes can be varied by a process of rotation as follows: the selected partials are ordered in a scale (in example 26 from 100 cps to

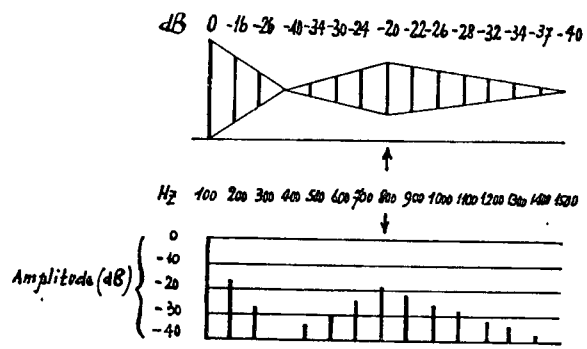
1,500 cps); for the amplitudes we will use a hairpin-type of dynamic notation—it is divided into two equal parts by a horizontal axis, and the breadth is measured in decibels (dB) (see example 25). The maximum breadth of the hairpin is to be equivalent to 0 dB; the point where the two halves of the hairpin meet represents −40 dB. If we set up an equivalent measure in centimetres for one dB (A=abscissa), and an equivalent measure in centimetres for one second (t=ordinate), we can establish an amplitude for every point in time.

Example 25



If we substitute f (frequencies in the series of partials) for t, and measure A (the amplitude) for every partial, we get a stationary sound spectrum:

Example 26



For the purpose of observing the variations of timbre produced by a rotation of the hairpin, we will draw two lines from the extreme points of maximum amplitude (0 dB) parallel with the horizontal axis of the hairpin (the axis of rotation). The hairpin rotates about an axis—for example, the dot above 800 cps—but the space between the two parallel lines represents an area of amplitude which remains fixed and independent of the rotation. Two interpretations are possible:

(a) whatever part of the hairpin remains *inside* the area of amplitude, can give the amplitudes of the partials; or

(b) whatever now appears *outside* the area of amplitude can give the amplitudes of the partials.

A series of angles of rotation for the hairpin can be defined by means of a proportion (e.g. 2:3). Thus we get the sequence:

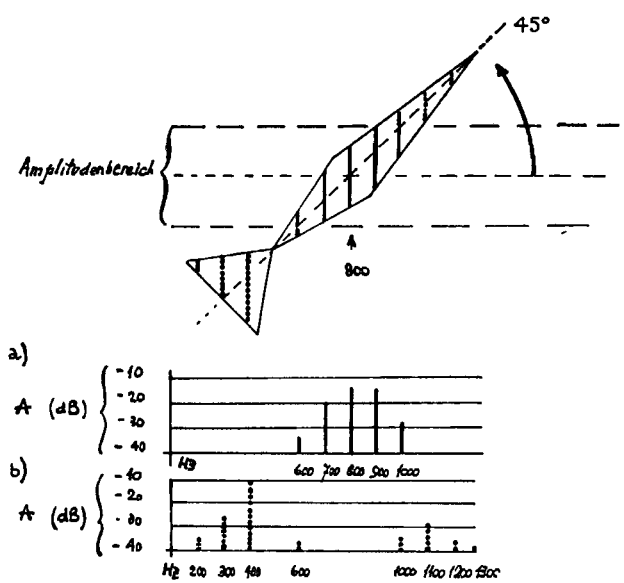
0°	20°	30°	45°	67.5°	112°	168°	252°	18° (378°) . . .
1	2	3	4	5	6	7	8	9

We will select 45° and 252° (4th and 8th members of the sequence) for the following examples.

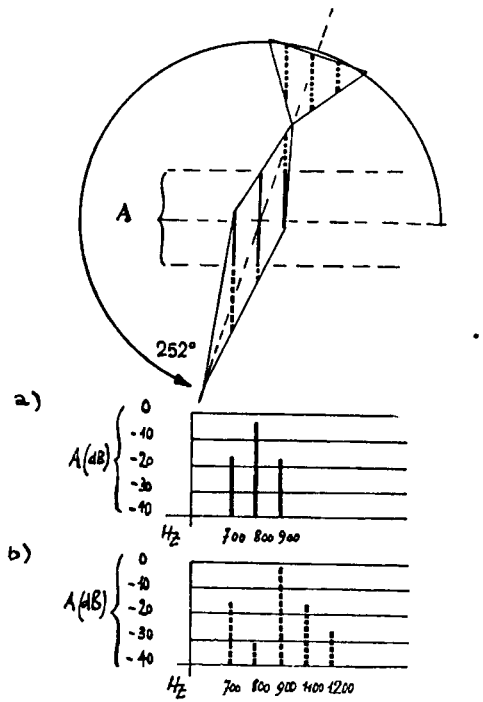
The length of the axis of rotation (diameter of the circle in example 27, divided by the angle of rotation) is to represent a defined duration t. With the diameter we can also get the circumference of the circle, $t \times \pi$; the circumference measured in cms corresponds to the duration in minutes of arc. By means of this procedure the speed of transformation of a timbre is incorporated in the process of rotation. In this case rotations combined with various co-efficients of t serve to articulate shapes which are governed by the relationship between t and the angles of rotation. If t has a defined duration, every angle of rotation (as an interval of rotation) has an equivalent time-interval which is proportional to the duration established for 360°.

A consistent procedure results from both intervals (∢and t). In examples 27 and 28 we can follow the transformations in timbre-spectra: t=14″ (example 25); amplitudes and frequencies are read off for the angles of rotation 45° and 252°.

Example 27

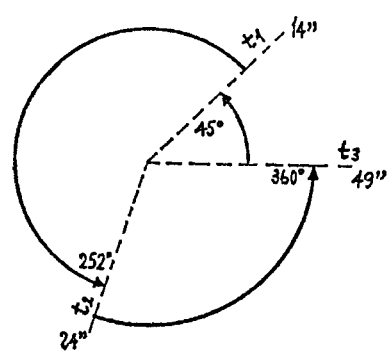


Example 28



It is not absolutely essential for a rotation to retain a constant tempo. t can change; for example t_1=14″ from 0° to 45°; t_2=10″ from 45° to 252°; t_3=25″ from 252° to 360°.

Example 29

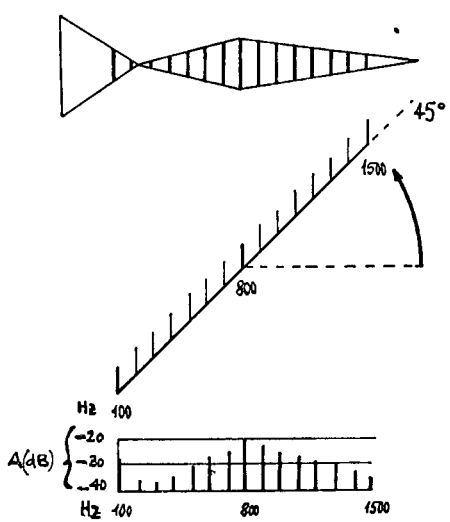


It becomes clear from the examples given that the results are very different depending on whether one takes the widths of the hairpin that lie *inside* the area of amplitude or the widths that lie *outside* it, or both. When angles of rotation are chosen that approach 0° or 180° the amplitude differences become hardly perceptible. (At 0° and 180° the amplitudes are identical.) Further, the results for frequencies and amplitudes are determined by the shape of the hairpin (or envelope-curve). The frequencies of the basic spectrum are to remain constant throughout all possible variations. If we start with harmonic or sub-harmonic spectra, every new angle of rotation is going to have a direct influence on the turning timbre, corresponding to the number and order of the selected partials (even-numbered, odd-numbered, or alternating) and their position in the spectrum (low, medium or high register).

However, when the frequencies do not fit the grid of the harmonic or sub-harmonic spectrum, and form an un-harmonic spectrum, then the rotations of the amplitude curve affect not so much the resulting timbre, as the particular frequencies themselves; the result is then perceptible as a dynamic variation in the components of a chord(*).

If, instead of the hairpin, we now turn the frequency scale (ordinate), we get—with the same angles of rotation—different results. The different results for amplitudes show the difference between the two different sorts of rotation. Whereas the frequencies of the spectrum are arranged graphically in a line, the amplitudes in the hairpin have 'breadth'. So the frequency line serves at the same time as an axis of rotation; the amplitudes describe a circle around their axis of symmetry. The process of composition is then decided by the selection of one of the possibilities offered by rotation round one axis or the other. Transformations can also be obtained by rotating both the frequencies and the amplitude curve at the same time; these transformations are different again from those described above, even though the angles of rotation are still the same. In

Example 30



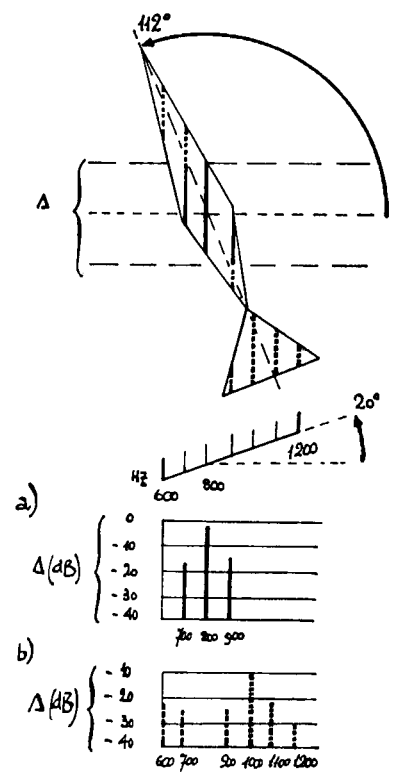
this case the *direction* is decisive; with a double rotation, it is the speed with which both axes turn that affects the total process.

If both axes turn at the same speed, we see that the original spectrum becomes altered. The parallelism of the axes of rotation does not prevent the relationship between each frequency in the spectrum and its amplitude from being different each time, because the area of amplitude always remains in its original position and measurements are always taken vertically.

There is however no possible variation in the amplitudes when both axes of symmetry rotate in the same direction with the same speed and the area of amplitude does *not* remain in its original position, but follows the rotation in company with the hairpin. The duration of the sound is shortened in proportion to the angle of rotation.

The determination of different angles for the simultaneous rotation of the frequency axis and the hairpin depends on the degree of transformation that is required. The shape of the amplitude curve determines the speed with which a particular transformation of the original timbre is reached. Complex envelope curves with many maxima and minima have a much larger capacity for variation than relatively simple envelope curves.

Example 31



The angles of rotation that we have applied in example 31 came from the previously derived proportion series 2:3.

All the above examples are easy to execute with electronically produced tones. Turning timbres constitute a problem which finds its simplest solution in composition with electronic means.

> Complete projection in space is not yet available in electronic music; but one can only imagine 'music in space'—a space without holes—where this complete projection in space is a constitutive element in the composition. Our present space is made up of several tracks which, with the aid of strategically suspended loudspeakers, provide some sort of substitute for an imaginary continuum. An organization of the mobility of sound by means of turning timbres will then be a specific category of the concept 'musical space'. Some of the principles of rotation explained here can be executed in space even with the primitive technical means at present at our disposal; a 'muted' spatialness does nothing to interfere with our perception of space. Although this 'muting' has proved itself a very musical business (the mute on a violin still allows the timbre of the instrument to be recognized), it is nevertheless a stage that will have to be superseded.

When the fundamentals and partials of a spectrum have been fixed, each frequency has its own amplitude; the superposition of these gives the general envelope curve of the spectrum. The same procedure can also be executed in instrumental music[10].

Postscript, by way of a footnote

We have characterized translation and rotation as only two of the many possibilities for the representation of the emergence of form and its evolution. Thus all the above examples are merely preliminary reflections on the subject; the choice of a method is not to be identified with a complete declension of the method. To define exactly the concept 'form' in its effect on all musical aspects, one would have to include a sort of *ad infinitum* in the definition, a status nascendi. The fact that both Boulez (Third Sonata) and Cage (Piano Concerto) describe their works as 'work in progress' indicates (not because the two composers represent aesthetic antipodes) a generalized conception of the current idea of form. 'Progress' in unobtrusive homage to Joyce; what they are actually thinking of is surely the unfettered growth of a musical form.

The problems connected with this 'unfettered growth' seem to constitute a psychological factor of composition; if a work is limited in respect of its duration and the extent of its form, this excludes functions that were always a part of composition: the more one regards the concepts limited-unlimited as a duality, the more uniform do the established footholds become. Limited-unlimited are not reciprocal values of determinate-indeterminate or unambiguous-ambiguous—which is the current association in musical jargon—but rather a hanging on to or letting go of processes (so far applied more in the technical primacy than as gesture) that are in constant control of the construction of the form and its duration. (There certainly exists a common genealogy between the Wagnerian idea of extending endless melodies by means of renovation, and the present-day procedure for finding endless form articulations by compromise with combinatory technique and the appropriate chance repertoire—which we quite consciously accept).

This striving for endlessness in the duration of a piece of music will perhaps be compared later with the false endlessness of Rennaissance perspectives, which, as Henri Focillon writes, 'playing with themselves, they work against their own ends'. But as long as formed duration is a problem that only reflects the most obvious part

of the evolution of form, all processes that determine the temporal function are going to stand in need of further development (dynamics included, both in the department of the amplitudes of individual sounds and in the department of the amplitudes of the components of a sound which determine the timbre. Actions of various significance should also be included, together with their reactions on each other). In the matter of rotating note-dots, the vertical and horizontal can only be materialized in fixed positions; the inclusion of circular shifts[2] resolves both dimensions into moments of a rotation: *simultaneous becomes successive and vice versa.* Change of register in the vertical with simultaneous alteration of the horizontal becomes the constant norm: this is perhaps the broadest basis that rotation can give to formal thinking. Between chord and melody there is not only one arpeggio; between its point of departure and its return to identity the basic shape describes an endless number of stages: the movement introduces a multi-dimensional variability.

'Earlier it was thought that when a thing changes it must be in a state of change, and when something moves it must be in a state of mobility. Today we know that that is a mistake[11]'. This seems appropriate for the interpretation of the concept 'movement' in composition. (Movable strips of paper and turning discs make the score a 'mobile'; movable surfaces paralyse continuous movement.)

'What I call elements of the graphic representation are those that visibly belong to the work. This requirement should not be understood to mean that a work must consist of a number of elements. The elements should provide forms, but without sacrificing themselves in the process. Self-preservation[12]'.

November 1958-December 1959

(I have to thank K. H. Stockhausen for his help in editing this article.)

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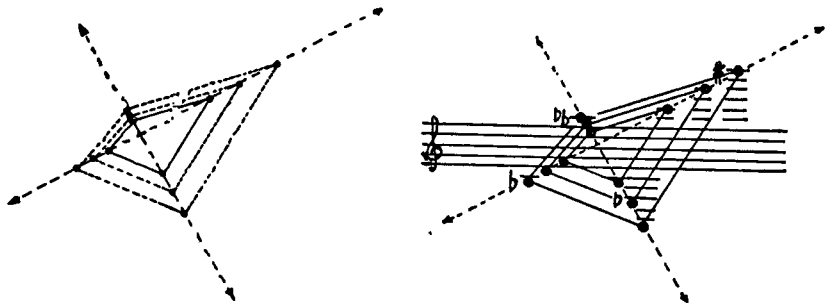
[1] 'Das Bildnerische Denken' (Pictorial Thinking) by Paul Klee—from which this remark is taken—should be confronted in its significance with 'Le Livre' of Mallarmé for the important connections with recent principles of formation. The important difference is that 'Le Livre' could not be considered the antecedent of a development in musical thinking without the illuminating studies of Jacques Scherer, which really follow through to the ultimate consequences. Klee's book on the other hand is a document that requires no commentary; his graphic explanations are at the same time the technique and dialectic of a language, and as such and because of the comprehensive experiments in the field of the evolution of forms, the book is well suited to serve as a basis for musical education. Our familiarity with this book has led us to no small number of observations—and it was not always necessary to transpose these into musical terms. Klee's pre-knowledge and prediction of serial and above all anti-serial music is more than pure chance. The reciprocal relations between musical and extra-musical problems are effective today more in abstracto than ever they were in the materialization: techniques, general solutions, single applications of processes from some other field—all these can be taken over in music with or without alterations. Only in such cases where the piece of music is a translation of a secret language or sounds like technological naturalism do we need to be reminded of music's capability of expressing itself with its own means.

[2] *Irregular shift* would be such a one as causes a deformation in the virtual outline of the basic shape (e.g. combination of different regular shifts affecting *partial* areas of the basic shape).
Our investigations are restricted to the effect of regular shifts.

[3] *Continuous shift* would be a shift such that the movement between original and final positions was audible as a time-interval. The continuity of the shift makes it possible to perceive the course of the process, i.e. an even dynamic alteration. Continuous shifts are not suitable for the present investigation since audible examples are not available. The most characteristic are spatial movements (e.g. from loud-speaker to loud-speaker); we do not wish to treat these here.

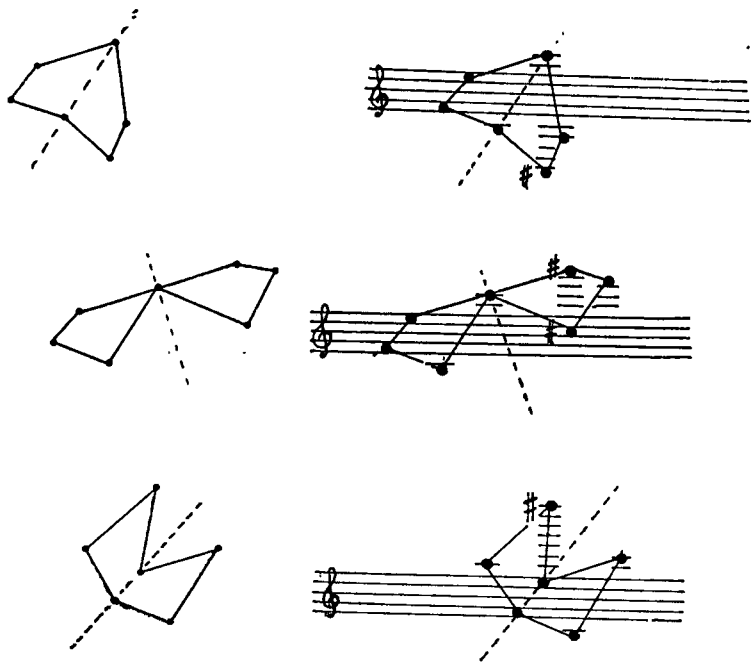
[4] There is a basic difference between shifts that take place only in the sphere of the audible, and those that are initially graphic and later acoustical. All categories of movement that entrain successive, temporal transformations in the basic shapes are determined as far as the direction of the process is concerned—e.g. from left to right; a shift can remain within a limited duration, so that an analysis of the movement is possible. When a basic shape is superposed on its derived form the shift remains in the visual field; the compositional sense should be understood as residing in the synthesis of a constructed reproduction. In the case of graphic shifts the derived shape can also stand on the left of the basic shape; the direction of a graphic shift is initially independent of the category that provokes the movement, and is also free from any connection with the flow of time. Such processes are made visible in the following examples; basic shape and derived shape are inseparable and are connected with an increasing or decreasing transition. Besides Translation (I) and Rotation (II) there are various subordinate *simple categories of movement;* almost all of them can be combined to form *coupled categories* (with the inclusion of regular and continuous shifts). We list the following *simple categories:*

(III) Stretching, or centripetal shift of the basic shape, with no change in the relationships of the outline.



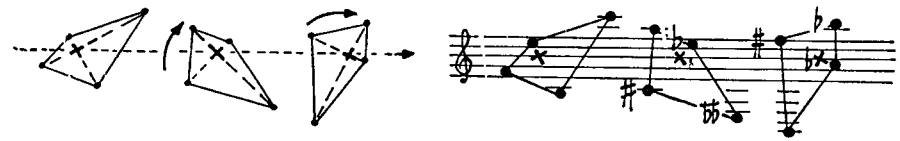
(IV) Jamming, or centrifugal shift of the basic shape, with no change in the relationships of the outline.

(V) Mirroring a basic shape on a mirror-axis (axis of symmetry). In the case of simple mirroring, the basic and derived shapes touch each other at the mirror-axis (vertical mirror is also called retrograde).



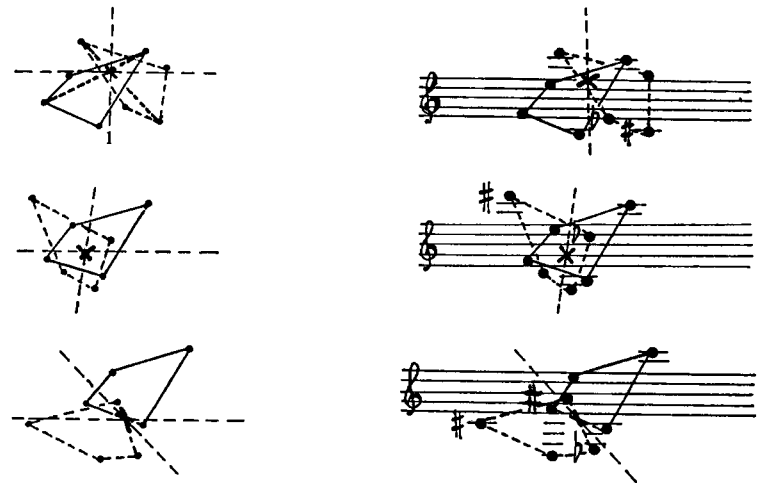
We list the following *coupled categories:*

Screwing, as a coupling of straight line and circular shifts around a screwing point and a constant axis of translation.



Rotation develops really as a changed principle of screwing—when one represents time as a (straight-line) sliding axis. If one hears successively the basic shape and a shape derived from it, this has the effect, temporally, of a turning in a certain direction.

Rotation and mirroring as a turning of the basic shape around one turning point and one mirror-axis.



The difference between this and the usual sort of rotation is that here the derived shape turns on top of the basic shape.

Rotation and spreading as a circular and centripetal shift (with regular or irregular growth of the basic shape) around a *spiral* axis.

Other coupled categories of movement could be: mirroring and spreading, translation and jamming, screwing and spreading, etc. All these categories of movement can be interpreted from the most various points of view. An investigation of all the combinatorial possibilities of these categories can only be justified by the intention to include them in a composition. In the main text of this article we have tried to dispense with a comprehensive and systematic treatment since, in view of the multiplicity of the resulting connexions, there is no room for such a development within the framework of this treatise. Our experience is based mainly on translative and rotative forms of shift (in the electronic piece 'Transicion I' and its instrumental pendant 'Transicion II'); these therefore are the object of our analysis.

For a complementary acquaintance with the principles of alteration of basic shapes the following literature can be recommended: *La Symétrie et ses Applications*, Jacques Nicolle, Paris, 1950; *Gestalt und Symmetrie*, K. L. Wolf and D. Kuhn, Tübingen, 1952.

Even today a large part of musical thinking rests on a symmetrical treatment of the material, and the effect of this on the formal elements. The difference between our attitude and earlier ones is that we now prefer the higher stages of symmetry. So we no longer have to find a 'golden mean' to which everything can be referred; in present-day composition we can achieve the highest equilibrium by means of a 'wandering mean'.

[5] The classical method of regaining the past in a piece of music is the reprise. Even when a reprise is varied it is not difficult to achieve the desired association with the music heard previously. No other method of accommodating the past in music is possible, without the use of repetition, for the 'experience of the past' consists above all in re-animating or bringing to mind the events, shapes and sounds (organized or not) that have already been heard previously.

Even if repetition were not an element of musical syntax that is difficult to incorporate into our present day musical language (chiefly on account of its aesthetic coloration), yet a revaluation seems possible. The strength of something re-experienced depends on the degree of variation of the reprise, on the new context in which it appears, and also on the memory of the listener. These three factors can form a basis for new principles of organization, if we consider not only musical elements but psychological ones as well. A reprise carries particular weight in the form, as even a 'quasi-reprise' of a section has to be chalked up on the account of 'formal articulation'; in such a case the ear performs of its own accord no mean poetic feat: it supplies the rhyme. (Perhaps that is why the favourite form in musical education is the Rondeau; making music is at the same time practice for the language lesson.) But there are aspects of repetition that—by means of coupled categories of movement containing translation—open up new vistas. A reprise of 'A' need not necessarily awaken (either in the composer or the listener) an automatic sense for formal organization by way of the association with the preceding 'A'. By presenting this 'A' simultaneously with a new event 'B' the intensity of our perception of what we have already heard is made dependent on the structural significance of 'B' and the duration-connection between the one section and the other.

In electronic music repetition and transposition are included and recognized as basic processes of composition. The transposing tape-recorder (which influences both pitch and duration) is one of the most important instruments in the studio. The unfolding of a sound-object on a variable sliding axis stimulated particular forms of transformation. Higher and shorter, or lower and longer can be coupled; the mechanical aspect of the method produces specific counter-methods for de-mechanizing the rigid schema. Therapeutic methods such as these in composition with electronic sound-processes can have an influence on the solution of analogous problems in instrumental music; where serialism has a traumatizing effect, one is justified in taking up with other determinations.

[6] We do not wish to identify note-dots with notes on the stave, on account of certain processes that are better expressed in terms of cps. In the following examples we do not retain the even temperament based on the interval $\sqrt[12]{2}$; nonetheless it is possible to present these processes in terms of the usual notation. Movements of notes always correspond to temporal changes; it makes no difference to the chronology of a sequence of note-dots whether it is expressed as frequencies or as notes.

[7] An angle of 30° between the axis and the 0°- position serves not only to establish the position of a point on the straight line; it corresponds as well to 30/360ths of the total duration that has been fixed for a single, complete rotation. The superposition of several different simultaneous speeds of rotation can determine the superposition of varous different total durations, so that the angles that are used do not depend on a common duration, but on the rhythm of rotation that is achieved in each total duration. This leads to a system of rotation in which the individual rotations are components of a total process of rotation.

[8] This new morphology can perhaps be described as '. . . how time *might* pass . . .' as a continuation of its real passing (see Stockhausen's article in 'Die Reihe 3').

[9] In the last two pages of his 'Harmonielehre' (Third edition, 1922) Schönberg indicates the necessity of investigating the function of timbre. In his remarks he attacks the separation of pitch and timbre as two distinct properties of sound. 'The pitch of the sound is nothing other than timbre, measured in one direction.' The consequence to be drawn from this remark is that timbre is to be measured, and based on a logic 'quite equivalent to the logic that suffices us in our dealings with melodies of pitches'.

It is remarkable that Schönberg does not mention the third of his 'Five Orchestral Pieces Op. 16' as an example of his experiments in measuring. Here his investigation of the 'harmony of timbres'—as one might call it—leads to the first result of the problem of a static-harmonic structure that is only articulated by means of dynamics, and is defined by the relation between the timbre and the register of the instrument concerned. This is the reason for Schönberg's underlining, in this third piece, the 'unbalanced sounding mixtures', which must not be levelled off.

The application of a block dynamic—i.e. a dynamic value that serves as a common denominator for all the instruments and in most cases does not represent an absolute dynamic value (*ppp* in the low register of the flute does not have the same value as the cor anglais' *ppp* in the same register, etc.)—underlines the *relative* character of a chord in relation to the overlapping and cohesion of the various timbres that it is made up of. Treatises on instrumentation occupy themselves with investigating the variety of different characters that a chord can have according to the way it is instrumentated. We do not wish to get involved in this question here, since timbre is an element 'that *serves* to . . .'. In the last paragraphs of his Harmonielehre, Schönberg presents a chord consisting of eleven different notes, taken from 'Erwartung': 'its effect is very soft, on account of the delicate instrumentation and the fact that the dissonances are placed very far apart'. In this example it is debatable whether the 'softness' of the harmony is the result of placing the individual notes of the chord far apart from one another. Any real mildness is effected by the dynamic level *pp* and the solo instrumentation. Re-instrumentated in *ff*, with piccolo E-flat clarinet, trombone and xylophone (among others) the chord would be deprived of any appearance of mildness.

[10] In his *Zeitmasse* Stockhausen articulates certain chords by means of different dynamic curves for each instrument. The danger of a static harmony is in this way obviated by a constant kinesis in the dynamics. The chord is thus 'coloured'. In the course of the work this method can be found by analysis to constitute an element which is subjected to the scale of changes which the composer uses to organize his material. A gradual multiformity of the dynamic aspect is to be remarked in every new superposition of long held notes, and this articulates an increasing 'density-flow'. The density of this change of timbre is determined by the *absolute duration* of each chord—which depends on the tempo—and by the chosen range of the scale of dynamics and the transition between values in this scale, which may or may not follow on from one another. The constant reduction of the initial durations and the increasingly explicit changes in the dynamic values are clearly perceptible in 'Zeitmasse'; therefore this process becomes a matter of paramount importance for the composition.

[11] Quoted from memory (Bertrand Russell?).

[12] See footnote [1].

MOVING PICTURES AND ELECTRONIC MUSIC

JOHN WHITNEY

I

The year 1940 marks the beginning of this short story. You could say it was a part of the story of the Western Frontier; there are traces of a frontier in it, if you like, and the feeling of a certain isolation.

Stimulated by the German and French avantgarde of the early twenties, I began work on my own, and was presently joined by my brother James, trying to make what was then known as an abstract film. My point of view was that of a composer; my brother was a painter. In Paris a year previously, René Leibowitz had acquainted me with Schönberg's twelve-note principles. Apart from this brief exposure to a new tendency in modern musical composition, we also possessed Ernest Krenek's pamphlet 'Studies in Counterpoint' and a number of recordings, including *Pierrot Lunaire*, the *Piano Pieces Op.* 19 and the *String Quartet Op.* 37 by Arnold Schönberg, as well as the *Lyric Suite* and *Violin Concerto* by Alban Berg. You could say that we were better acquainted with the spirit and essence of modernity in the plastic arts, including the German Bauhaus.

Our art was, by comparison, without historical precedent, and our apparatus was equally new and requiring invention. We considered it a natural aspect of our creative calling that we had to build the apparatus ourselves. This side of our endeavour we treated with respect; we carefully worked out designs, even for the external form of the instrument. Naturally we were prepared for the fact that formal considerations would somehow evolve as a result of the reciprocal play between us and the character of these apparatuses. And this is borne out when one observes how certain formal ideas emerged directly from the application of infrasonics—something we had thought out for the sound production in our films.

Our infrasonic instrument consisted of a series of pendulums connected mechanically to a wedge-shaped aperture. The function of this aperture corresponded to the normal wing-diaphragm on a standard film camera with sound. The instrument did not produce any audible sound. Instead, an optical sound-track of normal dimensions was exposed to the light, and, after being developed, could be played back with the normal projection apparatus.

The pendulum—to which the natural sine-oscillation is peculiar—was our sole limited source for the production of sound. Although the frequency range of our pendulum was only a little more than four octaves, the speed of our particularly slow drive-mechanism (for pulling the unexposed film across the aperture of the optical viewer) could also be varied within a range of several octaves. By switching over the drive speed, the pendulum could at the same time be shifted up or down in the frequency spectrum.

The pendulums could be adjusted individually to single frequencies. We soon discovered that the fairly slow oscillations of these pendulums could be measured by eye, and the weights could be adjusted for all the usual intervals. For example, it was a simple matter to count two strokes of one pendulum and adjust a second one so that it executed exactly three strokes in the same period; the two pendulums met at the same point after two and three oscillations respectively. Thanks to the mechanical connection,

any number of pendulums could oscillate simultaneously. In fact, the connection could 'mix' sine-oscillations without excessive distortion.

Composing for an instrument which—like ours—produced spectra of only a few tones had awakened in us the need to use our capabilities freely and to the utmost. There were of course other reasons, but it was this need for extreme economy that persuaded us not to tune the pendulums to a 'scale' which would not be used as a whole.

For formal reasons we decided to tune the instrument to a different series for each composition. This series could then be reeled off little by little in accordance with the horizontal flow of the musical structure. Also, the whole series or one of its parts could be played simultaneously. Note-mixtures (not chords) could be produced in this way whose timbre and components could be continuously varied by adding or subtracting different groups of frequencies. The commencement and cessation of the tones was affected by means of knocking or holding onto the pendulums, either suddenly or cautiously. Vertical and horizontal aspects of a composition were thus structurally related in a particularly lively way.

Since the drive-speed was so slow (sometimes only one picture in six seconds) it was possible to set around twenty pendulums in motion one after the other, and stop them, all during one picture; that is, within one twentyfourth of a second of performance time. It was even possible to set a small pendulum in motion for the duration of a particular number of oscillations of a slower one, and constantly to refer different phase-relationships (measured by eye) to one another. We soon saw that these clusters of transitory sequences of notes represented a rich vein of compositional possibilities. The dense clusters produced strange timbres; even when the elements of a group were spread out progressively in time, they were still audible as discrete sequences of notes in rhythmic order. We discovered that rhythm and pitch form a continuum. Our instrument could span the whole range. It became a structural foundation of our musical composition.

One further aspect of the sound technique should be mentioned before we describe the pictorial and spatial concept: at the very beginning of our film work we developed a method of recording four light-sound channels, initially to facilitate the recording of particularly complicated structures which would otherwise have been physically impossible to execute, even at the extremely slow recording speed at which we worked. The soundtrack was exposed during the second, third and fourth recordings with the film running at different speeds—in accordance with our system of notation.

It was possible in this way to understand a further aspect of the relation between time and pitch. The working of the instrument—chiefly consisting of the starting and stopping of the pendulums and the control of their amplitudes—could either be controlled according to the instrument-time (i.e. picture-speed) or the constant time: clock time. If we predicate a given interval of clock time, pitch and duration become functions of the recording speed. Thus the relationships between pitch and time were even more tightly bound up together, and consequently even more accessible as elements of the composition.

II

Our activity was not only musical; our first concern had after all been the design of abstract graphic compositions that, like music, existed in a time structure. We had

produced several abstract silent films before we began on the musical investigations described above.

The first complete film consisted of twenty-four variations on a graphic matrix. The potential action emerged from a very simple idea of movement. Figure one shows

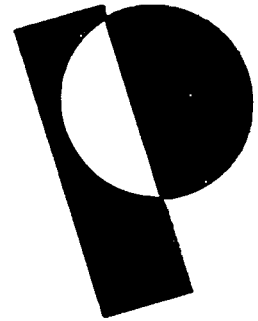


Figure 1

a diagram of the complete matrix, which actually never appeared in the film in this static form. This matrix was broken up serially as follows:

Figure 2

and produced with a spray gun; the forms of the matrix served as simple positive and negative models (figure 3). The resulting phases of movement were then photographed successively on black and white film.

This strip of film was in fact one of many possible serial permutations of the originally completely static matrix. We designed an optical copying apparatus for copying this strip of film on colour film with the aid of colour filters; forwards or backwards; upright, reversed or mirrored. This provided a graphic parallel with the transpositions, inversions and retrogrades of the twelve-note technique.

The first time my brother and I saw this short film after it had come back from the laboratory, we received the most satisfying stimulus of our whole film work. Within extreme limitations we saw our principles of composition beautifully borne out: the permutability of the simple graphic material permitted of enormous variety in the

compositional structure. We began immediately to develop the matrix idea on the assumption that the forms of serial permutation by means of inversion, retrograde and retrograde-inversion would be confronted with each other dynamically.

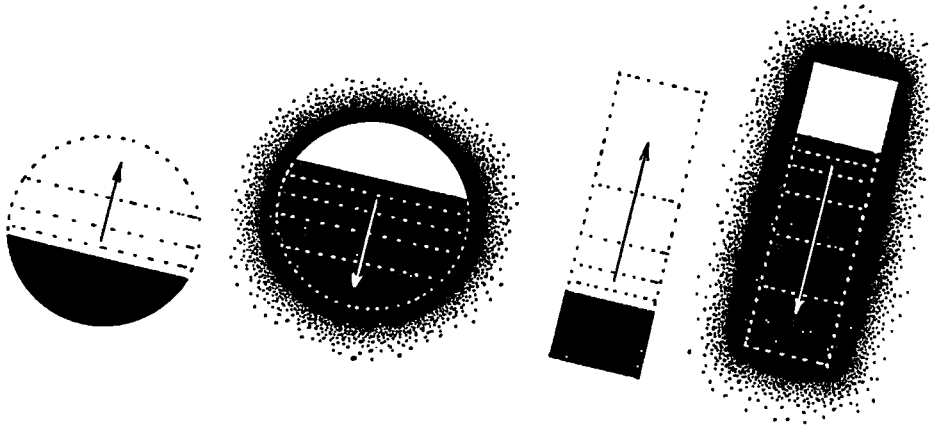


Figure 3

The following years were a time of constant discovery in the direction of a graphic basic element. The idea of a static matrix was modified and finally supplanted by other discoveries.

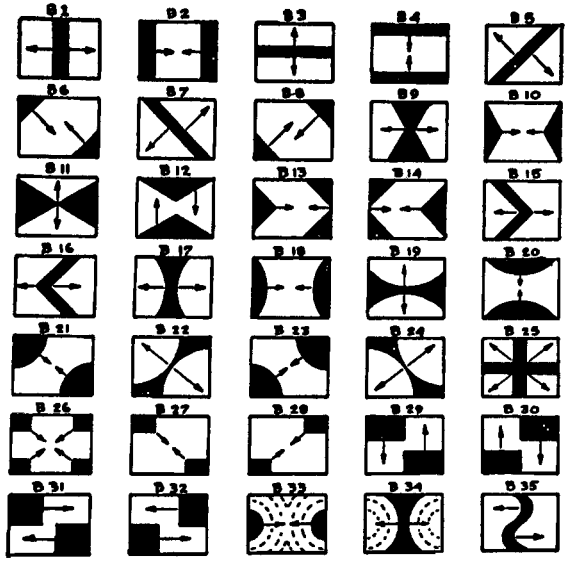


Figure 4

What is known as the 'dissolve' in film terminology opens up a lot of possibilities for element structures. The diagrams in figure 4 are taken from a catalogue of typical dissolves; their conventional function (nowadays somewhat passé) consists in

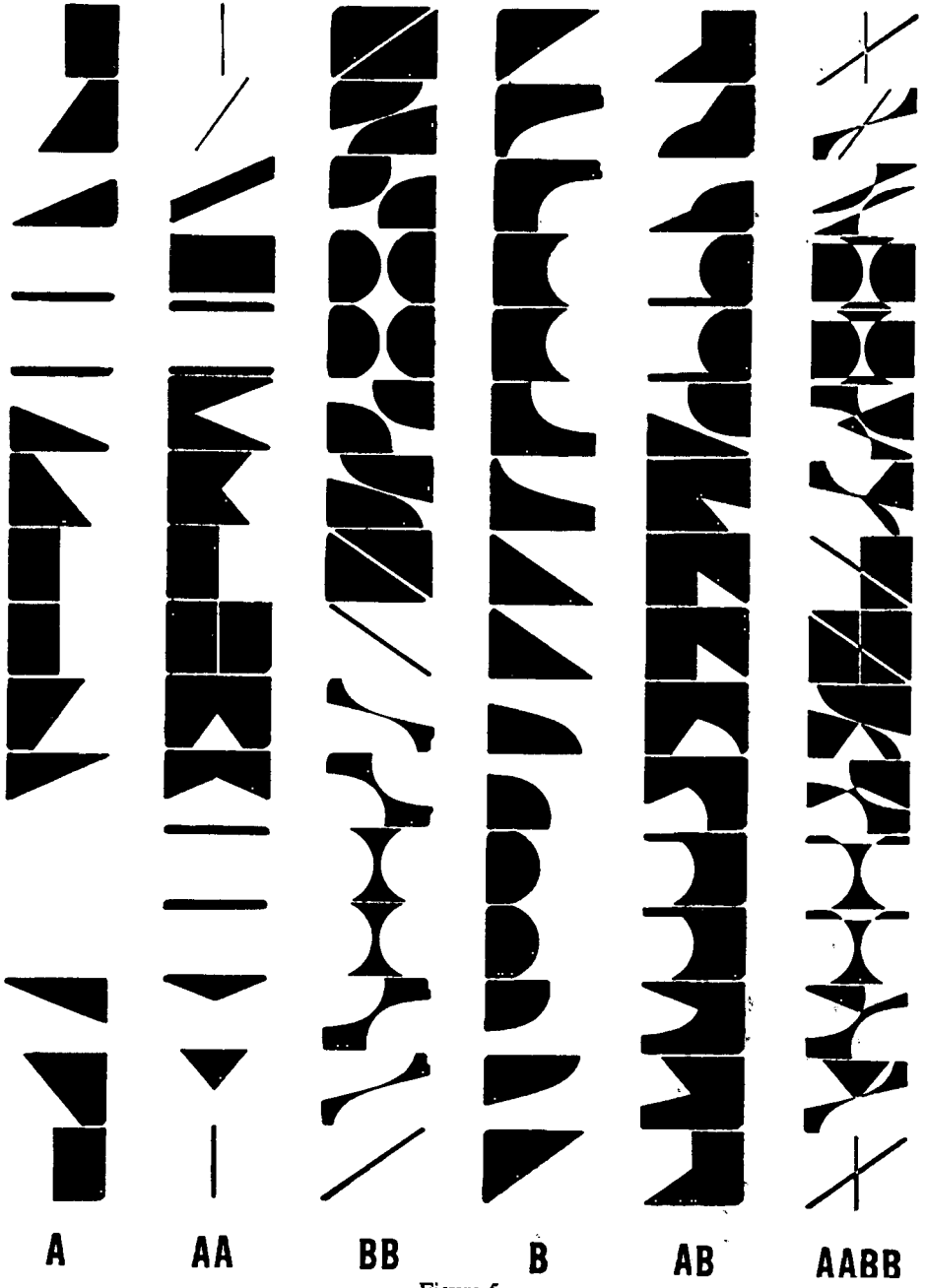


Figure 5

'dissolving out' one scene and simultaneously 'dissolving in' another one. Let us consider the line or wavefront between two scenes. Think of the black film that is often used for such dissolves. An abstract series of movements appears, black on one side, white on the other. Working only with black film we can arrive at a wavefront of very varied form, which cannot only move from one edge of the picture to the other, but is capable of complicated movement within the picture before finally disappearing —if at all—at one or other of the edges of the picture. If this black dissolve is carefully planned like a piece of serial music, and is used in its inversion, retrograde etc. we could get results like one of the sequences in figure 5 (these show only every twentieth picture in a film composition).

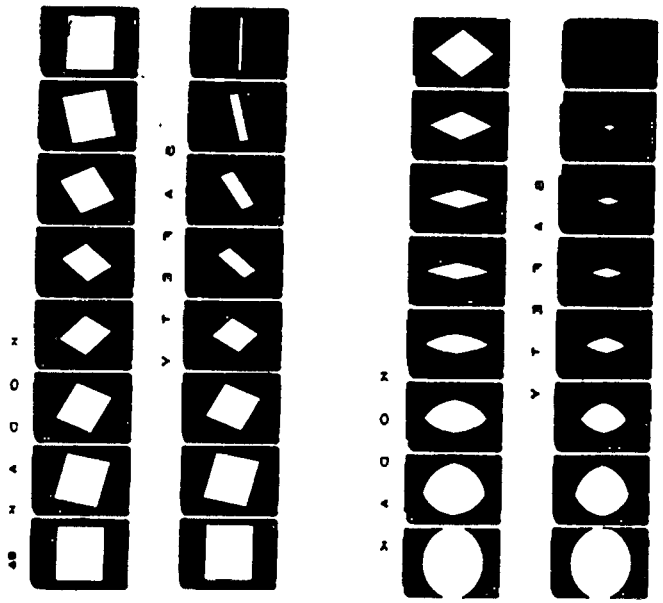


Figure 6

When a sequence is superposed three, four or five times on itself, the wavefronts get more and more broken up and finally separated from the edges of the picture (see figure 6), thus providing free, mobile forms in the picture field. In this way a whole graphic composition of movement consisting of several hundred pictures was derived from a simple strip of film.

It is significant that during the last couple of years we expanded these researches into something like a fundamental theory of movement by introducing a sort of speed-pointillism similar to the technique of jumping dots in television, in memory of Paul Klee's 'Pedagogical Sketchbook'. The mobile dot represents a more reduced and elementary dynamic than the preceding technique of dissolves. Still more; the aim of all our investigations of elements was to find a graphic block-schema or—still better—a fluid medium that would be as multi-dimensional and permutable as the sound-spectrum. Colour could, of course, only serve as one dimension of this medium—like intensity or pitch. It was our opinion that the problem was less a technical one than

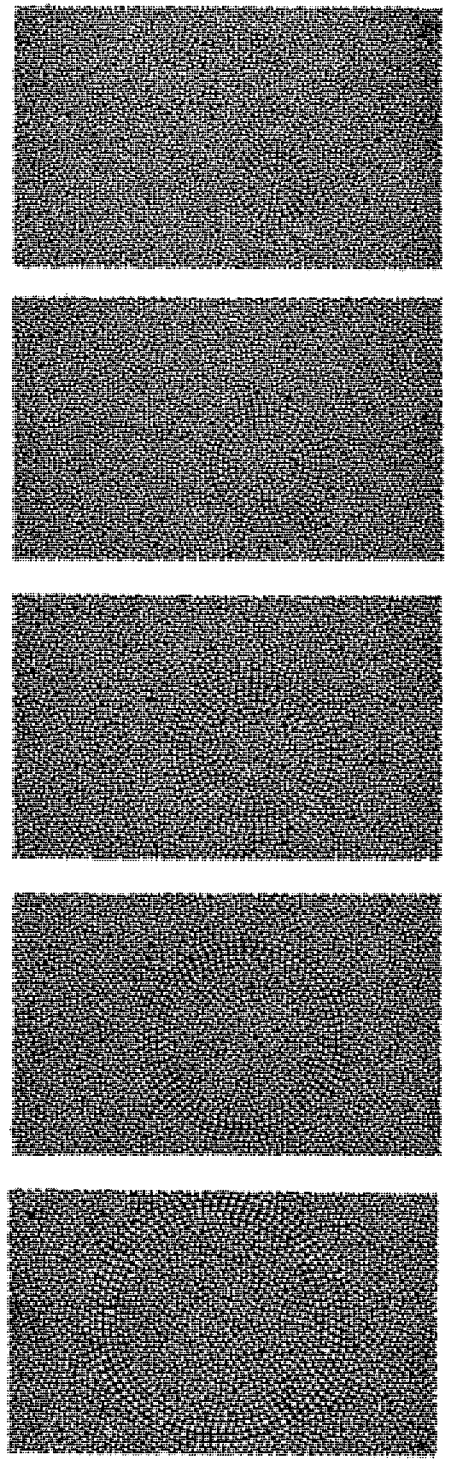


Figure 7 (a)

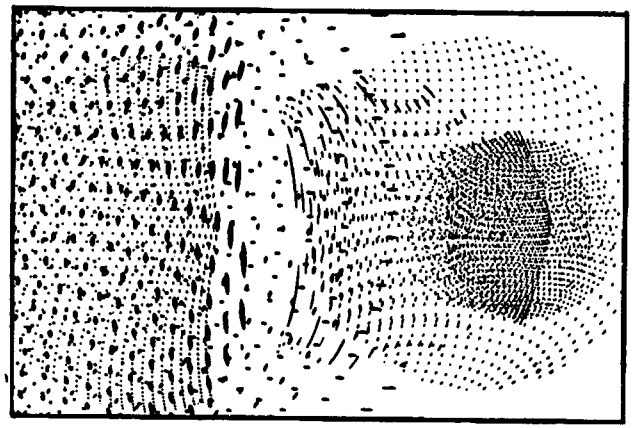


Figure 7b

an aesthetic one; in any case a question of form and moreover a matter of the artist's personal taste. We made searching enquiries into systems of modulation in the graphic arts as well as into technical systems ranging from the reproduction of tones of grey to the technique of jumping dots in television.

A space in which the intensification and volatilization of particles are the constant conditions; emerging and dissolving form; that is the basic idea of our present film work. Here one finds a relationship with the principles of electronic picture production. In fact some of the mechanical systems that we are experimenting with—such as the Lissajous pendulum and the Kampylograph—seem to be intermediate stages on the way to electronic systems (see figures 7a and 7b).

III

At the beginning of a discussion of the picture-sound relationship we must refer to the structural parallels mentioned above—however superficially. Naturally we had always attempted, where possible, to integrate common compositional fields, e.g. the basic time-units of sound and picture: in the single picture.

Another point is worth mentioning, not so important but perhaps symptomatic for the present stage of both arts—electronic music and mobile picture. It could be a help to such as are wont to ask whether sound is necessary to the picture (or vice versa), or whether any union is possible between the two.

There are limits which cannot be exceeded, wrote P. Boulez in the first number of 'Die Reihe', speaking of the public performance of electronic music: '. . . for psychological reaction of an audience to which the music is fed by loudspeakers can hardly be avoided where that audience is deprived of the possibility of associating a sound with a gesture'. Somewhat later on he asks: 'is it not then necessary to find new conditions for listening, or are we to contemplate the reuniting of this artificial music with a "visual double"?.' Vice versa, it seems that the composition of moving pictures stands equally in need of a 'doubled faculty of hearing'. Our first silent film, described above, was hardly ever performed, and for the following reason: In a hall with a 'silent' public, the fine, visual rhythms—even the whole structure—is destroyed

by the usual lack of a perfectly functioning sound apparatus. Visual rhythmic structures can only be perceived with the utmost attentiveness; any acoustic disturbance immediately negates their effectiveness.

So it looks as if the two fields have common problems, even if only in this business of the particular difficulties of the audience's reaction. But an inner relationship is also evident, and can be best brought out by a small investigation of the spatial conditions.

To begin with, graphic structures that move in space must not be confused with the 'representational space' that belongs to the long tradition of perspective drawing, etc. This was the reason we avoided photographing three-dimensional geometrical bodies, because a spatial negative would be *illustrated* and this would mean forfeiting all the possibilities of the moving picture. Illusion is destroyed in this sort of space; we know exactly what it means to see a film about e.g. a piece of sculpture, that moves to and fro 'somehow'.

Space does not exist without movement. Movement defines its depth. In general, a movement is directed towards the place of perception, or away from it. It is remarkable that in a graphic time-structure one has no time to take in at leisure the space surrounding the object, as one has in painting. Something that moves in the depth of any space seems to lead the eye in whatever direction it moves in. This faculty was similar to the route followed voluntarily by the eye when contemplating the motionless objects in a painting or a piece of architecture. The classical conception of painting rests largely on a kinaesthetic experience in the space that *surrounds* the painted object. Still more important is the fact that the ear can be 'guided' by a sound in the same way that the eye follows the route of an object. We found that these two routes could run parallel, or in contrary motion, or canonically.

More or less intuitively we asked ourselves if these requirements could be brought together; finally we began to compose graphic movement and sound structures along an escape-route in the depth of the space. Such parallels were common. But the matter did not rest at simple linearity. Other serial permutations ranging from complexes to note-mixtures consisting of only a few partials and ranges of intensity were employed, as opposed to 'types of action' that were referred to by us as 'radical' because motionless series of pictures were used in quite a different way from a single picture.

The construction of movement patterns that stood in mirror or retrograde relations to each other resulted in a symmetry around the vertical or horizontal axis. The axes thus produced, even though undefined, led us to the idea that vertical and horizontal representation could achieve particular significance as a foundation (Mondrian's 'constant relationship'). The caesura could be a return to the 'basic' representation. If one considers for example the dissolve structures and all the angles through which the wavefronts can move, one feels that immobility in the horizontal or vertical would be the same as a resolution in a maximum state of tranquillity or a stable equilibrium. Structures of tension in terms of movement, size, tone, and colour were ordered around these axes in symmetry or double symmetry on the basis of a graded dynamism of balance and tension.

That finishes the *resumé* of the considerations of space and picture-sound parallels that formed the basis of our compositions and came to be formulated bit by bit during

the course of our work. Before we begin the fourth part, which is to deal with present and future possibilities, there are two final points.

Until now, music has been dependent to a certain extent on played instruments, and these exert an inner, limiting influence—even if only a secondary one. Sound that is released from this dependence could occupy a spatial vacuum, whose dimensions would be determined by the graphic element. In contra-distinction to that described above, the problem of the psychic reaction in the concert hall, if eliminated, acts in favour of a new audio-visual experience. Our interest in synthetic sound-sources was the consequence of decisions taken after various experiments and failures with existing music, whether primitive, exotic or cultivated.

It is not my opinion that this contradicts the remark that moving pictures with electronic music represent the natural continuation in the present situation of the traditional relationship of music and dance. In fact it is significant that dance also, otherwise inseparable from the stage or at least the flat ground, is liberated in a spatial sense. Boulez, of course, has the last word; this 'liberation' does not mean any new freedom, '. . . there is merely a shift of the fields of action'.

IV

Frank Lloyd Wright is supposed to have said, speaking about abstract film in general, that it was the icing for an unbaked cake. It is my opinion that this remark applies exactly to the present situation, although I am not particularly familiar with the increasing versatility of the more recent electronic brains. On the one hand it is abundantly plain that one could set up chains of calculations that would promise an extremely imaginative realization of sound and picture structures. On the other hand one has to consider—not without a feeling of resignation—that these possibilities are condemned to virtual impracticality owing to the vast demands made by national projects. The situation is still so 'half-baked' as to awaken serious doubts as to whether abstract film, for example, is still *worth* our undivided attention.

The electronic brain is chiefly a means to control and information. It can be equipped with all the information necessary to supervise the working of a new kind of chemical factory, for example. After the factory has been erected, the brain can be programmed to control the daily chemical processes. But it could equally well be programmed to carry out all the actions of tone-production, synchronization, montage, mixing and editing, and could probably procure for the production of electronic music the inestimable advantage of immediate playback. It could also seek out optimal points in certain parameters, or open up fields of possibilities of which the composer would otherwise have remained unaware.

The construction of an electronic brain specializing in a visual medium offers remarkable advantages that stand in a significant relationship to abstract painting. A fairly large number of abstract painters, particularly in America, is interested in 'action'. When there is any discussion at all on this subject one finds a mute agreement about the idea of the play or mutual influences in the course of the *actions* of painting and composing. Well, there exist methods for the dynamic modulation of abstract pictures, i.e. the technical means for manipulating a composed moving picture, for example one filmed with a movie camera. One can surely envisage the hypothetical possibility of performing this sort of 'mobile painting' with an apparatus that can

not only photograph actions and play them back immediately, but also permits of later superpositions and selective erasing.

The painter of today would be very pleased with the possibility of composing a moving picture in front of his eyes, just as he would normally paint on the canvas. Strangely enough, the critics, whose attitude to the abstract movement is either sympathetic or negative, have stumbled on this possibility of dynamic design; they either set it up as the aim of abstract painting, or condemn it as being its end.

It is peculiar that a new style of 'performance' in the field of moving pictures should put in its appearance at almost the same time as a breakthrough in the development of electronic music. In the optical sphere it might be possible to adopt an ensemble type of technique similar to the technique of electronic music whereby the polyphonic impression of a music-making ensemble is achieved.

I believe this possibility offers certain advantages that make it worth a thorough investigation. I am preparing for the University of California in Los Angeles a group experiment to be devoted to performance technique.

Six to eight people are to rehearse in front of individual television cameras; each produces his own moving picture. The individual pictures will be combined with an electronic 'mixing panel', for dissolving them in or out and changing the result by mirroring, reversing, enlarging, reducing and other means.

The aim of the whole would be to increase manual skill, comparable to the skill of a good chamber orchestra. One would practise alone and with the group. The music would be composed as an element of the whole work.

The synthetic material, produced electronically, would be introduced during the live performance as an additional element; just as, of course, the picture material for a film. The final performance would be recorded either magnetically or optically. The film could also undergo further treatment in the laboratory, and be submitted to the usual editing processes.

It is to be hoped that the partnership of sound and picture will attract the attention it deserves in artistic circles. The problem that confronts the individual consists of a number of difficulties whose acquaintance he may already have made in the course of his experiences in modern music or painting. Whether the necessary technical apparatus will always be placed at the disposal of the artist is a question that touches on an elementary problem, whose solution lies hidden in the darkness of the future.

PROJECT FOR 200,000 INHABITANTS

RAINER FLEISCHHAUER AND JÖRN JANSSEN

Since the end of the 18th Century we observe an increasing separation between the various art-forms. Each tends to find the pure articulation that fits its own specific material.

This is an opportunity for us to make our present position clear.

Karlheinz Stockhausen defined music as 'articulated time'. Developing consistently he has now come to include space amongst the parameters of composition.

If we take our sociological structure into account, we see that even now it demands different methods of performance and presentation for music.

Music, literature, the plastic arts, science and technology have much in common in their structure.

In this context we would like to offer one product of our work.

The subject matter is a special programme; but in this project for Karlsruhe we believe we have stated our position with regard to a general problem.

We regard the project as a design for ordering a large organism. This order, shown here only in its general outlines, should regulate the organism right down to the smallest details.

In this project we have attempted to find a solution for the re-building of Karlsruhe after its destruction in 1944.

At that time the state of the remaining buildings, and traffic and maintenance services, was such that they could only survive a maximum of fifty years.

A plan made with a longer term in view could not, therefore, take this remainder into account.

The location of the new urban organism is thus not the same as that of the present town.

The town could thus develop according to its own needs.

The new plan was not burdened with the necessity for compromise.

Material of the new plan

1. Sociological structure of human society
2. Position with regard to
   (a) given facts of nature:
      1. topography
      2. vegetation
      3. climate
      4. geographical situation and orientation.
   (b) given artificial facts:
      1. traffic network
      2. economical and political foundations.
3. Internal functions
   (a) of technical traffic of all kinds—transport of goods and people, maintenance, development, etc.
   (b) of human life—material, biological and spiritual needs, growth, etc.
4. Architectonic material
5. Given technical facts of building.

Method of planning

1. A statistical comprehension of all peculiarities and requirements (listed above) of the material.
2. Evaluation of these tables.
   Aim: Form not as a result of intuition, emotion, formal aesthetics; form following a structure developed from the total material. In the calculations, each material is inspected according to its proper importance. The quantitative proportions are based on the total order.

Because the complete data were not available, the most important numerical values have been estimated for the purposes of this project.

For a final plan, more comprehensive and exact material would have to be provided.

The architectonic material can be presented preliminarily under the following headings:

Summary:
A (Arbeit) Work
- I Production
- II Planning
- III Management

G (Gemeinschaft) Communal
- I Maintenance
- II Communications
- III Education
- IV Care of the sick
- V Hotels

W (Wohnen) Dwelling
- I Dwelling

V (Verkehr) Traffic systems—horizontal traffic—
- I Goods Transport
- II Passenger transport

p (periodisch)=establishments that recur periodically
z (zentral)=establishments that are unique and centralized

Exposition:

A	I	p	1. Workshops—for various branches of industry—
		p	2. Spaces for recreation, personnel, medical treatment, treatment of accidents, etc.
		p	3. Warehouses—raw materials and finished products—
		p	4. Special aggregations in the open—blast furnaces, cooling towers, transformers, tanks, loading bays, etc.
	II	z+p	1. Offices
		z+p	2. Personnel
		p	3. Research laboratories, etc.
	III	z	1. Offices
		z	2. Personnel
		z	3. Large rooms for law courts, parliament, etc.
G	I	z	1. Central maintenance area—warehouses, milk distribution centre, slaughterhouse, market.
		p	2. Sale-rooms
		p	3. Institutions catering for daily needs, services, etc.
		p	4. Restaurants, Quickies, eating-rooms, cafes, etc.
		p	5. Areas for traffic, installations for vertical transport, installation shafts, service rooms, power distribution, heating, etc.
		z	6. Big stores
	II	z+p	1. (a) Rooms for mainly acoustical communications (b) Rooms for mainly optical communications (c) Rooms for mainly verbal communications
		z+p	2. Indoor exhibition areas—museums, depots, archives, libraries, reading rooms, etc.
		z+p	3. Conference rooms of various sizes
		z+p	4. Indoor sporting institutions—baths, gymnasiums, indoor games areas, etc.
		z	5. Post Office and central telegraph
		z	6. Radio, technical rooms, studios and installations
		z	7. Television, technical rooms, studios and installations
		z	8. The Press
		z+p	9. Open spaces for sports and games, fairs and parks.
	III	p	1. Nurseries, Kindergartens, playgrounds
		p	2. Basic schools

A project for Karlsruhe

Figure 1: The landscape situation, showing: wooded areas
existing dwelling areas
the Rhine
the Black Forest—contours at intervals of 50 metres—

Figure 2: Town plan showing ground plan and elevation, with a diagram showing the ordering of the architectonic material. The material is listed in the form of letters and numbers at the left-hand edge. The lines are indicated by arrows at the points where the appropriate establishments or institutions are to be found in the plan below.

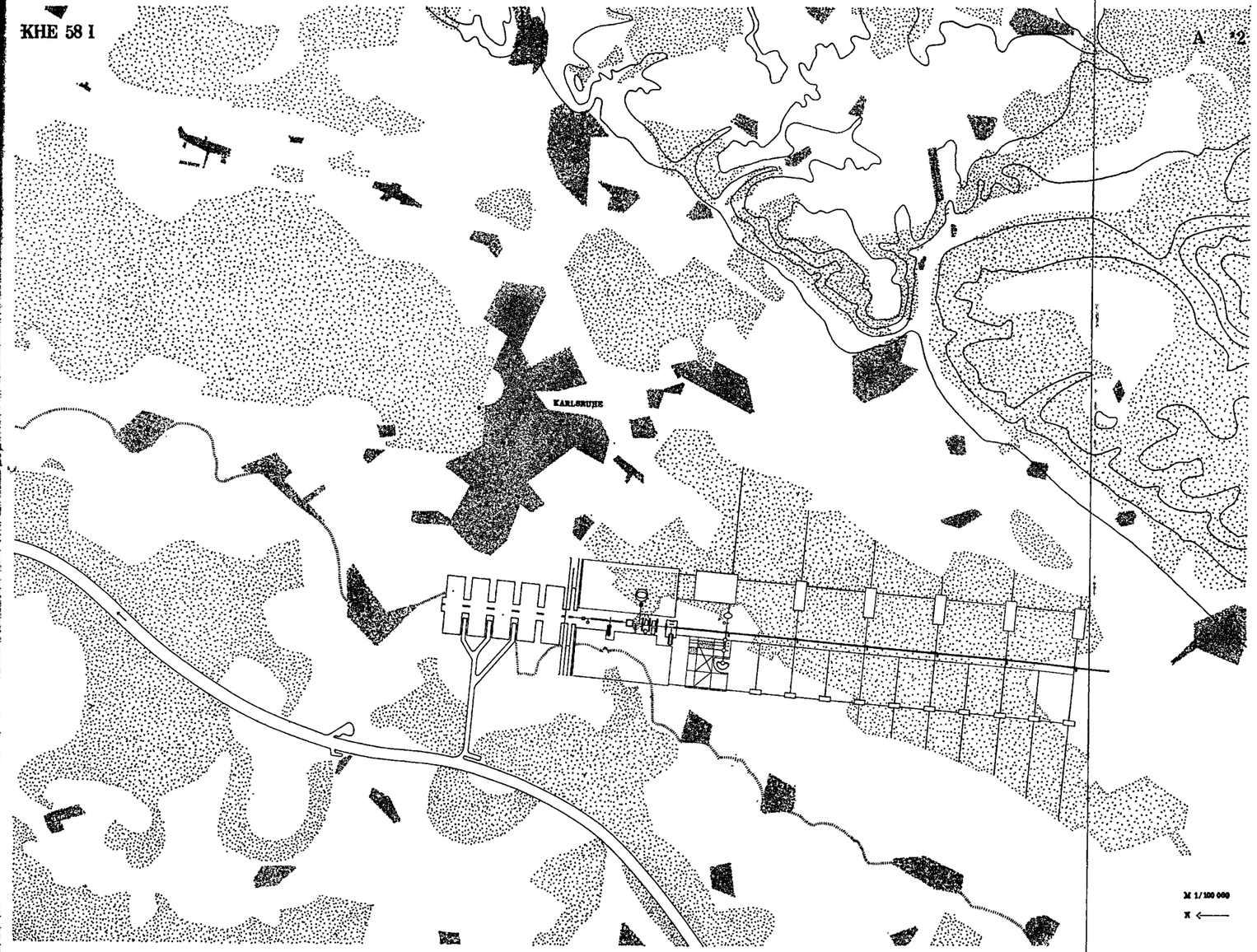


Figure 1

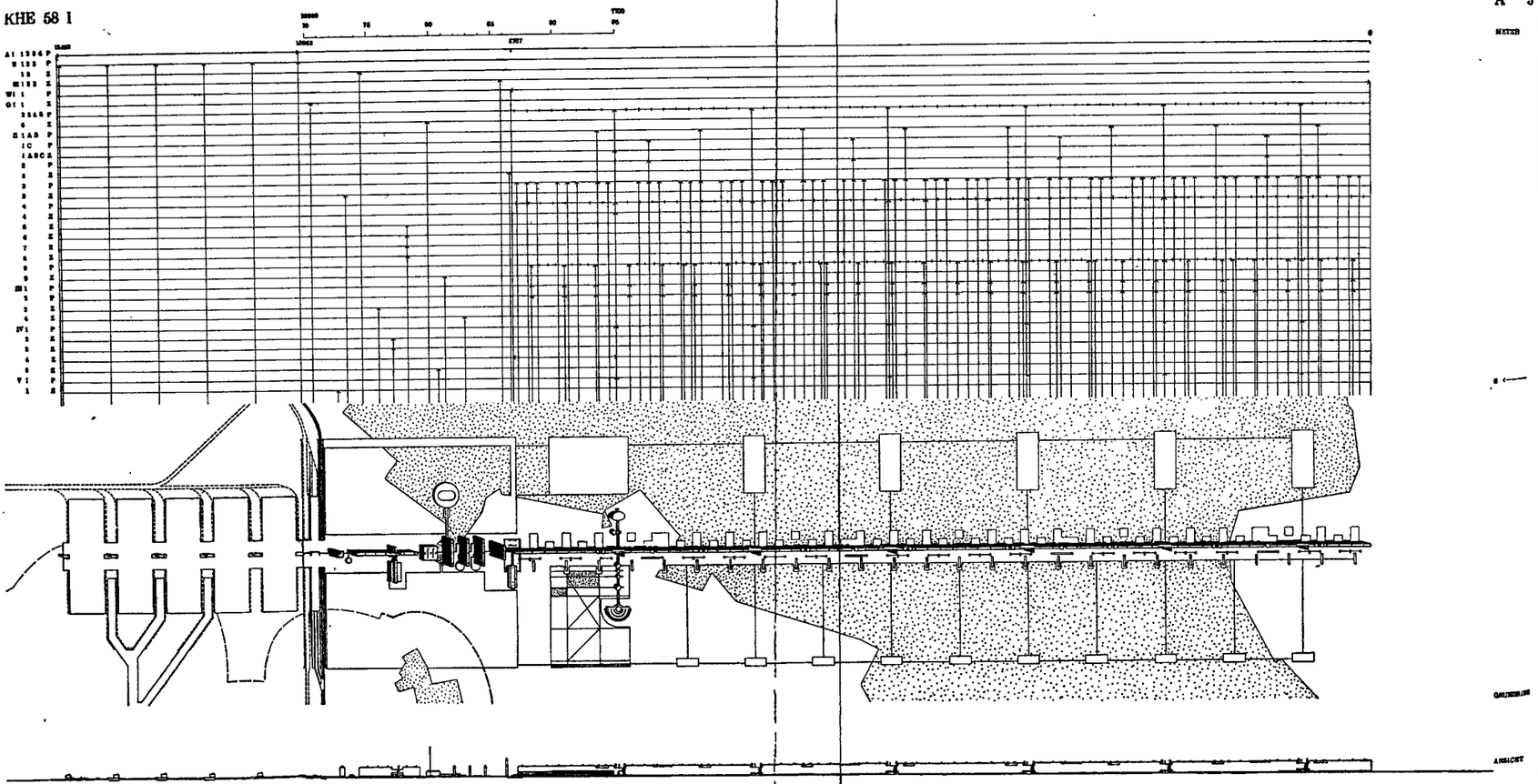


Figure 2

	z	3. Urban institutions for further education, specialized schools.
	z	4. Super-regional schools, technical high-school, or similar institution space for teaching, maintenance, accommodation and study.
IV	p	1. Doctors' surgeries, accident reception, chemists
	z	2. Hospitals
	z	3. Special clinics
	z	4. Institutions, Sanatoria, Homes
	z	5. Cemetery
V	z+p	1. Hotels
W I	p	1. Dwellings
V I		1. Routes
		2. Stops
II		1. Routes
		2. Stops.

The spatial volume of these establishments will determine the necessary length of a straight, horizontal traffic strip. This strip will be subterranean so as to avoid interference with purely pedestrian traffic. The latter has a free zone on the natural level of the landscape. The town is a coherent building-organism; although designed for 200,000 inhabitants, it can be extended to accommodate 400,000. Industry spreads northwards; dwellings and their specific periodically-recurring requisites spread southwards; the unique, communal institutions spread vertically upwards. The relationship between the parts is calculated as a function of optimal temporal and spatial connections, subject to material conditions. The single point of contact with the traffic network of the country will be plotted on the basis of traffic statistics.

The material is for the most part co-ordinated and evaluated according to the requirements that have been obvious for some time. Tendencies in development should be included in the planning on the basis of statistical investigation.

Total length of the town	13,462 metres (c. 8½ miles)
Length of the dwelling block	8,412 metres
Length of the industrial area	2,500 metres
Length available for central institutions	2,550 metres
Section of the dwelling block	20×100 metres

Lengths are measured on the traffic axis.

The method of work outlined above guarantees the unity of the whole conceivable material with the appearance of the organism; it also ensures the continuity of the active and passive processes of life.

A sensible mode of behaviour for people is made possible by the intellegibility of the relationship of the individual to the larger context.

The continuity of the processes of life is necessary for the eventual co-ordination of the various forms of communications, limited at present to the separate sense organs.

The essence of the processes of life is alteration in space and time.

The elements of every thing that can be shaped are properties of space and time.

Any order is realizable in all these elements.

The premise for this is an architectonically ordered environment.

INITIAL PROJECT

Designed for Gottfried Michael Koenig

JÖRN JANSSEN

An *initial project* for a studio complex for electro-optics and electro-acoustics, based on the experience and theories gained from electronic music and electron painting(1), worked out in collaboration with Peter Jockusch in November 1959.

The project caters for the following functions:

Planning of compositions

Production of compositions

Storage (Archive) of compositions

Performance of compositions

Acoustical: speech
song
instrumental music
electro-acoustics

Optical: mime
dance
instrumental work
electro-optics

All the elementary possibilities here selected for consideration can be made more complex for particular compositions. Their communication to a public will be regarded as in principle undirected. Any persons can simultaneously transmit and receive signals. The communication structures will be defined spatially in three dimensions, with mobility in respect of any particular programme.

In the present situation, institutions for the above-named purposes might well take the place of the theatre, opera house and concert hall, all of which have become obsolete. In accordance with this view, we can afford to neglect the usual decorative efforts; these merely erect monuments to dead objects and add representation to things that can no longer stand on their own and which no longer represent anything. Such institutions are related to the media of communication now in general use: radiophony, radiovision, cinematography. Their functions are both sociological and pedagogic and consequently they are an essential part of any large-scale planning, and of any educational institution or dwelling area.

The technical possibilities for reproduction that are available today enable us to depart from the earlier type of hall for large meetings—which was necessary and economical in those days—and design auditoria for the use of a mere 200 people at a time.

1 Compare 'Vom abstrakten Film zur Elektronenmalerei' by Karl Otto Götz, published by Limes Verlag, Wiesbaden in the book MOVENS 1960.

Ground plan

1:415

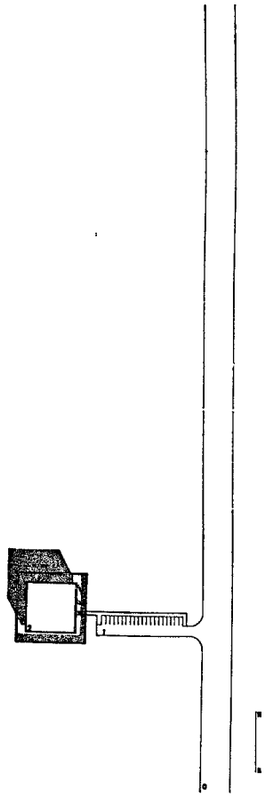


Figure 1

Programme and explanation of symbols

0 Main approach road
1 Car park
2 Building complex
3 Vertical transport for people—stairs and hydraulic lift
4 Shaft for the conditioning of the auditorium
5 Air-conditioning
A Chimney for incoming and outgoing air
B Ventilator
C Drive motor
D Filter
E Pre-heating
F Humidity
G Dehydration
H Heating—cooling
6 Water pipes and drainage
7 Echo chambers
8 Emergency stairs
9 Installation shaft—water supply, drainage, ventilation
10 Water closet
11 Shower
12 Archive
13 Places for written work
14 Production studio for electro-acoustics
I Amplifier panel
K Trolley for generators
L Aggregate for magnetic tape-recorders and control panel
M Work table
N Wardrobe
15 Production studio for electro-optics
16 Micro-studios
17 Control room
18 Workshop
19 Kitchen
20 Bar
21 Canteen
22 Main entrance
23 Cloakroom
24 Conference room
25 Offices
26 Library
27 Foyer and exhibition area
28 Auditorium
29 Platform or stage
30 Gallery
31 Suspended object, e.g. projection screen
32 Acoustic panels
33 Space for electro-optical and electro-acoustical projectors
34 Scaffolding and cat-walks for technicians to check equipment
35 Acoustic insulation
36 Exterior skin for protection against rain and sunshine
37 Store-room for chairs and equipment
38 Rails for the adjustment of hanging objects

Vertical section

1:415

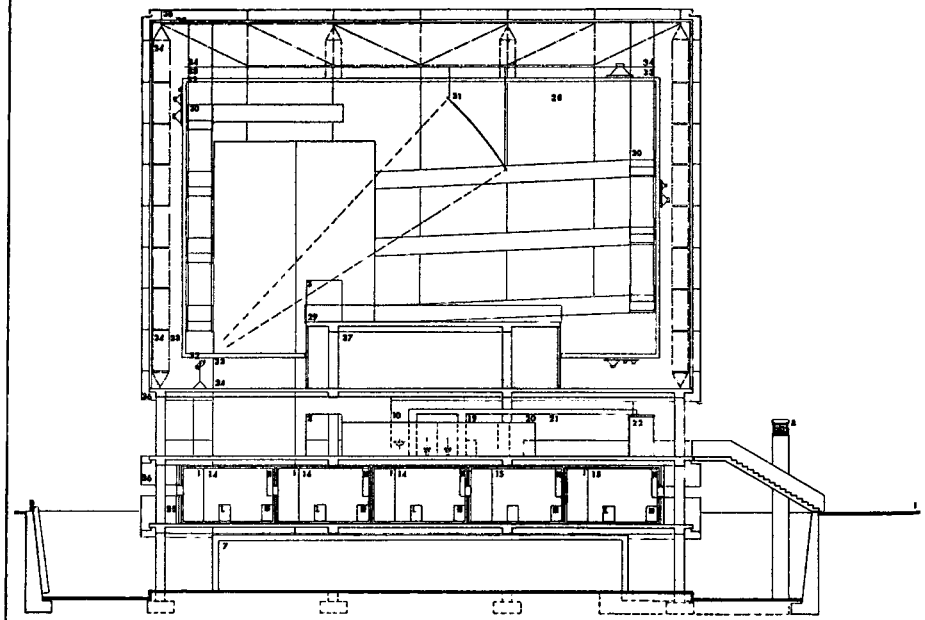


Figure 2

Horizontal section, first storey

1:415

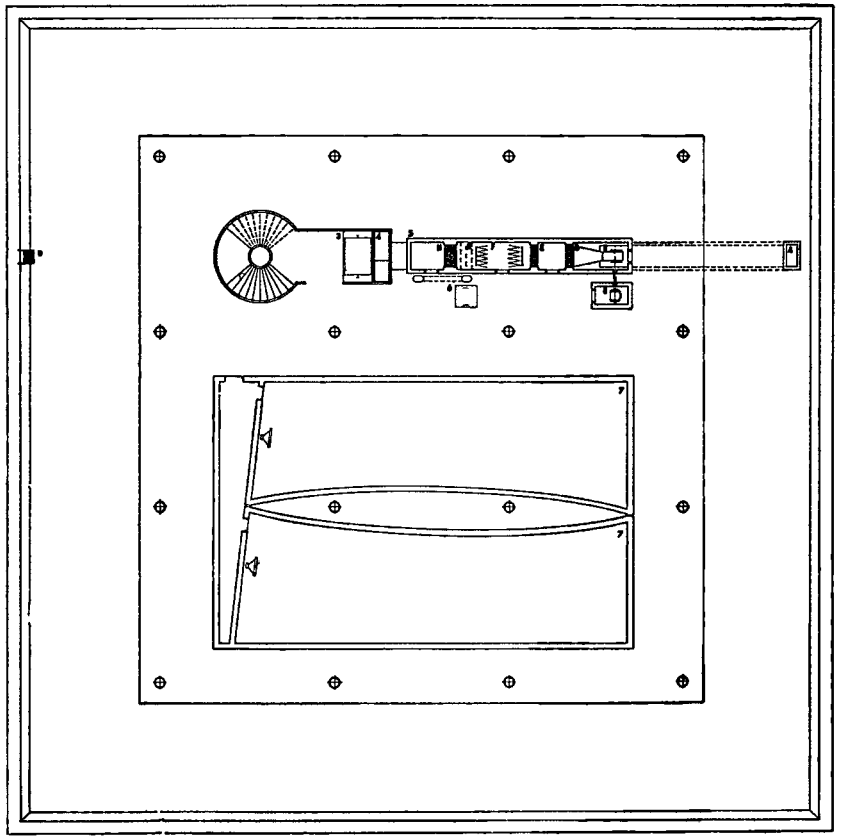


Figure 3

MUSIC LIBRARY

Horizontal section, second storey

1:415

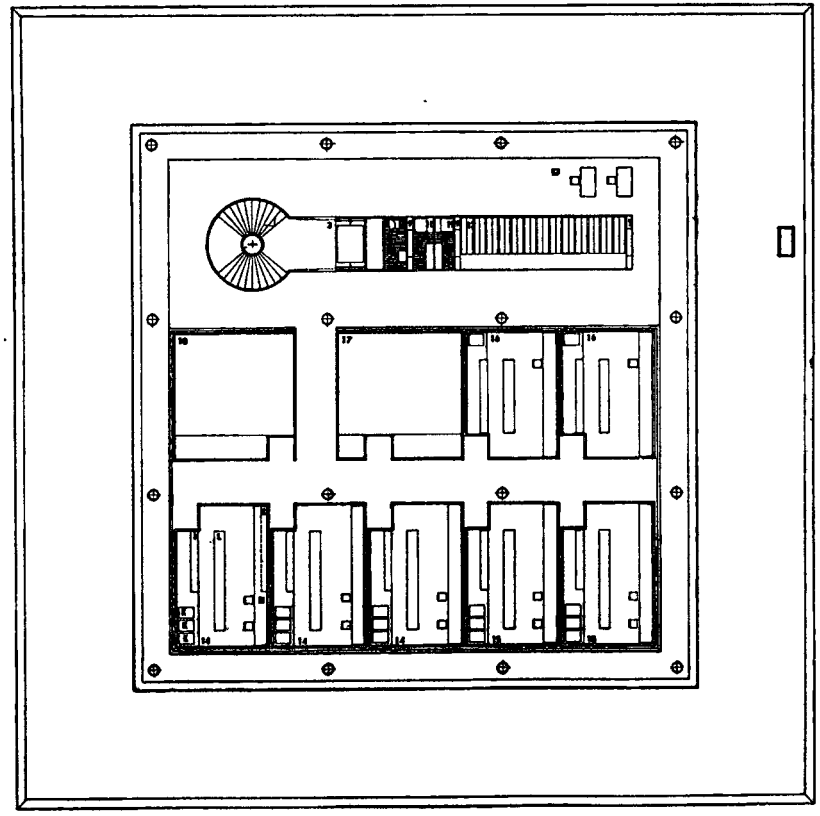


Figure 4

Horizontal section, third storey

1:415

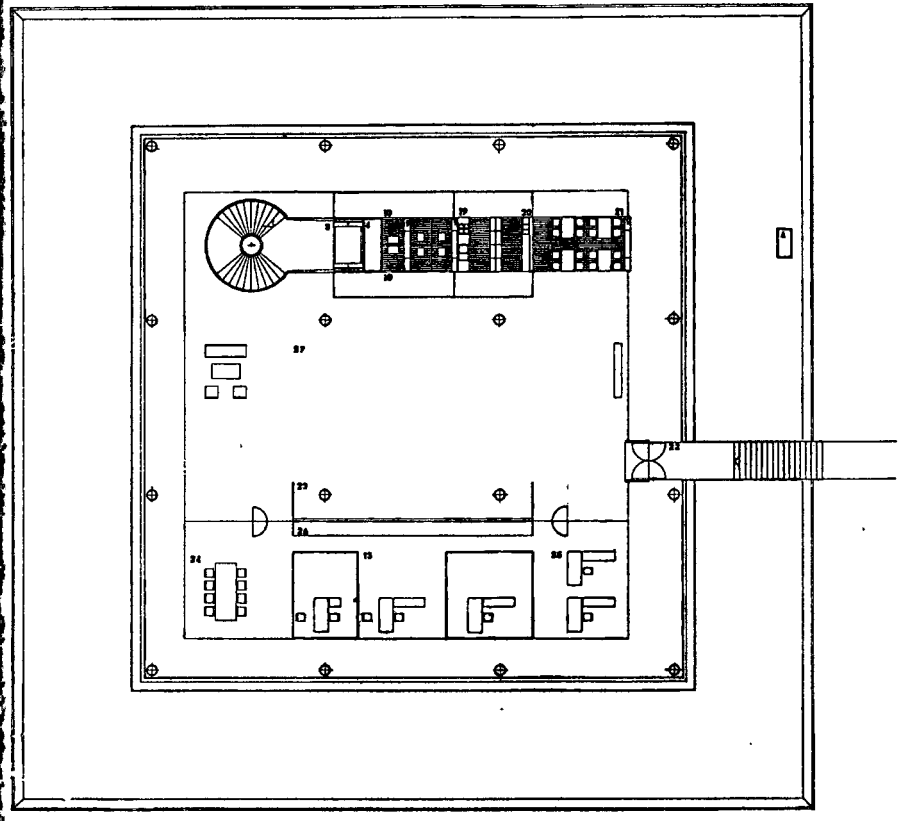


Figure 5

Horizontal section, fourth storey

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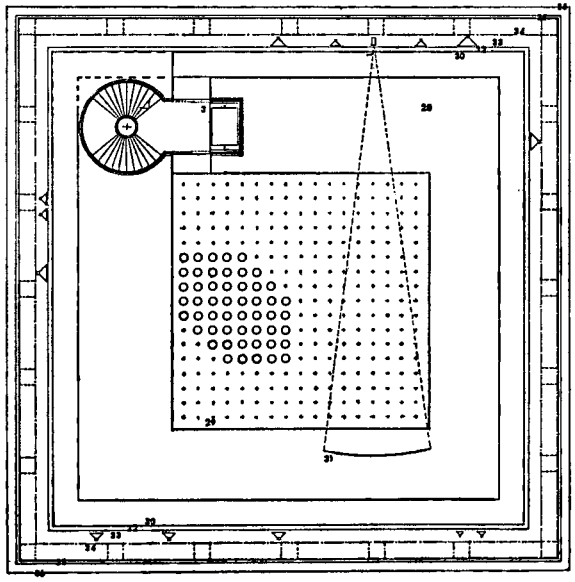

Figure 6

Front elevation, from the east

1:415

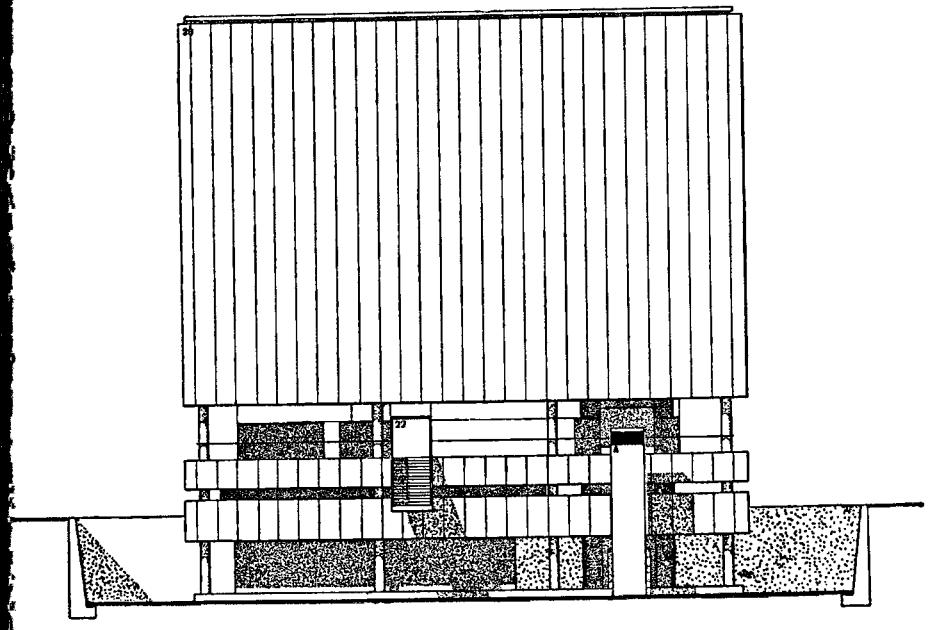

Figure 7

North elevation

1:415

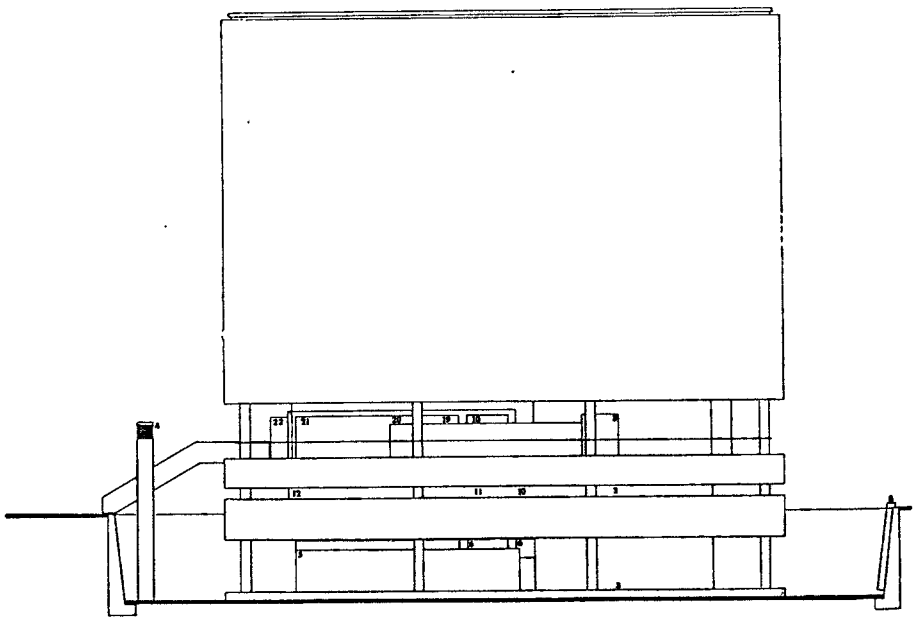

Figure 8

Figure 1 Ground plan
Figure 2 Vertical section
Figure 3 Horizontal section, first storey
Figure 4 Horizontal section, second storey
Figure 5 Horizontal section, third storey
Figure 6 Horizontal section, fourth storey
Figure 7 Front elevation, from the east
Figure 8 North elevation

Description:

The programme is divided into four units as follows:

Auditorium for recordings and performances with public.
Main entrance area, together with the most-frequented rooms.
Production rooms.
Special aggregations.

The auditorium is enveloped in an acoustic shell which reduces the reverberation to a minimum. This can be regulated by suspending objects—e.g. resonators, metal plates—from the ceiling. The shell consists of individual panels that can be removed at will, to make room for electro-optical or electro-acoustical projectors. Apparatus can be installed and removed from the technicians' cat-walks which surround the whole. Heavy panels shelter the auditorium from exterior noise. The platform and galleries can be used alike by the audience and the performers and their instruments. Removable swivel chairs are available on the platform and galleries.

The main entrance leads directly to the cloakroom, the offices, work-rooms and water closets, and beyond these to the production studios and the auditorium.

The production studios and archives are close to the workshops intended for slight repairs and alterations to electrical apparatus. Desks for written work can be added in the free space next the archives. The production studios are constructionally independent of one another, and are set on an elastic insulating material. Windows can be built in between studios as required. Each studio has its own air-conditioning tube so as to avoid any possibility of noise communication between the studios. The incoming air is relatively cool, the room-temperature being regulated by individual convectors.

The special aggregations are to be found on the lowest floor. The air-conditioning plant with its machinery and the echo chambers are built on separate foundations so as to avoid the transfer of noisy vibrations.

Construction: reinforced concrete skeleton with ceilings made of panels laid crosswise. The auditorium consists of a steel skeleton. Stairway and lift are housed in a reinforced concrete shaft.

DETAILS TO OTHER VOLUMES IN DIE REIHE

I. ELECTRONIC MUSIC

Translator's Preface	
Herbert Eimert	What is Electronic Music?
H. H. Stuckenschmidt	The Third Stage
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A periodical devoted to developments
in contemporary music

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Retrospective

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† Translated by Cornelius Cardew
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Werner Meyer-Eppler

In a commemorative broadcast for Werner Meyer-Eppler, given by the Westdeutscher Rundfunk in Cologne, Herbert Eimert gave the following introduction.

We are repeating a broadcast given on July 31st, 1959 with the theme "Acoustics and Information Theory". It is a talk with the late director of the Institute for Phonetics and Communication Research at the University of Bonn, Professor Werner Meyer-Eppler, who died on July 8th, 1960 at the age of 47. His life-work has been broken off abruptly, but it will continue to generate for the co-founder of communication research and most renowned German representative of information theory, a very young science coming from America and having attained great significance during the twelve years of its existence. Meyer-Eppler, who was born in Antwerp in 1913 and studied in Cologne and Bonn, was originally a physicist and mathematician. Perhaps nothing is more characteristic of his scientific career than the fact that he twice qualified as lecturer at the University of Bonn: in 1942 for physics in the faculty of science, and in 1953 for phonetics in the faculty of philosophy—hence his inner vocation for a new sphere of work between the faculties, and the ardour of a thought process which became fertile in the bold combination of the methods of natural and intellectual science.

Meyer-Eppler, whose new, extraordinarily versatile sphere of work has enriched the traditional university subjects, was able to extend an effect far beyond the narrower realm of his activities. Seldom did an international congress on his special subject take place without his presentation of the results of his research. He gave lectures in many European countries, in universities in North and South America; already suffering from

illness, he received an invitation from Japan. He has essentially contributed to makin Germany acquainted with the epoch-making American methods of cybernetics an information theory.

Meyer-Eppler was one of the initiators of electronic music. In 1949, his book on electro nic sound production appeared. In this book, the elements of generators, loudspeakers amplifiers, distorters and the various methods of frequency and amplitude modulatio were comprehensively described for the first time. The first electronic sound-model were produced by Meyer-Eppler in his institute at Bonn in 1951. At my initiative, th former head of the Cologne Radio Station, Hanns Hartmann, convened a foundatio assembly in which the technical director of the former Nordwestdeutscher Rundfun and the technical chief of Cologne Radio Station participated. It was decided, wit great support from Meyer-Eppler, on October 18th, 1951, to establish the Cologn studio for electronic music. In addition to sound experiments, the results of whic he had imparted in a series of Cologne broadcasts, there now came the entire phoneti work that Meyer-Eppler considerably increased; on the one hand by the new method of structural linguistics and phonology, on the other hand by the disciplines of com munication research and information theory.

There is no doubt that Meyer-Eppler, our esteemed mentor and friend, quietly exercis ed great influence in certain areas of the newest developments in music. I do not mea the fact that individual composers attended his lectures, or, like Stockhausen, complete entire phonetical studies with him; nor do I mean the fact that a number of terms fro his sphere of work suddenly cropped up in musical analyses, words such as parameter redundancy, aleatoric, or statistical and acoustical terms. I do mean the decisive inne change in an unprejudiced way of thinking which has left the old classical distinctio between acoustical and musical hearing behind, and has turned to an attentive, concen trated and keenly diagnostic way of hearing. This is, as it were, Meyer-Eppler's musica testament; in it, he has not placed music at the mercy of a positivism foreign to art, bu has directed attention to the inner elemental layers of musicality. To associate wit this amiable, optimistic, modest, learned man was to be afforded a perception of th pure joys of intellectual presence. He never flaunted his profound knowledge; for hi only the subject itself mattered. To seek his advice was always an act of refreshment, o serene, almost cheerful recognition and of deep, joyous agreement.

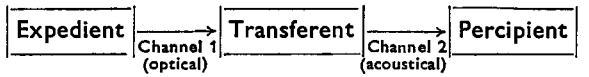
Meyer-Eppler wrote several books and about eighty newspaper articles; all of these ar specialist works with no concessions whatsoever to the reader. A few months befor his death, an important book of his appeared, a pioneer work for Germany: "Grundlage und Anwendungen der Informationstheorie" (Principles and Applications of Informatio Theory), a publication which impresses by its method and by an abundance of know ledge which will not be exhausted for some time to come. This work will always b connected with his name.

Werner Meyer-Eppler

Musical Communication as a Problem of Information Theory

1. In conversation with music lovers one frequently hears the question, "Is modern music (especially electronic music) still music or is it rather a mathematical construction?" A scientific answer to this question must first clarify what is meant by the term m u s i c. Let us try to find a definition in terms of information theory.

2. Let our research be based on the communicative situations arising in traditional music, usually with three communication partners, namely the c o m p o s e r, the i n t e r p r e t e r and the l i s t e n e r. In order to avoid any emotional prejudice that may be associated with these terms, let us replace them by the neutral concepts e x p e d i e n t, t r a n s f e r e n t and p e r c i p i e n t. The observable portion of the m u s i c a l c o m m u n i c a t i o n c h a i n can then be given the following representation:



The transferent's function is a double one, for he is the percipient of the optical communication with the composer and the expedient of the acoustical communication with the listener. To the physical processes transmitted in channels 1 and 2 we give the name s i g n a l s : the score is then a p l a c e - d e p e n d e n t or l o c a l i s e d s i g n a l and the sound produced by the transferent, i.e. the music itself, a t i m e - d e p e n d e n t or t e m p o r a l i s e d one.

Apart from this p h y s i c a l relationship of communication, there is another one between communication partners, pertaining to various spheres, namely

1. the s e m a n t i c sphere and
2. the e c t o s e m a n t i c spheres.

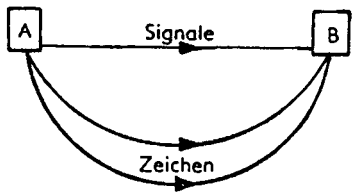
The s e m a n t i c s p h e r e (i.e. the one pertaining to language) comprises all signal attributes falling under some a g r e e m e n t or c o n v e n t i o n between the communication partners. Such signal attributes are called s y m b o l s. It is the symbols that enable semantic communication among people, i.e. human contact through spoken or written language, to take place. The signals used to transmit the symbols in the physical plane are called s y m b o l c a r r i e r s.

All other signal attributes, i.e. those not acting as symbol carriers, are classed among the various e c t o s e m a n t i c s p h e r e s. As examples of this, the attributes enabling identification of the expedient or transferent (by means of certain unmistakable personal traits) belong to the d i a g n o s t i c s p h e r e, while the attributes pertaining to feeling (of one, two or all three communication partners) are summarised in an e m o t i o n a l s p h e r e. The spheres are not invariable to a change of communication partners, and especially the change to a typologically different group of percipients can result in an i r r e l e v a n t s p h e r e, i.e. a non-participation of one or more percipients in the communication process. In information theory, the signals carrying this

sphere are then regarded as i n t e r e f e r e n c e. Hence it is quite possible that one and the same signal production on the part of a transferent (i.e. the same programme played by an instrumentalist or an orchestra) is subject to widely varying communication sphere arrangements, depending on the percipients.

The ectosemantic spheres will in general include all signal attributes by which the acoustic signal (transferent-percipient) differs from the acoustic translation of the optical signal, i.e. from the score (expedient-transferent). The expression "acoustic translation of the optical signal" must not, however, be taken within too narrow bounds, for it must include, apart from the translation of the visible signals of the score, l a t e n t c h a r a c t e r i s t i c s deduceable from historical circumstances, such as questions relating to performance style.

3. Let us now simplify the problem by uniting the expedient and the transferent in a single person A (corresponding to actual practice if for example a composer is playing his own works). If B is the percipient or group of typologically similar percipients, we obtain the following communication scheme:

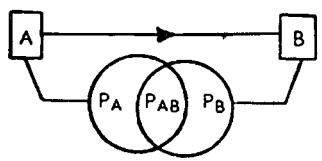


It is still very difficult to deal with the ectosemantic circumstances (except for certain diagnostic traits) in information theory, so that quite an essential portion of musical communication eludes exact treatment. This applies particularly to the percipient's emotional sphere, materially influenced, as it is, by the mood the individual happens to be in, environmental influence, and his readiness to associations, which all play a part that is as important as it is unpredictable. The best that information theory can do therefore is to confine itself to the s e m a n t i c part of the problem.

4. The range of a person's knowledge of musical symbols is called his i d i o l e c t, a term borrowed from linguistics. The symbols to be found in a person's idiolect can be extremely complex and will range from a single tone to a complete piece of music. Let P_A be the mathematical quantity expressing the active idiolect of the expedient-transferent A and P_B that expressing the passively receptive idiolect of the percipient B. Then the mass difference $P_A \cap P_B$ is the idiolect P_{AB} common to both partners:

$$P_{AB} = P_A \cap P_B$$

This may be illustrated by the following diagram:



5. In the terminology of BOCHENSKI, a symbol is e i d e t i c if its semantic counterpart, i.e. its meaning, is known, whereas it is merely o p e r a t i v e if it is only known how to operate with it. Eidetic symbols are rare in music and confined to programme music, leading motives, etc., i.e. cases with a constant relationship between musical signals and extramusical meanings. The exclusive use of operative symbols, as is the rule in music (directions for operations are, for example, traditional harmony, counterpoint, or rules for serial construction), is referred to as u n i n t e r p r e t e d c a l c u l u s. Most music, regarded from the semantic sphere, is therefore uninterpreted calculus and seldom transmits a l i n g u i s t i c c o n t e x t, so that its linguistic function can be compared more to g r a m m a r a n d s y n t a x.

6. In this light, how can m u s i c a l f o r m be defined? Let us regard a piece of music as a finite sequence of operative symbols $a_1\ b_1\ c_1\ d_1 \ldots$ To answer our question we shall have to find out whether it is permissible to replace one of the signs, say b_1, by another, b_2, i.e. whether, within the musical range under discussion, the sequence $a_1\ b_2\ c_1\ d_1 \ldots$ would be equally possible. If this is carried out systematically and if it turns out that each element of the first position class

$$(a) = (a_1, a_2, a_3 \ldots)$$

can enter relation with each element of the second position class

$$(b) = (b_1, b_2, b_3 \ldots)$$

which again can enter relation with each element of the third position class

$$(c) = (c_1, c_2, c_3 \ldots)$$

and that all combinations

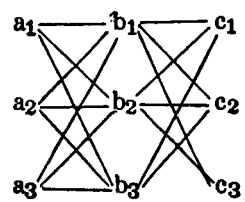
$$(a)\ (b)\ (c)\ (d) \ldots (F)$$

are permissible, then let (F) be called a m u s i c a l f o r m that can be filled with elements of the various position classes.

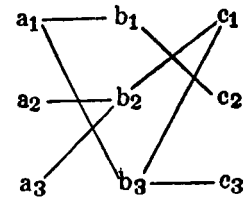
If, on the other hand, there are certain restrictions on the combinations possible among the elements of the various position classes (for example if a_1 can be followed only by b_1 or b_3 but not by b_2), these obligations effect an i n t e r n a l s t r u c t u r e of the potential symbol relationships.

This can be illustrated by the following diagrams:

Grid without structures



Grid with structures



The internal structures of music are not usually based on strict rules but rather on a certain preference of certain schemata or sequences to others. This state of affairs is expressed in information theory by calling the sequence of symbols a M a r k o f f c h a i n, which is the term given to a sequence of mutually dependent symbols.

7. Each musical style, and within it each better-than-average composer, has its (or his) own inventory of forms and internal structures (equivalent to certain probabilities of symbol combinations). Likewise, every listener has his inventory of forms and structures derived from his listening experience. For music to be understandable semantically, the composer's (expedient-transferent's) inventory of forms and structures must coincide with that of the listener (percipient) to a certain degree, below which such music played to such a listener can have only an ectosemantic effect so that no two such listeners will be able to reach objective agreement on it but will make only subjective remarks that are irrelevant musically, interesting though they may be psychologically. (There is no doubt that such a discrepancy in the inventories is frequent in present-day concert life, especially as concerns modern music.)
8. It follows that one and the same sound signal described as music may be classified in a completely different inventory by the composer and the listener, and a general, objective description of invariable inventory classifications on the part of an observer external to the communication chain is frequently impossible. This is why what the composer has formed as music may be perceived as noise by the listener, for whom the sound of music is perhaps more like the song of the birds or the jingle of coins in his pocket. There is a notable lack of objective criteria that might enable an external observer to decide whether a certain sound process is music or not; such an e x t e r n a l o b s e r v e r must obviously not question either the composer or the listener, and he must not be a listener himself nor base his objective judgment on personal, i.e. subjective grounds, which is evidently impossible.
Another impossibility is to distinguish a human score from an electronically calculated one, especially in the field of light music, as the form and structure inventory used for it is very small.
Our conclusion is that there exist at least two kinds of music, namely type A, regarded as music by the composer, and type B, so regarded by the listener. There is only one way to prevent a flood of emotional judgment and resulting arbitrariness, namely to adopt type A as "music" also in scientific metalanguage and to disregard the hedonistic verdicts leading to the percipients' description of "music" type B.
9. The question posed at the beginning turns out, at least in this light, as an apparent question only, as it is based on the irrelevant verdicts of the percipients and tends to class only type B as music. This by no means excludes the value of verdicts from c ó m p e t e n t percipients (i.e. those who possess a sufficiently large inventory common with that of the expedient-transferent), which might enable an external observer to classify some musical works A as being better than others. As such a classification would, however, be based on the statistical distribution of the various competent percipients' judgments in respect of the presence or absence of quality criteria, it would necessarily remain a matter of controversy even among the experts.

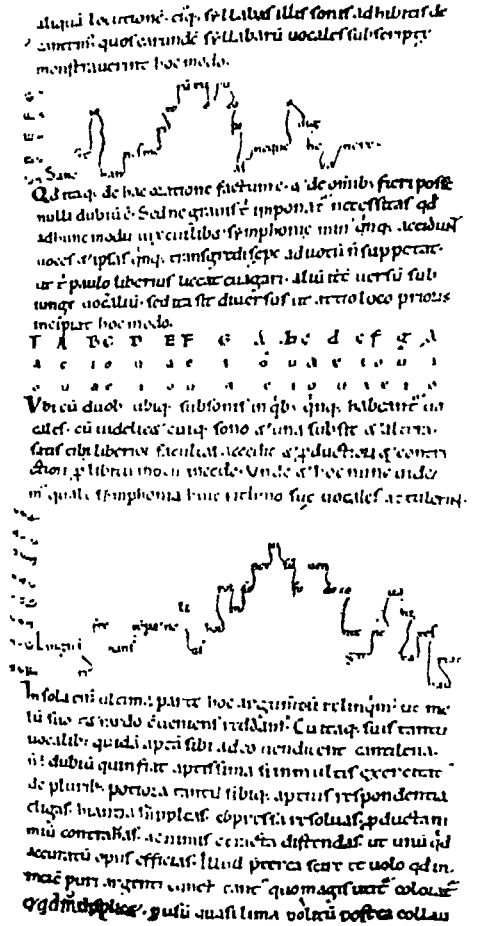
Helmut Kirchmeyer

On the Historical Constitution of a Rationalistic Music

A study of the progress of musical combinatorics from Guido d'Arezzo to the present day.[1]

Over the past few years a number of modern compositions, whose structure derives from principles similar to construction-kit combinatorics, have found their way into the concert halls. There has been a tendency in some quarters to deny these works any profound meaning or artistic value, but the fact is that few if any other compositional phenomena of recent years (we are speaking only of such as have acquired a certain prominence) can boast such a complete and unbroken genealogy—both historical and ideological—as these attempts to attain to artistic production on the basis of number-speculation. The movement we are referring to broke surface in 1957 when Karlheinz Stockhausen published his K l a v i e r s t ü c k X I, consisting of 19 small configurations of tones which are to be freely combined by an interpreter and yet are supposed (this is the composer's intention) to result in an autonomous musical form. Leaving aside the novel (in the real sense of the word) compositional idea of rhythmic prototypes for improvisation, we see that the art of musical combinatorics is by no means a modern discovery (or, as some would prefer to put it, by no means a new way of wasting time); as a technical system we can trace its history back a thousand years, although of course in the intervening centuries the rationalisations and realisations of the system varied in accordance with the differing spiritual-historical situations.
The year 1026 provides the historian with the first instance of the problem of the rationalistic control of the creative spirit. In that year the monk and musical scholar Guido d'Arezzo published a small work for the edification of singers entitled 'Micrologus'[2]. Chapter 17 of the treatise—which came to be a signpost for the Middle Ages as a whole—bears the superscription: 'Quod ad cantum redigitur omne, quod dicitur'[3] (that everything that can be spoken can also be sung). The chapter contains compositional instructions for the production of artistically unexceptionable melodies by means of the vowels of the text and the signs for notes. It is thus that Guido arrives at his conclusion, that everything that can be spoken can also be sung. If speech is to be written down one is obliged to make use of the letters of the alphabet, for without these letters it is not possible to write. But the most important of the letters are the vowels that give sound to the other letters. Neither syllables nor words can sound without the vowels. Since it is the vowels that contribute their euphony to all other words it is also conceivable that they can determine the shape of a song that is to be composed[4].

[1] This text is in general the same as that broadcast by West German Radio from Cologne and Hamburg on 28th January 1960 from 11.15 p. m. to midnight as a Musikalisches Nachtprogramm entitled "On the historical constitution of 'Mathematical' music. A study of the progress of musical combinatorics." The printed version contains a number of amendments. It also provides full details of all sources and references.
[2] Guidonis Aretini Micrologus, edidit Jos. Smits van Waesberghe, Corpus Scriptorum de Musica IV, American Institute of Musicology, (Rome) 1955. For list of editions v. Joseph Smits van Waesberghe: Guido von Arezzo, in: Die Musik in Geschichte und Gegenwart V, Bärenreiter-Verlag Kassel/Basle 1955, p. 1077; see note 11 below.
[3] Some manuscripts have 'scribitur' instead of 'dicitur', and one Paris manuscript has both: 'scribitur et dicitur'. v. Guidonis Aretini Micrologus, op cit p. 186.
[4] "Perpende igitur quia sicut scribitur omne quod dicitur, ita ad cantum redigitur omne quod scribitur. Canitur igitur omne quod dicitur, scriptura autem litteris figuratur.



Folio 9r of British Museum, London, Codex Add. 17808, 11th century. The page shown contains Chapter 17 of Guido d'Arezzo's 'Micrologus' almost in its entirety. Illustration taken from J. Smits von Waesberghe: Micrologus Guidonis Aretini, prec. p. 189.

From this reasoning Guido now evolves a technical system of composition. First he writes down the vowels in their usual order a-e-i-o-u several times in sequence, and above that—also in their usual order—the current signs for the steps of the scale, which correspond to the letters c-d-e-f-g-a-b in our present-day system. The result is a double series with the letters for the steps of the scale written on the top line and below them the cyclic sequence of vowels. Thus, since every 'note-letter' corresponds to a particular vowel, he has designed a kind of compositional key[5].

After making these preparations Guido casts about for a text (in Latin of course), extracts the vowels from each word, finds in his double series the note-letter corresponding to each vowel, exchanges this note-letter for the note that it represents and writes it in the form of a note on the stave (to the development of which Guido himself had made the largest contribution). The song is finished. Guido gives several examples. First he takes the text 'Sancte Joannes meritorum tuorum copias nequeo digne canere' and composes it on the scale which in those days began on G. Thus, under G we find the vowel a, under A the vowel e, under B the vowel i, etc. Using this key Guido obtains the note-letters C and D for the two vowels a and e extracted from the word 'sancte'. The next word, 'Joannes', which contains the vowels o, a and e, provides the notes F, C and D. Following this procedure the whole text is composed into song[6].

After this simple example Guido goes on to encourage any composers who find the framework of his system too narrow and desire more elbowroom with the suggestion that they write two series of vowels instead of one underneath the series of note-letters, whereby the second series of vowels should begin with a different vowel, for example i-o-u-a-e, etc. In this way the composer obtains at least two note-letters for each vowel, and—if we include the different octave positions—sometimes even more[7]. Thereupon Guido provides another musical example, which amazingly betrays no trace of its rationalistic method of production. It is music of his time[8].

Since every song is possessed, alone through its vowels, of a more or less suitable melody—so Guido proceeds—there is no doubt whatever that this melody can become

---

Sed ne in longum nostra regula producatur, ex hisdem litteris quinque tantum vocales sumamus sine quibus nulla alia littera, sed ne syllaba/sonare probatur earumque permaxime casus conficitur, quotienscumque suavis concordia in diversis partibus invenitur, sicut persaepe videmus tam consonos et sibimet alterutrum respondentes versus in metris, ut quamdam quasi symphoniam grammaticae admireris. Cui si musica simili responsione iungatur, duplici modulatione dupliciter delecteris. Has itaque quinque vocales sumamus, forsitan cum tantum concordiae tribuunt verbis, non minus concinentiae praestabunt et neumis", Guidonis Aretini Micrologus, op cit p. 187/188.

[5] Γ A B C D E F G a b c d e f g a
a
a e i o u a e i o u a e i o u a v. Guidonis Aretini Micrologus, op cit p 187/188

[6] Guidonis Aretini Micrologus, op cit p. 189/190; see illustration; transcription from Hermesdorff, op cit below (see note 11) p. 101:

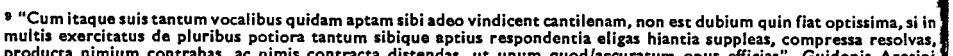
[7] Γ A B C D E F G a b c d e f g a
a
a e i o u a e i o u a e i o u a
o u a e i o u a e i o u a e i o, v. Guidonis Aretini Micrologus, op cit p. 190/191; see illustration.

[8] Schering: op cit below (see note 38) p. 27; Aribo in his Guido commentary (see note 13) has significantly taken up only the following example (op cit below p. 71), which is derived from yet another combinatorial key:
F G a b c d e f
e i o u a e i o
u a e i o u a e, Guidonis Aretini Micrologus, op cit p. 192: transcription from Hermesdorff, op cit below (v. note 11) p. 103:

perfectly adapted if one selects from several attempts only the most excellent and the most matching progressions, filling out wide leaps, extending what is compressed, bringing together what is too far apart and separating what is too close together with the aim of obtaining a work that is as unified and complete as possible[9].

The historical interpretation of Guido's experiment is a relatively simple matter, for he stood in the aesthetic tradition of the old Gregorian church music which regarded music as a means to the easier understanding of the religious truths contained in the text. The strict correlation of music and text was so thoroughly accepted a matter that it occurred to no-one to question it. On the other hand Guido found himself in an extremely rationalist century that was well able to explain his views on music according to its lights[10]. Guido himself was to all intents and purposes the inventor of a novel musical notation which proved at last generally usable, and the immediate spread of his system made it a musico-historical event with extraordinarily far-reaching consequences. This development of a musical notation and the later invention—probably also by Guido—of the syllabic sol-fa technique were rationalist/analytical achievements of the first order. For Guido it was the most natural thing in the world, having thus given more than sufficient proof of his rationalistic gifts, to approach the composition of a musical melody with close reference both to rhetoric and rationalist mechanistics, thus providing a rationalist solution of the problem of composition too.

This explanation may illuminate the situation but it is not adequate to protect Guido from the taint of unartisticness. In 1876 Michael Hermesdorff, musical director at Trier cathedral and editor of 'Caecilia', produced a new edition of the Micrologus with an especially exhaustive commentary on just this particular chapter. He thought that at first glance the whole thing appeared to be a brand of dalliance unworthy of the name of art, and that one might justifiably express surprise that an artist as serious as Guido d'Arezzo—who actually turned out to be t h e authoritative musico-theoretical key figure for the following centuries—should have occupied himself in such dubious pursuits. Hermesdorff then formally excuses the great mediaeval musical scholar and teacher with the assertion that it was Guido's desire to write a practical singing tutor and that he wished his pupils to progress as fast as possible. To this end he provided them with a few practical handholds so that they should be able themselves to undertake the composition of songs after but a brief period of study. These handholds were of course provided merely to help the students over their initial incompetence. The whole was intended as a support and point of departure for the free flight of their musical imagination; it was not intended as a serious rule for the art of composition in general[11].



[9] "Cum itaque suis tantum vocalibus quidam aptam sibi adeo vindicent cantilenam, non est dubium quin fiat optissima, si in multis exercitatus de pluribus potiora tantum sibique aptius respondentia eligas hiantia suppleas, compressa resolvas, producta nimium contrahas, ac nimis contracta distendas, ut unum quod/accuratum opus efficias", Guidonis Aretini Micrologus, op cit p. 193/194.

[10] Rudolf Schäfke: Geschichte der Musikästhetik in Umrissen, Max Hesses Verlag, Berlin 1934, p. 204, p. 206f.

[11] Micrologus Guidonis de disciplina artis musicae, d.i. Kurze Abhandlung Guidos über die Regeln der musikalischen Kunst, übersetzt und erklärt von Mich. (ael) Hermesdorff, Commissions-Verlag of J. B. Grach's bookshop, Trier 1876, p. 100/101 note 1. In 1955 however Smits van Waesberghe writes: "For the sake of stimulating the art of improvisation Guido devised a game, based on a mechanical mode of composition, but one which in its application permits full freedom to musical intuition and the creative faculty... This is where the actual musical game begins: having found or selected schematically a given series of notes, the pupil has to go on adjusting it until a musically constructed sequence emerges. Guido was ahead of his age in this mode of instruction in improvisation. Only in the 20th century has the music teaching profession paid any

That this attitude of Hermesdorff's—which is understandable in the context of his age—is wrong, can be conclusively proved with the information now available to us. Certainly Guido invented and taught this technique[12], but his followers branched off in many directions. We know of numerous other Low-Latin commentaries and independent treatises that expound Guido's compositional practice more extensively and sometimes with more discernment. Some develop it further and even loosen it up to the point of dissolution[13].

attention to this method". Joseph Smits van Waesberghe: Guido von Arezzo op cit p. 1075. As early as 1951 van Waesberghe put forward the theory that Guido's system of composition was conceived as a technique of improvisation intended purely for use in teaching. V. van Waesberghe: Guido of Arezzo and musical improvisation, in: Musica disciplina. A Journal of the History of Music V. Editor Arman Carapetyan, American Institute of Musicology, Rome 1951, p. 55ff.

[12] Guido begins his Chapter 17 with the proposition: "His breviter intimatis aliud tibi planissimum dabimus argumentum utillimum visu (usu?) licet hactenus inauditum", Guidonis Aretini Micrologus, op cit p. 186. Johannes de Affligemensis established the unusability of the method prior to Guido, but there is a possibility that he was merely quoting Guido when in his own treatise (v. note 13 below) he writes: "Adhuc et aliam modulandi monstramus viam pulchram sane, sed ante Guidonem inusitatem", op cit below p. 127. Schering on the other hand (see note 29 below) prefers to assume that it was a long familiar practice, because the method, as Guido himself observes, is irreconcilable with the rules for the use of the church modes, op cit below p. 27. Schering is then completely convinced of the wide general use of the technique in the post-guidonian epoch.

[13] Aribonis de Musica, edidit Joseph Smits van Waesberghe, Corpus Scriptorum de Musica II, American Institute of Musicology, Rome 1951, p. 70f. Liber specierum, in: Expositiones in Micrologum Guidonis Aretini, edidit Joseph Smits van Waesberghe, p. 31ff, North-Holland Publishing Company, Musicologica Medii Aevi I, Amsterdam 1957, p. 53ff. Commentarius anonymus in Micrologum Guidonis Aretini, in: Expositiones in Micrologum Guidonis Aretini... p. 93ff, op cit p. 169. Johannis Affligemensis: De Musica cum Tonario, edidit Joseph Smits van Waesberghe, Corpus Scriptorum de Musica I, American Institute of Musicology, Rome 1950, p. 127ff. Affligemensis documents a loosening and weakening of the guidonian technique when he castigates the use of threefold and fourfold vowel series as a 'confusio': "Possent tamen vocales tale modo etiam triplicari vel quadruplicari, nisi quod tunc nimia confusio obsisteret modulanti", Affligemnsis: De Musica cum Tonario, op cit p. 132. All sources discovered so far deal exclusively with Guido's single and double vowel series, with the single exception of the Liber specierum which teaches even fivefold vowel series both above and below the note series, thereby practically making the technique vanish by dividing it into itself, for naturally with five vowel series all five vowels can fall on each note so that nothing is binding any more. But Affligemensis is surely not referring to the Liber specierum since he speaks only of the threefold and fourfold series. His criticism hence proves the existence of further sources, hitherto undiscovered, which must have contributed in no small degree to building up Guido's system into a much-discussed didactic structure. But if we examine the Liber specierum in relation to Guido's system we do notice that it represents a clear attempt to develop an uninhibited melismatic technique. So there was at least some small reason for the development of the fivefold system, even though it turned out abortive in the end. The relevant passage in the book falls into six chapters each with illustrations. Chapter 42 is entitled 'De uno subsono Guidonis', Chapter 43 'De duobis subsonis Guidonis', and the next chapter ‚Detribus adiunctis'. Chapter 45 is headed 'De quinque subsonis', and explains the elaborated fivefold series, which are further extended in the following chapter 'De quinque supersonis'. The relevant passage runs: "Sed ut melius eos ostendamus, per ordinem superponantur litteris monochordi, ut sint quinque supersoni et quinque subsoni. Et statim auxiliante deo in quinque vocalium litteris neumare antiphonaria cum onmi fiducia poteris, ut tibi haec figura docebit" op cit p. 54. There follows a monster diagram to clarify the matter:

a e i o u a e i o u a e i o u a
e i o u a e i o u a e i o u a e
i o u a e i o u a e i o u a e i
o u a e i o u a e i o u a e i o
u a e i o u a e i o u a e i o u
Γ A B C D E F G a b c d e f g aa
a e i o u a e i o u a e i o u a
e i o u a e i o u a e i o u a e
i o u a e i o u a e i o u a e i
o u a e i o u a e i o u a e i o
u a e i o u a e i o u a e i o u (op. cit. p. 54)

The neat layout of this diagram allows one to read consistent vowel series both horizontally and vertically. Finally, in Chapter 47, with its long title 'Quod per quinque subsonos vel quinque supersonos sicut omne quod dicitur scribitur, sic ad laudem dei quicquid scribitur cani possit', we arrive at what the author has apparently been preoccupied with all the time, namely the ability sooner ('citius') to sing the praises of God from the written word. So in this case we are actually dealing with an improvisatory method that has to be learned, but in which the detail was left more or less free. "Si quis autem hos subsonos vel supersonos studiose requisierit, cognoscet pro certo, quia omne quod canitur vel quod scribitur citius ad laudem dei cantare poteris hoc modo" ... There follows an example on the words 'Gloria in excelsis Deo', in which the vowels e and o in Deo are set as vocalises and melismas running hither and thither amongst the fivefold series. These vocalises may well have been the writer's primary concern: he may have wished to provide his songs of rejoicing (based on Guido's system) with the appropriate jubilant melismas, without prejudice to the handiness of the system as a whole. A singer who had memorised the chart, or even had it in front of him while he sang, would certainly be able with a little ingenuity to solve any difficulties that came his way. So the system of fivefold series was st ll a useful object, even though it ought—if regarded strictly logically— to have destroyed the system. The writer ends with the following words: "Quod itaque de hac laudp factum est, sic et de omni cantu posse fieri nulli dubium est. Illud praeterea scire te volo in more puri argenti cunctus cantus, quo magis utitur, coloratur; et quod prius displicet, per usum quasi lima politum postea collaudatur", op cit p. 55.

About 100 years later than Guido d'Arezzo the (possibly) English musical theorist Johannes de Affligemensis, known in his day by the latinised form of this christian name, Cottonius, was working on the same lines. In his treatise D e M u s i c a he propounded once more Guido's technique of single and double series of vowels, adding on the subject of this form of combinatorial art a few important observations of timeless validity. After the exposition of the first examples we find a paragraph in which Affligemensis expressly warns composers to be especially careful in the under-laying of the series of vowels, taking pains that their melodies come out exactly where they want them to come out and end where they want them to end[14]. In other words, Affligemensis draws attention to the fact that the only decisive thing in the compositional process is the underlaying of the series of vowels under the note-letters, and that once the vowels have been ordered in a particular way the really active part of the process is over. That applies to all combinatorial games. In modern terms and expressed metaphorically, what Affligemensis is saying is that you can never get more out of an automaton than has already been put into it, and that a calculating machine can successfully execute the most monstrous calculations, but only on the scale catered for by the designer of the machine. Modern calculators have no trouble multiplying numerals of 100 digits, but they cannot add one and one unless this process has been envisaged by the designer or at least included in the machine as a mathematical corollary. So what appears to the common man as the most frightening thing about a mechanical process is actually the least amazing; what is truly wonderful is the human brain, able to think out a certain programme on the basis of which he produces an effect that seems enormous but has in reality been envisaged from the very beginning. To return to Guido's compositional technique: if the composer sets the series of vowels under the note-letters b l i n d l y,

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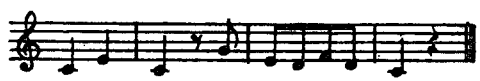
Another source may be quoted here for the sake of variety. William Tappert, the famous Wagner devotee, wrote an article in 1883 concerned with the currently raging dispute about authorship and plagiarism. After an exhaustive discussion of the reliability and unreliability of the opinions of experts for the establishment of what is artistically original and worthy of protection, he goes on: "Well, let's assume that my artistic conscience is now to be deceived! I want to compose music for a certain text, but nothing occurs to me. That's hopeless! Here we have a little innocent gadget to pep up our so-called 'inventive faculty'. We have five vowels:

A E I O U

and we assume a correspondence between these and the note series:

C D E F G

(any other series would produce equally adequate results). Now for a suitable text: T r a r i r a ! n u n i s t d e r S o m m e r d a ! Reading off from the vowels and the notes written below them, the following melody takes shape:



Sounds not at all bad, and was no trouble to compose! Probatum est, even in the most dubious cases. Is this method permissible or not? The First Book of the Maccabees, Chapter 12, verse 18". (Wilhelm Tappert: Eigenthum oder Diebstahl? Eine Frage an 'die musikalischen Sachverständigen', in: Musikalisches Wochenblatt XIV/39, p. 473–476, Leipzig 1883. p. 475). Tappert must have been a thorough connoisseur of old music, but it is not clear from his article whether he knew of Guido's system or not. At the time he wrote the article, Hermesdorff's edition of the Micrologus had been on the market for seven years, and it seems humanly unlikely that it could have escaped his attention. But it is still an open question whether he had actually happened on the relevant Chapter 17. Apart from all that, Tappert's aside about the music example sounding 'not at all bad' is very revealing. It is an admission, by a scholar obviously rooted in the intuitive aesthetic of the past, that music can actually be produced by means of the system, and that such music is not only quite serviceable musically, but also retains no trace of its rationalistic origin.

[14] "Vide autem ne te ista, quam praemisimus, vocalium dispositio ad hoc inducat, ut eas semper necessario ita disponendas existimes: sicut enim pictoribus atque poetis licet incipere quod volunt, sic nimurum sic modulanti per vocales aequa potestas est pro velle sui eas in principio disponere; itemque quemadmodum illis providendum est, ut id quod inceperunt perficiant, ita isti studendum est, ut ordinem inceptum finetenus deducat. Verbi gratia: Cum enim ego in praemisso cantu parhypate meson . o . . i . attribuerim, tu ibidem . e . . i . vel . a . . o . vel . a . . u . vel quidquid tale volueris, locare poteris, dummodo persistas in ordine quem inceperis", Affligemensis ,op cit p. 130.

he will never obtain a usable musical solution. Rather he has to consider exactly which vowel the vowel-series should begin with, and which second vowel-series has to be chosen in order to fulfil the requirements demanded of a melody in those days. Thus it was that Guido touched up his examples slightly, especially in the cadential phrases that were so important in Gregorian melodies: he reserved the right to eliminate undesirable turns in the melody, as it were. Hence too his advice to composers to adjust whatever unseemly formulae might appear. And Affligemensis permitted himself the same kind of intervention. So now we have arrived back at the conception of the greatest artist as he who manages by means of his system to produce melodies of substance that require no touching-up whatever.

The same principle has of course been active in all the other combinatorial procedures that the history of music has evolved, right up to Stockhausen. The numberless critics who have inveighed[15]—and still are inveighing—against combinatorics with cries of 'charlatanism' and 'inartistic, unmusical intellectualism' are confused, as has so often happened in the course of history, about the fact that words like content and form, technique and method, plan and will are merely the tools of conceptual explanation, and not standards of value in themselves for measuring the excellence of design and development, phenomenon and effect, substance and meaning[16]. The fact that someone sits down to write a sonata, a fugue or the florid sixth species of Fux's excellent counterpoint—or works out a formula for the production of 19 note-groups that may be arbitrarily mixed and yet always combine to make a piece of music of a particular individuality—says nothing whatever about the worth or worthlessness of what is produced (unless of course one is regarding the matter from an evolutionary-historical point of view). The worth or worthlessness of the product is a factor of the dichotomy of identity of plan and execution. What we wish to establish is that a combinatorial situation such as that used in Stockhausen's piece is quite feasible as a principle and furthermore that it is artistically manageable.

Guido's compositional technique was later subjected to a modification that sprang from the same speculations that had made Guido's system possible (ideologically speaking). For these were profoundly religious men, who had no more use for chance than the modern composer working according to statistical procedures. Everything man owned came from God. And it would have been impossible to persuade a mediaeval theorist —for whom the unity of the soul was a living experience—that correspondences between the different artistic dimensions could be the result of so-called chance events, i.e. of processes that were in themselves meaningless. It would have appeared quite inconceivable that language and the letters used for defining the musical notes should exist without any connection with each other; there had to be some mysterious relationship between God-given language and God-given music. So the mediaeval theorist—and the rest of the world too—was amazed at the simple fact that there are words and letters that bring with them—as it were from their place of origin—their own melody[17]. The speculations aroused by this situation were anything but lighthearted. They were earnest professions of faith, corresponding to the total basic speculative attitude of that century, which was concerned with many ideas that are still more alien to present day

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[15] Helmut Kirchmeyer: Igor Strawinsky—Zeitgeschichte im Persönlichkeitsbild. Grundlagen und Voraussetzungen zur modernen Konstruktionstechnik, Bosse-Verlag, Regensburg 1958, p. 354–363.

[16] Paul Bekker: Hanslick, in: Musikblätter des Anbruch V/10, 1923, p. 287.: Kirchmeyer, op cit p. 359.

[17] Schering: op cit below (v. note 38) p. 27.

sensibilities. Guido said of his system of composition that in it the basis of all melodies became completely clear—'cum omnium omnino/melorum causa clarueri t'[18]. And later he remarks that it is necessary to profit from such instruction so that one can forge ahead to the fulness of science—'ad plenitudinem scientiae'[19]. In other words, one must first hold fast to these rules until such time as one has penetrated so deep into the compositional context that one can grasp the structure of the composition even without such instruction. There can be no talk of mere dalliance or technical ingenuity in this context. Guido's technique was joined by a variant that appeared to be an improvement and a consolidation, based on the thought that the vowels of a text could be translated into sol-fa syllables and thus provide musical themes. Sol-fa syllables are the usual Latin and Romanic indications for the steps of the scale: ut-re-mi-fa-sol-la-si. These syllables contain all five vowels, which gives them a distinct advantage over the scale-letter system c-d-e-f-g-a-b. Hence it is possible to convert a n y word (not just a small number of words as was the case with the scale-letters) into solfa syllables. The Italians have a name for this technique of forming themes from letters: 'Soggetti cavati', literally 'excavated themes'.

As far as we know today, soggetti compositions of this kind were produced chiefly in the 15th and 16th centuries, and, were frequently addressed to princes[20]. The son of Duke Alfonso and Lucrezia Borgia in particular, the second to bear the name Hercules of Ferrara, seems to have given rise to numerous compositions of this kind. His fame as love of art drew many composers of the day to the court of Este in Ferrara. Josquin des Prez initiated the custom with a Mass for Prince Hercules I. He took the superscription of the Mass—'Hercules dux Ferrariae'—and dug out the vowels, translating them into sol-fa syllables so that e becomes re, u becomes ut, a becomes fa and in becomes mi. This gave him a theme that brought together the notes d-c-d-c-d-f-e-d (to revert to the use of scale-letters) and he used these as the thematic basis of the whole composition of the Mass. Josquin had already written his Mass 'La sol fa re mi', the theme of which was also derived from an Italian sentence[21].

Josquin's example was the start of an amazingly fruitful production[22] that led in the end to a further step when the solfa syllabification technique was elaborated to provide cryptic, programmatic puzzle themes. There is a composition by Lupus Hellinck that revealed itself after lengthy and intensive scientific research as a Mass extolling the marriage on April 6th 1528 of the Royal Pretender to the cousin of Francis I of France, Renée de France. The opening puzzle theme is quickly supplanted by a second theme that differs from the first theme only in the reiteration of two notes. This reiteration destroys the place-name Ferrara and converts it into the person-name Renata, the Latin form of Renée. After decoding, the text read off from the thematic development runs as follows: 'Hercules lucebit Ferrariae' ('Hercules shines over Ferrara'—that is the opening tribute) and then 'Hercules Lucebit, Renata vivet' ('May Hercules shine; long live Renata')[23].

[18] Guidonis Aretini Micrologus, op cit p. 186/187.

[19] Guidonis Aretini Micrologus, op cit p. 195.

[20] A.(dolf) Thürlings: Die soggetti cavati dalle vocali in Huldigungskompositionen und die Herculesmesse des Lupus, in: Bericht über den zweiten Kongress der Internationalen Musikgesellschaft zu Basel vom 25.–27. September 1906, p. 183ff, Breitkopf & Härtel, Leipzig 1907 p. 184. Wolff: op cit below (v. note 27) p. 82f, p. 84.

[21] Wolff: op cit below (v. note 27) p. 82, p. 60.

[22] For evidence v. Thürlings: op cit p. 188ff.

[23] Thürlings: op cit p. 185ff.

In Heinrich Isaac's six-part festive song 'Virgo Prudentissima' from the Song of Songs, the passage 'es ut sol' ('You are like unto the sun') uses constant leaps of a fifth for the words 'Ut sol', both of which are sol-fa syllables and make up the interval c-g. A man of Palestrina's rank was not above using the same techniques at the same passage[24].

The use of German scale-letter themes was common from Bach to Reger. Since the scale-letters include only two vowels one might expect the results to be rather meagre, but the availability of a number of consonants did enable composers to translate the occasional complete word. Composers' names such as Gade, g-a-d-e, personal remarks directed at critics such as 'Affe', a-f-f-e (the German word for ape) and other less printable words, themes chosen in a spirit of play, such as Schumann's variations on a-b-e-g-g, and numerous other verbal formations have been transmuted into music. In modern times Roman Haubenstock-Ramati has used the name Strobel in a composition[25], and Heinrich Lemacher wrote a short composition in several phases on the abbreviated form of the name of a well-known factory. Each individual phase is composed in a different style, and one might impose (falsely, as it happens) the interpretation that this is to indicate the international standing of the firm[26]. This technique reaches its climax of course in the legion settings of B-A-C-H, the name Bach[27], starting with the examples by Bach himself[28]. 'Note-syllable themes were not used in secular chansons, but as the sober and considered constructional base of Masses and motets'[29].

So whoever fundamentally rejects the applications of such principles of composition as mere triflings and unworthy side indulgences of serious artists, without consulting the individual work in question, should be consistent and castigate all composers who have ever indulged in this supposed trifling. The list would include all composers of the world, almost without exception.

It is just that we are too apt to forget that most of the formal principles of music—if regarded in that spirit of arrogant vulgarity characteristic of the opponents of modern speculative thought—are basically nothing more than dalliance. For example the problem of how to contrive a piece of music so that it can be played backwards or forwards and yet produce the same sounding result is, if one is concerned with the compositional principle and not with the way it is carried out, a form of inartistic, artificial dalliance to pass the time when one has nothing better to do, or an exercise for advanced stu-

[24] Thürlings: op cit p. 187.

[25] A few examples have to stand for a whole host. German composers seemed to favour a combination of note-letters and sol-fa syllables, often with pauses to represent unavailable letters. Alternatives abound. For example, ss can be read as -sol-sol- or -sol-si- etc. or simply as -es- (the German expression for E-flat). So a word like 'Fessel' (bond) can be read as -fa (or F)-E-sol-si (or simply E-flat)-E-la-, 'Mutter' (mother) can be read as -mi-do (for ut)-pause-pause (or ut repeated once or twice)-E-re-, 'Elisabeth' becomes E-la-mi (or si)-E-flat-A-B-flat-E-pause (or ut)-B (h is the letter for B-natural in German B-flat being represented simply by b), and 'Detlev' becomes do-E-pause (or ut)-la-E-do (equals ut when the v is taken as a w; or more simply fa or F can be used as a possible rendering of the hard German v). In this way almost any word can be used as a note-syllable theme.

[26] Heinrich Lemacher: 'Agfa' variations for large orchestra op 145, for double woodwinds, three trumpets, two horns, three trombones, tuba, timpani and string quintet. The piece appeared originally as a harmonisation of A-G-F-A for two trumpets and three trombones, and was performed in Cologne in 1954 as a sort of greeting for the composer's friend Dr. h.c. Bruno Uhl, a director of the Agfa company. Later it became a set of piano variations on a classical theme, and finally an introduction to a Chaconne. The orchestration was carried out in January 1955. The informal première of the piece took place in the Musikhochschule in Cologne, the orchestral material being available for hire from the Cologne publishing house Gerig. The official première followed shortly afterwards, in the autumn of 1955, in Leverkusen. When the piece was broadcast the name of the firm had to be suppressed to avoid the favourite accusation of 'sneak advertising'.

[27] For a list of all known settings of B-A-C-H up to 1952 both as integral compositions and used episodically (38 in all), v. Mies: op cit below (v. note 28, second source quoted) pp. 147/8.

[28] Paul Mies: Die Kraft des Themas, dargestellt an B-a-c-h, in: Bach-Jahrbuch. Im Auftrage der Neuen Bachgesellschaft herausgegeben von Arnold Schering, Jahrgang 19, p. 9ff, Breitkopf & Härtel, Leipzig 1922: Paul Mies: B-A-C-H. Stilistisches und Statistisches, in: Zeitschrift für Musik XCII/3, p. 142ff, 1925.

[29] Hellmuth Christian Wolff: Die Musik der alten Niederländer (15. und 16. Jahrhundert), VEB Breitkopf & Härtel, Leipzig 1956, p. 85.

dents. The fact that this kind of artificiality led to the huge constructions that are Bach's mirror fugues cannot be dismissed with the worn-out argument that Bach was after all a great composer and able to make something even along these lines. For that's what the argument is all about: that it is foolish to reject a composition merely because it is the product of a particular technical method (of whatever kind), and hence that the whole gamut of current obloquy ranging from 'intellectualism' to 'charlatanism' is out of place here, as long as no attention is paid to actual concrete productions and nobody takes a closer look to see whether the plan (of whatever kind) has been successfully carried out in this particular case or not—i.e. whether or not a certain arithmetical or other kind of methodical procedure has been given a satisfactory aesthetic form that makes sense in itself in the same way as it manages to communicate this sense to the world in general[30].

In reality, the formation of formal norms is always a matter of combining the highest degree of strictness in observance of rules with the highest degree of compositional freedom in their handling. In other words, the composer should be so adapted to the rule that he no longer regards it as a bind but merely as a wholesome regulator that protects him from the urge to spread himself to infinity. Our much-quoted German Classics are the ones who managed to think this problem through. Schiller, in writing his paper on Grace and Dignity, wished to reshape Kant's categorical imperative, which he found too determinative. That man lives in dignity who fulfils the moral law because he is under an obligation to fulfil it so as not to act contrary to morality. But he in whom the moral law is so ingrained that he feels it to be almost his own nature, and hence categorically cannot act otherwise than morally without doing violence to his own nature, he lives in Grace, understood as the real goal of human and spiritual self-realisation. So the problem of submitting to a law and yet, beyond that, so understanding and spiritualising the law that one can fulfil it not merely in a spirit of dignity but in a spirit of grace, has to be posed afresh for every one of the multifarious rationalistic methods of composition, at least for such as admit of combinatorial developement. For quite possibly it was in fact—although we cannot be sure even in this case!—an expression of 'rationalistic stubbornness' when for example the monk Mauritius Vogt of Prague in his musical treatise 'Conclave Thesauri magnae artis musicae' (1719) wished people to compose music by the method of bending a number of hobnails into different shapes, equating each of the different shapes with a musical figure, and then throwing down the hobnails and reading off the musical figures and writing them down in exactly that order in which the hobnails had fallen[31]. Although again what is senseless in this method is only the small number of musical figures that are brought into play. For there is no doubt that even a hobnail system of this kind could be interesting combinatorially (within limits), as we can see if we pose the problem differently, as: to write a series of figures that permit of all possible combinations amongst themselves.

This brings us close to the chance techniques employed by John Cage. Such a technique tries to relieve the composer of the final responsibility towards himself; it may produce musical aggregates with possible combinatorial connections, but the final version is left to the spin of a coin. In the speculations of the last few years chance has of course come to occupy a special position. There may well be a closer religious affinity between the Buddhistic, passive attitude of Cage and the contemplative attitude of the monk of Prague than at present appears to be the case.

[30] Kirchmeyer: op cit p. 354.

[31] Schering: op cit below (v. note 40) p. 28.

Vogt's technique is amply accounted for in the musical figure imagery of the baroque period, which had become a matter of interchangeable note-formulas.

For the strong expressive content of baroque music cannot be fully understood without an exact knowledge of the system of figure imagery[32]. Only such knowledge can explain why the death on the cross in a particular Passion used figures similar to those used by Telemann in a Cantata for the tragi-comic demise of a much-loved parrot. This is a product of a rationalistic system of composition stemming from the beginnings of early music in the Netherlands at the beginning of the 15th century and which determined all music up to and including the total production of Bach and Handel, that is, up to the middle of the 18th century. Originally the musical figures were not thought of at all as rigid note-formulas; they were something that emerged from the schematised confrontation of music and rhetoric arising out of the direct interpretation of the individual words of the text according to the principles laid down by the rhetorician Flacius Illyricus[33]. What emerged in fact was a system of modifiable musical grammalogues that brings about a fusion of graphic image and expressive strength. The musicologists of the day made systematic surveys—with a distinct bent for mathematical precision—of the innumerable variety of musical figures; they catalogued them and thus preserved them for posterity[34]. The composers found it completely natural to use musical figures, as is proved by the frequent complaints of scholarly theoreticians that so many composers composed with musical figures without even being acquainted with the proper sonorous Latin and Greek names of the individual figures[35]. Only one fact is necessary to prove how serious a matter the systematic research and application of musical figures handed down from generation to generation was for the musicians of that century: many of them learned Hebrew especially so as to be able to make the necessary correct interpretation of the original written word for the purposes of musical figuration[36]. Hebrew is particularly rich in embellishments, images and figures of speech, and it was the task of musical figuration technique to translate these into graphic musical imagery. This opened up a wide field of activity in the sphere of musical rhetoric above and beyond the theological foundations of the words. The Musicus Poeticus that was demanded in those days was not a matter of correctly declaimed music, of diligent attention to the rules of prosody, of the right accentuation of words, of punctuation and the rise and fall of the voice in accordance with the sense of the words; no, what was required was the exact interpretation and analysis of the individual word through musical figures, and this bound the musician very tightly to the laws of rhetoric and rhetorical poetics. This generation of musicians, growing up in the Protestant concep-

[32] Arnold Schmitz: Die Bildlichkeit der wortgebundenen Musik Johann Sebastian Bachs, Neue Studien zur Musikwissenschaft I, published by the Kommission für Musikwissenschaft der Akademie der Wissenschaften und der Literatur, B. Schott's Söhne, Mainz n. d. (1950). Heinz Brandes: Studien zur musikalischen Figurenlehre im 16. Jahrhundert (written under Arnold Schering!), Diss. Berlin 1935. Hans-Heinrich Unger: Die Beziehungen zwischen Musik und Rhetorik im 16.—18. Jahrhundert, Musik und Geistesgeschichte, Berliner Studien zur Musikwissenschaft IV, Edited by Prof. Dr. Arnold Schering, Konrad Triltsch Verlag, Würzburg 1941. Hans Heinrich Eggebrecht: Heinrich Schütz. Musicus poeticus, Kleine Vandenhoeck-Reihe 88, Vandenhoeck & Ruprecht, Göttingen 1959, p. 44ff. For summary and further literature v. Arnold Schmitz: Figuren, musikalisch-rhetorische, in: Die Musik in Geschichte und Gegenwart IV, Bärenreiter-Verlag, Kassel/Basel 1955, p. 176ff. Both Schmitz works refer to and argue with Arnold Schering's views, Schering being the real re-discoverer of the musical figures.

[33] Schmitz: Die Bildlichkeit... op cit p. 23, p. 26.

[34] The number of known musical figures approaches a hundred (although this counts only those listed by German musicologists). But the number actually used in practice is probably much higher, quite apart from the ambiguity and extreme flexibility of some of the figures and the fact that in the last analysis any form of notes can become a figure. v. Schmitz: Die Bildlichkeit... op cit p. 24; Eggebrecht: op cit p. 45 pp. 45/6

[35] Schmitz: Die Bildlichkeit... op cit p. 24/25, note 35 p. 25.

[36] Schmitz: Die Bildlichkeit... op cit p. 26/27.

tion of music, felt more than any other the Lutheran dependence on the revelation of God's 'word', determined by the doctrine surrounding each individual word[37].

This much-discussed Musicus Poeticus, which includes Schütz just as much as Bach, was concerned with the interpretation of the individual word as a means of illuminating an understanding the total word of God, and the composer of musicus poeticus approached his task with the attitude of a scientist—the task being the communication of theology through music. He was not composing for the sake of expressing his feelings and emotions—not for the sake of expressing himself in music—but rather as a scholar whose intentions are directed towards making the sense of a text comprehensible and who is concerned to explore that text in depth as music. He was not guided by the demands of a public, nor by sweetness on the ear, not by sensual perception and effect. His work came into being rather 'in the manner of research or discovery' and had as little desire for mere 'effect' 'as the work carried out on a scientific project'[38].

The violent arguments within the baroque aesthetic sprang from the same problem. If Scheibe was up in arms against Bach it was merely because he subscribed to a new theory of musical figures which Bach rejected because he was part of a different tradition of figuration[39]. The aesthetic reservations harboured by each against the other lay in the system that became the basic attitude of a whole epoch; but all were aware that despite the rationalism of the procedure it could never hinder—and far less supersede—the free flight of the imagination. Of course, in the hands of the weaker composers the system degenerated into a stereotyped, formalistic recipe, which prevented the composition of any important works, and on the other hand it could produce works in which the musical argument was rather easy to understand—a quality that is not necessarily reprehensible!

Now this portends a further rationalistic schema in baroque edificatory musical practice: the socalled 'invention systems', 'ars inveniendi' [40] developed by Kuhnau, Heinichen and Mattheson—that is, by personalities who were also the leading composers of the period—into masterly constructions of musical theory. For it was the avowed intention of the invention systems to leap into the breach in cases where the text seemed to exclude the possibility of using music-rhetorical figures. And here again only the historical background of the figurations can explain how Mattheson arrives at the conclusion that a composer can by all means use progressions developed by another before him, provided only that the effect does not appear forced and far-fetched. Anyone who cannot think of anything better to do should write down all the lovely passages, progressions and cadences that he has ever heard and read, and make a collection of them. Then, when the time comes to think of composing something, he can go to his collection for 'advice and cheer' as the author so charmingly puts it[41].

[37] Schmitz: op cit; Eggebrecht: op cit p. 11.

[38] Eggebrecht: op cit p. 45.

[39] Bach's figuration technique included the (grammatical) figures that emerged from Mannerism: in this he was following the tradition of the older musical rhetoric. Meanwhile however the musical theory of enlightenment (Scheibe) had moved so far away from this that it could not but regard the expression of small ornamentations as written notes as more than a little bombastic. This accounts for the contemporary comparison, so welcome to the newer theoreticians, between Bach and the bombastic literature of Lohenstein. Scheibe accused Bach of not paying enought attention to rhetoric. Magister Joh. Abraham Birnbaum on the other hand, well versed in the older technique and a professor of rhetoric at Leipzig University, asserted that Bach was a great and ingenious connoisseur of musical rhetoric and was prepared and able to defend his view. v. Schmitz: Die Bildlichkeit. . . op cit p. 37/38.

[40] Arnold Schering: Geschichtliches zur, ars inveniendi' in der Musik, in: Jahrbuch der Musikbibliothek Peters for 1925 p. 25ff, edited by Rudolf Schwartz, XXXII. Jahrgang, Verlag von C. F. Peters, Leipzig 1926.

[41] Johann Mattheson: Der vollkommene Capellmeister. Das ist Gründliche Anzeige aller derjenigen Sachen, die einer wissen, können und vollkommen innehaben muss, der einer Capelle mit Ehren und Nutzen vorstehen will: Zum Versuch

Actually he warns his readers against the 'invention-chests' that were current at the time (they were also known as 'sewing baskets' and 'filing cabinets'), for one should really have possession of these progressions in the same way as the public speaker has his vocabulary. One should only make a catalogue of the selected fragments when no other way out appears possible. Such fragments should be used as the speaker uses his vocabulary —that's the important thing. For the progressions that you write down are really nothing other than the old musical figures, and what finally distinguishes the great master from the small one is the way in which he applies, combines and develops them. The idea of 'melodic theft' was not unknown[42], but the compilation and exploitation of such 'sewing baskets' was not theft, it was merely making use of lists of figures such as numerous musicologists were in the habit of publishing anyway So—behind the supposedly free music-making, the expressive art of three centuries, lurks a system of composition as conscious, as worked-out, as rationalistic and yet as undogmatic as one can possibly imagine.

Now if we look at the isorhythmic motets which in the 13th century posed a solution to the problem created by the destruction of the equilibrium of the parts and the breakdown of modal parallel movement, we see that the past offers instances of even stricter and more rationalistic formal construction, even before the intricate canons of the Netherlands school. In the isorhythmic motets, based on the rational control of a sequence of periods slotted into a recurrent rhythmic scheme, melody is forced into a mathematical law of ever-increasing constructive rigidity. The periods are arranged in some abstract logical order and this exercises an equally strict and rationalistic tyranny over the continuous 'musicalisation' of the time in which the piece unfolds. The chains of identical sections—identical in their rhythmic scheme, hence 'isorhythmic' —are linked only by a mechanical principle, not by any genuine inner relationship. And these more or less integrated, equivalent musical strips and layers piled one on top of the other are typical not only of the isorhytmic motets but of the Middle Ages in general. Isorhythmy, as instanced initially in the second half of the 13th century in a few isolated tenor parts and then fully elaborated by Philipp de Vitry in 1316, remained valid almost without exception throughout the 14th century right up to Dunstable and Dufay[43].

And yet the history of music with its prodigal richness of creative plenty—passing now from the large, super-temporal formal type back to the individual work of art—has produced innumerable wonders that exact respect and astonishment even from present-day composers schooled in serial technique for the strictness of their construction and the logic and determinacy of their development. As examples, consider the cornucopia of canonic techniques ranging from the simple canon by inversion to highly complicated circular canons and puzzle canons[44]; the numerous musico-combinatorial dice and chess games[45]; the infinite number of amusing tricks such as music pages that can be

entworfen von Mattheson, Christian Herold, Hamburg 1739 (reduced facsimile edition as Documenta Musicologica. First series: Druckschriften-Faksimiles V, edited by Margarete Reimann, Bärenreiter-Verlag Kassel/Basel 1954), p. 123 §18.

[42] Mattheson: op cit p. 122 §11ff, p. 123 §22. Johann Kuhnau: Der musicalische Quack-Salber (1700), edited by Kurt Benndorf, as: Deutsche Literaturdenkmale des 18. und 19. Jahrhunderts, edited by August Sauer, no. 83/88—new series 33/38, B. Behr's Verlag (E. Bock) Berlin 1900, Caput IX, p. 37—39, Caput XVII, p. 70ff.

[43] Heinrich Besseler: Studien zur Musik des Mittelalters, II. Die Motette von Franko von Köln bis Philipp von Vitry, in: Archiv für Musikwissenschaft VIII, p. 131 ff, edited by Max Seiffert, Johannes Wolf and Max Schneider, Fr. Kistner & C. F. Siegel, Leipzig 1926, p. 198-202. Wolff op cit p. 28.

[44] Laurence K J Feininger: Die Frühgeschichte des Kanons bis Josquin des Prez (um 1500), Diss. Heidelberg 1937.

[45] Hermann Güttler: Musik und Würfelspiel, in: Zeitschrift für Musik CIII/2 p. 190 ff, 1936. Fred K. Prieberg: Musica ex machina. Über das Verhältnis von Musik und Technik, Verlag Ullstein, Berlin (Frankfurt) Wien 1960 p. 112ff. With reference to the 'Komponium'. an automatic musical instrument constructed by the Amsterdam mechanic Dietrich Nikolaus Winkel, which at the touch of a lever (variative) began composing and contained sufficient combinatorial possibilities to last

read backwards, forwards, from top to bottom or upside down, from the centre outwards, etc. and sometimes all at the same time. There are pages of music written so that they can be placed amongst a group of musicians in such a way that when each player plays the page as he sees it from his position the result is a perfectly ordered, harmonious-sounding piece of chamber music. These are just a few musicological instances to show that every age has attempted and solved—validly in terms of its own musical language and aesthetic—problems grounded in musical technique. Above and beyond this, the inexhaustible topic of Music and Mathematics[47] proves indubitably that all past epochs in the history of music have busied themselves with the mastery of the mathematical problems of the age. To demonstrate this both in terms of large-scale historical evolution and as represented by individual art facts would require a book of no mean proportions. Such a book would show finally that every single great composition, from Gregorian Chant[48] and Perotin the Great's monumental Organa Quadrupla to Schönberg's Moses and Aaron[49] is in its own right a masterpiece of mathematical inspiration and symbolic connection. And this in the form of uniquely valid solutions of uniquely posed problems.

The musicologist can do no more than write out and interpret the continuity of rational and rationalistic music-making in the course of history. But it is extremely doubtful whether anyone will consider it necessary to draw conclusions relating to the polemical situation of the present after this illuminating and authoritatively documented and guaranteed study of the past. Hegel argued that the only thing one can learn from history is the fact that one has learnt nothing from it. Nonetheless the point of musicology is and always has been the following: to counterbalance a knowledge of history with a respect for creative achievement of whatever kind and in whatever period. This it does by showing how every age is to be understood according to the laws proper to itself, so that these can be accepted as the legacy bequeathed by the past to the present. Science can never reach this end, the most it can do is approach it as a limit; for there will always exist that dubious type of purely practical musician lacking in any profound insight into the super-temporal problems of his art. Such types mistrust their contemporaries for exactly those qualities that produce storms of enthusiasm when they meet them in the past, namely the prophetic gift of opening up new spaces of sound and new musical laws, and the perseverance of genius in comprehending the traditional inheritance in its true spirit, and then absorbing it and persisting in its perfection.

138 trillion years, compare Alexander Buchner: Vom Glockenspiel zum Pianola, Artia Verlag, Prague, p. 79f. Winkel constructed his unique automatophone in reply to Johann Nepomuk Mälzel's theft of his Metronome in 1815.

[46] Josquin Desprez wrote his Mass 'Di dadi' using the six dot-numbers of a die: he had the same notes dotted differently, thus changing the reading of their duration values. v. Wolff: op cit p. 91/92.

[47] Ernst Bindel: Die Zahlengrundlagen der Musik im Wandel der Zeiten, Verlag Freies Geistesleben, in two volumes, Stuttgart, I 1950, II 1951. Ernest Bloch: Über das mathematische und dialektische Wesen in der Musik, in: Von neuer Musik, Beiträge zur Erkenntnes der neuzeitlichen Tonkunst, p. 5ff, Marcan-Verlag Köln 1925. Martin Vogel: Die Zahl 7 in der spekulativen Musiktheorie, Diss. Bonn 1955. Wolff: op cit p. 89ff. Schäfke: op cit p. 22ff, p. 203ff. Kirchmeyer: op cit p. 359ff, p. 534f, note 86 p. 535.

[48] Lucas Kunz: Textrhythmus und Zahlenkomposition in frühen Sequenzen, in: Die Musikforschung VIII/4 p. 403ff 1955.

[49] Karl H. Wörner: Gotteswort und Magie. Die Oper 'Moses und Aron' von Arnold Schönberg, Verlag Lambert Schneider, Heidelberg 1959.

The Three-dimensional Music Stave

Music notation is both more and less than a script; it is an image, a blueprint, a graphic representation. Yet it is a script as well, that is, something written down that can certainly dispense with the exactitude of ruler and graph paper. What is the connection? The connection is simple. But simple things are so often left in the dark, unremarked, unknown and un-understood.

A note-head makes a point either on a stave-line or precisely between two stave-lines. This note-head can be hand 'written' and is clear and distinct when it is plain where its 'kernel' or centre, that mathematical place, lies. So something geometrically exact can certainly be made plain by something handwritten and inexact. When notes are to be printed all the equipment of technical draughtsmanship is brought into play: drawing board, straight edge, ruler. The length of bars and the distance between notes has to be calculated exactly. Again, music printing is both more and less than printing. To a large extent it is drawing, and here too there have to be certain peculiar imprecision factors, these being actually essential for the legibility of the whole. A bar full of semiquavers is written longer than a bar containing only a single semibreve, and the eye follows this, doubtless finding that this inexactitude facilitates reading. On the highest level music printing is so far removed from ordinary printing as to be worthy of consideration as a real art, and the idea of printing music by means of machined movable type remains an absurdity. There are so many factors to consider that the profession of music-engraver is predominantly an artistic one, certainly not a calculating one.

A scale composed of equal rhythmic values is written as eight dots on a straight line that crosses the stave obliquely. The angle of incidence is arbitrary only insofar as we can choose the length of the bar. This would determine the angle. Obviously we would not be able to read these dots as marked by a designer on the drawing board. It is as though our eyes had to read the whole fruit, although the only important thing is the kernel. Music notation has two coordinates: the horizontal coordinate of metric and rhythmic relationships, and the vertical coordinate of pitches and chords. If one attempts to explain these coordinates and their function to a beginner who knows nothing of music notation one encounters certain difficulties and it is no easy matter to persuade him to imagine a tone in the symbolic form of a note-head. It would be equally possible, though not entirely practical, to use a sort of Phonola-roll notation in which tones are represented as punched holes whose lengths represent the durations of the sounds. Compared with such a mode of representation, our music notation appears as an abstraction, perhaps a convenient one, but in the last analysis not a very direct and graphic representation of musical events.

As for the learning of music notation, we must draw attention to the peculiar fact, whose consequences are hardly ever considered by anyone, that most young people are taught a notation that is without doubt highly questionable. Our schools teach the

sol-fa (vocal) system. There are two main points of difference between this and instrumental script: 1. it gives the phrasing twice over quite unnecessarily, namely by means of phrase-marks and beaming (for values of a quaver and less); 2. it is anti-visual, and above all anti-rhythmic. There is no visible difference between 3/4 metre and 6/8; the quaver flags carry on unconcernedly, making no visual distinction. Singers will continue to be stupider than instrumentalists as long as we persist in teaching our school children this notation. The system is a fossil and if it ever disappers from off the face of the earth, that will be the occasion for a great celebration. It is the cardinal error in music teaching, and it is to blame for the fact that mankind is musically illiterate except for a minute percentage. In this vocal notation the symbol-content of music notation has shrivelled away. The note-head is the symbolic form of a tone, and similarly the whole notation symbolises the animation of tones. For this reason music notation has to be studied primarily in its horizontal aspect, as a symbol of movement, of walking and stepping, for tone-steps and tone-leaps are really nothing other than actual 'steps' and 'leaps'.[1] The two coordinates of music notation are joined by a third, the coordinate of space. Here we could quote quite a number of important musicologists who have grasped the space-components of music notation more or less clearly, sometimes approaching the threshold of concrete knowledge but never actually bringing them out into the open light of day. The spatial coordinate of music notation is no purely theoretical construction, it is a historical matter for which a large body of evidence is available. In its various aspects it permits of various different views of 'space', but all within the one space in which they are different, whether we are considering the music of Palestrina or Bach, the chromaticism of the 16th century or that of 'Tristan'. The emergence of space and the spatial-mathematical laws of music in structure and dynamic may be illustrated by examples mainly from the epoch of tonal music. The pre-classical chorale is one of the most perfect vehicles for space-notational definitions; it is not so much a matter of tonality as a matter of 'space', that is, a principle of representation that retains its full validity even with the obvious proviso that the implied space components are those of tonality. And even where the classical concept of space ceases, in Non-tonality, in the Un-space, Other-space and Super-space of Schönberg's thinking, yet space is still space, just as non-euclidean geometry is still geometry.

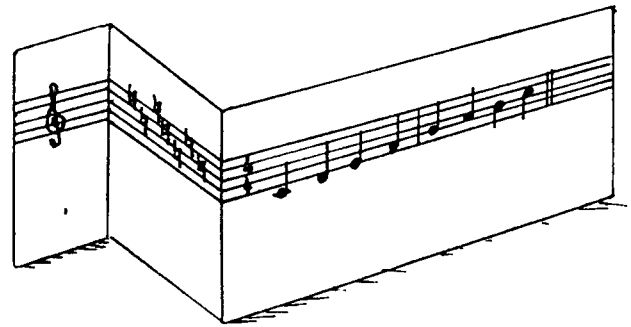
The third, the spatial coordinate is manifested in tonal music by key signatures. These categorical or marginal accidentals play a different kind of role in a piece of music from those that appear in the course of it for modulatory or chromatic purposes. On the stage of tones, they allocate a specific area to the musical plot, close to the footlights or far away from them, and the fact of their disappearance in non-tonal music is a very different thing from the fencing off of the C major boards in tonal music. The stage area is narrow in the simple case of school harmony based on classical models; 'Tristan' on the other hand exploits the full depth of the stage, using the full quota of $5 \times 7 = 35$ note-names. I grant that these matters are considerably obscured by two deficiencies that resulted from notational practice in tonal times and which can only be grasped in relation to tonality. 1. The series of sharp key signatures runs contrary to the series of flat key signatures. 2. For reasons of notational convenience the marking of 'naturals' was dispensed with. They would have served to bring the number of accidentals in any key signature up to the full seven, by complementing the sharps or flats with naturals. C major and

[1] A while ago the press carried notices of a Frenchman who had developed a choreographic script that was virtually the same as traditional music notation. I was anything but surprised. Music notation is choreography, and it can be used in the form of a full score to determine the motions of an entire ballet right down to the smallest movements of the fingertips.

A minor would thus be the keys with seven naturals. Occasionally we do meet such notations, for instance in the change from A flat major to A major, where the four naturals (logically D-natural, A-natural, E-natural, B-natural, but in practice written in reverse order) precede the three sharps (F-sharp, C-sharp, G-sharp).

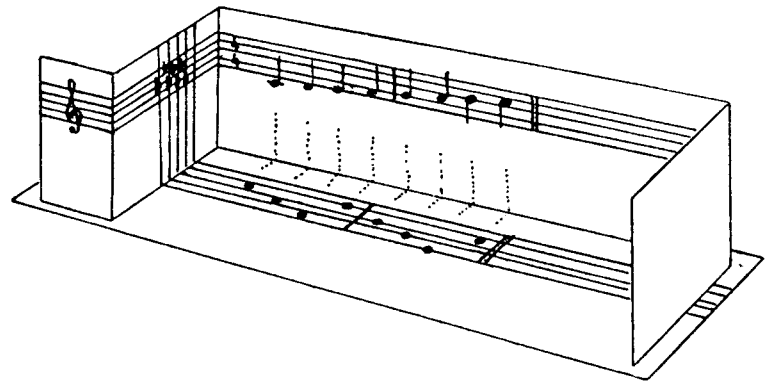
It is possible to make the spatial coordinate of the music stave literally appear before your very eyes by setting up the two folded strips of paper as shown in the following illustration:

Example 1



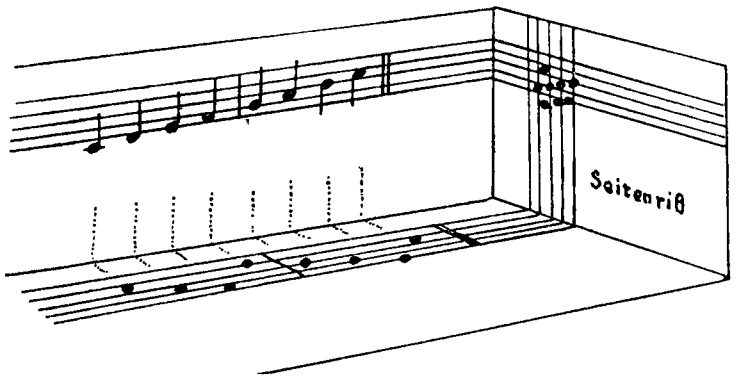
If we substitute seven sharps for the naturals we have a picture of the C-sharp major scale. In the case of seven flats it is better to fold the paper the other way and draw in a 'ground plan':

Example 2



Using the same method we can construct a 'side elevation'. Seen in the spatial notation-perspective and in relation to the image and the ground plan from the left hand side, it appears thus:

Example 3



Seitenriß = side elevation

Taking a further step from here one can think of the marginal signature as a selectios from a scale of all 35 note-names, symbolised by their accidentals and double accidentals, and these can be set to every notatable key by means of a sliding rule. The resulting relationships of spatial notation-perspectives are shown in a picture where the toneg are presented as spheres floating in space (example 4). Appropriately, these note-spheres are tonal spheres. They cast shadows on the back wall: these make up our usual notation for the C major scale. They cast shadows on the floor; this ground plan can be used as a diagram for modulation. Finally, they cast shadows on the end wall: and these represent the harmonic sphere (in the tonal sense).

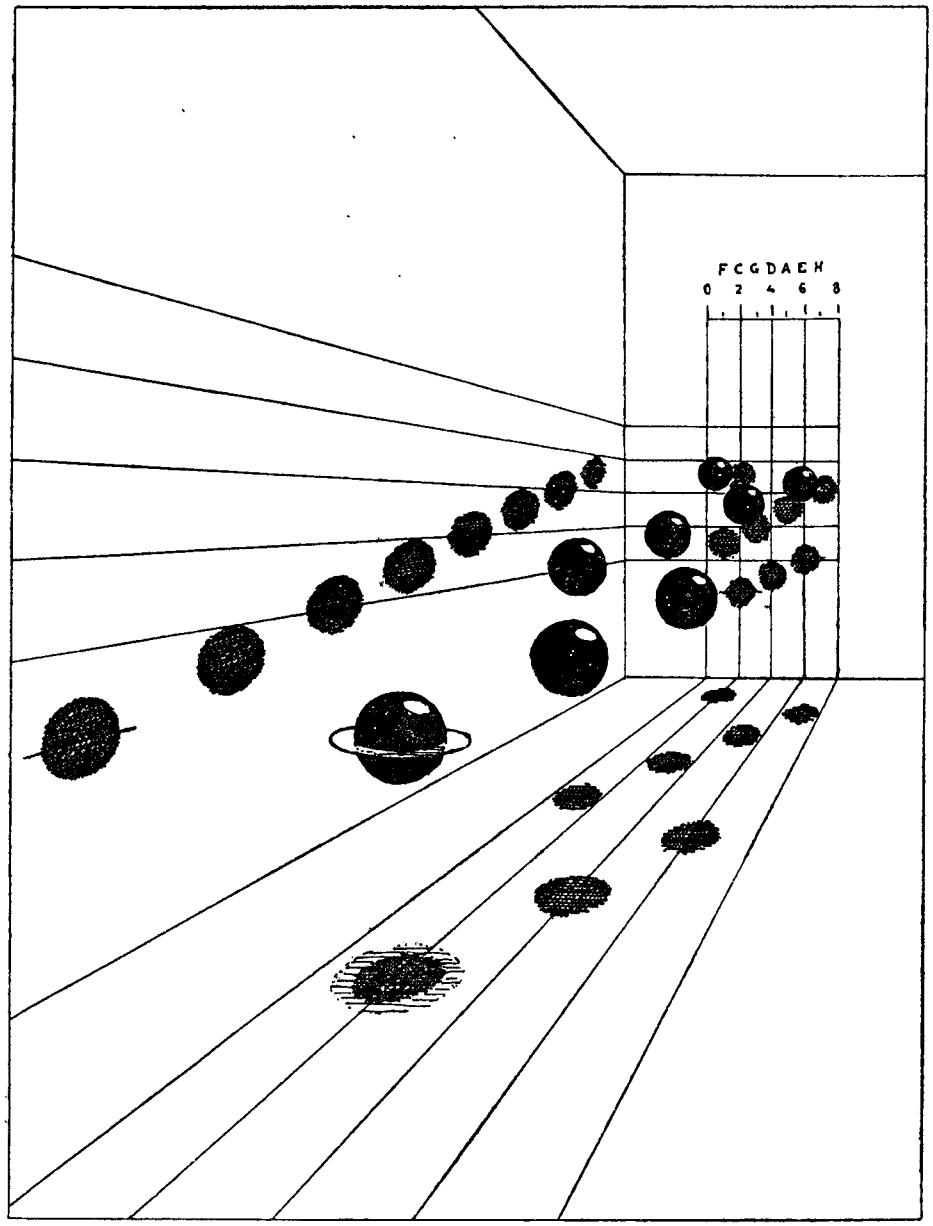
Space notation, as illustrated here with simple note-relationships, permits an initial step towards a calculatory grasp of musical structure. For the extension of the tone-space to include the whole musical stave and enable measurements to be made within it, all we need do is use the relatively simple device thoroughly and exhaustively described 100 years ago by Arthur von Öttingen in his 'Harmoniesystem in dualer Entwicklung' (1866). The treble and bass staves are brought close together so that the middle C leger lines of both staves exactly coincide. Let the three axes of the tone-space be designated X (Greek Chi), Y and Z. Z seems suitable for 'Zeit' (time). Y is the vertica axis. X (Chi) can be derived from 'Chromatik' and represents the new axis of depth in space[2].

The space picture of tones obtained in this way may be considered initially purely as a working hypothesis. Tones are not spheres. But when we recall what was said about music notation, we see that the principle remains unchanged. The mathematical points are now floating in space. Let us look at the picture, drawn flat but in perspective, and consider the front elevation, the YZ plane. If we now take the C major scale (without key signature) and consider it as a 'Picture' with spatial properties we can now 'see into it' the difference between whole tones and semitones, we can think ourselves into the picture. The oft-remarked fact that the semitone (i.e. the s m a l l e r interval) is charged with more tension than the whole tone is seen in this picture as a platitude. The X-axis of tone-space depth is thus seen to be the mensural area of diatonicism, chromaticism and enharmonicism. Hence it appears useful to collect these sub-areas,

[2] It is perhaps more than a mere chance that our organ for orientation in space, with its three arches, is closely connected to the sense organ of hearing, the cochlea. Investigation of such matters lies of course in the province of the physiologist.

whose differences are purely quantitative, under the higher-order concept 'plasticity'. Its scale of measurement is the circle of fifths, as is apparent from the side elevation of the XY plane that we showed beforehand. Reading off the units (in Xs or Chis) on the

Example 4



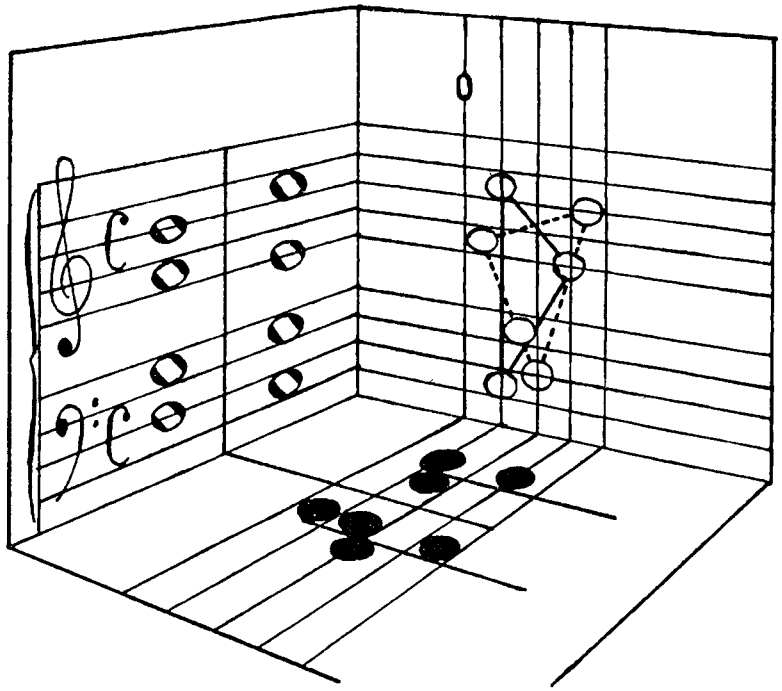
X-axis we find that the 'plastic' tension between an E and an F is 5X, in whatever octave they occur. Between F and G the plastic tension is 2X; from G to F the tension is −2X, reduced by 2X. Accidentals in music are often like indications of height and depth, and this provides a remarkable correspondence with the geographical 'chromaticism', the colouring, used on maps to mark differences of altitude. The adjectives major, minor, augmented, diminished are plastic prefixes to the names of the intervals. It is revealing that the adjective 'perfect' occurs where the plastic tension is 0 or ±1, the smallest possible values. It has always been known that no interval is sensuous without its plastic adjective. Words like 'sharp', 'flat', 'durus', 'mollis' are also to do with plasticity; they all relate to the sense of touch, to the finger or the potter or modeller. Even the 12-note technique, operating with such concepts as 'T o n h ö h e 3', 'S t e l l e n w e r t 8', etc., still retains the old interval names, despite the fact that they are senseless in a logical serialisation of tones. The traditional tone-relationships are out of the running, but the network of internal connections between tones is retained. Measurement of intervals and sounds as introduced today by serial technique can be applied with great advantage even in the traditional four-part writing of chorales. Chorale-style is homogeneous as regards the structure of the sounds used: harmonies of three tones are set for four voices, with a general tendency to double the root of the chord. Let us take one such chord, in section through all four parts, and call it a 'three-value chord'. If the root is doubled we call that form the 'ideal form', if the third or fifth is doubled we call it a 'compromise form' (symbols: J, K3, K5). In this way chorale composition becomes a 'field theory' of tonal composition. Measurements both horizontal and vertical are taken 'under constant conditions'—the situation has become scientific, mathematical. Chorale composition is not really teachable the way one is led to believe by the innumerable books on the subject, but at least it is learnable, empirically and like a kind of musical Yoga. Anyone who has been concerned with it in any detail gets the impression that it is a simple matter of a switch mechanism: it must function so simply that it is comprehensible to all as soon as the casing is opened. Even in this mechanism there is some prefabricated matter, some preformed material, a tonal guiding principle and system of thought whose relatedness to the automatisms of serial music has not yet been investigated. In the space of this short tract it is impossible to list and describe the large number of possible schemata or slide-rule apparatus separately: they all amount to the same thing. The table of cardinal number differences is one such schema, made up of three-value sounds in 'ideal form'. The chords in this schema are pure 'pictures' that either get their plastic life through the choice of a particular real tonality, or else are juxtaposed purely arbitrarily according to some purely chromatic relation. A reading window has to be used with such a table, and this reading window is positioned over a particular triad as starting-point. The three upper voices, as opposed to the bass, constitute a unity that we may naturally regard as a descant type. The schema can be converted into a slide-rule by attaching the number scale as a sliding piece. A further slide is necessary to cover up all destination chords that are technically 'wrong'. It is fascinating to observe in this method how the traditional rules—all of which are negative, in the form 'thou shalt not'—become opposite poles of a series of positive laws. In this context it will have to suffice to name the four classes of sound pairs that can be derived from the schema: similar pairs (Alterates), neighbouring pairs (Proximates), middle pairs (Mediates) and main pairs (Dominates). From my own fund of experience I can testify that this 'dynamic' terminology, which renders the old static terminology unnecessary for the time being, is easily grasped by students.

So far one of the great basic principles of tonal composition in its original form has been recognized. It is an amazingly simple numerical law, on the same basis as the faces of a die. Like the other two principles that we have yet to discuss, this one has nothing to do with acoustics. The faces of a die, which played a part even in the old rationalistic theory of music, are complementary in pairs, each pair adding up to 7. 1 is opposite 6, 2 is opposite 5, 3 is opposite 4. In 'ideal' form we should also add the pair 0 and 7. The main pairs, the 'dominates', are distinguished from the 'alterates' (the inversions of a chord) by possessing two possibilities of connection with a destination harmony. Mediates and proximates on the other hand possess besides 1 and 4 the opposite numbers 6 and 3. This grouping—alterates/dominates against mediates/proximates—is reminiscent of the 'casus recti' and 'obliqui' of declensions. The parallel 'ear-eye' is revealing. Compare what we have said above with the sub-division into 6 colours, three primary and three complementary (cone of the retina), and the black-white-grey scale in relation to the sound-pair scale 0 and 7 (rod of the retina). Similarly we can determine 'grey tones of the ear' as plastic values. The numerical law of the die is equally valid in both fields, that of eye and ear. And here for the first time we encounter the number 7 as a sort of standard, and it recurs constantly as a limit number. The second fundamental principle we have to consider in this context is the rotation principle of intervallic values, which can be described as the principle of tranformation of intervallic values or as the 'tri-cycle' (which we cannot go into here) in three out of the four voices. The parallel 'eye-ear' leads us back over and over to the space problem, not least in those cases where the old naturalistic space is no longer functioning, as in all 'abstract' music and painting. For some viewers of painting space has simply ceased to exist, a painting is just a 'surface par excellence'; for others even the pattern on wallpaper is to be regarded spatially. One could apply a drastic, terrible simplification to describe what is happening in art: Wallpaper has usurped the frame/ throne of the picture. Painting in exile pursues its new profession: the creation of picture-wallpaper. Equally one might describe syncopation, which caused such a stir in the dance music of 40 years ago, as a kind of oppressed creature breaking through from the servants' quarters of simple accompaniment rhythm up into the mezzanine of melody, and seizing power there. (The accompaniment promptly abandoned all syncopation!) Similarly Schönberg's chord of fourths can be thought of as a cosmic reversal in the universe of tones comparable to a tilting of the polar axis in the plane of the equator, whereby the traditional groundplan turns into a new elevation, as shown in the following illustration (Example 5, p. 32): From this one sees that our traditional chords take on the form of fourth-chords (i.e. 'pictures' of fourth-chords) in the groundplan.

Even the preformed material of the series, say an all-interval series, does not lie outside the traditional continuum of tones. To convince oneself of this all one need do is draw lines connecting all tones that are enharmonically the same in all octaves. These lines divide every octave into twelfths, whose structure can easily be located in the note-space we have been describing, as shown by example 6.

You enter the tone-space from the left, as it were and there you see the C major triad from the side as a triangle. Following the oblique lines you arrive at the same chord, but now presented in terms of the 12 divisions of the octave. The two triangles are perspective distortions of one another. Abandoning space, we rediscover it in a new elevation with a new system of lines. This is similar to 'Klavarscribo' which has something of the dignity of a phonola-roll script. But whereas Klavarscribo represents the situation on the actual keyboard and is hence unusable for the purposes of our measurements,

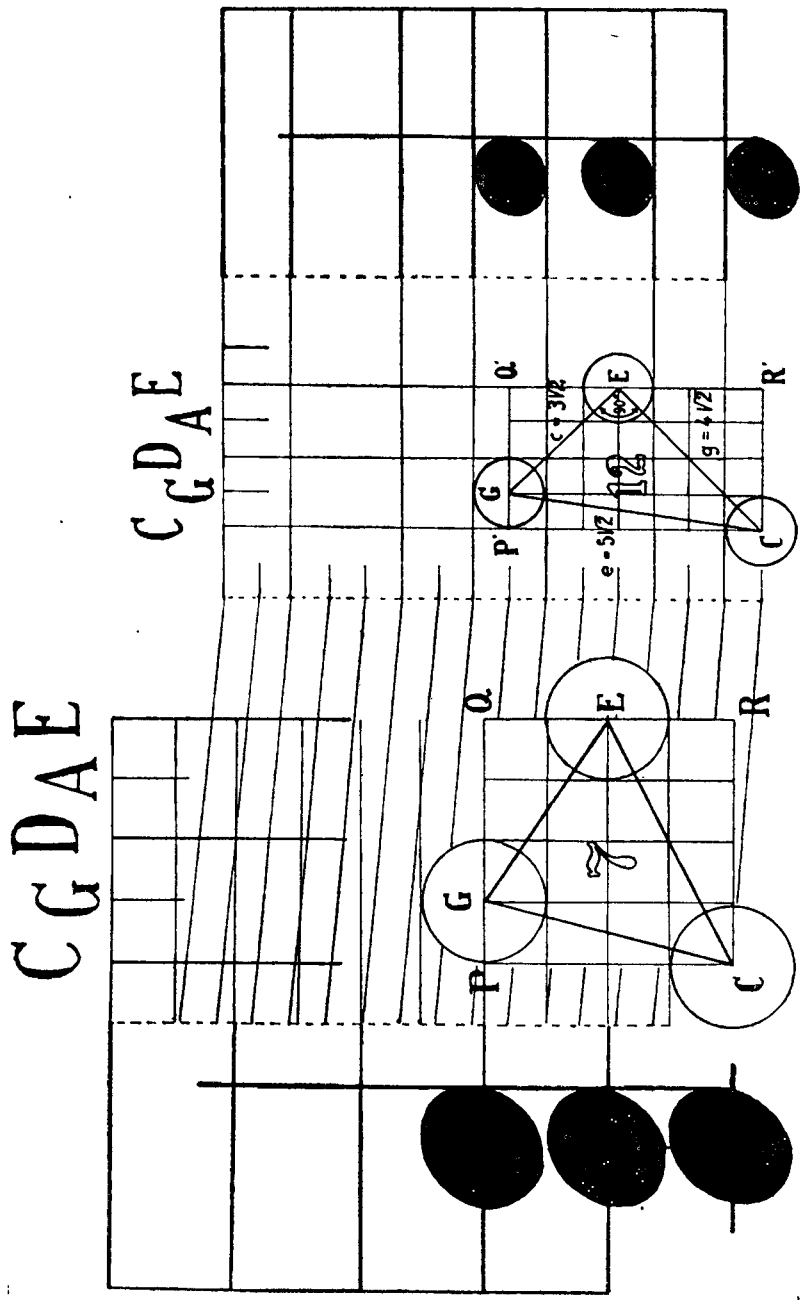
Example 5



the script shown here represents the situation b e h i n d the keyboard, where all the keys are the same width. On the sound-surfaces of the diagram the traditional C major triangle has a surface area of 7 of the small squares, arising as the product of m X. 7/2mX or a whole-number multiple of it is the value of all sound-surfaces, provided it is not zero, as in the case of the triad C—E—G-sharp, i.e. chords composed of equal intervals. This applies also to completely hypothetical chords whose notation is incomprehensible. Substituting 12 for 7 in the 12-note triangle, all that we have been saying still holds good. It is worthy of mention that the triangle in the 12-notespace is a so-called 'special' triangle, namely the First Pythagorean triangle with sides in the proportion 3:4:5.

Our presentation of musical space-coordinates is emphatically not the product of mere speculation. It grew up in close association with actual practice, quite in the spirit of Kant's remark: "There is nothing more practical than a good theory". If spatial mathematical laws and the numbers are not consulted, structures such as the ones we have been discovering would never come to light. Number—but not Art—might with justice say of itself: "Wherever I am sitting is automatically the top". Number plays hardly any part in traditional musicology, especially since the infiltration of romantic-vitalistic tendencies.

Although from earliest times Number has been the surest foundation for the determination of pitch and the measurement of time (Aristotle: "Time is the Number of Motion"), it seems now to have fallen away into the extra-musical regions of speculation. The morals of a country never fall; it is the country that sinks morally. So our



Example 6

present-day traditional musical theory, surrounded by the proud structures of physics, chemistry and the other sciences, is a decrepit old ruin due for demolition. Its interior is so musty and dark that modern man flees in disgust after a single horrified glance—that is the way young G.B. Shaw must have seen it as he briefly and ironically recalled the memory in the dialogue of Cleopatra and the old harpist.[3]

[3] The preceding tract with illustrations is an excerpt from the author's manuscript 'Musiklehre auf mathematischer Basis'.

Walter O'Connell[2] Tone Spaces[1]

It comes—exact, fragmentary, barbed with meanings that ensnare it in the matrix of some mute whole, tangible yet inarticulate. Concrete tokens of reality will be shaped to its bidding, assembled, perfected, fixed: growth comes easily in the finite and transitory. Thus does it begin.

What is a theme? Notes alone cannot confine, contain, this nascent form. But only through the actualization of that whole which it implies can it fully enter other minds, there to be freed, created anew. Music exists that moments may endure.

The composer listens. What questions can elicit needed clues? For how can so tangled a net of implications be spread upon a page and read from left to right? None can say. He is alone with the unique gift granted him.

Mathematics is the epitome of metaphor. While the pure mathematician is concerned only with the relations between essentially undefined symbols, mathematics owes its extraordinary usefulness to the apparent similarity in structure (isomorphism) of these abstract symbol relations to events in the real world. As gesture, music too may point to many realities, expressing not only the human qualities we are able to associate with it, but some of the most basic processes and relations in all of nature. Mathematically, music may seem merely an elaborate arithmetic. Yet mathematics remains limited by the very source of its effectiveness: the precision with which its relations are defined. Music as we hear it exists without symbols as such. Out of a complex of sounds we are free to choose which relations will be perceived, and to be moved by whatever metaphors those relations evoke in us, consciously or unconsciously. It is in this sense that music is like an emancipated mathematics, ready to yield constructs that may prove as useful in probing the realm of the spirit as mathematics has for its physical counterpart.

Can mathematics then be of any use to the composer? Symmetry, transformation, and invariance—these mathematical conceptions are the instruments with which the physicist probes his equations in a search for the unity underlying an apparent diversity. The most fundamental laws of physics are now recognized as statements about various symmetries of space-time, and of still more abstract spaces. The physicist reveals these symmetries (or their absence) by subjecting his equations to various transformations, and discovering what properties each leaves unaffected. The unchanging property is said to be 'conserved', or to be 'invariant' under that transformation. Perhaps similar methods can aid the composer in his preliminary examination of the possibilities latent within his given material. Every age has had its stockpile of formal techniques of mani-

[1] For K. R., who listened, and asked, and said.

[2] Los Angeles City College, Los Angeles, California

pulation, and it is these that constitute the teachable craft of composition. Yet at every turn the composer's full awareness and sensitivity must be brought to bear upon this growth process, lest it become a purely mechanistic elaboration of formal elements. Granted this, we may be assured that mathematics can no more encroach upon the musical impulse than have electronic computers dimmed man's urge to fly, or yet to reach the stars.

The transformations referred to are most often produced by interchanging two variables, such as x and y, or x and t, etc. The symmetry of a regular geometrical figure (e.g., a hexagon) can be characterized by specifying the symmetry-operations that bring it into coincidence with its former position (here 60°, 120°, 180° . . . rotations about its centre). Even when the symmetry is absent or incomplete, the nature of the asymmetry can be revealed more clearly by such rotations. The interchange of variables can be represented as a rotation that brings one coordinate axis into the position formerly occupied by another. Any symmetry about the axis of rotation will be preserved by such a transformation. Our conception of space transcends the two-dimensional image on our retina just because we can subject that image to such transformations: only by walking around a statue do we perceive its full three-dimensional form. That form, symmetric or not, is the invariant that underlies the various projections (the two-dimensional images) it casts. It was the discovery of such invariants for Einstein's equations that led Minkowski to propose the concept of a unified space-time. Schoenberg's comments ("The two-or-more dimensional space in which musical ideas are presented is a unit." . . .) seem closely related to Minkowski's concept.[3] It is the purpose of this paper to examine certain classes of space-like transformations of a series, and to discover the features of the row which survive each such transformation. Then, perhaps, some form-behind-the -row will be revealed.

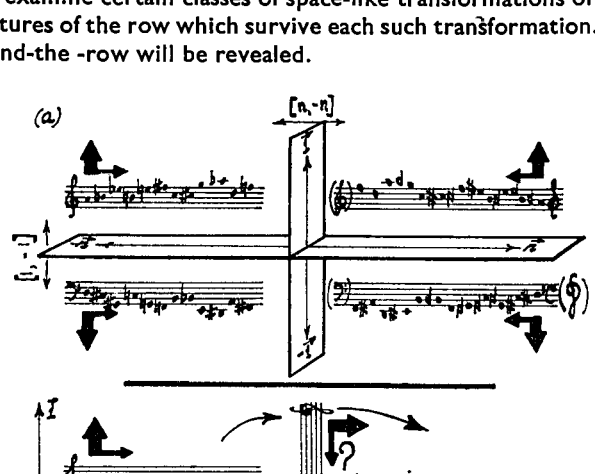


Fig. 1.

[3] Compare Milton Babbitt, "Twelve-tone Invariants as Compositional Determinants" in *Problems of Modern Music* edited by Paul Henry Lang (W. W. Norton, 1962): p.120.

Here I should like to express my appreciation to Mr. Leonard Stein for generously sharing his extensive knowledge of twelve-tone and serial composition, and for performing the otherwise unavailable works that first suggested the present analysis.

I

The familiar mirror forms are the first and most fundamental of the transformations to be considered. There is a distinction between reflection and rotation, and in general they are not equivalent. (Mathematically, reflections are known as 'improper rotations'.) But two successive reflections in mutually perpendicular planes (mirrors) produce a form which can also be arrived at by a 180° rotation within the plane. In this sense, the retrograde inversion is just the original basic set slipped around to an inverted position on the page. Thus viewed it seems more closely related to the basic set than when we regard it as the product of two successive transformations. We might now ask, can the rotation be stopped at, say, the 90° position? (Fig. 1).

The Chromatic-to-sequence Rotation, [1,n,—1,—n] Diagonal Symmetry and the [1,n] Transformation

Six examples of 90° rotations in the plane of the paper are shown in Fig. 2. In the first three examples, the rows of three of Schoenberg's later works are spelled out horizontally, the pitches being read from the left-hand column. In this orientation, no horizontal labelling has been provided, but we may supply it mentally. The horizontal coordinate is thus read from the sequence axis, $\vec{n}$; successive points along this axis represent successive positions within the row: position No. 1, No. 2, and so on, (corresponding to the 'order numbers' in Milton Babbitt's notation). The chromatic scale seen at the left is then the chromatic pitch axis, $\vec{1}$. Turning the page upside down, we can now read off the retrograde inversion. (The new pitch coordinates have been adjusted to preserve the axes of inversion-symmetry which are indicated by the horizontal dot-dash lines.) This 180° rotation in the plane of the page may be designated as [1,—1] [n,—n] signifying that we have reversed the orientation of the chromatic pitch axis (producing the inversion) as well as that of the sequence axis (producing the retrograde).

In this mode of representation it becomes possible to stop at the 90° (or 270°) position. To read off the results, notice that we have slipped the chromatic scale into the position formerly occupied by the $\vec{n}$ axis. Thus $\vec{n}$ has been replaced by $-\vec{1}$ (since the scale is descending to the right). Similarly, the direction formerly occupied by $\vec{1}$ is now occupied by $(\vec{n})$. This 90° rotation in the plane of the page may then be designated as [1,n,—1,—n], with the understanding that each axis is being replaced by the one which follows it in this symbol.[4]

[4] In three cases the pitch axis has been rotated without transposition. However, for Schoenberg's Op. 37, and the rows designated as A and B, the rotated pitch coordinates have been transposed so as to retain the original inversion axis (to be described later). This happens to be possible for these three rows since for each the 90° rotation exhibits the same inversion property as the original row, the second six tones being a rearrangement of the inversion of the first six.

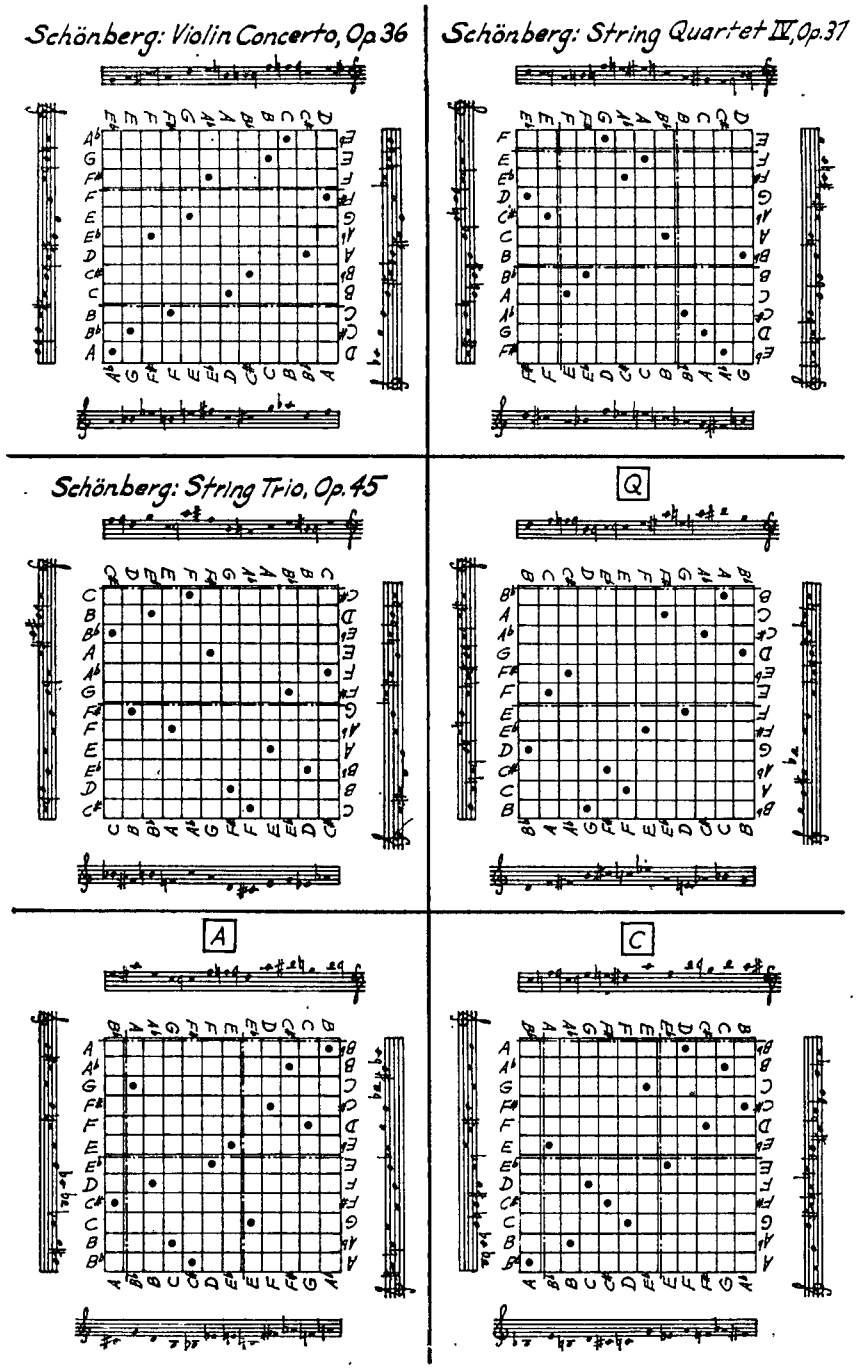


Fig. 2. The Chromatic-to-sequence Rotation, [1,n,—1,—n]

Here we have the first concrete results of our search for mathematical transformations of the basic material.

What then are the invariants of the chromatic-to-sequence rotations? If the original row were an ascending chromatic scale, its 90° rotation in the plane of the page, [1,n,—1,—n], would be a descending chromatic scale, as would the [1,—n,—1,n]. A row formed by exchanging only pairs of notes of the chromatic scale (Fig. 3a) would be symmetrical about a 45° line inclined to the right. Thus the chromatic scale line in the (1,n) plane may serve as an axis of symmetry—not to be confused with the vertical i axis. The operation [1,n] may now be simply interpreted as a 180° rotation (o u t of the plane of the page) about the ascending chromatic-scale-line axis. This is most easily visualized by imagining the grid pattern to be drawn on transparent material. The pattern is simply flipped over about its diagonal, and reread on the original axes. Since it is conceptually simplest for symmetry considerations, we shall now confine our comments to the [1,n], but each statement made applies also with only slight modifications to rotations in the plane of the page, [1,n,—1,—n], etc.

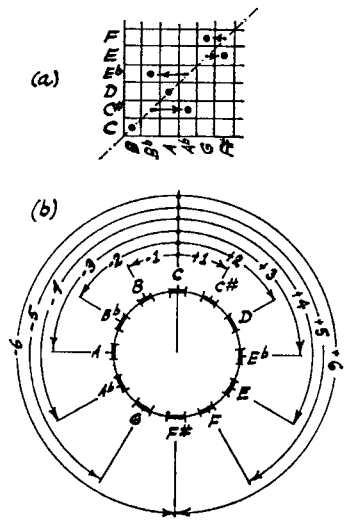


Fig. 3.

Complete symmetry about the chromatic scale line (45° diagonal) may now be defined as invariance of the row under the [1,n] transformation. Though rare, it is exhibited by Webern's Op. 18, no. 3. The row of Webern's Op. 21 is not diagonally symmetrical, but consists of the hexachord of Fig. 3a, and its transposed retrograde. Omitting the first note of Fig. 3a produces a five-note figure found in the last song of Webern's Op. 17 (his first serial composition), twice in Op. 18, no. 3, and in Op. 27, as well as in his last work, Op. 31. A three-fold symmetry is produced in the rows of Op. 28 and 30. In each a pair of ascending and descending diagonal symmetry axes intersect at the central point of the grid pattern, producing invariance under [1,n], [—1,n] and [1,—1] [n,—n].

Here we have an illustration of how a transformation defines a symmetry type, and vice versa. We see that the presence of a symmetry reduces the effective number of trans-

formations available, because of the identity of some of the transforms with the original row. But now new classes of transformation are suggested: those that leave not the row but merely its symmetry characteristic, invariant. Thus we may imagine sliding the grid pattern along its diagonal symmetry axis (the chromatic scale line) to produce 'cyclic transpositions'. Here the row is transposed down a half-step, and begun on its second note; down a whole step and started on its third note; etc. Such transforms retain exactly the original axis of diagonal symmetry.

Even for rows of high asymmetry as a whole, certain small note groups may still exhibit this symmetry, and transform accordingly. Notice for instance, notes Nos. 9, 10, 11 of Op. 37, or Nos. 4, 5, 6 of Q (Fig. 2). Moreover, the asymmetries likewise are transformed: a melodic interval of four semitones in the original appears in the [1,n] transform as a lapse of four notes before the next note of the chromatic scale occurs. Though the axis of incomplete diagonal symmetry has clarified the nature of the [1,n] transformation, we are now free to choose among the cyclic permutations of the primary transform, and to make structural use of conflicting requirements.

Thus far we have been concerned with what may well seem rather dubious properties of patterns of note names, seen in their relation to the chromatic scale. We turn next to a consideration of interval relationships. Further analysis of tone structures will require frequent alternation between, or juxtaposition of, these two complementary elements—notes, and intervals.

The Group-Property of Intervals

When we replace actual pitches by note-names, independent of octave register, we may regard a musical interval as the operation of moving from one point to another on the chromatic circle (Fig. 3b). We see that there are only six distinct operations, and their inverses (rotations in the opposite direction): ±1, ±2, ±3, ±4, ±5, $(\pm)6$, plus the identity operation, 0, which brings us back to the starting point. These are the familiar intervals, measured in semitones. Any combination of these operations is equivalent to some one of them. Thus, $+5 +2 = +7 = -5$. (If from C we move a fourth to the right to F, and then a whole step to G, we have gone clockwise a fifth from our starting point; but that is to say that we are a fourth to the left of C.) The above conditions guarantee that the intervals, thus construed, constitute what the mathematician calls a group[5] —here more specifically, a cyclic group of order 12.

Only through the separation of pitch into its three aspects,—note-name, register, and intonation,—does the group-property of the intervals (between note-names) emerge. The even-tempered scale of the keyboard has fostered the practical realization of this fact; but once recognized, the group-property is seen to be independent of equal temperament. Even as each note-name stands for a class of pitches having different octave positions, it may also include a range of intonations. How much may a pitch differ from its equal-tempered value? The intervals will constitute a group so long as the combination rule is maintained; this requires, e.g., that any major third (+4) plus any minor second (+1) must produce a fourth (+5). If the pitches are confined to cells extending

[5] See, for example, H. S. M. Coxeter, Introduction to Geometry (Wiley, New York, 1961), p. 31; Hermann Weyl, Symmetry (Princeton, New Jersey, 1952); or texts in "the new mathematics".

less than an eighth step to either side of the tempered pitch, this condition is fulfilled: any fourth is then smaller than the smallest tritone, and larger than the largest major third. Likewise, a certain blurring can be tolerated,—instrumentally, varying amounts of vibrato; electronically, phase modulation, and filtered white noise. We require only that the uncertainty in pitch does not reach the limiting quarter-tone width of the tone-cell.

Thus, though numbers are used to designate the musical intervals, they are not measurements, but labels for qualitatively distinct relations between tones. Nuances of intonation, slight rubatos within the specified durations, still lie within the domain of the performer's art.[6]

The different intervals form cycles of various orders, corresponding to the number of times a given operation must be repeated to return to the starting point.

Interval	m2	M2	m3	M3	P4	A4
Semitones	±1	±2	±3	±4	±5	6
Order of cycle	12	6	4	3	12	2

Here a harmonically complex interval, the augmented fourth, exhibits a compensating operational simplicity ($+6 = -6$), and a symmetry is revealed between the minor second and the perfect fourth or fifth. Only for ±1 and ±5 can an equal-interval scale be constructed covering all twelve notes. Thus the circle of fifths forms a natural complement to the chromatic scale. Exchanging the $\vec{1}$ and $\vec{n}$ axes produced the first transformations considered here. If $-\vec{5}$ can properly be regarded as a third axis mutually perpendicular to the first two, additional transformations are suggested.

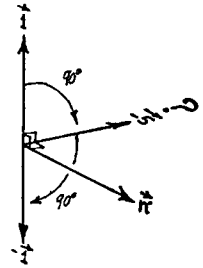


Fig. 4.

The Chromatic-Fifths Transformation, [1,−5][7]

Three methods of performing the [1,−5] transformation are shown in Fig. 5. In the clock-face method at (a), the transformation is accomplished by spelling out the row on the chromatic scale circle, and reading it off on the circle of fifths. Notice that alternate

[6] Compare Karlheinz Stockhausen, "...How Time Passes...", die Reihe, Vol. III.

[7] After the completion of the first edition of this article, it came to my attention that the same transformation is described on p. 29 of Herbert Eimert's Lehrbuch der Zwölftontechnik (Breitkopf und Härtel, Wiesbaden 1950), and there designated as "Quart- und Quintverwandlung.". The spatial representation of this transformation described

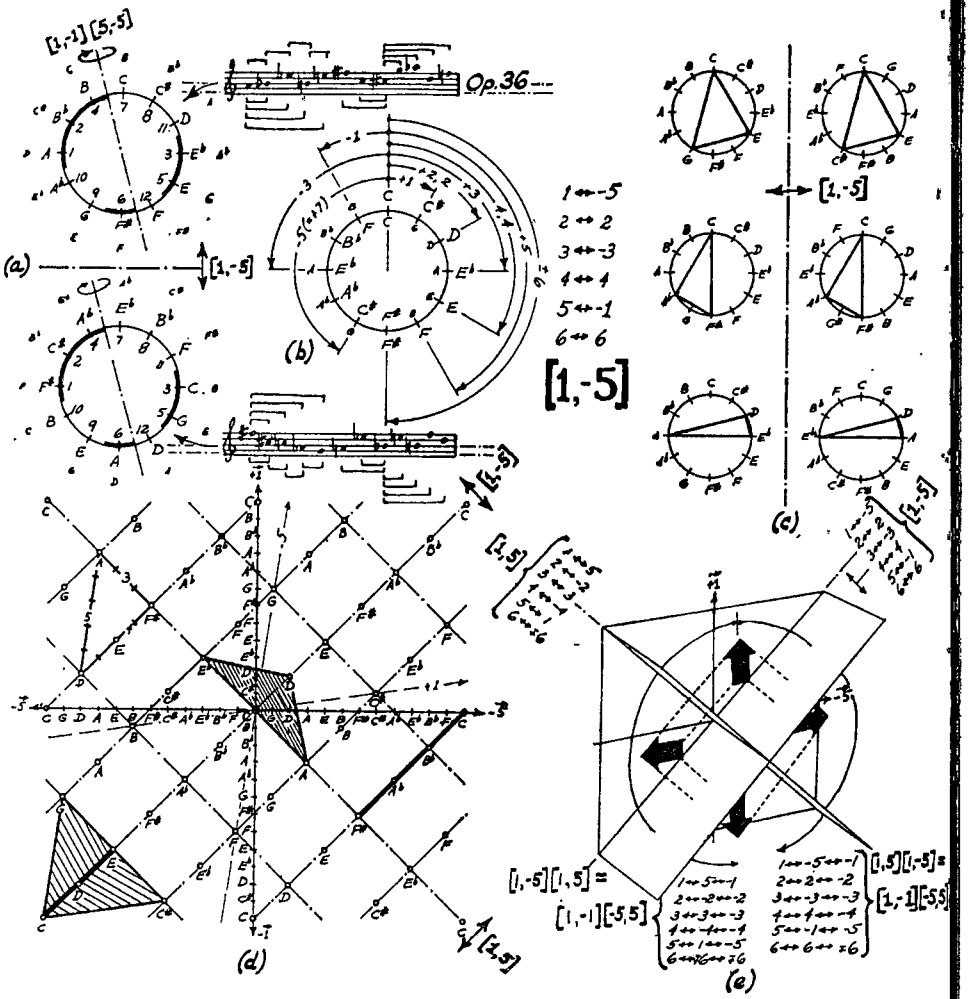


Fig. 5. The Chromatic-Fifths Transformation, [1,—5].

notes on the circle at Fig. 5b have been interchanged with notes a tritone away; but in 5a the circle of fifths has been rotated so as to preserve the axis of symmetry present in the original row.

Let us investigate inversion symmetries more closely with the aid of these scale circles. In Fig. 5a, the first six notes of Schoenberg's Op. 36 have been indicated by the heavy lines along the circumference of the circle at the upper left. When the figure is rotated (folded out of the plane of the page) about the dot-dash axis shown, these first six notes move into positions formerly occupied by the last six notes. Such a row may be said to consist of two invertible hexachords.[8] While Schoenberg spoke of an "inversion at the lower fifth", we now see that any inversion defines an inversion axis whose location completely characterizes that inversion. The row shown has a between-note[9] inversion-symmetry axis which we may designate as the FF♯—BC axis.

A reflection, or folding, about the inversion axis produces the inversion; this may be read directly from the small outer notes in Figure 5a. We see that the inversion is formed by replacing each note by its inversion-tone, that is, by the note which is its mirror image with respect to the inversion axis. It is also apparent that each of the first five transpositions (rotations along the scale circle within the plane of the page) will have a new axis of inversion symmetry, but that the transposition at the tritone (180°) returns to the original symmetry axis. Seen in this light, the transposition at the tritone is unique, in that it leaves the axis of inversion-symmetry invariant.

The same may be said of the (±)6 cyclic permutation which exchanges the hexachords. When the tritone transposition is combined with hexachordal interchange, we have a transformation that preserves both diagonal- a n d inversion-symmetry axes: the (±)6 cyclic transposition. In all, we see that inversion symmetries are as naturally related to the chromatic circle as diagonal symmetries are to the (1,n) and (—5,n) planes.

From the lower circle in Fig. 5a, we see immediately that the [1,—5] transformation preserves the inversion symmetry, and may be performed in such a way as to leave the inversion axis invariant. When such symmetry is present and the inversion axis is to be held constant, the transformation is limited to just two transpositions. Here the chromatic axis tones B and C have been replaced in the lower figure by the fifth which symmetrically surrounds them, A^b-E^b. They might equally well have been replaced by D and A (tones which are equally symmetrically related when we allow for octave transpositions), producing the transposition at the tritone, which results in the same symmetry axis, as we have just seen.

If the row exhibits no inversion symmetry, the [1,—5] transformation is equally feasible, but now no one pair of transpositions is singled out. Then the transformation is most, readily performed by means of the interval table at the right of Fig. 5b. It states that the ascending half-step is to be replaced by the descending fourth (or ascending fifth) and vice versa; the direction of the minor third is reversed, while the even-numbered intervals are unaffected. Thus the second note of all odd-numbered intervals (1, 3, 5) is displaced by a tritone; even intervals remain unaffected. Notice that no such table can be written for the [1,n,—1,—n] rotations. Together with the mirror forms (I, R, RI), the [1,—5] and [1,5] are unique among the interval transformations to be considered later (Fig. 11). They alone transform a l l interval relationships (even those between notes widely separated in the row) according to one given rule. Test, for example, any of the marked intervals at the top and bottom of Fig. 5b.

In (c) of Figure 5 we see the [1,—5] transforms of some typical three-note sets. Here the scale circles are aligned as in (b), a relation which would be appropriate if we were dealing with an on-note inversion axis. In such a case, inversion tones would be an even number of half-steps apart, while for a between-note axis as in (a), they are separated

in the preceding article by Walter Schulz-Andresen was apparently developed independently of this present paper. It has seemed best to let this section remain, in spite of the accidental overlapping with the above authors' works, in the interest of logical continuity, and for the contrast offered by the differing approaches.

[8] Compare George Rochberg The Hexachord and Its Relation to the 12-Tone Row, Presser., 1955.

[9] While an inversion may also be performed about an on-note axis (say, that passing through C and F♯), two hexachords with such a symmetry will always have at least one tone in common, the axis tone. However, two hexachords may individually be axially symmetrical, sharing the same on-note axis, without duplication.

by an odd number of half-steps. However, notice that the interval transformation rule is independent of such choices of alignment.

As with the mirror forms, this transformation is its own inverse. This means that if the operation is repeated upon the transformed row, the row returns to its original form.[10] Reflection in a mirror exhibits this property. In (d) and (e) of Fig. 5 the [1,−5] transformation is seen as indeed a kind of mirroring, now as a reflection about the whole-tone scale line. If we reflect, or rotate 180°, about this diagonal axis, the $\vec{1}$ and $-\vec{5}$ axes will be interchanged. Hence the designation [1,−5], which indicates that 1 is to be replaced by $-\vec{5}$, and that $-\vec{5}$ is to be replaced by $\vec{1}$. Similarly, the [1,+5] transformation may be regarded as a reflection about the +3 axis (the diminished seventh chord line). In Fig. 5e, we see that the operation [1,−5] followed by [1,+5] can be represented as two successive reflections which bring us to the inversion. Thus [1,5] [1,−5] = = [1,−1] [5,−5], The right side of the equation is merely the full expression for the inversion. Symbolically, the second operation to be performed is written to the left of the first. Here the results do not depend upon the order in which the operations are performed, but in other cases they will. An essential point to be remembered about our operator notation is that the individual symbols, 1, −5, n, denote a x e s, not intervals. To carry out the operation may require a diagram or a table. However, we may arrive at a symbol for a succession of operations by manipulating the symbols alone.

Our understanding is that each axis is to be replaced by the one following it in the symbol, with the last named axis to be replaced by the first. Thus our transformation symbols may be called axis-permuation operators, or rotation operators.

Another group property of the intervals becomes apparent in Fig. 5d. The two sets of diagonal axes correspond to separable subgroups of notes: the two whole-tone scales, and the three diminished seventh chords. (The four augmented triads, and six tritone pairs, themselves subgroups of the whole-tone scale, complete the subgroups.) Also, it is remarkable that the major triad (CEG at the extreme lower left) appears as a triangle whose sides are exactly 3, 4, and 5 units long; for in just intonation its frequencies are in the ratio 3, 4, 5, while here its interval relations (with the +7 = −5 reduction) are 3, 4, −5. Perhaps this multiple coincidence helps to make the major triad a "good Gestalt"—which in turn can render it rather refractory for certain compositional procedures. Other 3-4-5 triangles appear (the minor triad and the [1,−5] transforms of the triads), but their frequencies are of course not in corresponding ratios.

If it seems in any way unnatural to use the cycle of fifths as a coordinate axis complementing the chromatic scale axis, we should be reminded that the pentatonic and diatonic scales comprise respectively any five or seven adjacent notes on the circle of fifths, exhibiting a simplicity of structure which is obscured when they are seen only against the chromatic pitch coordinate. In fact if it were not for the acoustic importance of the fifth (for Western instruments having a harmonic overtone series), we might well subdivide the octave quite differently. While the Pythagorean derivation of the diatonic modes has been questioned by Helmholtz and others, there can be little doubt that the usefulness of 12-note tempered scale depends upon the comparative accuracy with

[10] Likewise [1,n] is a self-inverse operation. In contrast, the [1,n,—1,—n] transformation is seen to have a cycle of order four, meaning that the operation must be applied four times before the row returns to its starting point. This follows from its representation as a 90° rotation in the [1,n] plane. On the other hand, notice that 90° rotations are prohibited for the present within the (1,—5) plane; this is a consequence of the difference in spacing exhibited by the rows and columns of notes seen in Fig. 5d. Such a rotation, [1,—5,—1,5], produces points whose $\vec{1}$ and $-\vec{5}$ readings do not coincide. We consider such a possibility toward the end of this section.

which it renders the fifth, for it offers a far poorer approximation to the thirds of just intonation. And of course the classical concept of the degree of harmonic relatedness of keys is just a measure of the interval of transposition of these seven adjacent notes along the $\pm\vec{5}$ axis. Thus the $\vec{1}$ and $-\vec{5}$ axes stand in the relation of two complementary tendencies in classical music: the chromatic-linear relations represented by $\vec{1}$, versus the diatonic-harmonic relations revealed by $-\vec{5}$.[11]

The Axis-Transformation Group

The complexity of Figures 6 and 7 should not be allowed to intimidate the reader. They present a condensed statement of technical problems and their proposed solutions. Since the content of this section is not essential to understanding the remainder of the paper, it may well be skipped at a first reading.

Here we are concerned with the relations between the transformations so far discussed, and their combinations. Since the $-\vec{5}$ axis was first proposed as a direction mutually perpendicular to $\vec{1}$ and $\vec{n}$ (Fig. 4), we see that the (−5,n) plane is a natural complement to the (1,n) plane. If the original row (again that of Schoenberg's Op. 36) is spelled out in each of these planes, it gives rise to two separate grid patterns, designated as R_1 and R_{-5} in Fig. 6. The (1,−5) plane just examined gives the relation between the two grid patterns, as shown by the projection lines in the upper part of Fig. 6. The two grids, R_1 and R_{-5}, may be folded outward from the plane of the page to form the three-dimensional figure seen at the lower right of Fig. 6. The notes of the row then occupy points in the (1,−5,n) space forming the space-row, $\vec{R}$, which casts its projection (or shadow) onto each of the three planes. This space-row is symbolized by a triple arrow in all succeeding diagrams. As the space-row is rotated into new orientations with respect to the three axes, the grids (which are its projections onto the planes) take on new meanings. These results may be read from the two grid patterns by placing either the ascending or descending chromatic scale, or the circle of fourths or fifths, along any edge of either grid. Results are tabulated for two edges in Fig. 6, and the operations relating one to another are indicated in the operator notation previously described. Though it appears unbearably cumbersome as a means of indexing the rows, our notation does make it evident why one set of four rows is common to the two grids, while the rotated forms are unique to each grid. For bookkeeping purposes the notation R(i,j,k) of Fig. 7 is much briefer. Together, the two notations form a true operator algebra, but it will be appropriate only if the operations constitute a group.[12]

[11] Throughout this discussion we have arbitrarily given precedence to —5, the descending fourth or rising fifth. This was done purely as a convenience; we could equally well have chosen +5.

[12] In Figure 6 we do not yet have a true group. The first 90° rotation has been performed by carrying the four scales unaltered around to the next side of the figure. But if this operation is now repeated, it will spoil the inversion property of the original plan, whereby after two 90° rotations we arrive at the retrograde inversion formed about the original symmetry axis of the row. If we insist, as in Fig. 6, that the right-hand set of scales constitute the inversion tones of the left-hand scales, then the second 90° rotation becomes a different operation from the first. Various alternatives are considered in Fig. 2, but there only the diagrams for Op. 45 and for Q offer solutions. One solution for Op. 36 is shown in Fig. 7a. Note that it no longer leaves the row in closest form. Since the scales are now being carried around the grid without transposition, only two are needed, the inversions being read when the scales are at the opposite side of the grid. These operations now constitute a group.

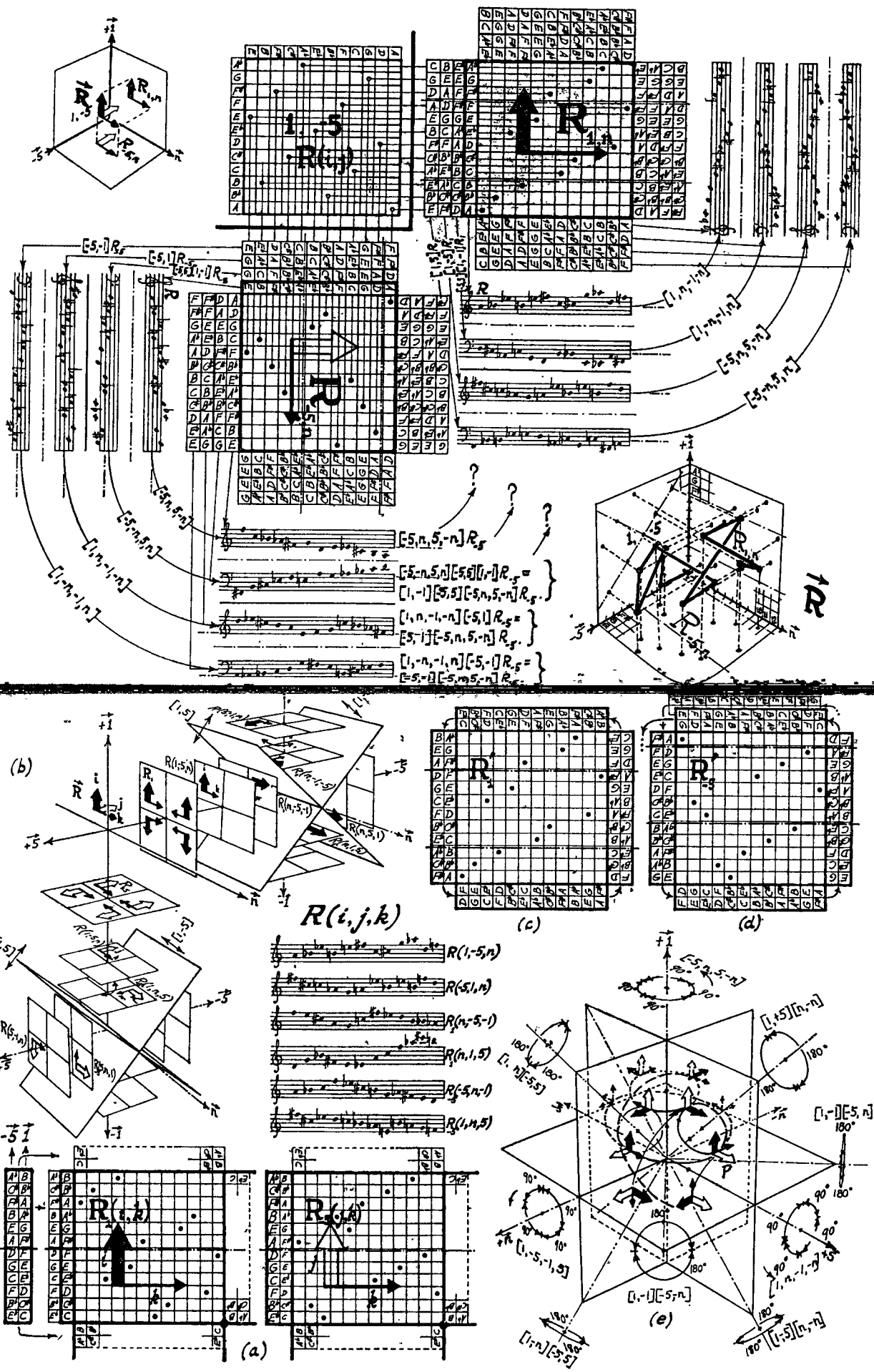


Fig. 7. The Axis-Transformation Group.

The totality of the resulting rows consists of the six shown, plus their retrogrades, inversions and retrograde inversions (all about the same inversion axis). Although the group closes at this point, it may readily be expanded by considering additional operations. In fact all of our cumbersome efforts to achieve the group property have been directed toward restricting the amount of material to a minimum: providing one unique pitch level for each form, etc. We have already seen that we may add the transposition at the tritone without altering the inversion axis. Associated with this possibility is an ambiguity in the [1,n] and [−5,n] rotations. Notice that the location of the inversion axis in the original grid determines which notes will appear first in the 90° rotation. Even following the prescription used in constructing Fig. 7a another alternative could have resulted. With the grid redrawn so that the other inversion axis is at the center, the new 90° rotations will start on the seventh tone of the former ones. Thus beginning any row on its seventh tone and/or transposing it a tritone constitute a first expansion of the above group, which now includes the transposition, the cyclic permutation and the cyclic transposition of each transform, each being taken at the (±)6.

Two other types of solution are shown in (c) and (d) of Fig. 7. (c) may be treated much like (a), but (d) has the interesting property that it leads through all twelve transpositions, linking them to the rotation operation, and greatly expanding the group.

At this point one may readily construct two grids for any given row following the method of Fig. 7a, and using the sliding scale-cards read off the six basic forms and their mirror transformations without further ado. It is only if we wish to order the transitions from one form to the next in some way that the indexing of forms becomes significant. Otherwise the cumbersome notation which follows may be dispensed with entirely, and the two grids will suffice.

In Fig. 7b, the space-row $\vec{R}$ is represented by a triple arrow symbol whose tips are labelled i, j, and k. If $\vec{R}$ is now designated as $\vec{R}$(i,j,k), the grid pattern R_1 is simply R(i,k), while R_{-5} is R(j,k); these grids will be called the components of $\vec{R}$. As the axes are interchanged, or the vector rotated with respect to them, we wish to know along what axis i lies, j lies, and k lies.[13] For a particular orientation of R(i, j, k), we insert in the first position, in the place of i, the name of the axis along which it lies; and similarly, in the second position, the axis along which j lies, etc. Then R(1,−5,n) designates the vector in its original orientation, with i along $\vec{1}$, j along $-\vec{5}$, and k along $\vec{n}$, —and the R(i,k) and R(j, k) components are both read as the original row. Now the [1,−5] transformation replaces $\vec{1}$ by $-\vec{5}$, and $-\vec{5}$ by $\vec{1}$. So [1, − 5] R(1,−5,n) = R(−5,1,n). We say that R(−5,1,n) is the [1,−5] t r a n s f o r m of R(1,−5,n). Since this transformation produces the same row form for both grid-patterns (see Fig. 6.), we need not distinguish between R_1(—5,1,n) and R_{-5}(−5,1,n). Again, [1,n,−1,−n] says to replace $\vec{1}$ by $\vec{n}$, and $\vec{n}$ by $-\vec{1}$, etc.; so [1,n, − 1,−n] R(1,−5,n) = R(n,−5, − 1). Successive operations cause no difficulty if we merely remember that the operator closest to R acts first, and the next operator operates on the transform produced by the first, etc. Thus,

[1,n,−1,−n] [−5,1] R(1,−5,n) = [1,n,−1,−n] R(−5,1,n) = R(−5, n,−1), while again [−5,1] [−5,n,5, − n] R(1,−5,n) = [−5,1] R(1,n,5) = R(−5,n,−1).

[13] Note that i designates a direction in the grid pattern R_1 originally occupied by the 1 axis, while j is the direction in R_{-5} originally occupied by $-\vec{5}$. k is that direction in either grid originally occupied by $\vec{n}$. Throughout, we must remember that i, j, and k are fixed in the grid patterns, but change their relation to the $\vec{1}$, $-\vec{5}$, and $\vec{n}$ axes as the space-row is rotated.

(Notice that [−5,1] is equivalent to [1,−5], and implies [5,−1].) This verifies one of the equalities stated in Figure 6. Others may be checked to test one's grasp of the notation.

Diagrams (b) and (e) of Figure 7 merely present these results in visual form. (b) represents the interrelations of the various transforms of R_1(i,k) and R_{-5}(j,k), allowing only the reflections [1,—1] [—5,5] (inversion), [n,—n] (retrograde), [1,—5], [1,5], and rotations of R(i,k) and R(j,k) in whatever plane they happen to lie. Each form appears several times, associated with different neighbours. A series of transforms now appears as a way of walking through this diagram.

The interconnections found in Figure 7 (e) are quite different. Here reflections have been excluded, all transformations being represented as rotations about the various axes shown. Any axis in this diagram can serve as a symmetry axis in the design of a row. Each such symmetry is preserved in rotations about that axis, and reappears as another sort of symmetry for other orientations. The vector in (e) has been chosen as the mirror image of $\vec{R}$ in (b) to emphasize that no rotation can make it congruent to that $\vec{R}$. Only a few orientations are shown; there are 24 in all. Together they constitute the rotation-group for a cube. (The 24 additional orientations of a mirror-image version of (e) might be excluded if we wish to tighten the limitations). We can reach each form from any other by rotation about just one appropriately chosen axis; and no more than two steps, using that axis, are required in any case.[14] Here the newly introduced axis-transformations appear as closer relatives of a given row than do the older mirror forms, inversion and retrograde. Thus apparent degrees of relatedness depend upon the representation we choose, and will have repercussions in our treatment of the various forms.

Notice that in (e) we are looking in from the +5 axis, and the original R(1,−5,n) is far to the back. Its (1,n) and (−5,n) projections will be identical, as before.

But at P we have R(1,5,−n). Its (1,n) projection is R_1(1,−n), the retrograde. However, its (−5,n) projection, R_{-5}(5,−n) is the retrograde inversion, since +5 has replaced −5. Thus the two projections do not coincide, although they arise simultaneously. Here, at last, we have an interpretation of a 90° rotation in the (1, − 5) plane. R(i,j,k) is a form whose projections sometimes coincide, sometimes split into separate images. For some orientations the chromatic scale or cycle of fifths emerges as one of the two projections formed. This occurs whenever the R(i,j) component lies in either the (1,n) or (−5,n) plane. Thus for R(1,n,5), on the (1,n) plane we have R(i,j), which is just the circle of fifths; the (−5,n) projection has been written out as a row, R_{-5}(1,n,5).

The temporary disappearance of whatever component lies in the (1,−5) plane is reminiscent of the way a sound pattern may be "folded out of time into space" by the process of recording. There as here this 90° rotation could precede its reversal in time (achieved by playing the recording backwards). Or, to mention an analogy from cellular biology, we might compare the manner in which specialization of cell-function requires the suppression of some genetic traits and the enhancement of others, with the choice of traits so emphasized 'rotating' as we proceed from one tissue-type to another throughout the organism. At the level of molecular biology we find a parallel to the redundancy built into our conception of the space row, and manifested by the emergence of scale-forms in some of its projections, a redundancy which arises by letting R(i,k) completely determine R(j,k), so that their original readings in their respective planes coincide.

[14] This statement is true only when we include four more symmetry axes not shown in Fig. 7e. They do not lie in any of the planes shown, but make equal angles with each of them, as do the main diagonals of a cube. Here only 120° rotations are permitted, and each corresponds to a permutation of all three axes: for example, [1,−5,n] R(1,−5,n)=R(−5,n,1).

In the Watson-Crick model of cell-duplication,[15] the genetic information is coded into two intertwined helical strands of DNA. Each strand is the unique complement of the other, in that each unit of one strand is linked to its complementary unit (defined according to a very simple rule) in the other strand. In cell division, the two strands are envisaged to untwine, each acting as a template for a new complement which is the exact replica of the other. Thus an apparent redundancy in the molecular structure of the individual chromosome provides for its self-replication.

Elsewhere nature assiduously avoids redundancy, even to the point of challenging our tendency to equate organic wholeness to a unitary conception. In the union of sperm and ovum, the unpaired chromosomes of one haploid cell couple with the corresponding, but genetically distinct, chromosomes of the other cell. Similarly, a true non-redundant space row is conceived when two different rows are used to generate the (1,n) and (—5,n) grid patterns. For the independently chosen[16] $R_1(i,k)$ and $R_{-5}(j,k)$ together imply the form of R(i,j), which will no longer be a scale pattern, but will itself be a true row which comes into evidence on the (1,n) or (—5,n) plane as the space-row is rotated.

The coupled projections being discussed suggest the linkage of a pitch row R(i,k) to a row R(j,k) governing some additional parameter such as duration or phase. Throughout, such an interpretation will be possible for any variable exhibiting the clock-face property (congruence modulo 12, in mathematical nomenclature). For this to be the case, an equivalence relation analogous to the octave must be defined. For durations, Stockhausen again chooses this to be the 2:1 ratio,[17] providing a duration structure closely paralleling the pitch structure. Or a phase-row determining metrical positions could be utilized; here the bar line marks the interval of repetition, and addition is the operation replacing the multiplicative combination of ratios. While such a parameter as intensity can be serialized, it exhibits no clear-cut cyclic structure, and the methods of this paper cannot be applied to it without modification.[18]

The axis-transformation group may be enlarged to include a transformation used by Berg and others prior to the occurrence of any of those so far mentioned. Just as the coordinates found on the $-\vec{5}$ axis may be regarded as a particular permutation of points (note-names) on the $\vec{1}$ axis, a new $\vec{n}_{-5}$ axis may be related by exactly the same permutation to the old $\vec{n}$ axis, henceforth called $\vec{n}_1$ to avoid confusion. $[n_1,n_{-5}]$ then designates the systematic permutation of notes of the row, counting through forward by sevens, or backwards by fives. (Note that here we have adjoined the last note of the row to the first, as required above.) Using the notation so far developed we may name a host of new transformations, but using only two grid patterns we find that most of them duplicate forms already produced. Instead of six transformations (including the original) plus their mirror forms, we now have eight.

This expanded transformation group is most conveniently examined by means of a table. Here pitches will be designated by number, counting up a chromatic scale which

[15] Christian B. Anfinsen, The Molecular Basis of Evolution (Science Editions, Wiley 1959), p. 50, for example.

[16] We might well have had some doubts about regarding the $-\vec{5}$ axis as a true dimension perpendicular to $\vec{1}$, so long as we required the readings on the two axes to coincide. The very concept of physical dimension requires mutual independence. This was first achieved above when we allowed 90° rotations in the (1,—5) plane; the free choice of R(i,k) and R(j,k) follows from that independence.

[17] Karlheinz Stockhausen, op. cit., 6 p. 21.

[18] Note that we have implicitly looped the $\vec{n}$ coordinate back on itself, making of the row a cycle which may start at any point. The grids, seen unfolded as squares lying on a plane, actually have the topology of the toroid or doughnut-shaped surface, as required by the joining of both pairs of opposite edges.

begins on a note just above the inversion axis, and ends on a note just below it (C to B for Schoenberg's Op. 36, as in Fig. 7a). For Op. 36, the table appears as follows:

(i)	10	11	4	12	5	7	1	2	8	9	3	6
(j)	7	2	1	9	8	10	4	11	5	12	6	3
(k)	1	2	3	4	5	6	7	8	9	10	11	12
(l)	4	11	6	1	8	3	10	5	12	7	2	9

The first row of the table (i), was constructed by recording the pitch numbers (counting up the C-to-B chromatic scale) in the sequence in which they occur in $R_1(i,k)$ of Fig. 7a. The second row, (j), similarly records the pitch numbers of the original series read from the circle of fifths, as in $R_{-5}(j,k)$. The third row, (k), just consists of the order numbers we have always assumed to lie along the $\vec{n}_1$ axis. In the fourth row, (l), we have permuted these order numbers by counting through forward by sevens, or backward by fives, starting at no. 4, giving the sequence in which these numbers appear on $\vec{n}_{-5}$. (Note that the number pairs formed between (k) and (l) are exactly those formed between (i) and (j).)

To read each of the transformations from the table, we let any one row designate pitch numbers on the chromatic scale already chosen; we then let either row in the other half of the table designate conventional order numbers, n_1. If (i) designates pitch numbers and (k) order numbers, we obtain the original series; if (j) designates pitch and (k) order, we have the [1,—5] transform. If (k) designates pitch and (i) indicates the order numbers, we obtain the [1,n] transform; but note that to read off the results we will have to present them with the order numbers in numerical sequence. Below 1 in the (i) row we find 7 in the (k) row, indicating that the first note of the [1,n] transform is $F^{\sharp}$; the second note is 8, or G, the third 11, $B^{\flat}$, etc. Here we are obtaining the inversion of $R_1(n,-5,-1)$ which appears in Fig. 7a. Reading off the other possible transformations in a similar way, we see that there are four choices of pitch number, for each of which there are two choices of order number, giving the eight possibilities mentioned. The mirror forms of each of these are then obtained by the usual methods, or by counting down the scale for pitch numbers, and/or backwards for order numbers. The two new forms are (i, l) and (l, i).

Here we have been dealing with four dimensions, 1, $-\vec{5}$, $\vec{n}_1$, $\vec{n}_{-5}$. On the coordinate planes of 4-space, a 4-row casts six projections: (i,j), (i,k), (i,l), (j,k), (j,l), and (k,l). For a non-redundant 4-row, three of these projections (grid patterns) must be chosen independently; they then determine the remaining projections. Thus three independent rows may be 'crossed' in 4-space to produce a 4-row which exhibits six distinct grid-forms. As the 4-row is rotated, each of these six grids produces its various readings. In any one orientation, two of the grid-forms are suppressed (those lying in the (1,—5) and the (n_1,n_{-5}) planes); the remaining four readings might all be regarded as occurring simultaneously, or the two involving the $\vec{n}_{-5}$ axis might also be suppressed or treated in some special way, depending upon how 'real' we consider that axis to be.

In fact, what meaning can be assigned to two independent sequence axes? Perhaps the ordering of notes within a single row takes place in a dimension different from that in which a succession of rows unfolds. For instance, twelve rows may be arranged one under another to form a table, or square array. Each such row is the reading of a differ-

ent $(1,n_1)$ grid: thus with the $\vec{1}$ axis perpendicular to the page and the $\vec{n_1}$ axis lying horizontally within it, each row is represented by twelve points at various distances above the page. The twelve rows together constitute a 12-by-12 array represented by a matrix of 144 points distributed above the page. It is possible to select the rows in such a way that the vertical columns read down the page also constitute complete 12-note sets, identical to, or closely or distantly related to, the horizontal rows. The array then becomes a Latin square, a special case of the magic squares which so intrigued Schoenberg. His matrix of transpositions, in which twelve transpositions of a single row are presented horizontally in such a sequence that the inversion transpositions appear vertically (in a different order), is perhaps the earliest use of such an array, but it is far from the only one possible. Any systematic permutation of order twelve may be used. The analog of transposition along the $\vec{n}_1$ axis produces the cyclic permutations (beginning the row at successively later order numbers); a systematic permutation of inversion-tone pairs; other pair-permutations used by Krenek:[19] all may be ordered so that the vertical columns are also of interest.

$\vec{n}_{-5}$ seems a natural choice for the vertical dimension of such a matrix. Now the full battery of rotations can be applied, not merely to a single row, but to the entire matrix. For example, the $[1,n_{-5}]$ transformation produces an array of rows whose grids are the patterns formed by all the E's, all the F's, etc., of the original matrix. At least one virtue of the axis-rotations is that these new arrays are again Latin squares. The musical value of their symmetry-preserving features may have seemed doubtful when these rotations were applied to a single row. But without implying that one or another type of matrix symmetry can be heard as such, we may now at least assert the following. As the 4-matrix is rotated, one type of symmetry in the 12-by-12 array of rows is preserved, or exchanged for another. These symmetry restrictions cause one projection to differ systematically from another, in such a way that each form has its own subtle 'flavour'. A row isolated from one such projection might seem equally closely related to the rows of another projection; yet when an entire array of twelve rows is played through or used compositionally, its distinction from other rotated forms becomes obvious. The musical problem seems to be neither that of producing variety and/or relatedness exclusively, but of generating a hierarchy of relationships so that, despite the variety presented within a given section, we may still 'modulate' to a recognizably new section of a single organic whole. n_{-5} is an important variable in that hierarchial structure of a tone space which is to be explored plane by plane.

The construction of the matrices themselves then involves less far-reaching transformations than those of the axis-rotation group. In addition to the methods just mentioned, 'modal transpositions' have been introduced: Here the row is seen as extracted from a scale-form appropriate to it. The scale-form is a highly symmetrical cyclic arrangement of the twelve notes, and the row is a quite simple permutation of this arrangement.

[19] Problems of Modern Music, op. cit. 3, p. 72.
The systematic permutation of sets of inversion tones has proven to be a quite valuable transformation. Once a between-note inversion axis has been defined, three four-note sets are determined: those 1, 3, and 5 quarter-steps away from the axis. From their permutations two additional rows are formed. These three rows together with their inversions and tri-tone transpositions form a 12-by-12 Latin square, (which may be arranged with diagonal symmetry if desired).
Two 12-by-12 arrays may be related in such a way that the positions of all the E's in one are complemented by a complete 12-note set at the corresponding locations in the other array: and similarly for each of the twelve notes. This relation defines two 'Graeco-Latin Squares', which are said to be 'orthogonal' to each other. (Compare Martin Gardner, Scientific American, Nov. 1959, p. 181). The permutation of inversion tones just described lends itself to the construction of such squares, in that the 12-by-12 array may then be regarded as the product of a 3-by-3 and a 4-by-4 array. By trial and error one can find a second 3-by-3 array orthogonal to the first, and a second orthogonal 4-by-4. Their product is then a 12-by-12 array orthogonal to the original one. (It is the permutations of 1, 3, 5 that constitute the 3-by-3 square, while the combinations of inversion and transposition yield the 4-by-4).

Thus we have divided the row into a symmetrical (scale-) and asymmetrical (permutation-) component. Now the permutation may be shifted along the scale to give twelve different readings from it. When the scale itself has an appropriate inversion symmetry, it may happen that these modal transpositions can be arranged into an array having the same symmetry as Schoenberg's magic square of transpositions, with the inversions in the vertical columns. For this procedure it has seemed best to transform the scale rather than the rows, by the axis-rotation group.[20]

II

The Tone Lattices

The fact that the $[1,-5]$ operation can be regarded as a transformation of intervals (1 to −5, 2 to 2, 3 to −3, etc.) suggests the possibility of other interval transformations. If we start to form these merely at random, we soon feel the lack of restriction. There are $12 \cdot 10 \cdot 8 \cdot 6 \cdot 4 \cdot 2/2 = 23{,}040$ ways that each interval (1, 2, 3, 4, 5, 6) can be brought into a one-to-one correspondence with any one of the possible intervals (± 1, ± 2, ± 3, ± 4, ± 5, 6). Among these we seek a smaller class of transformations of special interest. The interval between any two non-adjacent notes of the row is the algebraic sum of the intervening intervals. Thus we are led to consider how the intervals, regarded as operations, combine. We find that there are just two basic ways that the six fundamental intervals can be exhibited by only four notes: in the tetrachord-type CEF♯G and its inversion; and in its [1,−5] transform, CC♯EF♯, and its inversion. These four forms constitute the all-interval sets. Now the regular tetrahedron is a figure connecting four points by six lines. Its faces are equilateral triangles; each corner is equidistant from every other corner. If the notes of an all-interval set are placed upon the corners of a tetrahedron as shown (Fig. 8) the intervals between the notes can be represented by directed numbers lying along the edges in such a way that the numbers on two edges of any face add up to that on the third edge. Here another aspect of the group structure of the the interval operations is revealed. Its geometrical representation has added a new dimension to our tone space.

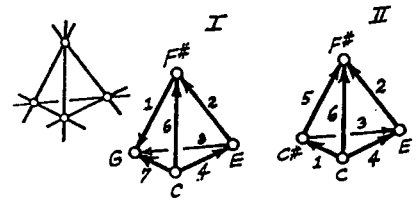


Fig. 8

We now have a way of representing the six different intervals by six different directions in space. The pattern may be continued by extending lines along each of the six direc-

[20] One theoretical weakness in all transformations involving $\vec{n_1}$ or $\vec{n_{-5}}$ is the implicit assumption of closure, which is realized in practice only if the row is immediately repeated, so that no.1 follows no.12. Such closure is actually realized for the scale forms and the modal transpositions extracted from them, as well as for the cyclic and cyclic-based permutations. Thus rotations involving the sequence axes seem more strongly justified for matrices than for individual rows. However, when rows are used individually, their cyclic nature can be emphasised by including at least one cyclic permutation of each (e.g., the (±)6, in which the hexachords are interchanged).

tions and placing tones at uniformly spaced points along them. The new tone space is then filled out with notes placed along additional lines parallel to those just formed, so arranged that the six directions are available starting from any tone. The points so chosen form a pattern known to the crystallographer as the face-centered cubic lattice.[21]

There are thus two basic lattices, I and II, (plus their mirror images) in which each tone is surrounded by twelve other tones, eleven of which differ from each other. The one duplication of note-name arises from the tritone which forms a cycle of order two. The tone at −6 forms an octave with the tone at +6. Note that the lattice points correspond to tones having assigned registers, so that successive octaves are correctly represented. The limits of audibility then determine the otherwise indefinite lattice boundaries.

In Fig. 9, three parallel layers of each lattice have been represented. The hollow circles lie in the plane of the page, the black circles above, and the small squares below. The relative orientations of the two lattices have been adjusted so that when any figure is translated from Lattice I to Lattice II without rotation, the [1,—5] transform of that figure results. The characteristic tetrahedron and its inversion are shown in perspective above each lattice. Because of the chromatic-fifths transformation requirement, the C-G line in I is replaced by the C-C♯ line in II; EG by EC♯, etc.

The qualitative distinctions among the intervals are now represented by their differences of direction in a three-dimensional space. If the intervals had to be ranked in some linear order, we might refer to the position of their occurrence in the overtone series, and the combination tones they form. We might consider interval 'sizes' measured on the −5 axis as justifiably as on the $\vec{1}$ axis. Perhaps reference should be made to the order of cycle which the interval's repetitions form. But the interval which appears first in one such series is last in another, as we have already seen in comparing ±5 and 6. The total scores for such a ranking are sufficiently similar, and the idea of scoring degrees of relationship sufficiently ridiculous, that Schoenberg spoke long ago of a 'democracy of tones' asserting their equality before the law. Thus we may well be pleased at finding all other notes equally distant, differing only in their direction, from a given tone.

An essential point of the lattice representation is that parallel directions between pairs of adjacent tones correspond to equal intervals. Every geometrical symmetry that appears in any figure in either lattice reveals some musical feature. The parallel sides of a parallelogram, e.g., remind us that in a major seventh chord, FACE, the fifth appears twice (FC and AE) as does the major third (FA and CE). Glancing at this figure in Lattice I gives us no information about the remaining relations, FE and AC. It happens here that the reduced intervals between these last two note pairs do not duplicate each other, but in another example they could. We must remember that the lattice is organized only on the basis of adjacent tones. Here, while A and C are adjacent, the tones F and E on the opposite diagonal are not. Similar comments can be made about any parallelogram in either lattice, whether it be the minor seventh chord which appears as the reflected form in Lattice I, the diminished fourth parallelogram shown in Lattice II, or a parallelogram lying in one of the inclined planes.

Notice that there are only three basic types of relation between intervals. The lines representing them may make an acute angle (60°), completing a triangle. They may intersect at 90°, the three tones involved lying at three corners of a square (AA♭ C in

[21] See, e.g., David Hilbert and S. Cohn-Vossen, Geometry and the Imagination, Chelsea, New York, 1956, p. 46.

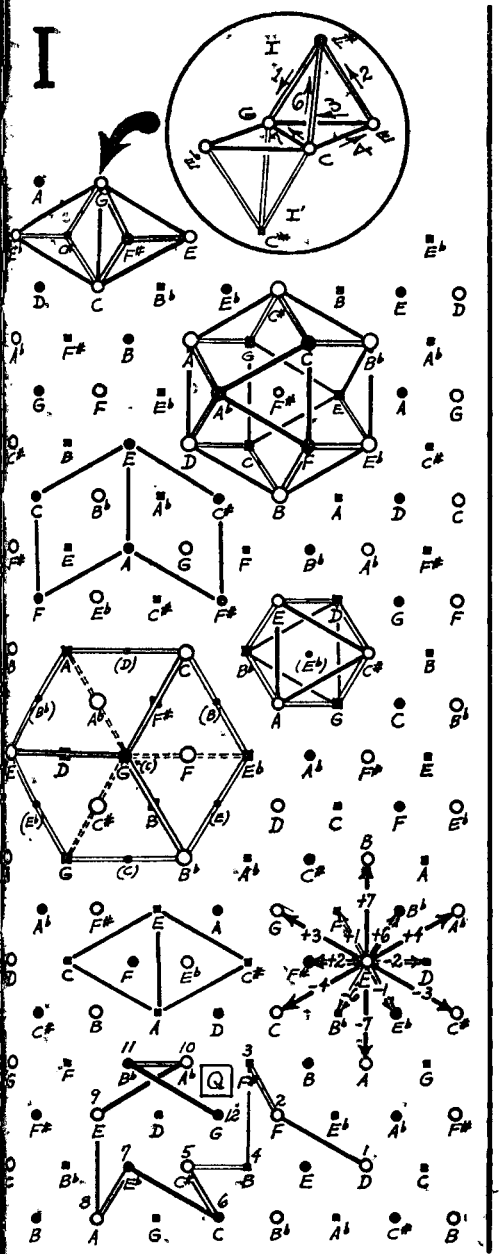


Fig. 9.
Lattice I
(diatonic—harmonic)
seen in the 4-3-7 plane of triads
Lattice II
(pentatonic—chromatic)
seen in the 1-3-4 plane of the diminished fourth

Lattice I, for example; E♭A♭C in Lattice II). Or they may form an obtuse angle (120°), with the tones becoming three corners of a parallelogram. A tone relation that has one form in Lattice I will appear as a different geometric form in Lattice II. Notice in particular that the $\vec{1}$ and $-\vec{5}$ lines are no longer perpendicular to each other, but intersect at angles of 60° or 120° in the two lattices.

Lattice I has been presented in its harmonic plane, the plane of triads. Many of the classical diatonic relations appear here. Only the dominant seventh chord seems to be missing; but it will be found contained in the dominant eleventh chord octahedron. Its more common form (with the fifth omitted) appears as an inclined face of the inverted basic tetrahedron in both lattices (E♭GC♯ in I′, AC♯G in II′). And even the variability of the dominant chord is suggested both by the octahedral set and by the CGC♯ face of the tetrahedron in each lattice. Much contemporary non-serial writing manages to skirt traditional harmonic expectations by intermixing note groups characteristic of each of the two lattices. Thus, e.g., a major chord outline is balanced by the juxtaposition of its [1,−5] transform, the diminished-fourth group. Even the emphasis upon fourths as opposed to fifths seems to imply an unconscious exploitation of Lattice II.

Other planes of each lattice may be seen in the large tetrahedra of Fig. 11. For clarity, many notes have been removed to expose various surfaces. On the back surface of I is the 2-1-3 plane in which the diatonic scale lies; its complement which contains the pentatonic scale is the 3-2-5 plane at the back of II. The corners of the five-unit tetrahedron from I constitute a II′ all-interval set and vice versa, for by going five units in each direction we have performed the [1,5] transformation. And from the [1,−5] transformation we see that each lattice is contained in the other, magnified sevenfold.

What then of the all-interval sets so clearly incorporated into the structural design of the rows of Schoenberg's Op. 25, 30, and 31, where every note is a member either of such a set, or of a repeated two-note motif (1 or 5) (Fig. 10a)?. Each such set appears as a tetrahedron in its corresponding tone lattice (I and I′ in Lattice I, etc.), and in fact it is just these tetrahedral sets that are the basis of the close-packed structure of the lattices. And if we assume an urge towards completion, towards achieving the maximum possible concentration of interval relationships, then these complete sets are the natural limit of this contraction process. Each is totally non-redundant, for note, interval, and triad content,—and totally asymmetrical so far as any planar representation is concerned. Yet in the lattices where each interval is represented by its own unique direction, the completeness and non-redundancy of the all-interval tetrad produces a figure of higher symmetry than any we had previously met. In contrast with the two- and four-fold planar symmetries, the tetrahedron may be brought into congruence with itself in twelve different orientations, together with their mirror images. Since four non-coplanar points are the minimum needed to define a volume, the tetrahedron is the topological 'simplex' of three-dimensional space, as is the triangle for two dimensions. As such it is the basic module of rigid 3-dimensional structures. In sum, the tetrahedron, like the all-interval set which can be brought into correspondence with it, is a strong Gestalt. The asymmetrical projection that it casts upon a plane will tend to 'pop out' into three-dimensionality, where its full symmetry is perceived by inference, as it were, independent of the usual rules of perspective. If we may regard classical tonality as one means of suggesting a musical space beyond the pitch plane—a type of perspective-convention that relates all tones to the tonic 'vanishing point'—, then Schoenberg's structural use of the tetrahedral sets would appear to be a powerful alternative for extending the dimensionality of tone space.

The interval content of a triangular set of tones from either lattice can be 'completed' by the note at the fourth corner of the tetrahedron. For the 2-4-6 and 1-5-6 (7-1-6) triangles two alternatives exist, since these sets occur in both lattices; for the remaining four triangles, the fourth note is uniquely determined. Whether such 'implied' tones are of any significance can be tested only by examining them in specific musical contexts. Classically such progressions as FAC-B, D♭FA♭-G, BF-EG, BF-CE♭, DA♭-EG will be found embedded in various cadence formulas in the key of C. Other such embeddings, and a general tendency towards a concentrated presentation of complete interval sets, tend to be found wherever harmonic forces come strongly to the fore. (Consider, e.g., the quasi-tonal cadences of Hindemith's Ludus Tonalis.) Were this tendency toward a completion of interval relations a perceptual reality, care would be needed to prevent its fragmentation of the series into isolated tetrads. Regarded as a powerful short-range binding force, it would require strong linkages if tension were to be sustained across a wider span. These connections could be provided by the overlapping of the tetrahedral sets themselves, their interlocking with motivic or highly symmetrical units, or their logical inclusion in some wider plan. The range of interconnections could be extended, and the tensions modulated, by allowing the overlapping complete tetrads to interrupt each other. If such additional tetrahedral sets are marked into Fig. 10a, the apparently sharp articulations indicated for Schoenberg's Op. 25, 30, and 31 will be seen as links in characteristic chains of interlocking sets. In Op. 31, in addition to four such tetrads, a third uninterrupted set will be found linking the three motivic units. The row of Moses und Aron presents a cascading sequence of these overlapping tetrads, culminating in an uninterrupted II′.

From this point forward we shall let 'triad' designate any unordered 3-note set ('chord'); similarly 'tetrads' are 4-note sets, etc. Not counting inversions and transpositions, there are just twelve possible triads, and twenty-nine tetrads. The interval structure of any such set may be indicated by listing in order the intervals between adjacent notes as they occur on the chromatic circle. For example, tetrahedral set I is 4-2-1; II is 1-3-2. Here intervals between non-adjacent notes are implied as sums of the interval numbers given. On this basis a triad requires only two digits; 4-1 represents CEF at any transposition or inversion, with the notes taken in any order or sounded simultaneously. For triads it will sometimes be convenient to specify in parentheses the third interval between the outer notes (the reduced sum of the other two interval numbers) thus: 1-4(5), not to be confused with the tetrad, 1-4-5, CC♯FB♭. For ordered sets, the directed intervals are presented in the order of their occurrence: +1, +4.

Of the twelve triads, the six triangular sets are seen in the two circles at the top of Fig. 9. Five of the remaining sets are redundant in interval content: 1-1(2); 2-2(4); 3-3(6); 4-4(4); and 5-2(5). The one remaining triad, 1-4(5) is unique in that it is both non-redundant and non-triangular, thus having no tetrahedral completion tone in the sense mentioned above.

It is instructive to tabulate the twenty-nine tetrads according to their reduced interval content, diagramming them on the chromatic circle, classifying them by intervals omitted and duplicated, noticing symmetries together with their interrelations under the [1,−5] transformation. There are ten that omit one interval and duplicate one, ten that omit and duplicate two, six that omit three, and one that omits four. Many of their features will be found reflected in their lattice representations.[22]

[22] For a further analysis of the interval content of these and larger sets, see Howard Hanson, Harmonic Materials of Modern Music, Appleton-Century-Crofts, New York, 1960.

The fact that two overlapping triangular sets can be completed by a single additional tone serves an almost symbolic motivic function in Wagner's Tristan. In addition to the all-interval tetrads I and II and their inversions I′ and II′ as shown for measures 2 and 3 in Fig. 10b, the tritone transpositions of the four sets also appear distributed across the bar line separating the two measures; a retrograde presentation of I and II, F-EDA♯ and F-EG♯A♯, together with I′ and II′, now differently partitioned as FD♯A-D and BD♯A-D. This occurrence of eight different tetrahedral sets in the space of two measures containing just eight distinct notes might seem a sufficient account of the interval relations found. But what then of the E of measure 1? Without it, the entire thematic complex collapses.

For Tristan und Isolde, a mutual completion is predestined . . . and impossible. A, F, E, −4, −1; 1−4(5): the only non-redundant triad for which no completion tone exists: here is a second complementary motivic element from which the whole is generated— or is it the first? Reading from E across the second bar line, we find the AFE linked to its −1 cyclic transposition, ED♯G♯; and to the retrograde inversion about the common tone E, ED♯B, and its reflected +5 transposition EG♯A. Reading across the third bar line, we encounter as well AFE repeated, (G♯)AG♯E. D♯A♯B, FAA♯, AA♯D, D♯DA♯, and a BD♯E retrograde: at least eight distinct occurrences plus three repetitions are embedded in these same eight notes. How remarkably the first four linked forms of this motif of incompletability have been combined, their pivotal tone E deleted, to form the Tristan chord and its resolution, the pentad that portends fulfilment in another sphere.

In the +3 transposition beginning at measure 5, there is but one minute change. The ascending minor sixth A F has become major: B G♯. With this slight brightening our attention is drawn to new potentialities. For BG♯G, 1-3(4), is a triangular set; its completion is possible. And it too has been abundantly present since the beginning. In the first three measures we find FEG♯, FG♯A (FAG♯), BD♯D, (FEG♯ repeated), and perhaps most prominently, DA♯B. But despite its potentiality, the first of these triads enters into no all-interval set. Only at bar 10 does the interval permutation within the chord allow the preceding A to enter the sets II and I′. And extracting the four-note descending chromatic line (measures 8 and 9) has allowed the 'cellos to pass from the major back through the minor sixth, condensing and then extending the implications of the previous two occurrences. The density of intertwining continues to build toward the apex at bar 17 where tetrad I stands isolated in simultaneity,—a dissonance sounded against its note of resolution, as the text books would have it. A thread has broken, but the outline is complete. A new strand of the presentation is arising; the narration begins now as a dialog—I, II′, I, I′, alternating, approximately one per measure . . . three tones, a chord, three measures, seventeen, . . . a prelude, an act, an opera.

We now list, merely as curiosities, a few examples of the abstract possibilities available. Pentads containing both all-interval tetrads are readily formed around the two triads common to both I and II or II′. We find that there are just two hexads (hexachords) that each contain I, I′, II and II′. They are CC♯E♭EF♯G, and its [1,−5] transform, B♭CC♯ E♭F♯G. The heptad B♭CC♯E♭EF♯G contains all four sets plus their transpositions, or eight sets in all. However, note that it is impossible for notes nos. 1—4, 5—8, and 9—12 each to form an all-interval set in a complete 12-note row.

In an all-interval tetrad, the six interval magnitudes, 1, 2, . . . 6, are expressed by the six possible dyads that can be extracted from the unordered four-note set. In

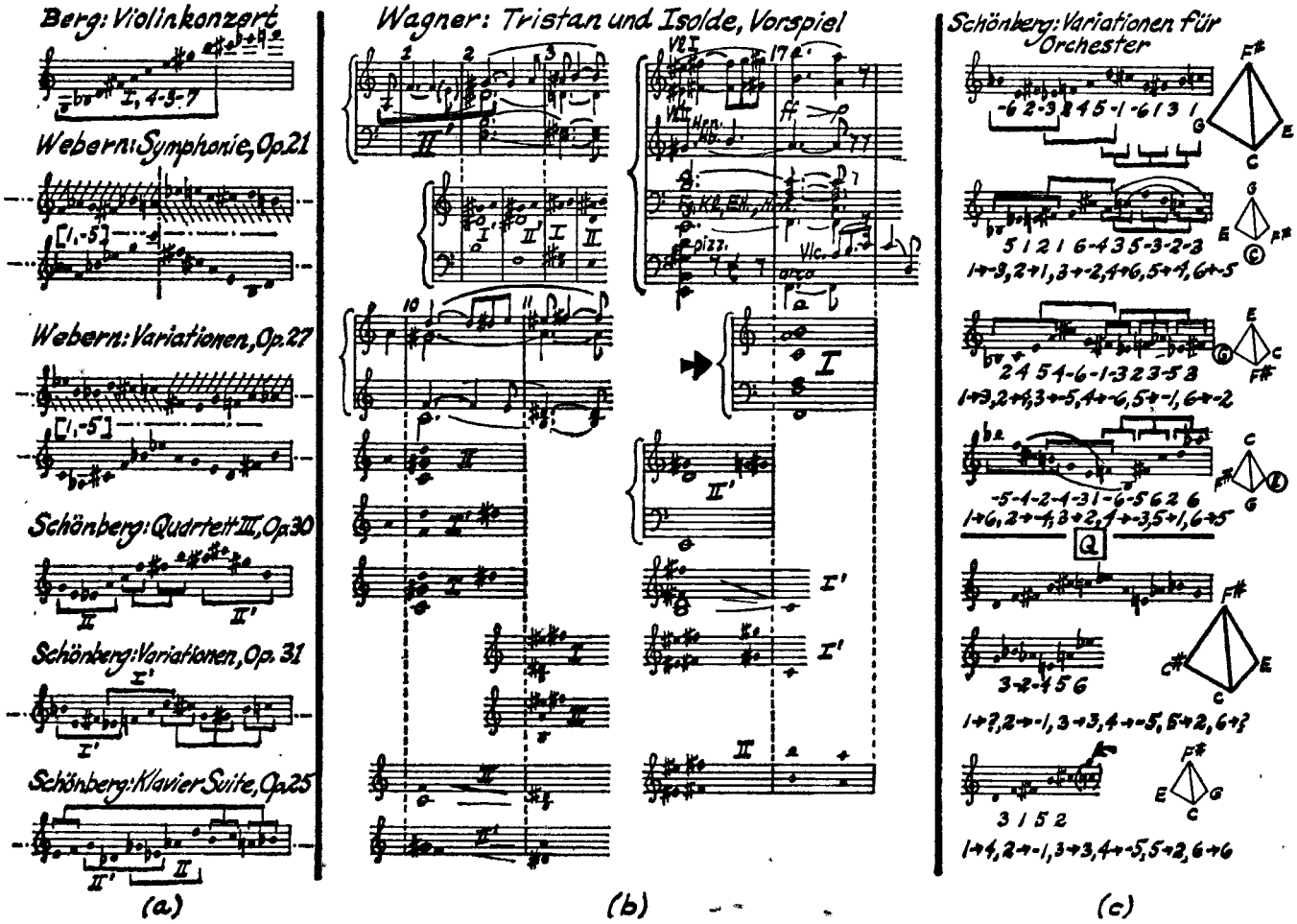
contrast, the adjacent note-pairs of an all-interval row present the eleven possible directed intervals, ±1, ±2, . . . ±5, 6, as, for example, in Q′, a variant of Q: DFF♯BC♯CAGE♭B♭EA♭. (Since +6 = −6, an interval redundancy always results when the row is regarded as a closed cycle, the interval between notes nos. 12 and 1 being the second tritone.) An all-interval row has the interesting property of yielding a complete 12-note difference row, a row whose pitch numbers (with respect to a fixed reference note) are taken as the intervals of the original row. Here △Q′ is CE♭C♯FDBAB♭ A♭GF♯E if C is chosen as the reference note. When △Q′ is played note-for-note against Q′, there is only one repetition among the directed intervals formed between simultaneously sounding note pairs, a situation vaguely reminiscent of the Graeco—Latin squares mentioned in Part I.

Corresponding to tetrahedral sets I and II, the all-dyad tetrads, there exists an all-triad hexad: CC♯DEGA♭. Here all twelve possible 3-note sets are exhibited, but of course there are repetitions among the twenty possible combinations that can be extracted: the set is complete, but redundant. It is equivalent to its own [1,—5] transform. A highly redundant all-tetrad octad results when a tetrahedral set is extracted from a chromatic scale. Many of the tetrads appear in their inversions as well.

When a row is regarded as a closed cycle, it can happen that its twelve successive 3-note sets form the twelve possible triads. CEA♭FDAGF♯C♯E♭BB♭ is a non-redundant all-triad row. Of possibly more musical interest is still another variant of Q, DFF♯BAB♭GC♯ E♭A♭CE. In addition to eleven triads, it exhibits the two all-interval tetrads and eight of the ten tetrads that omit only one interval. As an index of harmonic variety, the interval content of successive tetrads appears more significant than does that of the triads. Because of the extreme symmetry of the 4-4(4) triad, no all-interval row can be an all-triad row. Likewise no all-triad row can contain the two tetrahedral sets together with the ten tetrads omitting only one interval, because two triads, 2-2(4) and 4-4(4), occur in only one tetrad each.

Rotations in the Tone Lattices

The significance of the tetrahedral sets is further revealed when we return to our search for special classes of interval transformation. We have seen that completeness is in fact a type of symmetry. Rotations in the lattice are the operations by which that symmetry is defined. As before, the symmetry operation yields a new class of transformations. Suppose, e.g., that a row to be examined is spelled out in one of the lattices, as is Q at the lower left of Fig. 9. We now regard the resulting form as a bent-wire figure that can be rotated to new orientations in the lattice. Any triangular set of tones will be transformed into a set in which the three interval relations have simply been interchanged, if the wire figure is rotated in the plane of that triangle. There are two such rotations, plus three more if the figure is turned over, and the triangular set is replaced by its inversion. If some one type of triangular set is predominant throughout the row, (e.g., the triads of Berg's Violin Concerto), this feature will be preserved for these transformations. If triangles in different planes are present, rotations will exchange one kind of triangular note-set for another. But for all possible rotations that bring the wire figure back into coincidence with the lattice, any tetrahedral set is transformed into a tetrahedral set—either a permutation of the same notes or their transposition, or likewise for their inversion. Equal intervals of the row appear as parallel lines in the wire figure.


Berg: Violinkonzert
Webern: Symphonie, Op. 21
Webern: Variationen, Op. 27
Schönberg: Quartett III, Op. 30
Schönberg: Variationen, Op. 31
Schönberg: Klavier Suite, Op. 25
(a)
Wagner: Tristan und Isolde, Vorspiel
(b)
Schönberg: Variationen für Orchester
(c)

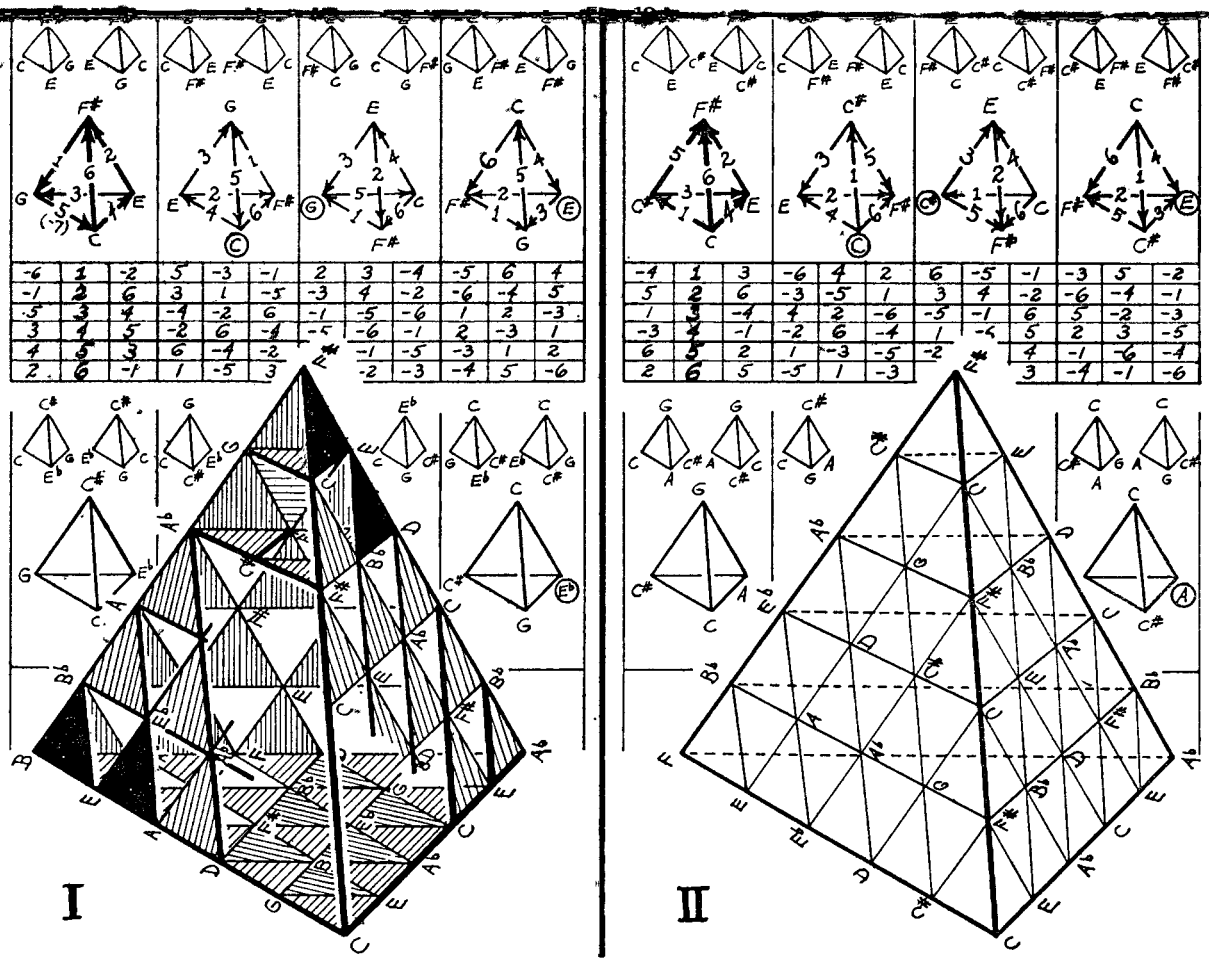

I
II

Fig. 11

Since under rotation these parallel lines remain parallel, we see immediately that we are dealing with an interval transformation, in which one set of equal intervals is replaced by another set of equal intervals different from the first. But only for a tetrahedral set of tones will notes not adjacent to each other in the row undergo the same interval transformation (Fig. 10c).

This is the extension of the mirror forms and chromatic-fifths transformation that we sought; for [1,—5], all interval relations, adjacent and distant, undergo the same transformation. The lattices provide the next more general group of transformations; they preserve the interval-transformation rule for adjacent pairs, and for all members of a tetrahedral set, but not for other tones separated by more than one lattice-unit. Thus the tetrahedron (all-interval set) is the invariant of the lattice rotations, just as was the chromatic scale for the [1,n] [—1,—n] rotation. Previously it was the axis of rotation that was the invariant; now, it is the figure that remains invariant while being brought into coincidence with its former position through rotations about various axes.

A tabulation of the resulting interval transformations has been sketched in the background of Fig. 11. For each rotated position of the tetrahedron, the table shows what interval (edge) corresponds to 1, to 2, to 3, etc. on the primary tetrahedron at the upper left. To complete it, we must fill out the lower half, comparing with the same primary figure. Additional transformations occur if we read a tetrahedron from II on the primary figure of I, or vice versa. But in each case we get the [1,—5] transform of a previous transformation, and it is easiest to write this down from the interval rule for [1, —5]. We have 24 rotations in lattice I, 24 in II, and the [1,—5] transforms of these: a total of 96 in all, if there were no duplications; but four of these are the identity transformation which leaves the row unaltered. These have not included inversions and retrogrades. The inversions may be regarded as occurring in two mirror-image lattices, while the retrogrades are formed by counting backwards along the wire figure; or the complete axis-transformation group may be applied to each rotated form. Even then we are a far cry from the 23,040 unrestricted interval transformations mentioned at the outset of this section.

In Fig. 10(c), three rotations in Lattice I have been written out for the row of Schoenberg's Variations for Orchestra. The intervals between adjacent tones are tabulated just below each row. Looking in the transformation table (Fig. 11) under the appropriate rotated figure, we read out the transformation rule; each interval of the original row is then replaced by its transform. We see that the tetrahedral sets and motivic interval relations between adjacent notes have been preserved, as predicted. But there was no guarantee against repetition of tones! The disparity between the first and second halves of the first rotated row seems almost ludicrous although the other forms are less implausible. These are typical results for a full twelve-note row. Marked differences exist for smaller groups. Rotations of the first six-note set of Q frequently produce such repetitions; the second six-note set produces none. While these transformations are most conveniently carried out by means of the transformation tables, actually bending a wire form to fit into a full-scale drawing of the lattices can reveal some unexpected facts. It was thus found, e.g., that the wire form representing notes nos.8 through 12 of Q in Lattice II is identical to the form for notes nos.1 through 5 in I. If the form of nos.12—7 is taken as fundamental, it produces a modification of note no.6, replacing the C by a G as shown. But now the two halves cannot be combined to form a complete twelve-note set. The incomplete sets (less than twelve tones) produced by these rotations may even have

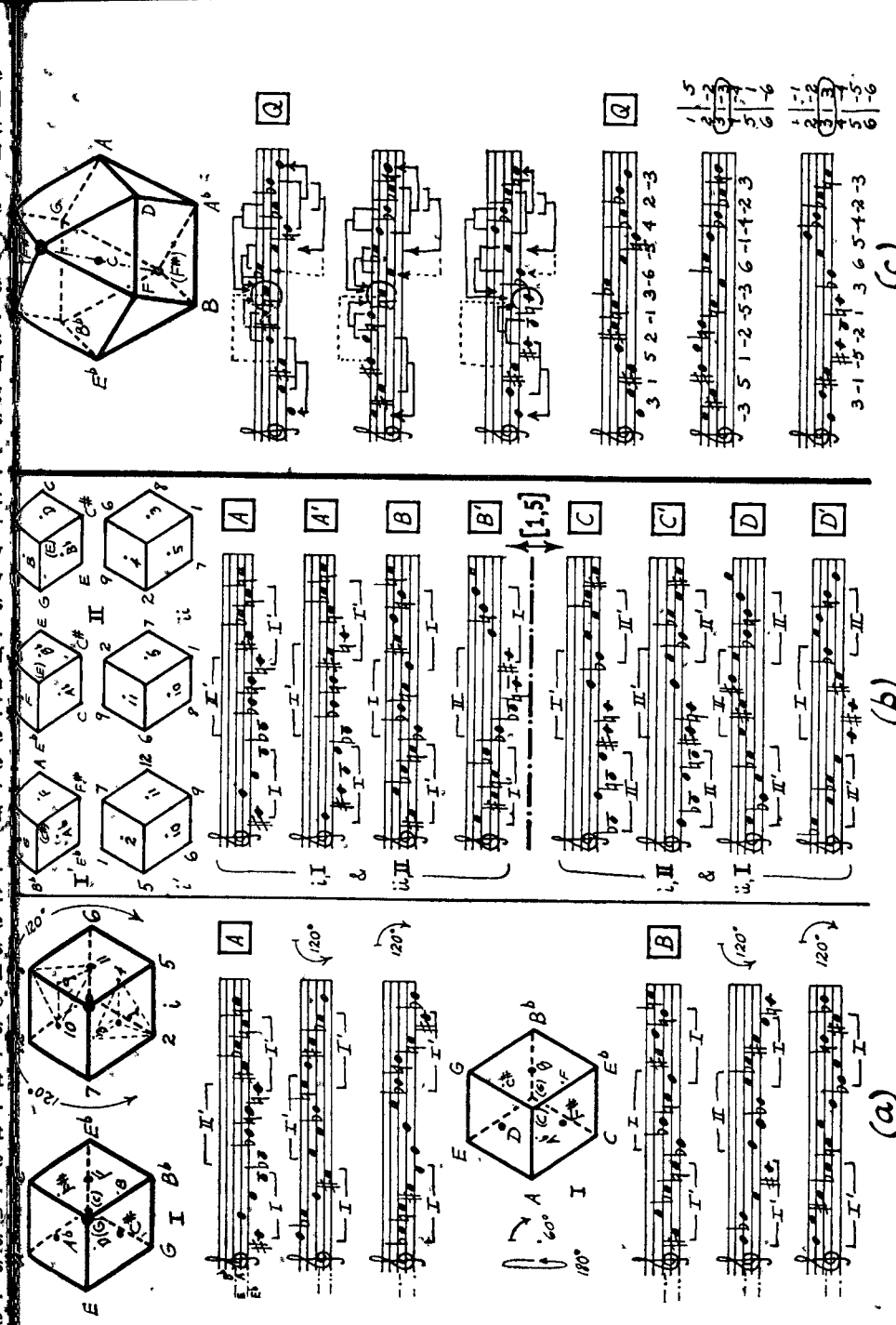


Fig. 12. Figures excised from the lattices.

a virtue. Just as the greater part of a living cell is not genetic material, but composed of simpler substances which have been appropriated and organized by the nucleus, so we find a need for more 'neutral' compositional material if the central structuring is to be kept clear. Schoenberg achieves 'dissolves' by blurring the presentation of the row, so obscuring it that the effect is that of a return to the raw materials or only partially ordered substances. In twelve-note composition, close repetition of notes has already had a structural significance, signalling the link between rows, etc. But now repetition combined with omission implies that we are dealing with a derived quantity, which, like all projections, exhibits redundancies and lacks complete differentiation. All such dissolves—the classical development section, transitions, interludes, etc.—function toward the same end: enhancing, by contrast, the ensuing more direct presentation of essential material.

Figures Excised From the Lattices

Yet complete twelve-note sets may also stand in varying degrees of relationship to some central core. In Fig. 12 we see two types of rotation that avoid repetition. In (a) we have row A spelled out on a face-centered cube excised from Lattice I. 14 note names appear, the C and G being repeated. These latter two corners are omitted in the spelling-out of the row, and serve as the axis of rotation, yielding three upright and three turned-over positions. The cube was chosen to satisfy two conditions: the axis tones (C-G) are inversion tones, and all rotated forms maintain A's axis of symmetry; and the all-interval sets I and I′ appear as tetrahedra in the cube. Another such cube can also be found in Lattice I. Cubes excised from Lattice II preserve the set II′. Each numbered form can be read off the cube from which it was derived, or any of the others. Of the 96 resulting rows, 8 are repeated four times each (in inversions or transposition at the tritone); these are listed in (b). Note that D′ is the [1,—5] transform of A, etc. These eight then constitute a core, surrounded by the remaining 64 subsidiary forms (four of which appear in Fig. 12a). Note how the above procedure extends to three dimensions the method of forming modal transpositions, (shifting a simple permutation pattern along a highly symmetrical scale form) mentioned at the end of Part I.

The figure at the top of Fig. 12c is the cubo-octahedron, containing 13 note-names, the F♯ being repeated. Noticing the peculiar interval-symmetries with respect to the C, D, G, and A in row Q, we might seek a transformation group which preserves them. Centering the cubo-octahedron about C will guarantee that symmetries with respect to C are maintained. But the surprise is that when a row-form is spelled out and rotated about the F♯-C-F♯ axis, all of the indicated symmetries are preserved. Again there are several similar figures, and many resulting forms. This particular type of symmetry leads to many whole-tone-scale or diminished-seventh sets of lesser interest, but the two transforms shown here seem motivically valuable. It happens that they are also interval transforms of Q, differing from the [1,5] and [1,—5] transforms only in the opposite sign for 3. These excised figures may be chosen to preserve certain specific relations between non-adjacent notes; the price we pay for this is that notes adjacent in the row are no longer necessarily adjacent in the figure. The rotated forms then will not generally be true interval-transforms, but some peculiarity in the row may allow them to be so.

Another characteristic of Q is that notes nos.1-2-3-6 and nos.1-3-4-6 constitute tetrahedra II′ and I′ respectively, while nos.7-8-9-12 and nos.7-8-11-12 are II and I. Thus, as 'completion tones' in the sense previously defined, notes nos.6 and 12 (and nos.1 and 7 in the retrograde) produce a kind of harmonic closure for each hexachord. Only one type of set (I or II) remains invariant under all the ordinary lattice rotations. But it was later discovered that a hybrid cubo-octahedron combining properties of Lattices I and II could be formed by interchanging the C♯ and G of the cubo-octahedron of Fig. 12c, preserving all four tetrahedral sets. For such a figure transposed a tritone, the four resulting rows are Q, its [1,—5] transform, and essentially the two additional rows shown. Thus the less interesting forms mentioned can be excluded by a judicious choice of figure.

An examination of the rows of Fig. 12(c) reveals that they are just transpositions of Q and its [1,—5] transform, with members of the two tritone note-pairs, F♯-C, A-E♭, interchanged. Such tritone interchanges can produce a local [1,—5] transformation in a small region of the row under the following circumstances: (a) when each member of the pair is approached and left by an odd-numbered interval (1, 3, or 5 semitones); or (b) when the tritone-pair consists of notes adjacent to each other in the row, and the pair is approached and left as above. Though suggested by the excised figures, such interchanges might now be freely investigated in their own right, without the necessity for geometrical interpretations.

Dealing with such excised figures suggests considering the regular polyhedra, or Platonic solids. The lattices have been based upon the first of these, the tetrahedron. The remaining four define two distinct rotation groups, that of the cube and octahedron, and that of the dodecahedron and icosahedron. Each of these figures contains twelve edges, vertices, of faces, on which the twelve notes may be placed. However, the structures of their rotation groups do not parallel any intrinsic properties of note-relations. But if some essential characteristics of a row can be represented by one of these figures, they can be preserved by its rotations.

Our tone-space transformations began with those rigourously deducible from a given form, granted a certain minimum of postulates: these were the mirror forms, then the axis-rotation group. But in moving from the lattices to the excised figures, we see increasing need for creative insight into just what is essential in the form given, and how to preserve it by inventing the most appropriate transformations. Lacking some still deeper mathematical intuition, we may find that for every prediction fulfilled, other unexpected facets of the transformations are revealed in the actual manipulation of specific rows. For example, we may notice that every triad may be classified as a triangular relationship in Lattice I, II, both I and II, or neither. In row A, cataloging successive three-note sets (nos.123, 234, 345, . . .) as above, we find the following pattern: I&II, I, II, —, I&II, II, I&II, I&II, I, II. Of the 72 transforms, just the central eight preserve this pattern, though of course the transformation was not designed with this in mind. Again, if it occurs to us to try to make a 'space-row' taking A as $R_1(i, k)$ and B as $R_2(j, k)$, the deep interrelation between the two is revealed in the fact that R(i, j), though no longer just a set of a whole-tone scale lines, is a simple three-note cycle in four equally spaced transpositions, reminiscent of the scale-forms underlying our 'modal transpositions'. Perhaps it should be mentioned that rows A and Q both occurred (in 1956) over a year before any of the present methods were developed, though they might well seem invented to illustrate them.

We must stress that this entire discussion has been concerned with only one aspect of tones: the group-property of intervals. Of course, such limitations are characteristic

of any scientific discussion, and are the reason musicians, laymen, (and scientists) justifiably resent the presentation of mathematical forms as 'reality'. Quantum physics emphasizes the incomplete nature of scientific description, stating that different aspects of reality require complementary descriptions which appear mutually contradictory if any one alone is regarded as complete and self-sufficient. Music is as elusive and many-sided as reality itself. But even as the various branches of physics represent partially distinguishable aspects of physical reality, so we may look forward to a variety of attempts to penetrate the inherent properties of our chosen musical materials. We should not be dismayed if differing approaches give different answers, since they describe and partially solve different problems. Thus, e.g., there may be real laws of harmony—in a much broader and deeper sense than any yet discovered, and these may have little to do with the group properties discussed here.

Our biological analogies may have seemed remote; yet what is a row if not the genetic material of a composition? The serial composer creates much in the manner of nature herself, manipulating the genetic characteristics of his material to bring their logical consequences into closest accord with his deepest intuitions. At his best, he presents solutions to problems which are 'overdetermined'—for which no general solution exists. This is the justification for the composer's concern with particularity, and reminds us again of why there can be no single comprehensive theory of 'how to find the consequences of a theme'. Any battery of special methods can be no less arbitrary than their musical (or unmusical) results. If it should happen that we have added to the possibilities to be investigated, that is as much as any facet of artistic technique can claim. If the grids and lattices can help reveal analyzable aspects of those fragments with which the composer begins, if somewhere among the formal consequences of this analysis there appear new projections whose musical import expresses a bit more of the music-behind-the-notes that guides and judges the composer's every move, then there is cause for rejoicing—unless he should realize too late that his unfettered intuition might have led him to those forms more surely and directly. Perhaps all such modes of analysis are just this: exercises in perceiving more aspects of the tonal material than have been considered heretofore. After a diversion of modified eartraining, the composer may, as Schoenberg suggests, put aside all preconceptions, and write (and hear).

The Crystalline Congruences; Generalization of the All-Interval Set

Meanwhile the theorist continues to erect his house of cards. The concept of the all-interval set leads us to a series of (tempered) scales which generalize the notions of the tone lattice. These we have called the crystalline congruences. The following statements about all-interval sets will most easily be verified by sketching out a scale-circle analogous to that of Figure 3b for each scale mentioned. The number of notes in the scale is called its modulus; throughout this paper, we have been dealing with modulus 12. A two-note all-interval set contains just one interval, and can represent either a two-note scale (C, F♯) or a three-note scale (CE of C, E, G♯). A three-note all-interval set contains three intervals, all that are present in a six- or seven-note tempered scale. The CDF♯ of the whole-tone scale may be designated as 1-2, indicating the number of scale-steps between adjacent notes of the chord. (Of course the third interval, 3, the three whole steps between C and F♯, is not designated explicitly, but will be evident in the sketch). The two four-note all-interval sets of modulus 12 are 4-2-1 and 1-3-2 (the CEF♯G and CC♯EF♯ which form the basis of the three-dimensional lattices I and II). For modulus 13 they are 2-1-4 and 1-3-2.[23] Modulus 3 may be represented by evenly-spaced points along a line; modulus 6 or 7 by points of a plane lattice arranged like the white circles of Fig. 9; and both modulus 12 and 13 by the face-centered cubic lattices. No five-note all-interval set can be found for modulus 20. But the set 3-1-5-2 exists for modulus 21, forming the basis for a four-dimensional lattice. It transforms into itself under the possible interval transformations. For modulus 30 again no 6-note set can be found, but for modulus 31 five sets exist. They are: 1-2-5-4-6; 1-3-2-7-8; 1-7-3-2-4; 1-3-6-2-5; 4-7-2-1-5; they transform into each other under the 15 interval multiplications. Each forms the basis of a 6-dimensional lattice. Thus the 31-note even-tempered scale now acquires a new interest, after having been proposed in the seventeenth century by Huyghens as the first even-tempered scale after modulus 12 to give a closer approximation to just intonation.[24] If such a scale were to be realized electronically, it could encompass various modes of twelve-note rows, so that a truer sense of modulation could be felt in transpositions, etc. Using the structural functions of the all-interval sets, there would be no need to go to a 31-note series. Of course, all of the above are immediately available for use in duration rows.

When a scale is composed of a prime number of notes (as for modulus 7, 13 and modulus 31, each divisible by no number other than itself and one), each interval becomes the basis of a scale that runs through all the notes. Thus each line of nearest neighbours within the crystal acts much like a coordinate axis, and each interval transformation has the same invariances as the [1, — 5] transformation previously discussed.

The only non-redundant all-interval sets yet found for a non-cyclic linear variable (intensity, e.g.) are: 1-2; 1-3-2.

The all-interval-set concept can be extended to the space-rotation groups also. We have seen that the axis-transformation group is the rotation group of a cube. Consider the eight corners of a cube, and their interrelationships. Two corners may be (1) adjacent, (2) separated by the diagonal of a face; or (3) by the main diagonal of the cube. Two adjacent corners, plus a third corner at the opposite end of the main diagonal from one of these two, constitute an all-interval set of three corners. From this hint, remembering that three 120° rotations are possible about the main diagonal through each corner, one can pick out 'all-interval sets' of spatial orientations. Thus of the 24 orientations of the space-row mentioned in Part I, a carefully selected few will suffice to imply the entire group.

The present methods have implications over a broad aesthetic field, the cyclic or clock-face property, together with quantization into an appropriate number of discrete elements, being the only requirement for applicability. As one element of a partially unified aesthetics, the notion of the all-interval set recurs wherever little must imply much.

Los Angeles, 1957-59; revised English edition, 1965.

[23] For a use of modulus 13, see Ernst Krenek in Problems of Modern Music, op. cit.[3], p. 81. With reference to modulus 7, it is said that the music of Thailand and Cambodia utilizes a 7-note uniformly tempered scale apparently arrived at without the aid of any written notation. Our traditional convention of classifying intervals as seconds, thirds, etc., operationally treats the diatonic scale as a particular intonation of modulus 7. (Note that the all-interval set is then the 1-2 of that scale, corresponding to a seventh chord with either its third or fifth omitted.)

[24] Hermann Helmholtz, On the Sensations of Tone (trans. by Ellis), Dover Publications, New York, p. 436.

Adriaan D. Fokker

Wherefore, and Why?

Questions relating to new music

Throughout the ages styles are constantly changing. Whenever a certain style is established by a generation of brilliant artists, and their epigones have exhausted all its possibilities, a certain dissatisfaction begins to grow. Tradition degenerates into a mere form which can no longer inspire the younger generation nor offer them the means of realising their full powers and intentions. They begin to doubt, and with their minds in a ferment of criticism, the young avant-garde elevate their doubt into a principle. All tradition is suspect and must be rejected, and at the end they are suspicious even of their own judgement. A few, however, sometimes endeavour to seek new points from which to begin afresh by appealing to supra-personal achievements in the arts, which are now being regarded almost as scientific disciplines.

It must be admitted that there is always a changing of style, even if it is unnoticed and not commented upon. At certain periods, however, controversies become very vocal, and it is evident that we live in such a time today. The most varied of arts show this unrest. To find his way among tendencies so utterly divergent is not easy for an unspecialised amateur of the arts. He will welcome, therefore, the third issue of "Die Reihe" which offers enlightenment on the work of an important group of contemporary composers under the title of "Musical Craft". As a representative of science, as a physicist, I would like to react to this exposition of musical craft with a few questions and observations. Physics is also an art, and one that is also struggling with immensely great new problems in the face of recent discoveries. I shall avoid on purpose the mentioning of names: we are concerned only with the published material. With such turbulent developments in view one cannot tell if the authors still confirm the opinions they expressed some three or four years ago.

C h a n c e. A method of composition has been described which leaves as much as possible to chance. Only the system of notation has been retained from tradition: the remainder is disposed of by some rules of gambling. The final outcome is handed over to the executor with instructions leaving him free to determine the tempo and dynamics. This seems a very paradoxical method. The composer withdraws and leaves his work to chance. It seems that he has no faith in himself being able to say anything on his own account. One may believe that this randomness appears to result from the composer's distrust of himself.

Physics is much concerned with chance. We have classical statistical methods which explain certain laws as the effect of randomness in the case of very great numbers. A hundred years ago, Clausius created the wonderful concept of entropy in dealing with the transformation of heat into energy in engines. Some thirty years later Boltzmann saw that this quantity, entropy, entailed a certain amount of disorder, a quantity which increases whenever randomness prevails in the course of events. Accident, however, that is absolute randomness means death. Every choice, the laying of red to red and white to white, is acting against chance. All human endeavour fights against chance, realises a purpose, avails itself of chance in the furtherance of an aim, and, if possible, to attain a creation. Whoever elevates randomness to a first principle contradicts all human aspirations and efforts. Liberated chance breaking away is a King of Chaos. Art has its casual fortuities. Casual fortuities never create art.

P h a s e. Let us listen to another author, who delves deeper. He wants a programmatic, scientific basis for his proceedings. He begins from quite a general point of view and talks of changes in a field of sound. Between these events he discerns intervals of time, and proposes: "let these time intervals be called phases".

But stop! Why this term and on what grounds? Phase is a word with an exact definition. It means an instant, a momentary state. It is never related to a duration, to an interval of time. Everybody knows that the moon shows four principal phases: full moon, last quarter, new moon, and first quarter. Between these phases we find the first evening crescent (one-eighth) and the last sickle at dawn (seven-eighths). Every night the moon shows another phase, every hour, and, more exactly, every second. The moon's cycle consists of innumerable phases. It would never occur to anyone to say that a month —the duration of the cycle—would be the moon's phase. No, the month is the period of the transfigurations of the moon. The same reasoning applies to every pendulum, to every vibratory motion. An infinity of phases, of time sections, together constitute the motion in question. The interval of time between two repetitions of the same phase is called, simply, a period. There is no need whatever for a new word. After all, as has already been said, phase is not a new word at all. It has a well defined and generally accepted meaning. Something like sepha—with the syllables reverted—would have been a new word.

It seems that the author has some motives in avoiding the word "period". Has it the stigma of being handed down by tradition? Let us look, then, for another term. I find in my dictionary the English word "while" for the Dutch word "poos". I venture this proposition; let time-intervals be called "whiles".

A juggler, manipulating three balls, shows three identical motions. The phases of every two of these motions are mutually shifted, indeed, over one third of the complete time of the motion. In electrical engineering there is the quite common combination of three alternating currents with equal differences of phase, a three-phase current. It is not the phases, but the difference of phases which have the character of a time-interval.

Again, in not-periodical motions one can denote an instantaneous state as a phase. The aperiodic motions of the projectiles of a machine-gun are identical, but they have different phases. A musical canon, too, consists of identical melodies, with definite differences of phase, i.e. delays of their entries.

M a c r o w h i l e s a n d m i c r o w h i l e s. We take a steel ball and a horizontal marble slab. We drop the ball from some height. It falls down perpendicularly and after the impact on the plate it rebounds. The rebounds repeat themselves. Gradually they decrease, and the time lapses diminish. A bound up and down of 20 cm height, say, takes about 0,4 sec. A bound of 2 mm height takes 0,04 sec, and one of $\frac{1}{2}$ mm takes 0,02 sec. The separate impacts of the ball concentrate into a roll. The roll transmutes itself into a sound, a note of rising pitch, until the energy of the motion has been dissipated. We hear macrowhiles between the initial impacts. There are microwhiles between the

impacts in the final state, which we no longer hear separately, perceiving a note instead. This experiment shows the similitude of macrowhiles and microwhiles; of course and of fine-grained temporal division. That is the subject with which the author of this article is engaged.

Frequency. A concept which is essential in this matter is frequency, formerly called vibration number. It means the number of repetitions of a (periodical) motion within a second, the number of cycles per second. Why does not the author mention this concept by its proper name? His explanations would have gained much in lucidity. First of all, pitches are determined by frequency, as everybody knows. He takes them to depend on a "microphase", i.e. on a single time interval. Why? On the other hand, whenever he wants to define the duration of a macrowhile, he uses a metronomical number, even where he wants to exclude repetitions, writing M = 60, instead of 1 second. This is rather ambiguous, for by increasing the macrowhile the metronome number decreases, e.g. 1.2 sec corresponds to M = 50. It is quite clear that a metronome does not determine duration; but a tempo. It presupposes a series of repeating beats. Therefore it does not define a duration, but a frequency, in cycles per minute. The notation should not be M = 60, but: frequency = 60 cycles per minute (f = 60/M). What is the origin of this muddling of concepts: phase, period, frequency?

Acuity of pitch. Special observations dealing with pitch and frequency require examination. Let us assume that a clock strikes, and we hear twelve strokes within twelve seconds. Between the strokes there are 11 interperiods. How long is one period? Putting the question somewhat more roughly: how many seconds will the clock take to strike six strokes? Beware! The answer is uncertain owing to the fact that we do not know whether the while of 12 seconds is just sufficient to contain the 12 strokes, or whether it is all but sufficient to contain 13 strokes with 12 interperiods. In the first case the interperiod is a trifle less than $\frac{12}{11}$ second, in the other case the interperiod is a trifle longer than $\frac{12}{13}$ second. In both cases there is a deviation from one second of one part in 12. For a series of n periods the relative uncertainty would be 1 part in n. The length of a period and thereby the frequency can only be defined with sufficient precision if the number of periods is very large. From the mathematical point of view we have to bear in mind that every motion (even an unharmonic motion) can be resolved into a continuous spectrum of single periodical vibrations, by the well-known theorem of Fourier. The fewer the number of repetitions in the given motion the wider the spectral distribution on both sides of a maximum intensity. The width corresponds to the ratio (n+1)/n which results from the indicated uncertitude 1/n. In a series of 8 equal whiles the frequency is uncertain between 8 and 9, and the continuous spectrum of pitch will accordingly have a width of a whole tone. Let us return to music, and to a well-known fact! Violins and double-basses (or flutes and bassoons) have pitches two octaves apart. If they are playing a quick passage in unison, this passage will be heard quite distinctly in the higher pitch, and more vaguely in the lower pitch. The string G (with 96 cps) has no more than 12 vibrations in $\frac{1}{8}$ of a second, and in that stretch of time the frequency has an imprecision of (12+1)/12. Therefore the pitch is uncertain up to $\frac{3}{4}$ or $\frac{2}{3}$ of a whole tone. The g′ of the violin has 384 cps, that is, 48 vibrations in $\frac{1}{8}$ of a second. In that length of time the frequency is uncertain between 47 and 48, up to $\frac{1}{5}$ of a whole tone. A sound passing away in 1/1000 of a second (e.g. a whip-crack) does not release a sensation of pitch corresponding to a frequency of 1000

cps (say, b″). The width of the pitch spectrum would amount to all but an octave. In the case of one millisecond containing three percussions, the pitch-spectrum would have a width of a fourth round f″″-sharp. We know that bats emit shrieks of about one millisecond with frequencies between 20 and 50 kHz. These pitches are defined somewhat better, but we can no longer hear this "radar system" of the bats.

It is quite misleading to put a certain while in direct relation to a pitch. In the first place a single microwhile is not sufficient to determine a pitch, and in the second place, by increasing the length of the microwhile, pitch is neither increasing nor rising, but sinking and decreasing.

Composite metrum. Some time ago Dr. M. Van Crevel edited Jacob Obrecht's (†1505) Mass "Sub tuum praesidium". In its metric structure he found numeric relations which corresponded to the harmonic intervals of the polyphony. Our author, too, aims at a parallelism of microwhiles and macrowhiles.

Some twenty years ago, when I began to ponder over what, in the realm of seconds, might correspond to a harmonic interval in the realm of milli-seconds—say to a fourth—I thought of the vibrations of two strings on a double-bass. One of them performs three vibrations against four of the other string. By a continuous retardation one gets to a superposition of trioles and quartoles. That leads in a simple way to a composite metrum. In the case of a fourth (numerically 3:4) I denote the metrum in question by $\frac{3\times4 = 4\times3}{12}$. I want to indicate that 12 units of a period may be divided into either three bars of four units or into four bars of three units.

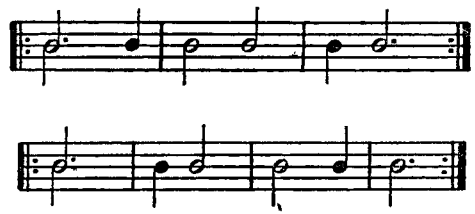


Fig. 1a and 1b

Here it is presumed, that trioles and quartoles start simultaneously. A very able pianist might shift the phase of the trioles in such a way that their first stroke falls between two strokes of a quartole. That gives rise to a metrum which I denote as $\frac{3\times8 = 4\times6}{24}$. The ground period has 24 units, which can be joined either in three groups of eight or in four groups of six.

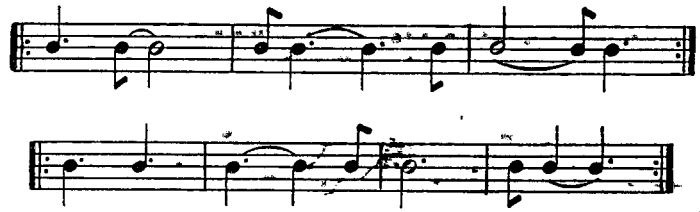


Fig. 2a and 2b

To realize the metrum corresponding to the major sixth (3:5) one may put marks on the rim of the dial of a watch. We want a triangle with marks on 0, 20 and 40 minutes and a pentagon with marks on 0, 12, 24, 36 and 48 minutes. A hand moving uniformly will register a metrum $\frac{3\times5 = 5\times3}{15}$.

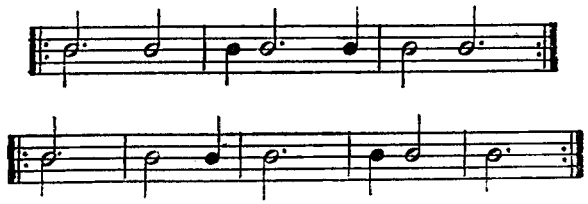


Fig. 3a and 3b

if the pentagon had been chosen on 6, 18, 30, 42 and 54 minutes, the composite metrum would have worked out as $\frac{3\times10 = 5\times6}{30}$.

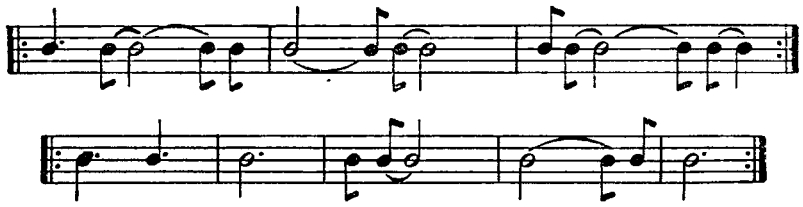


Fig. 4a and 4b

I feel that in this manner one could get very fine and very strong metra, and I wonder why the author does not mention these parallel counterparts to the rational intervals. Is it because the rationals no longer belong to music? Are they anti-programmatical? Are these composite metra inadmissible for the very reason of their rationality?

Complementary relations of macrowhiles and microwhiles. The author tackles another problem. "Is it possible to find a serial structure of durations corresponding to a serial structure of pitches?" He puts down a series of pitches, taken from the system of duodecimal equal temperament (the twelfth-root of 2). By their very definition the interval relations must be irrational. It is very difficult indeed to experience irrational relationships of durations. One always judges by the number of equal durations of sound, and this procedure always resolves into ration of integers. The author, therefore, does not keep to powers of the root of 2, and he takes rational proportions of integer harmonic numbers. The given series reads:

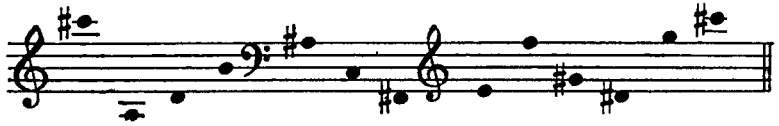


Fig. 5

Among these we find some uncontested classical intervals. Taking these for reference I interpret the series of intervals as follows

$$\frac{1}{5}\times\frac{3}{4}\times\frac{3}{5}\times\frac{15}{7}\times\frac{7}{4}\times\frac{10}{7}\times\frac{7}{25}\times\frac{7}{15}\times\frac{12}{7}\times\frac{4}{3}\times\frac{7}{18}\times\frac{5}{7} = 1.$$

The author, however, puts down another series of intervals, as follows $^{10}/_{2}\times{}^{3}/_{4}\times$ $\times{}^{7}/_{12}\times{}^{13}/_{6}\times{}^{9}/_{5}\times{}^{11}/_{8}\times{}^{2}/_{7}\times{}^{6}/_{13}\times{}^{5}/_{3}\times{}^{12}/_{9}\times{}^{4}/_{10}\times? = 1$ The two series are different. The author does not take for the major sixth, from d′ to b′, the ratio 3:5, but 7:12. One is startled at this high-handed procedure. He evaluates the interval from a-sharp by c to F-sharp as $^{9}/_{5}\times{}^{11}/_{8} = {}^{99}/_{40}$. It should be $^{100}/_{40} = {}^{5}/_{2}$. The interval from c by F-sharp to e′ should be $^{2}/_{5} = {}^{22}/_{55}$. The author's statement makes it $^{11}/_{8}\times$ $^{2}/_{7} = {}^{22}/_{56}$. The interval e′ : g′sharp should be 4:5. The author's conclusion is $^{6}/_{13}\times$ $\times{}^{5}/_{3} = {}^{10}/_{13} = {}^{20}/_{26}$ instead of $^{20}/_{25}$. The given proportion 5:3 may be right for the interval f″: a′flat, but not for f″ : g′sharp. The latter interval is represented by $^{12}/_{7}$. In the beginning of the series the ratio $^{7}/_{12}$ has been attributed by the author to the major sixth d′: b′. The difference amounts to $^{35}/_{36}$.—Again, the estimated $^{11}/_{8}$ for the interval c/F sharp is too small. It should be $^{10}/_{7}$. The difference is $^{77}/_{80}$.

It is an amazing puzzle. Why was the author unaware of these discrepancies? Perhaps one could make allowances for an error of one comma (99:100). Semitones, however, like $^{25}/_{26}$ and $^{77}/_{80}$, a quarter tone ($^{35}/_{36}$) and a fifth of a tone ($^{55}/_{56}$) are by no means slight errors. There is a second question. What reason is there for replacing $^{5}/_{1}$, and $^{4}/_{3}$ by $^{10}/_{2}$ and $^{12}/_{9}$ respectively? There is complete numerical and musical equivalence. A friendly remark reminded me of the fact that, by replacing my question mark in the second row by $^{11}/_{8}$ (returning from g″ to c‴-sharp), one would have a collection of fractions where all numbers from 2 to 13 inclusive would be present, both in the numerators and in the denominators. This completeness would be lost if any of the discrepancies shown were to be amended. That is true. But there is no reason for that. What is the use of such a frivolous play with, or of such regard for numbers? Is there any music in it? If any of us, physicists or other scientists, were to offer this sort of argument, we, should certainly be reminded at once that numbers do not make music. The author however, is quite an honourable and serious musician. I therefore feel justified in asking: what is the musical sense of such a dance with numbers, which so obviously falsifies actual facts?

The serial structure of durations. The author does not carry the idea of placing macrowhiles proportional to microwhiles to its conclusion. He inverts the idea. He takes a number of macrowhiles together in a group. For the sake of definite clarity I propose to call such a group a super-while. I want a special word, because it is not elasy to explain the intricate procedure of the author.

He paces two equal super-whiles in succession. Each is divided into a number of macrowhiles. The two numbers should be proportional to the frequencies to the microwhiles concerned in the interval which has to be represented. However, he never uses the word frequency. He just writes:

> "wir können deshalb die Proportionen umkehren, da jetzt nicht die Dauerverhältnisse der einzelnen Grunddauern gemeint sind, sondern die Anzahlverhältnisse der Grunddauern in den Gruppen".

I understand that he wants to say:

"therefore we can invert the proportions (of the macrowhiles), because now ew are not concerned with the relations of durations of the single macrowhiles, but with the relations of the numbers of the macrowhiles in the super-whiles".

The author proceeds as follows. The prescribed series of intervals is the following: 10:2, 3:4, 7:12, 13:6, etc. He has two equal super-whiles (which he calls groups). The first super-while is divided into ten macrowhiles, the second one into two. These are super-whiles number 1, say, super-whiles I. For the realisation of the next proportion 3:4 one needs a super-while with three macrowhiles. The last of the now extant super-whiles I contains only two macrowhiles, one less than required. Therefore a third macrowhile is added, thus extending a super-while I to a super-while II, now containing three macrowhiles. This is followed by an equal super-while II, divided into four equal macrowhiles. To proceed to the next proportion 7:12 we need a super-while with seven parts. Adding another three macrowhiles to the second super-while II, we obtain a first super-while III, containing seven equal macrowhiles. This is followed by an equal second super-while III, which is divided into twelve equal macrowhiles. This procedure is continued. It is clear that for each interval a separate length of super-whiles is required. The interval $^{10}/_{2}$ is served by the super-whiles I, the second proportion $^{3}/_{4}$ is served by the super-whiles II.... The proportion $^{11}/_{8}$ is served by super-whiles VI, the next proportion $^{2}/_{7}$ is served by super-whiles VII... etc.

Now, the posterior super-while VI contains eight macrowhiles. The anterior super-while VII must contain no more than two macrowhiles. After these the posterior super-while VII enters. Therefore, there is an overlapping of the anterior part of the first super-while VII with the posterior part of the second super-while VI. More such overlappings occur in the given serial structure.

Let us look up what the author has to say. My own words are in brackets:

"...in this way different numbers of equal durations (macrowhiles) are united in groups (super-whiles): these are equal in length from one group to the next (the first ten as long as the next two)".

Evidently this means: the first super-while I with 10 macrowhiles equals the second super-while I with two macrowhiles. Again:

"Every group (super-while), however, with the exception of the first and the last, is ambiguous. It is a second member of a first interval ($^{10}/_{2}$) and a first member of a next interval ($^{3}/_{4}$)"

Obviously here is an error of expression which impedes good understanding. The second member of the first interval is a super-while I, the first member of the next interval is a super-while II. These are two different "groups", by no means one ambiguous "group".

"From this ambiguity the result is either rests or temporal superpositions".

Again, this remark corroborates that the "groups" are not ambiguous, they are different. In the case of the first super-while II the so-called "group" contains, besides two macrowhiles of the second super-while I, one rest in order to complete a super-while II of three macrowhiles. There is no question of one "group". There are t w o groups, two super-whiles of different length.—The "temporal superposition" mentioned relates to the fact that super-while VI (for the representation of the proportion $^{11}/_{8}$) is longer (8 is larger than 2) than the superwhile VII (for the realisation of the proportion $^{2}/_{7}$) and this super-while again is longer (7 is more than 6), than the next super-while VIII (for the realisation of the proportion $^{6}/_{13}$).

The resulting temporal intricacies have been represented in a diagram. This shows that sometimes four super-whiles overlap.

Here again, if some scientist happened to hatch a temporal construction like that, intrigued by what looks so interesting on paper, everybody would ignore it. The author, however, is an honourable leading composer. We must presume that there are other composers who are working with such things and who can find use for them in their music.

As to the programmatical demand of conjugating a serial structure of durations to a serial structure of pitches it must be said, as a matter of principle, that a pitch becomes perceptible only if there are a great many repetitions. The conjugate structure of durations, therefore, should show a great many repetitions too. But that might be in contradiction with the serial program!

F o r m a n t s. The author considers a basic period, and its aliquot parts.

"The basic phase (fundamental period) serving as a unit of sensation, its aliquot parts are always taken with reference to it.... For one basic phase there are two halves, three thirds etc. We shall define such a formation as a harmonic spectrum of phases (whiles)".

Besides the word "phase" used instead of "while", it is not at all clear what "formation" is alluded to.

"Basic phase (fundamental period), in relation to the harmonic spectrum of phases (whiles) is also called fundamental tone. For the particular harmonic divisions we choose the denomination Formants".

But stop! Formant is known as a concept in phonetics. Fourier's well known theorem states that every periodic motion, every musical tone may be decomposed in sinusoïdal vibrations. It may be split up in single harmonic partial notes, or, as one often says, in overtones, natural tones. According to the relative intensities of these partials, we perceive a different colour of sound. Experimental phonetics show that the variety of our vowels a, e, o, u, etc., is hereby determined. The form and size of our oral cavity determine a range of resonances (or several ranges) centering round the possible proper vibrations of the air in that cavity. Those partials will be enhanced by the sound produced by the vocal chords which happen to lie within such a range. Such a r a n g e o f r e s o n a n c e is a formant. The concept of formant includes resonance. Resonance presupposes two bodies: one actively vibrating, one passive in forced vibration. The vibrating string of a violin is such an active body. The body of the violin has proper vibrations with very wide ranges of resonance. These ranges are its formants. They are responsible for the timbre quality of the sounds of the violin. The artistic value of a violin is determined by the quality of its formants. The author, however, chooses the word formant for another purpose with a different meaning, thus losing sight of the concept of formant. What has been called overtone so far is rechristened arbitrarily. Henceforth its name must be formant. Our understanding is hampered considerably by this wrong nomenclature. Why is all this necessary? Is the word overtone too undistinguished, not sufficiently grand and high-brow? Just any overtone is not a formant. The harmonic spectrum of overtones is not a spectrum of formants. A formant belongs to the body of the violin, it does not belong to the string as one of its overtones.

After a century of labour the scientists worked out a concept, and they selected a word for it. I hold it unreasonable to devalue that word now. False notions are the conse-

quence, the equivalent of bad music. The author explains the superposition of two overtones by drawing a vibration curve, which, as he says, deviates from the "usual presentation". By this deviation it is deformed to irreducibility. This, for the expert, is rubbish.

The geometrical (tempered) duodecimal series. The author seems to be greatly annoyed by the dominating integer relations in the structures of durations, such as do not occur in the scale based on the twelfth root of 2. He calls it a contradiction. Of course it is evident that he is not responsible for this discrepancy. The sophisticated scale is to blame. It is well known that Schönberg (Harmonielehre, ed. 1911, p. 24) has called the tempered duodecimal system "a truce, concluded for an indeterminate time". It will "be absorbed in a higher order". He talks of a "compromise between the natural intervals and our incapacity to handle them". To-day our ability to handle the natural intervals is much greater than in Schönberg's time. The time has now come to stop making do with a temporary device, and to break the constraint of the compromise. But instead we see that the propagators of "new musics" proclaim as a foundation the merely provisional means-to-an-end. One acquiesces with inadequacy, while doing away with things handed down. One brands harmonic relations as anti-stylistic, but retains a musical monstrosity, to which in practice nobody adheres, neither vocalists, nor string-players, nor wind-players. How is it possible to be satisfied by the platitudes of this characterless series, if one is in the forefront of the search for new values?

Formally, piano and organ should be tempered according to the powers of the twelfth root of 2. Even that much is rarely realised. Factories try to dimension the valves of wind-instruments according to this root, but the artists with their lips shift the tone a trifle sharp or a trifle flat — often without being conscious of doing so — by a conditioned feed back. Turks and Arabs have an ear far more attuned than ours to the refined melodic steps in their monophony. At best we bother about semitones; they sing their melodies with commatic shades.

Neither does the autochthonic music of southeastern Europe and in Asia comply with the tempered duodecimal scale.

Can the clumsy coarseness of our system offer a foundation for further development? Who is able to believe, seriously, that the inadequacy pointed out by Schönberg must be preserved under all circumstances?

Other twelve-tone series. Why is it that nowadays composers do not know any series of tones other than the tasteless scale of semitones? I venture to put forward two examples.

In their so-called "gamelan slendroh" the Javanese practise music with supra-seconds. These are steps with the harmonic interval $^{8}/_{7}$. Our fifth contains three supraseconds $(^{8}/_{7})^{3} = {}^{512}/_{343} = (^{3}/_{2}) \times (^{1024}/_{1029})$. Why not take eleven of these steps, and use the resulting twelve notes? For sake of notation I use half-flats and flats-and-half (Tartini 1753) and half-sharps:

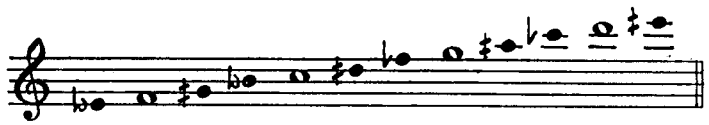


Fig. 6a

One has f′ : c″ : g″ : d‴ with supraseconds below and above. A thematic twelve-note series might be:

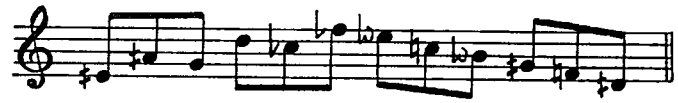


Fig. 6b

We have four fourths, the first and the last with harmonic centre (6:7:8), the second and third with arithmetical centres $(^{1}/_{6} : ^{1}/_{7} : ^{1}/_{8})$. The fifth between c″ and f′ is divided into three all but equal steps. So is the fifth between g′ and d″.

Second. Starting from b one rises five times by a minor third and again one descends five times by a minor third (6:5). Or, one descends five times and rises five times by a major sixth. By shifting over octaves in both ways one gets the same eleven notes. We add for a twelfth note d-flat. On two staves we arrange them in a triangle, with d-flat, d and d-half-sharp at its corners.

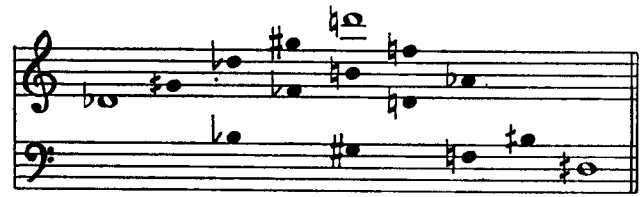


Fig. 7

Lines rising to the right show intervals 7:10. Lines descending to the right show the intervals 5:3. Sloping lines parallel to the base show the intervals 7:6. Put together within an octave there is a scale consisting of four enharmonic tone groups, of four, two, three and three notes respectively.

Fig. 8a

With the exception of d-flat the notes lie symmetricaly on both sides of b. There are two harmonic chords of the seventh, and a subharmonic one.

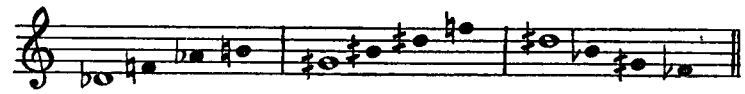


Fig. 8b

The unfamiliar is unloved. On the usual keyboard it is impossible to become familiar with similar scales. But, replacing the duodecimal temperament by division with 31 diësises, after Christiaan Huygens (1629—1695) one can master them without difficulty.[1]

Chords by addition. Having freed oneself of the chains of the tempered semitones, one becomes aware of the important chords by addition. In these chords the frequency of one note is the sum of the frequencies of the next lower pair of notes. Again, the difference of frequencies of two neighbouring notes is the frequency of the next lower note. The physiological constitution of the ear is such that hearing two notes it is apt to hear a third note, with a frequency equal to the difference of the two actual frequencies. Therefore, these chords have a special sensation quality.
The number series of Fibonacci are well known, where each is the sum of the two preceding ones.

0—1—1— 2— 3— 5— 8—13—21—34—55....
1—3—4— 7—11—18—29—47....
2—5—7—12—19—31—50....

Every series has a corresponding addition chord. The tempered duodecimal system approaches only the chord 1—2—3—5—8 and no more. It cannot produce a note corresponding to 13. Neither is it able to present the numbers 7 or 11 with any degree of acceptability. With the notations mentioned before we can put down some of these chords.

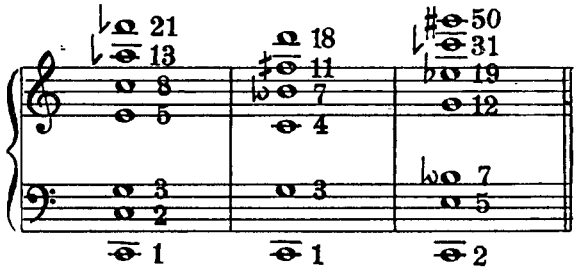


Fig. 9

A survey of the many possibilities would require a special treatise. We show here some examples of relieving triads with one constant note, and representing the same set of simple numbers.

8	7	10	9	12	11	16	18	20	23	25	24
5	4	6	5	7	6	9	11	12	15	16	15
3	3	4	4	5	5	7	7	8	8	9	9

If the lower note is the binding note, then the other notes have parallel movements. If the upper note keeps constant pitch, then the other notes show contrary displacements.

[1] This temperament has been realised in the Huygens-organ in Teylers Museum, Haarlem, Netherlands.

Fig. 10

Conclusion. I am indebted to the editor of "Die Reihe" for allowing me space for my questions and observations. These observations have been critical but I must emphasise that I want to support these endeavours at innovation in a constructive mood. I am not too old to understand that there are great problems which have to be tackled in the face of new possibilities. If someone attempts to present a scientific account of his aims and methods, we have to consider his endeavour with sympathy and with a realisation of its promise. But he ought not to invest scientific terms with other meanings. He should not say phase instead of period, nor write permutations where permutationless repetitions are intended, nor envelope where there is nothing to be enveloped. He should not speak of formants where there are simply overtones. Such transmutations of concepts obscure the issue instead of clarifying it.
Pseudo-science is no better than pseudo-music. The explanations should be given in the simplest manner in the most familiar words. Where I have been denouncing failures, these denouncements belong to the feedbacks (in the sense of cybernetics) which have to be activated whenever a great task is attempted.

Gottfried Michael Koenig

Commentary

on Stockhausen's
...how time passes...

on Fokker's
wherefore, and why?

and on present musical practice
as seen by the author

In the third volume of "die Reihe", Karlheinz Stockhausen wrote an article with the title "... how time passes". It may be presumed that it was read with varying degrees of comprehension. This is more on account of the subject itself than of its presentation. The subject which is here so difficult to grasp is the series, which people like to accept as a complex scheme. However, the fat is in the fire as soon as someone examines the series as to its implications and comes across things capable of shaking the good conscience of those content merely to reel off the series. The complementary nature of pitch and time is the point of departure of the entire serial technique.[1] The fact that an article clarifying what was previously not clear meets with opposition shows how few understood this, although everyone composes serially. The article presents in a concentrated form considerations made by the author in connection with his own composing. It is consequently not theoretical in an analytical way, but more programmatic; yet it is analytical inasmuch as music, having once taken the first big step into the electronic terra nova, has not been able to do entirely without instrumental practices. These had to be investigated in order to gain full consciousness of the electronic results as well as to cordon off the instrumental field functionally. Even today imprudent critics still tend to confuse these two fields—even if they do it one-sidedly—by readily accusing new instrumental music, if its author is suspected of electronic interests or has in fact realised them in an electronic studio, of merely transferring electronic conceptions (of which the critics don't approve either) to instruments to which they are not appropriate. The article is programmatic in the bold concept of a complementary nature of the perception of time and pitch; to put it briefly: of timbre and rhythm. The programme is not just wishful thinking, but is illustrated with palpable musical facts and in detail. Perhaps it is not superfluous to go over it again here—also in connection with the objections of Adriaan D. Fokker, the eminent Dutch physicist.

[1] "At first, numbers were only accessories to dodecaphony. Tabular control was extended merely over one parameter, that of frequency, and the substituted number-series, whose emancipation marks the beginning of 'pointillist' music, stood only for the sequence, not for the proportions. Sensitive composers who began composing at a time when the Schoenbergian era had already become legendary, submitted only with suspicion to the compulsion of the series but asked themselves, at the same time, whether the manipulation of the pitch-series didn't have consequences in durations and intensities. The auxiliary scheme of numbers needed only a slight pointing up to reverse the relationship: namely, that notes be substituted for the numbers. The ordering of numbers corresponds to that of notes, which was settled for by a predodecaphonic consciousness which could not imagine the note (and the intervals formed by notes) except as a harmonic function; in that the differences between succeeding values are observed as a succession of intervals, allowances are made for the tonal relics from which dodecaphony lives, however allergic it may be to preponderances that threaten to relapse into tonality... The numerical character that the twelve-tone series must procure for itself is therefore already included in the tonal system. The steps by which modulation can move away are contained in the circle of fifths; unchecked movement in either direction necessitates more and more enharmonic changes until, finally, each of the twelve steps is thought of as ambiguous from the start. Neither can dodecaphony step out of this circle; once a modulatoric capacity is no longer required of the fundamental-tones, their numerical character comes out into the open. As such it draws in everything it can get hold of; the numerical character frees itself from the twelve-tone series. Dynamics and rhythm, only through which the functionalism of tonal music became possible, renounce their freedom and come under the numerical idea, in return for which they are allowed to take part in the construction. The universality of the sequence of numbers forces the splitting of the sound event into areas which can be articulated independently of one another." (From an unpublished article of the author.)

First of all it must be stated that Stockhausen's remarks are beyond the accepted theoretical disciplines of counterpoint, harmony and form. He is attempting a "new morphology of musical time"[2]. All events in the sphere of pitch, thus melody, harmony, timbre, are in reality time-events, and could therefore be put aside for the time being in this basis of a new theory. To make up for this, time is even more intransigently held on to as elementary layer, vehicle and context of the entirety. The objection could be made that not only the time-curve, the sequence of points in time, is musically relevant, but especially the acoustical event occupying a point in time; that it is only the sequence of these events that constitutes the musical work. This could be countered with the remark that these events are time events too, so that the entire plan of all the intervals in time contains them in any case. Stockhausen distinguishes the spheres as micro- and macrotime. His premise is that "durations" and "pitches" belong to the same dimension (time), just as heat-waves, light-waves and radio-waves, being electromagnetic, differ only in their wavelengths and can only be qualitatively distinguished by our sensory perceptions (if they can be perceived at all). Stockhausen refers to a regularly accelerated sequence of impulses[3]; Fokker to the steel ball which rebounds from a marble slab[4]. Both examples show how the perception of duration gradually becomes that of pitch; they show in addition that the perception of rising pitch corresponds to the quickening movement. The impression of a continuum is not affected by the fact that the opposites meet (highest speed—lowest tone) at the point where perception becomes uncertain. Stockhausen's train of thought begins with the temporal minimum. This is familiar to us in rhythm: the smallest time-value that can or should be played. Up to now, pitch composition had nothing to do with such a temporal minimum. "Pitch" was to a certain extent a property of the shortest sound, too. If we examine the phenomenon "pitch" more closely, we see that it is composed of single vibrations. These are contained in the concept of frequency; for if concert pitch is given as being 440 cps., this means that the tuning fork vibrates to and fro 440 times in a second, according to which the single vibration lasts one four hundred and fortieth of a second. That the "minimum", the individual vibration, was of no interest up to now proceeds from the concept of frequency, which does not measure the duration of the single vibration but merely indicates how many vibrations together last a second. However, the second is not a musical standard. There are therefore good reasons for the absence of the word "frequency" in Stockhausen's article, especially as it would have been an obstacle in the discussion of all irregular processes, of noise.

It goes without saying that there are difficulties in basing the discussion about pitch on the individual vibration, which does not convey a definite sense of pitch. Stockhausen has already referred to the fact that the ear needs time to perceive pitch[5]; Fokker expresses this mathematically[6]. He writes that the uncertainty in recognising pitch is $n/1$; in order to distinguish two semitones, each would have to be at least 15 vibrations long. Perhaps this condition is valid in practice. Theoretically, pitch is exactly indicated by the duration of its "minimum", the single vibration—admittedly only for this duration; in order for the pitch to be perceived, the vibration process must be correspondingly often repeated. Even Fokker does not hesitate to base the theoretical observation on the single vibration: "Some twenty years ago, when I began to ponder over what,

[2] Karlheinz Stockhausen, "How time passes...", die Reihe, volume 3, page 11.
[3] ibidem, page 10.
[4] Adriaan D. Fokker, "wherefore, and why?", page 69 of this volume.
[5] Stockhausen, see above page 10.
[6] Fokker page 70.

in the realm of seconds, might correspond to a harmonic interval in the realm of milliseconds — say to a fourth,— I thought of the vibrations of two strings on a double-bass. One of them performs three vibrations against four of the other string. By a continuous retardation one gets to a superposition of trioles and quartoles"[7]. It would be difficult to see why the exact mathematical definition should not suffice just because the ear is not a very precise measuring instrument. After all, this comparison between micro- and macrotime does not imply that three vibrations should be set against four (the unique superposition of both vibrations = one period) whenever a fourth is supposed to sound. Compare Stockhausen's example[8], in which a time-spectrum is repeated seven times; even more repetitions are possible, indeed recommended, according to this concept[9].

The reduction of all events to their minima, their elementary layer, has, however, yet another aspect. We are familiar from harmony with the examples showing a certain sequence of chords, a cadence as a rule. The chords are usually notated in semibreves, as their duration is of no interest. The cadence in tonal music is not merely a row of certain chords but a context, a unit. This unit could be said to be cyclic, as—at least in the pedagogic examples of the species—there is always a return to the initial key. In order to register the course of this cycle in all details, I could do the same as Fokker does when he observes the moon. I distinguish the various kinds of appearance of the course and call the stages "phases". Each chord is a phase within the cadence. I have said nothing about the duration for which the chord does not alter. If I do note an alteration, I call the result of the alteration a new phase in the entire process. If time, then, plays a part at all in this experiment, it is only as "moment of the observation". Stockhausen, however, has not undertaken an examination of harmonic courses where the duration of a chord is irrelevant. He is experimenting with rhythmic phenomena, thus with the time-dimension itself. Instead of chords (or degrees of intensity or timbres), he observes various durations, regardless of how they are separated from one another. The rhythmic model (it may or may not be cyclic) consists of several durations, just as the harmonic model consists of several chords. The analysis of this model shows various "quantities", durations of various length. Fokker describes the lunar period as a sequence of the main phases, full moon, last quarter, new moon, first quarter[10]. A duration-period could be something like this: $^1/_2\,^1/_4\,^1/_4\,^1/_2$ second. In note-values: ♩ ♪♪ ♪ ♩. The individual durations would be the phases of the process. "Phase" here does not, then, mean "duration of the process" but "momentary image" (smallest perceptible dimension) of a process consisting of durations. In this way, the expression "phase" seems to designate a duration, that is, the duration of a process in question, thus a secondary characteristic. This is easily misunderstood, as one first tends to consider the events between which the duration occurs. However, the time-character of music is so emancipated today that it is just as necessary to examine the relationship of various durations to each other as it used to be with various tones of a melody or of various voices. The duration of a sound—theoretically considered and thus of necessity simplified—has become an independent category. According to this, a sequence of durations can contain just as much musical meaning as a sequence of dynamic values or chords or timbres. It is this emancipated sequence of durations that is the subject of the debate. The borderline case crops up in which the term phase, which in the field of physics from which it has been borrowed just does not indicate the duration of a state, is forced here to designate duration, but, it must be stressed, a "duration", and not the "duration of a duration". The tautology is only feigned, for "duration" designates a musical parameter; its actual quantity should correctly be called "duration-value".

If we consider in this way the individual duration as the "momentary image" of a sequence consisting only of durations, two questions result: is the "phase" part of a cyclic process? And: has this "phase" other properties apart from its duration?

Duration (as an interval between two "alterations in the sound-field"[11]) in general belongs to a superior duration context, and is thus by all means a "phase" of an entire process which is defined by the sum of its phases. This total process may be called cyclic whenever, to a certain extent, it returns to its starting point so that a repetition in the same form would at least be conceivable. In this case, the interval up to the return of a phase could be called a "period". If for instance a triplet is superposed on a quadruplet, the following phase-sequence results: 3 1 2 2 1 3[12]. This is a symmetrical process; it returns to its starting point and could be continued periodically. Or, to put it more precisely, if both pulsations are retained, the same phase-sequence results of necessity. But unsymmetrical phase-sequences can also be cyclic. If a total duration is divided into a certain number of parts of various length corresponding to a fixed duration list, this phase-sequence — per definitionem — is somewhat inescapable; the choice becomes more limited towards the end and we are left with the last duration. Permutations of this sequence would lead to similar results all having the same total length, the same number of individual durations, the same individual values. These versions would retain the most important characteristics, but would not be literal repetitions.

But "Again, in not-periodical motions one can denote an instantaneous state as a phase."[13] According to this, duration sequences which obey no recognisable law, which are not symmetrical, which do not recur periodically, which do not form the permutation of an arithmetic or geometric series, in short all durations fulfilling an articulating function are "phases" as far as they are only regarded as durations in the context of durations.

Just as the sickle moon, half-moon, full moon are irrevocable "characteristics" of the lunar phases (which are distinguished according to them), the "duration" is the irrevocable "characteristic" of what Stockhausen calls "phase". The "phase-duration" is not the phase itself, although inseparable from it. The phase as such has its opposite in the "non-phase", in the phaseless state. In some music, the feeling of caesura'd time is dispensed with—continuous semiquavers in baroque music, for instance, or the long, echoing, metallic noises in Stockhausen's "Kontakte", rather like an oversized gong[14]. In the first example, the force forming the context has its effect in themes, canons, fugues, in stretti, double counterpoint, in the harmonic progression, in echo-like dynamics, in the changing of instruments. The rapid succession of attacks does give the impression of uninterruptedly quick movement; in the end, however, one is not so much conscious of high speed as of a reference system for the various speeds in the sequence of the other parameter values. This effect is especially clear when the harmonic flow suddenly comes to a standstill without the speed of the continuing movement being reduced.

[7] ibidem, page 71.
[8] Stockhausen, page 28.
[9] ibidem, page 24, example 14.—See further below for the real correspondences between macro- and microtime.
[10] Fokker, page 69.
[11] Stockhausen, page 10.
[12] Compare Fokker, examples Ia and Ib.
[13] Fokker, page 69.
[14] 2′ 10″ to 7′ 13.2″.

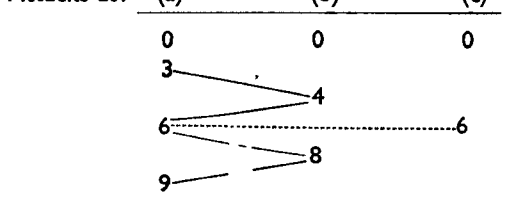
In the second example, however, the expected feeling of especially slow movement does not even occur. What does happen is that time seems to stand still; the rushing sound is perceived as an object outside time. Few parameters change, and then only slowly.—We should only speak of "phases", then, when they possess a constructive function, when the music is really working with phases. This is always the case whenever the arrangement of the pitches and that of the rhythmic events are based on a common idea of time; it is also the case when "phase-arrangements" ("time-spectra" and similar things) turn into time-flows in which phases are not perceived. In all other cases it would be better to keep to the term "duration".

Let us proceed from the phase to the phase-group. Stockhausen makes a distinction between periodic and aperiodic groups, whereby the periodical ones play a less important part. After all, the periodic groups are perceived as a phaseless state whenever the aperiodic ones—their counterpart— are "overheard". Consideration of the simplest aperiodic conditions, however, immediately leads to superior periods, to metre. This is produced in a direct or indirect manner. Of course, indirect metre cannot be expressed by means of phase-relationships alone because a sequence of equal durations does not tell us how many must be put together to form the metre. (A single duration ("phase") and the metre are then identical; the difference between phase and phase-group ceases to exist.) If a metre is to be noticed, other parameters must come to its aid, such as dynamics (regular accentuation) or pitch (sequential melodies or the like).

We must not forget that "phase" does not mean the "duration" of an event, but the interval in time between two alterations in the sound-field. It is true that these alterations can only be expressed as alterations in the other parameters (perhaps limited to one), whereby the sections of time are of the same or varying lengths. By "phase" we merely mean the section itself, without taking the character of the alteration into account. Regularly recurring accentuation or melodic peaks or timbres are consequently not properties of the phases; the phases remain undistinguished, no matter how much the other parameters change. On the other hand, the direct metre can without further ado be expressed in phase-relationships. The above example showed how two different periods were imposed upon each other; the phase-sequence was 3 1 2 2 1 3. The metre lasts 12 units and can be divided into three regular processes:

a)	b)	c)
3	4 (3+1)	6 (3+1+2)
3 (1+2)	4 (2+2)	6 (2+1+3)
3 (2+1)	4 (1+3)	
3		

But the first and last divisions are identical, the attacks of their parts coinciding; the first and second divisions (apart from the beginning) differ in this respect.



Only after three or four phases do both components encounter each other again; the superposed phases form a group-phase. The metre is brought about directly, by means of a combination of phases repeated in its entirety. Even without repetition metre is inherent in the phase-sequence by virtue of internal symmetry. The other parameters do not have to support the metre.

Stockhausen calls the schematic superposition of all whole-numbered divisions of a basic duration ("basic phase") a "phase-spectrum", and a selection of these a "formant-spectrum". Fokker's objection here is that a "formant" is not a characteristic of the sound-producing object, but a resonance phenomenon. To be sure, the Stockhausen formant-spectrum has nothing to do with "sound"—whether original or resonating; it has much more to do with a fact which plays a part in the very phenomenon of resonance and which therefore yielded this term. The term used by acousticians, "two-formant vowel", is inexplicable; nobody speaks of the two-formant oral cavity. If the nomenclature is unclear here, one could find arguments for unambiguous usage which would at least closely approach Stockhausen's terminology. Acousticians speak of formant areas when they mean the frequency ranges in which a body sympathetically vibrates when stimulated. This general definition should not exclude bodies which because of their characteristics are only capable of being stimulated by a single frequency. According to this, the formant range of such a body would have the form of a sinus tone. And on the other hand, if formants can only be perceived in resonating objects, this still presupposes a force which causes the resonance. When we are observing the formant phenomenon (that certain tones or groups of tones are brought about by periodical vibrations of the object), it is immaterial in which way the object is stimulated that is, whether it is affected by another object or by variations of air pressure. There is a difference whether I speak about resonances and cite the formant when defining them, or whether I talk about formants and explain their properties. The final deffect is, however, the same; and as Stockhausen is talking about formants and not about resonances, the former are to be explained and not the latter. When a sympathetically vibrating body is mentioned, its vibrations are called formants; and when vibrations are mentioned, Stockhausen calls them formants, too, because what he calls formant-spectrum is just as characteristic for each sound (or time-structure) as is the acoustical formant for the resounding body. The musical formant owes its existence to the abstraction from the vibrating body, just as the musical phase owes its existence to the abstraction from the actual sound, so that the mere section between alterations remains. After all, what Stockhausen explains as being a formant or formant-spectrum would be in no wise affected if these phenomena were referred to an ideal resonating body.

Even if the objection to Stockhausen's formants appears to be of a formal nature only, it must be maintained that a common term for the whole-numbered division of a superior duration is needed. We do speak of the "overtone" or "partial", but there is as yet no term for the so-called irrational values. The "formant-spectrum" indicates nothing more than a certain combination of whole-numbered divisions of a basic value. In micro-time, this results in a "timbre" ("sound-colour"), in macro-time the result is "time-colour". The slower the flow of such time-colours, the greater the clarity with which they represent themselves as simpler or more complicated rhythms. They are identical with the composed metre which Fokker could not find in Stockhausen, although the whole-page illustrations in his article[15] can hardly be missed.

[15] Stockhausen, pages 27 and 28; see also examples 5 and 20 and the musical example in the text on page 18.

A vertical stratification of the phase up to the complete formant-spectrum results in the following manner[16]:

a) The individual phase is noticeable as a section between alterations in the sound-field.
b) Several phases in succession are completed to form a phase-group. Recurring phase-groups result in the metre; when the phases have the same length, phase and metre are identical.
c) The basic or group-phase is a superior duration which is divided by whole numbers. This leads to
d) formants. An unbroken formant construction results in the complete formant-spectrum (Stockhausen: phase-spectrum); otherwise we may speak of an incomplete formant-spectrum.
e) As far as the metre is not identical with the individual phase, it is composed. Fokker's expression, the composite metrum, is already contained in the formant-spectrum. The uncomposed metre is either a single formant or a series of different phases.

This vertical stratification can be developed breadthwise. In this dimension, a distinction could be made between periodical and aperiodical processes.

a) At one end, there would be room for purely periodical processes, which in present-day music have little significance: pure tones, indirect metre.
b) Next the direct metres would be arranged, combinations of few formants.
c) Then the intermediary steps would come:
on the one hand complete formant-spectra,
on the other hand perhaps tempered duration-series and spectra whose formants would be irregularly subdivided.
d) Statistic processes would come at the other end: completely unforseeable rhythm and noises.

The transition from the periodical event to the aperiodical one seems here to be a floating one. Especially in this scheme regularity and chance (statistics) are at the extremes. This could give the impression that they are always just as clearly distinguishable in the musical process. Experience—or just simple consideration—teaches us the opposite. It is true that conditions can be created according to which the single musical event owes its existence to chance. However, the listener can, if need be, reason that—when chance is operating—irregular process are more likely to occur than regular ones; or vice versa: if regular processes are heard, there is little probability that they were brought about by chance. Moreover, the contradiction is of a methodical nature. The serial system of composing has really made it possible to control the irregular processes. It realises the desire for the most differentiated expression, whereby the complicated acoustical sensation is not an end in itself. In the densest texture of events, everything should still be determined by the structural nucleus. The complexity of statistic events as opposed to this is only an apparent one. It is due to an ideological concept of freedom, as if the composer could not voluntarily choose the possibility of writing a dense and fulfilled text but was forced to do so from without. The surprise effect imputed to chance structures does not even occur: the listener measures—just like anybody else—the chance character of an event against what he is used to, that is the degree of insight

[16] I wish to avoid Stockhausen's term, phase-spectrum, as it appears to me to be inaccurate. His phase-spectrum also consists of formants and not of phases, although formants after all consist of single phases. I prefer to distinguish between the complete and incomplete formant-spectrum.

which he possesses in causality. The determinism of a musical work occurs, however, outside the range of experience of the listener; he cannot even hear if an event obeys the in any case complicated mechanism of serial rules. Also, the size of the possible surprise is already contained in the plan of material and function; the thinking capacity necessary for a plan with extreme possibilities of surprise could be of direct benefit to a controlled structure. On the other hand, composers of pieces giving the performers degrees of freedom like to prescribe the manner in which the players should react to one another. Such rules of play either sink to the level of a game played on a board, where if the counter arrives on a certain square, the player may throw the dice again or must miss his turn; or decisions are demanded which the accomplished specialist in this métier—the composer—only trusts himself to make after long consideration. It is no wonder that "improvisation" and "fantasy" ceased to exist as art forms of spontaneous music-making. The freedom supposedly given to the interpreter is in polemic opposition to the traditional manner of interpretation where the player had to perform set actions. His performance was naturally judged by how well he was in command of the written music, so that he was always capable of spontaneously hitting on the correct manner of playing. Liberated from this obligation, he now really becomes a centre of reaction. Spontaneity presupposes knowledge of the circumstances and power of judgement, not a short reaction-time, rightly called a moment of terror.

The statistical musical curve can only be distinguished from the composed one to a small extent; the extent is also small to which control insures against statistical perception. Every composer who writes serially determined music knows from experience that the order in his products can not always be heard. The danger that everything could be different, a danger threatening all carefully constructed works, cannot just be met by intentional simplicity of structure. The composer should rather be no less familiar with the statistical, that is diffuse perception of music than with musical boredom. This sort of experience may be made, for instance, in Cage's work. To be sure, his chance operations are based less on theoretical considerations than on a desire to exclude man's disposal over his equals. The more sincere conviction remains, however, outside the musical event; it does not become language. The actions of his interpreters arouse the suspicion that when freedom is not stated, but simply put into the picture, one might say into behaviour, it is only realised at an infantile level. It would also be unjustifiable to call the traditional interpretation of music a dictatorial restraint. It does not acquire this appearance until most musicians can no longer keep up with the progress of their own métier, or are supposed to react to situations which they cannot know about, the statistical plan not permitting any previous prospecting. Yet there are works of Cage where the mode of musical perception is not so very much different from that of certain serial works. This shows that complete determinism turns into the statistical character, just as every listener is at liberty to misconstrue a statistically composed work as best he can, to fabricate contexts which do not exist, to perceive relationships not established by the composer, to undertake arrangements which the author abhors. It must be assumed that formulations of this kind are actually to be found in the statistical work and that the "wrong" interpretation is blamed on the composer. In the beginnings of serial music, the composers were intent on strictly eschewing everything smacking of tonal circumstances, in order to avoid misunderstandings, or, to put it technically, for the sake of hygiene of style. In his Kranichstein lecture of 1960 about music and graphics[17], Stockhausen reported American attempts to produce music by means

[17] Darmstädter Beiträge für Neue Musik, Mainz 1960, page 10.

of computers. Here the method made it possible for all forseeable elements to be combined in every conceivable way. All connections already used in the past had to be stored in a special "memory" so that they could be excluded after being compared with the general possibilities[18]. Cage purposely does not devote such care to his works, and the idiosyncrasy is also decreasing in the European field. However, indifference to the specific is practically the same as readiness to take whatever comes.

Mastery of chance seems to be a central problem of present-day composing. This lies in the bent towards determination in occidental musical development. If this is consequently pursued further, one arrives at the border where the ruling becomes as entropic as chance itself[19]. Blind insistence on the most extreme predeterminism is just as narrow-minded as the ideological glorification of chance; to take the best of both would be a prescription, not a cure for the aporia. In fact every serious musical effort today has to cope with this. It can hardly be forseen how it will be able to settle the contradiction between compelling consequence and chance. As this contradiction is not made arbitrarily, but conjured up by means of dialectical transformation, it can only be suspended in a higher category. In the meantime, it might be worth making the effort to penetrate to the border. Compelling necessity, suspension of all logic: both a criticism of all music pretending to be an obligatory context, yet without quite being able to live up to this claim.

This problem is technically expressed in the endeavour to make macro- and microtime equally accessible. As long as both areas were governed by simple intervals, the first of the overtone series, the contradictions were not noticed. With increasing differentiation of compositorial means, however, the incapacity to keep the time-events on the level of harmony grew. After dodecaphony had prohibited the repetition of pitches, aperiodicity became programatically the beginning of serial matters. Now the serial principle is applied to rhythm. It follows that we find denser percussion scoring today, so that aperiodicity (up to statistics) — often probably unconsciously — asserts itself in the field of micro-time. In the electronic field, Stockhausen[20] has finally defined basic rhythms which as such regulate macrotime, but at the same time determine microtime, such rhythms being recorded on tape in the form of sequences of impulses and then accelerated to such an extent that coloured noise is the result. The selection of suitable intervals between the impulses permits the band-width and at the same time frequencies

[18] A matrix of this type is to be found in "Movens", Wiesbaden 1960, page 176.

[19] "The series already prepares to enmesh all conceivable connections within the composed piece. The instrumentalistic character of what is nowadays called a parameter is fitted into the series not only against its own definition, but even against the conscience of the composer. In the present state, an abyss which is not bridged by the reduction of the claim to that which is possible at present, yawns between theory, which is indebted to the reflection on practice, and this itself, in that the former helplessly emulates the latter; in practice history and the future are meeting. Serial compositions of today smack therefore of housekeeping, not dissimilar to the layman's idea that the electronic studio is a dispensary of sounds and noises from which the components of the piece are extracted like the ingredients of a sauce. This in fact melts down pre-serial, instrumental formations into the dough, from which the most incommensurable are tasted out like currants in a cake. Not only is there a lack of parameters; they themselves are only sub-divisible within limits. The series must therefore get by with only a few terms, especially when the rococo rule of dodecaphonics forbids repetitions. Permutation is also hampered, because a good series does not guarantee the usability of its variants. Yet all this does not curtail the universality of the series.—The astronomical number of connection possibilities comes into the picture when one works through one of the simplest constellations: let the parameters of a short sequence of notes be pitch, register, duration, entry delay, dynamic, colour, and form of entry (attack and such); let each parameter have seven values and each series (formed from these seven values) seven permutations. The result is 823543 different combinations. The differences between them are of course so tiny that only a considerably smaller number could be used. Even if only 50 distinctly distinguishable variants were selected, they could not be accommodated in a piece. But if the choice falls on only seven, where the parameters permutate simultaneously and use only one of the seven possible values, that is the 117649th part or approx. 0,00085% of all the possibilities. The more the serial principle is understood as a permutation programme (that includes permutation of the connections) and thus tends to become statistical, the more it opposes the composition of a piece of music; the more carefully the selection is chosen, the more the serial character is suspended: it is pleonastic to declare the data, connected according to the taste of the composer, as numerical relationships, presentations of parameters or series." (G. M. Koenig, ibidem.)

[20] In "Kontakte".

that might possibly dominate to be fixed. Of course we must not forget that the programmatical demand for aperiodicity is limited by the human organs of perception. The desire for irregular rhythm does not necessarily mean relinquishing all definite pitch. (Just as it is not important, having previously dealt with regular processes, now to deal exclusively with irregular ones; the field is enlarged in order to be completely available — in its enlarged form.) As definite pitch is usually understood as being not a sinus tone, but a harmonic spectrum (the timbre of one of our orchestral instruments), the balance is not difficult. The spectrum which has been transposed downwards is not a periodic sequence of maxima but a superposition of periodical processes which can by all means be complex, so that the periodicity of the individual layers is hidden. Thus there is a great amount of free play on either side.

Coloured noise,
spectra,
sinus tones

in microtime correspond in macrotime to

statistical rhythms ("time-noise"),
superimposed periodicity ("time-spectra"),
regular processes.

The balance between the extremes can be brought about in any piece of music, whether electronic or instrumental, so that the programmatic demand for aperiodicity can to a great extent be fulfilled.

Stockhausen refers concretely to the possible complementariness in micro- and macrotime. It is, however, a long way from insight into a matter to musical context, and Stockhausen only mentions the first stations[21]. But even here a new way of thinking takes place: the transformation of theoretical desiderata into concrete music. Fokker only perceives a "dance with numbers" and enquires about the musical need for it[22]. An answer, or at least an indication of one, can be given. We must grasp two circumstances beforehand. On the one hand, mechanical processes in instrumental music as described above are excluded. Instead of accelerating rhythms until they turn into timbres, they must be composed in detail, taking technical playing conditions into account. On the other hand, composed time-colour, just as the relationship between time and sound, must always obey the rules of serial combination.

The starting point of Stockhausen's conception[23] is a twelve-note all-interval row[24].

[21] Stockhausen, pages 22—29.

[22] Fokker, page 73.

[23] The following explanation refers to his "Gruppen" for three orchestras.

[24] Stockhausen, example 8, page 22.—Fokker calls the geometric duodecimal series makeshift, and believes that we are far more capable of using the natural intervals today than in Schoenberg's day (page 76). That is true inasmuch as the continuum of pitches (and thereby any desired tempering, also pure intervals) were not unlimitedly at our disposal until electronic music. The impression arises all too easily, however, that the pure intervals represent an ideal. If this were so, it would not have been necessary to have introduced temperament 250 years ago instead. After all, even if this system of pure intervals was not ideal, a musical language had been established, so that nothing was of more consequence than to adapt the regular division of the octave to this system. In this manner, however, certain premises for better systems were already fulfilled. Which system was better or worse cannot be decided outside the music itself. When nowadays various theorists invent scales which are supposed to overcome the alleged imperfections of the present system, these scales are not any the more useful because they have been constructed outside practice. Incidentally, they too make the same claim as that imputed to the twelve-tone system: that of being ideal. Schoenberg suspected this (Harmonielehre, 4th edition, page 26). Scales which deviate from the twelve-tone temperament are usually corrected by the ear, especially steps closely resembling the octave. Even if Schoenberg called the tempered system a truce concluded for an indefinite time, this time is now up. Most orchestral instruments are gauged to this temperament, and this will not change in the near future, but on the other hand, every conceivable scale can be executed in electronic music. It is becoming apparent that the electronic studio has an advantage over instruments in that any number of scales can be used instead of just one. Consequently there is no sense in introducing another scale instead of the twelve-tone one. The progressing differentiation of compositorial

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Its function as a pitch series does not need to be explained here, as it corresponds to the general usage of dodecaphony. Additional meanings (in order to limit, increase or vary this) will be mentioned presently. As this series, however, must at the same time regulate the flow of time in the piece, it must be converted into corresponding durations: micro-phases (single vibrations of the frequencies) become macro-phases or metres. The duration series is again tempered. Of course, geometrical series cannot be expressed in our notation system. Stockhausen consequently selects metronome values and prescribes sufficiently long stretches of time to make it possible for conductor and musicians to change tempo punctually and precisely. The conversion results in 12 metronome values, which—like the tones of the twelve-tone series—lie within an octave[25]. As the piece should not be limited to an octave either "spatially" (in its pitches) or in time, an octave register is fixed for each tone and a time-register for each time-value[26]. For reasons of performance practice, the metronome values were left in their original time-octave; but there are various "units" to mark the change of octave: instead of multiplying the metronome value by, say, 2, the "unit" for which the metronome value stands is divided by 2[27].

In this manner, the "basic durations" are brought into being. They are an exact projection, gained by transposition, of the original twelve-tone series. They are, however, not small enough for the articulation of the musical detail. As the only possibility of composing tempered time-values is by changing metronome tempi, which is technically limited in performance, another method must be found for the time-flow in miniature. Here,

means does not demand, for instance, more steps per octave but above all variability of the scales. Even with the more developed mechanical instruments, this would hardly be realisable. It must basically be emphasised that there is no problem of scale in the present stage of music. It does not matter how one interprets the relationship of pure intervals to equal temperament: musical development has proceeded to the latter and would not have taken place without it. Criticism about temperament would perhaps still be justified if it were the only alternative—and this merely theoretical—to the pure intervals. Now that it is possible to make music in any scale whatever (or without scales) in electronic music—and to a certain extent in instrumental music (in practice only a few can be considered in any case)—the scale becomes a historical reminiscence. Especially now that music has completely gone over to the quantification of every sort of parameter, no more arguments can be used allocating quality or rank to the scale a priori. If we are going to demand of the pitch arrangement that it operate with intervals of equal size, we must realize that the twelve-tone temperament is perhaps not ideal but most usable. In any case, music has been being composed in this system for the past 250 years, and what was composed before that hardly ever finds its way onto a concert programme. If it does happen to be performed, the tempered division into twelve does in fact approach the pure intervals the most closely (Schoenberg expressly calls the compromise quoted by Fokker a "reduction of the natural circumstances to manageable ones" [see above page 23]). For these archaic purposes there would be no sense in adapting the entire instrument industry and all musicians to another scale. And prevailing practice is just as obligatory for the instrumental music still composed in this system today. The instrument-builders should be asked to build instruments with variable scales; and budding musicians could be taught in pedagogical institutes—there is little hope of this—to think in scales per se instead of just in one. They would then be capable of producing intervals of equal size regardless of how these would be defined. This would also be of direct benefit to the music of the past; for it is wrong to perform a piece of music—whether vocal or instrumental—which owes its construction to the possibilities of temperament—and this includes practically every piece of importance since about 1700—in intervals other than tempered ones (thus "pure"); wrong because such a performance wantonly violates the elementary demands for justice's being done to the work. To a musically educated ear, every "wrong" interval (for example, a pure one where a tempered one was composed) is painful. It is a well-known fact that especially string-players are backwards in this respect. Their special attitude arises from the fact "that their instruments are the only ones still used in regular music-making that have not essentially changed since their construction nearly four hundred years ago. They have been spared the process of chromaticism which other instruments—such as keyboard and wind instruments—have experienced in order to have become serviceable for tonal music" (Rudolf Kolisch, Über die Krise der Streicher [The crisis of the String-player], Darmstädter Beiträge zur Neuen Musik, Mainz 1958.) However, the remaining instruments may not be excepted from the reproaches made by the violinist, Kolisch, against violinists. Wind-players also 'put pressure' on the tone occasionally, and not only in order to smoothe out irregularities of attack. To what extent this practice is 'ideology', false consciousness then, is shown in the fact—to which Kolisch also draws our attention—that it has apparently not been understood that the harmonic course is decided by the fundamental steps. The harmonic abundance of Bach's works, made possible by equal temperament, reduces the renunciation of the difference between 'G sharp and A flat' to a trifle. If 'humanity' is seeking its musical expression, then surely in the capability of differentiation of musical material which has been propelled far beyond previous practice by temperament, not by mechanical fingering practice or the 'beautiful tone' which is insofar an amusical category 'as no work of serious music was ever written for "beautiful tone". Its exclusive care substitutes a subjective-sensualistic, musically indifferent moment for all dynamic-expressive ones of the language of music. Under its aegis, musical reproduction is effected beyond its actual task, that of unveiling construction, merely as cult of beauty.' (Kolisch, ibidem.)

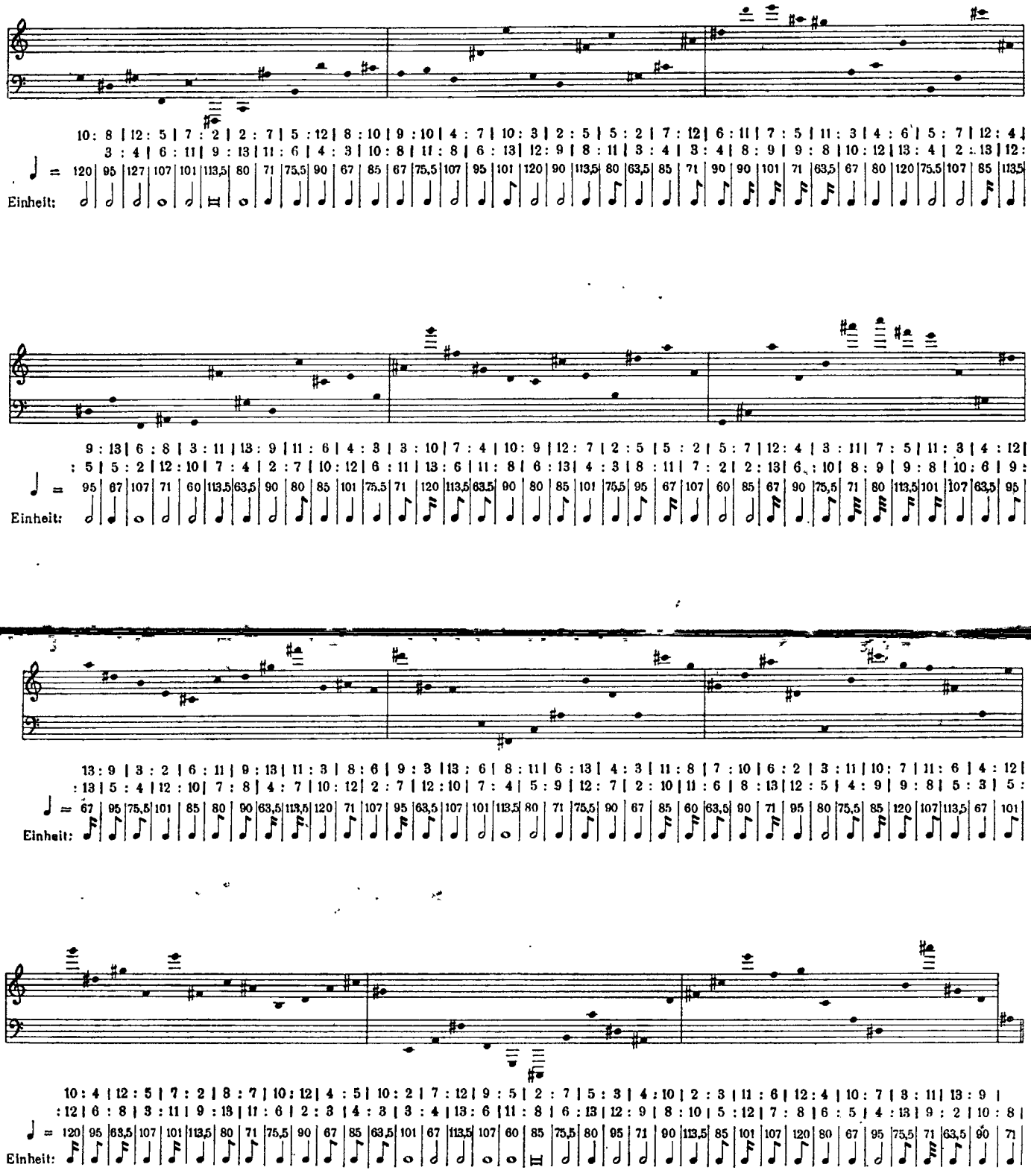
[25] Stockhausen, bottom line of example 8.
[26] ibidem, example 9.
[27] ibidem, bottom line of example 9.

the following consideration helps: the tempered frequency relationships of the twelve-tone series merely affect the basic tones. However, every basic tone—as long as we are not operating with sinus tones—has a timbre which in most cases is brought about by a harmonic spectrum.—But there is nothing to stop its being transposed into time, as we saw above. Here is already one possibility of rhythmically subdividing the rough basic durations. But this material, too, is not fine-grained, not flexible enough. In fact the tempered duration-series (including harmonic time-spectra) is insufficient for construction of the whole piece. However, as the processes do not only follow series in all parameters if possible, but should also be connected with each other in these series, the question arises as to whether the original twelve-tone series could not yield the entire serial scheme.

For this purpose, Stockhausen substituted a series of numbers for the tone-series; this was not an arithmetic series with whose values, these being subharmonically related to one another, the tones would be numbered. He rather uses fractions most closely approaching the tempered intervals, but without affecting basic serial rules (forbidden repetitions etc.). These proportions strengthen at the same time the interval-character by not contrasting (as does the sequence of the basic durations) merely absolute stretches of time which we are not particularly well-trained to distinguish, but amounts which can be counted off: 4 to 3, for instance, or 2 to 7. The substituted proportions[28] were chosen so as to conform to the general requirements of serial work: both numerators and denominators form by themselves series (with the elements 2 to 13), in which no value is repeated. The missing final link in the example quoted should be 11/8; then the series would return to its starting point and both series in numerator and denominator would at the same time be completed by the missing number.

Fokker objects to this interval series because it only illustrates the sequence of tempered basic durations inexactly. He would be right in objecting if the only task of the substituted intervals were to replace the tempered ones. But this replacement would hardly be legitimate as the tempered duration series already exactly corresponds to the relationships of the twelve-tone row. The proportion series also has a function far exceeding that of supporting consciousness of intervals. In the end, serial composition is composition of quantity relationships; musical articulation always presupposes a lattice, from whose network one can spatially, as it were, read off what is meant. 3 instruments play, or 11, 5 tones are soft and 7 loud, 1 short brass chord in 1 long string chord. That the proportion series seems to arise from the sediment of serial matter, and only adapts itself to the curves of the covering time-arrangement without replacing it or tautologically doubling it, is given away by the serial character of the numerator and denominator. It is in reality the combination of two arithmetic series and already regulates quantities, whereas the tempered series produces the relationships between pitches on the one hand and basic durations on the other. These periodised basic durations consequently constitute a layer in which two systems of measuring meet: measuring and counting are carried out at the same time. As long as the quantities still have a direct relationship to the basic durations, they combine to form interval series corresponding with sufficient accuracy to the basic durations; if this relationship does not exist, the mere number is left over from the interval. In this manner, a further characteristic of the twelve-tone series is unfolded: that of the whole-numbered tone-quantities. To sum up:

[28] ibidem, example 12.



Example 1
(Einheit = unit)

The time-flow can be directly read off at the pitch: high tones correspond to short durations, low tones to long durations. The basic durations correspond exactly to the frequency relationships.—The proportions directly under the stave are for the conversion into the whole-numbered division of the basic duration: they form, together with metronome values which can be read off on the next line, the demanded tempered intervals.—The third line shows the "units" to which the metronome values, always applying to a crotchet, refer. In this way extreme or unconductable metronome values are avoided.—The "transition" from one time-octave to the other always happens at "g": the "unit" ♪ is notated from G^4 downwards, ♪ from G^3 downwards, etc., up to the semibreve, from G downwards, and breve, from G_1. In exceptions, the metronome value leaves its "octave", as, for instance, right at the beginning at the third minim where, in order not to have to change the unit, ♩= 127 is written instead of ♩= 63.5.—The proportions in the first line are chosen in such a way that formed series occur in both numerator and denominator. The connecting intervals from one series to the next correspond to the interval sequence of the first passage.

a) the basic tones of the twelve-tone series obey a geometric series ($12\sqrt{2}$);
b) the overtones (timbres) obey the harmonic series (1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ ...);
c) the tones as such only occur in whole-numbered quantities (1 tone, 2 tones, 3 tones...), they thus obey the subharmonic or arithmetic arrangement (1, 2, 3, 4...).

The piece is unfolded in these three categories. The twelve-tone series appears as a sequence of basic durations. They are tempered but immediately replaced by proportions which do not constitute "pure" relationships, but which originate in the field of numbers. This interval series rules the entire work in twelve permutations, whereby the order of the connecting intervals (from one permutation to the next) is identical with the order within the original series. Eleven intervals of these series (without the connecting interval then) obey the general rule that no value should be repeated, and are at the same time all-interval series (as transpositions of an all-interval series). The rule applies to both numerator and denominator. The twelve series round the work, just as twelve tones complete a series. Just as the serial process flows into the beginning, it is as a whole raised into a superior category. The serial form becomes in this way teleologic.

Intervals tempered at all times correspond to the series of basic durations. The flow of time in the piece can therefore be written in the form of a twelvefold twelve-tone series, as just indicated (see example 1).

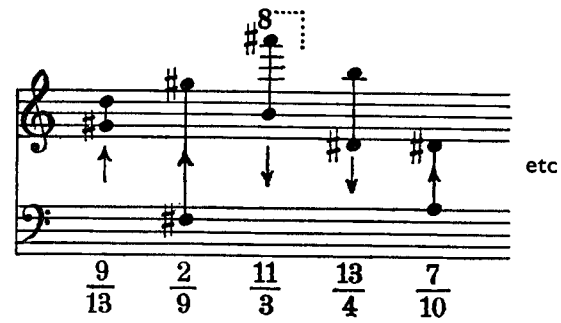
The retrograde of this interval series is used for the ambit of the pitch fields: the first 10 crotchets only occur between G sharp^1 and D^2, with an upwards tendency corresponding to the rising interval. The last tone of example 1 (A sharp) is not taken into account here; it represents another connecting interval which would have been used if the piece had continued. The calculation is complicated but reasonable: first of all the retrograde interval scheme (compare example 1) was transposed an octave higher in order to fix the pitch fields. In this way the last tone (A sharp being disregarded) is D^2 (see example 2). From it, a tritone can be formed, but proceeding downwards, as the interval in its original form (example 1) is a descending one: D^2/G sharp^1. However, the direction of the movement must be assumed as "ascending" because the entire interval sequence is read backwards. Then G sharp^2 (see example 2 again) becomes the starting point of the next ambit: the interval of the series is the major ninth over an octave, once more—corresponding to the original form of the time-flow—descending: thus G sharp^2/F sharp. Here, too, the tendency is "ascending". A sharp^4 thus becomes starting point of the third ambit, B^2 becomes that of the fourth, and so on; the original twelve-tone series is inserted for the articulation of two more parameters (ambit and direction).

Each attack (10 attacks in the first group, 2 in the second, and so on) is supplied with a time-spectrum (corresponding to the "timbre", or "time colour", of a basic tone). Each spectrum is defined with respect to various characteristics:

a) number of formants,
b) register of the formants,
c) form of the formant-spectrum,
d) dominant occurrences (in formants, finally in dynamics and timbres).

These definitions follow series derived from the original twelve-tone series. Its eleven intervals are: 8 5 9 11 2 6 10 1 3 7 4. The twelve-series from these (beginning with 1) is: 1 9 2 11 10 12 6 4 5 8 3 7. If the two highest numbers are omitted in order to obtain a

ten-series, there is not an all-interval series. A few rearrangements must be performed to obtain (in transposition): 10 6 1 8 7 9 3 4 2 5. This series determines the number of formants of the first 10 spectra. Altogether a complete formant-construction is provided, so that all 10 formants are contained in the first spectrum, a selection of 6 in the second, only one in the third, and so on. Which formants should be combined each time results from the planned frequency of occurrence: the 5th formant is represented in



Example 2

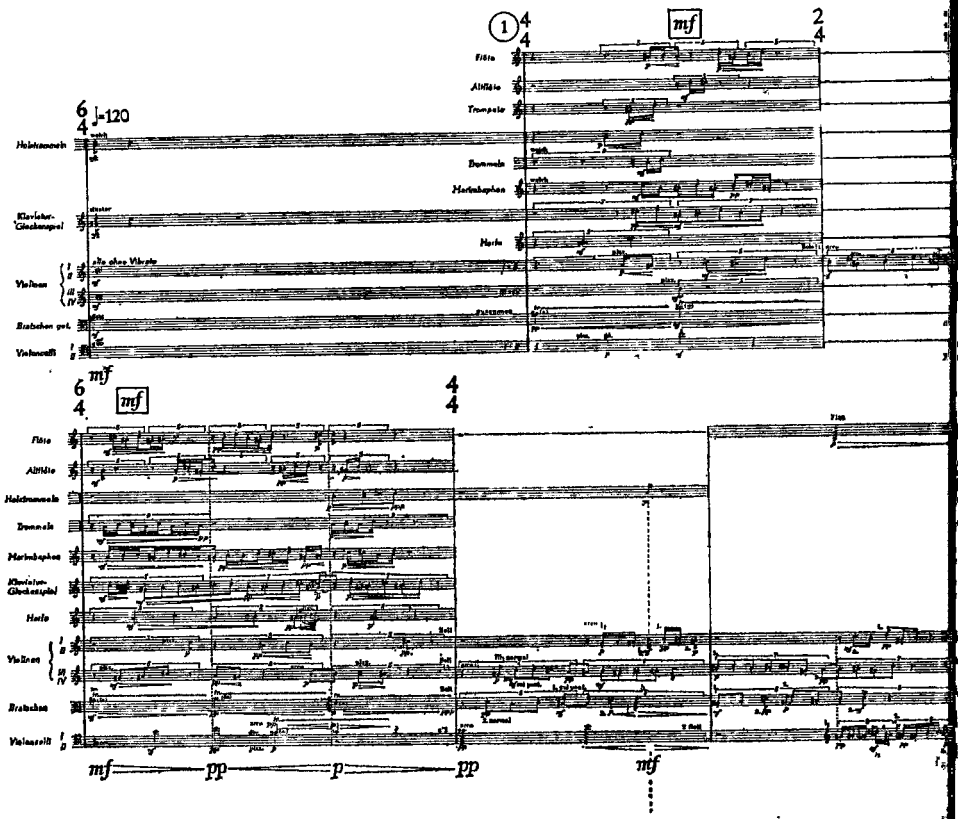
each spectrum (thus it occurs ten times), the 7th is employed nine times, the 1st eight times and so on until the 6th, which appears only once (of necessity in the 1st spectrum, which was formed from all formants: it is just as necessary that the 3rd spectrum, which only has 1 formant, receives the 5th, which must participate ten times). The following scheme results:

10.	×	×		×	×	×			×
9.	×			×		×			
8.	×	×		×	×	×		×	×
7.	×	×		×	×	×	×	×	×
6.	×								
5.	×	×	×	×	×	×	×	×	×
4.	×					×			
3.	×			×	×	×			
2.	×	×		×	×	×			
1.	×	×		×	×	×	×		×

In this case, then, an arithmetic series was used; its components correspond to the order of the original geometric series (with small corrections in order to keep up the all-interval character). Once the twelve-series has been shortened to form a ten-series, the scheme can be used for further reductions down to series with three components. The all-interval character was preserved as far as possible. In this way, the entire "serial" material follows a single initial series.

The spectra being defined with respect to their formant-construction, they each received characteristic form. The use of all the time-points was provided for, also the linking of those coinciding in the formants, the insertion of pauses (that is leaving time-points unoccupied), the combination of long links with single points. Small groups, again

serially formed, appear within the formants by means of links of pauses. Pauses can not only be in the middle, but also at the beginning or end, so that growths and decays, as it were, are formed[29]. Finally, characteristic forms can be cut out of the scheme of all the time-points of the spectrum, or curves can be drawn which in their turn overlap, diverge or converge. This sort of shape is made clear by other parameters (dynamics, instrumentation, tone-form). Examples of this work with time-spectra are to be found in the Stockhausen text already mentioned. For the record, the beginning of "Gruppen" is also illustrated. The characteristics already mentioned can be easily recognized. The 10 ♩ of the first group are again subdivided into 4 sub-groups of 2, 1, 3 and 4 ♩ (see example 3).



Example 3

The beginning of the piece in terms of the explained construction is at number 1. The bari nserted inf ront of this is du to the consideration that the complicated texture of the actual beginning would hardly be perceived without it; in th way, the "growth" is made easier for the ear. The sustained chord fills the ambit D²/G sharp² of the first group.—Inste of the required 10 crotchets, there are 20; the division of the basic duration was later doubled in the entire piece in orde to avoid ♪ as far as possible.

[29] Compare ibidem, example 17a.

It would be going too far to analyse the work in detail or in typical sections. The main thing here was to prove that dealing with interval series and arithmetic series substituted for a geometric series had a real musical meaning. It can be seen that it is not numbers that are being manipulated, but musical events; it can also be seen that no numbers were drawn from a piece of musical matter (such as the original twelve-tone series) if they were not intended to gain further forms and to keep the relationship of all parts as close as possible.

Finally, a little error on Fokker's part must be referred to. Towards the end of his article he finds fault with the term permutation, "where permutationless repetitions are intended"[30]. This reproof can only mean the one place in Stockhausen's article where permutation is mentioned[31]. Fokker possibly did not notice that the element-series used as an example already contains a permutation: 12 11 9 10 3 6 7 1 2 8 4 5/11 10 8 9 2 5 6 12 1 ... The numerical order after the diagonal stroke is a transposition of the first 9 values. In the following one we have to do with the group-series, then with the multiplication series. Both can be combined in such a way that components of the series can be combined according to the group-series and then correspondingly often permutated according to the instructions of the multiplication series. This has nothing to do with permutationless repetition; the above example, which already contains a permutation, makes it more than improbable that mere repetition is meant where permutation is expressly required. By the way, even repetition would be a borderline case of permutation, just as in geometry a straight line is a curve.

When studying theoretical articles, which the composers themselves must provide today, one must clearly distinguish between musical facts and resources of presentation frequently borrowed from mathematics. A widely-spread superstition is that composers of serial music are really mathematicians or at least arithmeticians; in the case of electronic music that they are really technicians or sound-engineers. Unfortunately the people who are taken in by such rumours do not bother to convince themselves of the actual state of affairs by glancing at the scores. It is of course easy to suspect that untruth arises where relevant knowledge is not at hand or deviously concealed. Here the possibility of confusing these resources of representation with musical facts, or even of mistaking acoustical, physiological, information-theoretical or other information for what the musical citizen maintains to be his culture, helps. Anybody in need of a plumber is also happy if the latter can also get a bent lock open. But woe betide the composer who knows how to work with logarithm tables, or who puts his nose in a book in order to find about the physiological processes of hearing. He who has contact with music has his own ideas, however they may be, about it; it is not always his fault if they are wrong. Only intellectual theft is spoken of; but the removal of mistakenness and untruth is at least as strictly punished. The confusion of music with non-musical assistance keeps on penetrating the music itself. Since serial music has been being composed, the opposition has not died out; now that some composers are beginning to transcend serialism too, the lie-a-beds and reactionaries are getting up and wanting to preserve serialism at least. Once one is used to opposing, one gets angry when the resistance disappears. There are reasons for assuming that it is evaporating even in composing. Especially as serialism —as a coming-to-itself of all rationalisation in music—favours the interception of all laterals in systematically placed nets. A sort of auto-motion is imputed to the musical material, the composer passing on the pressure from above. It is questionable if there

[30] Fokker, page 79.
[31] Stockhausen, pages 14—15.

ever was plasticine which yielded to subjective impulse. However, historical hardenings are willingly explained away technically today. They remind the subject of its own scars. This flashes through every time composers perorate on theory and how it is always demanding new things, but only describe their own pieces. In this way, the best they can do is transformed into hypocrisy. This should be noticed all the sooner, as articles like the one to which Fokker devoted critical attention hit the matter itself by their own efforts. This is confirmed by the fact that the article in question contains hardly any references to composing; how it is done is not given away technologically. The question as to musical need is misplaced with regard to the article; this need is not actually presupposed and neither does it appear at the end as something suppositious after it has already been fulfilled. The material, as Stockhausen explains it, is ambiguous. Without it, not a single tone of his music is achieved, and yet his music seems to float above it. Music could be said to be the practical superstructure of theory. But this would cede to the latter a priority which it does not possess. By penetrating the form, what is heard inwardly assumes something of its constraint. It easily degenerates to an agreeable arrangement, to applied art. It can only be otherwise by dint of self-forgetting devotion; the intention sinks into it with its entire weight. Finally it breaks through: the form is split open like the shell of a nut which has ripened into its form.