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3: Larry Polansky:

The Early Works of James Tenney

THE EARLY WORKS OF JAMES TENNEY

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Preface

James Tenney's work, as a composer, theorist, performer and teacher, is of singular importance in American music of the last twenty-five years. He is by nature a quiet, almost publicity-shy musician, but his musical and theoretical works are steadily becoming widely known, despite the fact that few have been published and almost none, to this date, have been recorded on disk. META/HODOS seems to have the widest "underground" readership of any treatise of its kind, although it has never appeared in print in any readily available form. The drum quartets, For Ann (rising), and a few other works are also familiar, in a wide variety of contexts, to contemporary musicians. However, general knowledge of Tenney's total oeuvre, and of the integrities found therein (to borrow a term from Fuller, in whose work Tenney has always been interested) is at best spotty. To some, Tenney is known as one of the first composers to successfully make use of the digital synthesis techniques developed by Max Matthews at Bell Labs, and to make these ideas known to the music world. He is also known for his groundbreaking work in the development of compositional algorithms. To others, he is the pianist who plays the Concord Sonata so wonderfully from memory, and who, as a conductor and pianist has long been a courageous pioneer and advocate of contemporary music, particularly American. He is known solely as a theorist to some, and as a composer to others. Very few have the opportunity to appreciate the "complete" James Tenney, and I intend this current effort as a small token toward this end..

In my attempt to provide an overview of the music and the theoretical works of Tenney, several disclaimers need to be made. First, time and space permit only brief analyses/descriptions, even of major works. It is my hope that these small introductions will stimulate further consideration of this music. I am painfully aware that because most of these works have not been discussed in print, and few musicians are familiar with the majority of them, much of what I have to say might prove in some ways incomplete and even slightly inaccurate, or at best only a part of the story. Yet, since I believe that a sincere first effort is both necessary and better than none at all, I have simply tried to include much of what I know or can determine about some of these works. Second, much of the music is not recorded. Of those recordings that do exist, (due to performance or recording problems), few are adequate representations of the music. In many cases, we have only our eyes and imagination (but not our ears!) to make use of when considering the pieces. Once again, I hope that this brief essay might stimulate more frequent and careful performances of Tenney's work. Tenney's own strong critical and analytical abilities make him the best authority on these works, and though he has been generous and detailed in explaining

many of the musical ideas to me, my own understanding remains at best that of a careful, interested and educated listener. It would indeed be a wonderful thing to read Tenney's analyses of his own music some day; something which we have all had a taste of in his published remarks on Ives, Nancarrow, Ruggles, Varèse, and others.

Third, Tenney is still a young composer, and quite prolific. His output of the last twenty years will probably require another twenty before its historical and musical significance is properly appreciated. I have tried to confine my comments mainly to the descriptive, and to avoid historical and critical conclusions as much as possible. Yet the reader will no doubt sense quite quickly my admiration for the man and his work, and my feelings that the work represents a musical statement of unique importance in the latter half of this century.

"I know nothing I can say about any of these pieces can possibly replace the extraordinary experience of listening to them, but I shall try,..., to communicate some of my own observations, impressions, thoughts and feelings, in a way that may make it easier for others to 'hear into' the music." (From Tenney's introduction to his article on Nancarrow)

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James Tenney himself has been careful and quick to respond to my various questions and requests, except to the one that he refrain from composing any new works until the article was completed.

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Introduction

There are several important ideas which seem to pervade and unite Tenney's work, and the understanding of them can aid in the proper appreciation of the music. This "list" is by no means exhaustive. Not only does it necessarily omit certain "spiritual" and perhaps less defineable qualities, it also cannot describe the synergy of his work (again, from Fuller: "The behavior of whole systems unpredicted by the behavior of their parts taken separately;" Synergetics, page 3) nor the multiplicity of ways in which these ideas relate and interact, like the vertices of a complex polyhedron.

Economy

Economy of idea, musical material, and above all "dramatic embellishment" is extremely important in Tenney's music. "Avoidance of drama" is a concept we will see again and again in the pieces that follow. Tenney is interested in generative studies which are in themselves metaphors, representations, or even invocations of philosophical, physical, or perceptual processes. His music is an attempt to free these processes, to let them "resonate" - and he utilizes all his considerable compositional skill towards this end. David Rosenboom has put it beautifully:

"... Tenney is a formal, conceptual purist, believing that ultimately a greater musical universality may be achieved by sticking to the inspirations of nature and its evolving forms, rather than clouding our perceptions with one man's emotive point of view."

(private communication)

In a sense, many of the pieces (like For Ann (rising), the Chorales, the Harmonia, ...) are monothematic in that they systematically and exhaustively explore the ramifications of a particular sonic idea, using the various musical parameters to directly re-enforce the perception of that idea. Thus, direct, large structures perhaps suggest what is often called (lately) minimalism. Certainly Tenney was part of the musical "scene" from which that school was born, but in his music I believe that it would be a misnomer. In every other way, these pieces present the listener with a maximally complex set of musical events, in many cases achieved by an equally maximal compositional effort (as in the string trio). Tenney is constant in his fealty to the single idea, and all decisions in a given piece seem to be made so that that same idea might be most clearly perceived, as well as most resonantly heard. For example, once the harmonic idea

of the Chorales has been envisioned, the act of writing the beautiful melody is a secondary but extremely important compositional task, and one in which we can even find integral relationships to the harmonic "meta-theme".

Formal Ideas

As a result of his quest for economy, simplicity and clarity, Tenney has sometimes embraced ergodic and canonical forms, and in other cases has drawn the form directly from some pre-existing material. I think that this is his way, in a Cagean sense, of freeing the composer from the act of imposing a formal structure on sonic material, when in fact the composer has no interest in or reason for doing so. In an ergodic structure, any given temporal "slice" is equally likely to have the same parametric or morphological statistical characteristics as any other slice. The listener realizes very early on that certain things will not change, and that no surprises are in store for him along at least one given axis. He is then free to concentrate on his/her perception of the resultants of a single set of ideas. Examples of ergodic forms are the "koans", some of Quintext, For Ann (rising), the Chorales, and several of the computer pieces. Canonical forms, such as the drum quartets, the Harmonia, Quiet Fan, and Spectral CANON also free the listener from certain dramatic and formal surprises, and allow the composer another way in which to realize patterns, processes, and complexities from simpler, limited material. Tenney's mastery of canon is wonderfully evident in everything from Seeds, which uses imitation in more subtle but traditional ways, to the Harmonia, in which contrapuntal and harmonic ideas are integrated in virtuosic ways reminiscent of the "masters". Examples of works in which pre-existing structural or formal information is simply translated into the piece are the Three Indigenous Songs, Saxony (the harmonic series!), Hey When I Sing..., and to some extent Collage #1-("Blue Suede"). In these pieces, Tenney is happily "yielding" to the form of the music or text that he at once pays homage to and transforms. This type of non-imposition of dramatic intent is certainly consistent with both the canonic and ergodic structures, and also with the revolutionary ideas of John Cage which have been of such tremendous importance to Tenney. Several early works, particularly 13 Ways..., Seeds, Monody, and the rags, employ more dramatic forms, as do parts of the later works. Tenney's facility with this aspect of composition is quite evident. This perhaps finds its way into all his music, touches of a different poetic style occurring here and there.

An important aspect of this formal economy is the frequent use of what might be called, borrowing from literary usage, "multiple perspective," in which the same facts are presented in several different narrative personae (as in, for example, Faulkner's As I Lay Dying). This affords

Tenney the opportunity to elicit variant "dramatic" perspectives of a single generative idea. In the Chorales, a single melodic/harmonic idea is stated four times, with only the orchestration changing. The Harmonia are, in a sense, several different personalities of the modulatory-intonational scheme, and the Three Indigenous Songs can be seen as an attempt to alter the meanings of the given musics/texts by placing them in a different "narrative" context. Tenney's intent, I believe, is to allow the listener to extract his own aural "truths" from the sonic "arguments" and in this way it emerges as still another device by which the composer can free himself from imposing his dramatic will upon the audience.

Historical Sense

A third important facet of Tenney's work is its strong sense of history. He often uses and investigates the act of homage as a kind of aesthetic motif. Not only the titles of many of the pieces, but the particular forms and questions asked in them point to his tremendous sense of musical continuity, both with his contemporaries and with the past. These references are not simply dedications - Tenney makes the things he loves into essential, integral parts of his own works. Often his pieces take the form of a kind of public and artistic communication with another artist. This respect is also shown in his pervasive sense of American cultural and musical heritage. Tenney has made it his business to promote American music in all of his several capacities. This is not, of course, blind chauvinism, nor is it a reaction to a perceived oppression by European culture - rather, it is an affirmation of his own background and knowledge, a sense that one can perhaps make the deepest contribution if one is transforming what he knows best. Implicit in this is the frequent use of quotation, which is again embedded in the very fabric of the musical idea (like the drum quartets, or Quiet Fan). When quotations do appear, they are usually the seed of the particular process at hand, although in several instances they are juxtaposed with another, related idea (examples of both occur in Quiet Fan).

Koan

The koan, a traditional zen question in which the answer is less important than the processes stimulated by contemplation of an apparent paradox, is also important in most of the pieces since 1964. Tenney likes to set a process in motion and let its aural manifestations be a kind of meditative fabric, as in the music of Pauline Oliveros, LaMonte Young and others. His processes/questions are often rather complex in their formulation - usually outgrowths of the tireless investigation of deeper, perhaps "simpler"

musical and perceptual problems. I have tried to illustrate in many of the pieces not only how the immediacies of the music are beautiful and powerful, but that the theoretical formulations that lie beneath are of tremendous interest and intricacy. In this sense, they are not unlike the wonderful complement of intellectuality and sensuality one finds in the music of Schoenberg, Webern, Ives, Ruggles, and a few others.

"Clang" and "Swell"

Two unique and important formal ideas are common in Tenney's music, perceptible both as simple sonic events and as formal/philosophical "generators". The first is the clang, a term and idea which has several shades of meaning in Tenney's music. Its "formal" ramifications are explored in theoretical detail in META / HODOS, but Tenney uses it frequently in a much simpler way, in what might be called "aggregates" of indivisible sound combinations. In this idea, we can see the powerful influence of the sonorities and techniques of both Cage and Varèse. A frequent "Tenneyism" along these lines is a percussive attack followed immediately by a sustained pitch and/or sound which seems to arise out of that attack. This sonority, or some minor variation of it, is found in nearly every work. It is at once a kind of philosophical integrity and simply a sound that Tenney likes. It is a consistent compositional choice which contributes to the individuality of his music.

The second related formal idea is the swell (pun intended, I'm sure), found in so many pieces. The "swell" is one of the simplest geometric forms: an arch with no plateau, the two sides of an isosceles triangle, the movement from nothingness to existence and then back again. Often it is the entire work, as in several of the postcard pieces (which can be considered either a single clang, swell, or both). Tenney's awareness of his own interest in these sonic ideas is reflected in the fact that several works draw their titles from them. On a more mundane level, they are identifiable musical signatures.

Orchestration

Something that has often been overlooked in Tenney's style is the importance of his instrumental technique. Tenney's mastery of instrumental nuance is essential to the clarity and uncompromised quality of his work. Pieces like Seeds are more obvious examples of this, but the subtle use of orchestration is even more important in Clang, Three Indigenous Songs, the Harmonia, Quiet Fan, and several other works in which the orchestrational virtuosity is not quite so much in the foreground. Yet the instrumental choices are of paramount importance to the final clarity of these pieces, and to their particular emotive effects.

Musical "Personality"

One final aspect of Tenney's work that should not be overlooked but is not so easily demonstrated is the fundamental good-natured quality of it. He is genuinely glad to be composing and making music, and this joy is as present in the music as the complex musical and intellectual ideas. His music is a kind of exultation of musical truths and the joy of experiment, and he is not above even poking fun at himself (punning shamelessly and often). This childlike quality of Jim's music most absorbs my own interest, and is perhaps what makes it so attractive to many others as well.

I. Seeds (1956-1961; for flute, clarinet (in A), bassoon, horn, violin and 'cello)

Before discussing the larger work, Seeds , I would briefly mention another work which originates in this period (later revised, in 1971), and which has much in common with it. Thirteen Ways of Looking at a Blackbird , based on a poem by Wallace Stevens, and originally scored for two flutes, violin, viola, 'cello, and tenor voice (later rescored for flute/alto flute, oboe, viola, 'cello , bass and bass voice) is a fine example of Tenney's early writing. Though not quite as developed in contrapuntal and orchestrational technique as Seeds , it remains a fresh and beautiful piece, and should certainly be performed more often than it is (almost never that I know of, with the exception of one performance at Cal. Arts, the source of the recording I've heard). If time and space permitted analysis of it here, I think we would discover many of the same intervallic, formal and contrapuntal explorations that Tenney was later to use in Seeds, Monody, and other works.

Seeds , one of Tenney's earliest works (though it was revised over a five year period), remains one of his most satisfying. In one sense, it is a six movement study in the use of simple melodic motives (notably the minor second and unison) to generate dense, yet lyrical musical structures. There are several techniques used consistently throughout the work, and indeed, these techniques become the "seeds" of many of his later musical ideas. For example, the use of klangfarbenmelodie, especially in the case of one instrument attacking and a second sustaining a given pitch (the "clang" spoken of above) is found in several later pieces, including the Swell Pieces , the Harmonia, Clang, Hey When I Sing..., Crystal Canon , and in a way the Chorales and Three Indigenous Songs. This idea is also something of a distinguishing feature in the music of Varèse, as can be seen in this example from Deserts (Example I.1; note the use of minor seconds as well).

Each of the six movements, especially the first three, is a rather singular, focused development of a simple idea, although in IV - VI this idea is not so easy to put into words, and is perhaps better understood aurally. This monothematic trend in Tenney's music grows more and more pervasive later on, finally becoming one of the central points of Tenney's aesthetic. A strong interest in timbre, and, in a related way, vertical harmonic relationships is present in Seeds , and this also presages much of Tenney's future exploration.

Seeds clearly shows Tenney's earliest musical influences: Webern (whose complete works were first appearing on record in the late 1950's), and Varèse (whom Tenney came to know personally, and who must certainly be considered Tenney's most dominant influence. In fact, Tenney is, at the present time, assisting in new editions of Varèse's

Example I.1

The image shows a handwritten musical score for three instruments: Flute (Fl.), Clarinet (Cl.), and Piano. The score is divided into two measures by a vertical bar line. The Flute part is written in treble clef and includes markings for *ff* and *tr.* (trill). The Clarinet part is written in bass clef and includes markings for *ff* and *tr.* (trill). The Piano part is written in bass clef and includes markings for *ff* and *tr.* (trill). The score is annotated with *(Fl.)* and *(Cl.)* above the respective staves. A bracket under the piano part spans the two measures and is labeled *(figs 14-15)*.

music). There are four rather specific musical ideas central to this work:

- 1) the frequent use of the minor second (minor ninth, major seventh) which indirectly, as in the case of Varèse and Ruggles, generates quasi-serial structures with little pitch class repetition.
- 2) short, transparent motives, continually transformed (as in Webern)
- 3) the special case of *klangfarbenmelodie* where a unison is passed from one timbre to the next ("note-passing").
- 4) very little extended melodic development of any kind, combined with a delicately interwoven contrapuntal texture. (Both of #3 and #4 are characteristic of Varèse as well).

Formally, Tenney seems to have set up a rather deliberate restriction for himself: the brevity of each movement does not allow him to work with extended forms. In fact, I

can think of no work, with the possible exception of the earliest pieces (like Thirteen Ways..., Essay for Chamber Orchestra, Sonata for 10 Wind Instruments) in which Tenney has been interested in the type of "dramatic" development conventionally associated with a large scale musical form. Although this avoidance of a certain mode of composition has become more common in the last twenty years, in the late 1950's and early 1960's it was not so - John Cage and others had begun to experiment with the removal of the composer from composition, but Tenney was one of the first to devote his explorations to what might be called "self-generating" pieces. Tenney's debt to and friendship with Cage are profound and long-lasting, and I believe he was one of the earliest composers to fully embrace and understand the latter's ideas, and then to develop and expand upon them.

The brevity is, I think, clearly out of interest and intent. In these short movements, Tenney is not thinking "formally," but in terms of musical essence: stripping the music down to motives, timbres (aggregates?), and what he later called clangs. Where traditional formal notions appear (sectionality, recapitulatory ideas, drama), they are straightforward and elegant. There is as well a certain toying with serial procedures, though I think that Tenney devises his own concepts of seriality in much the same way Wolpe and Ruggles did - using a defined set of compositional and motivic primitives to organize the pitch material. This is not serialism per se, but rather the result of a systematic avoidance of pitch class repetition to negate tonal tendencies.

(The following analyses/description should, in an ideal world, accompany the score and/or a recording of Seeds. In the absence of these, this chapter might appear relatively dense, but still (I hope) comprehensible to the reader. I have attempted a more traditionally detailed analysis in this chapter because of the similar intent of the work itself.)

Movement I utilizes all of the above mentioned techniques. The opening flute motive (Example I.2), a series of "minor-second" intervals, generates nearly the entire movement. It reappears exactly four times, the last bringing in a sort of recapitulation at measure 12 (accompanied by a

Example I.2



return to the initial tempo). Although it is split up, inverted, condensed, etc. throughout, its most perceptible variations occur in ms. 7-8 (Example I.3). Note the Varèse-like quality of this opening solo flute entrance (as in Example I.4, taken from *Octandre*). Note-passing is common as well, beginning in the first measure where the final E in the flute is preceded by a sixteenth-note anticipation in the 'cello, which holds the pitch through measure two. These passings occur in almost every measure, and the structure of the overall timbre is in some ways simply a network of the minor second and note-passing sounds. A third motif in this movement is a vertical texture derived from interlocking minor seconds, first heard in measure 5 with the entrance of all the instruments for the first time (Example I.5). The sonority recurs, like a chime tolling the musical progress, every few measures. Another interesting aspect of note-passing, or timbral melody, is the passing of the minor second motive through different instruments in complex ways. Often, the source of the first note in a half-step pair is in another instrument, as in the E in the violin to the D# in the flute in measure six. (This measure shows several uses of all these ideas). Measure six also marks the end of

Example I.3

Example I.4

Example I.5

the first "section", and the low 'cello and bassoon theme in the next measure begins the next, characterized by sustained minor seconds (Example I.6a; I.6b) and more extended melodic passages, (such as the already cited figure in measure 8). Measures 10-11, a slow duet for clarinet and bassoon in minor seconds and rhythmic unison, return the piece to the initial theme, in measure 12, a kind of third section similar to the first in texture and motivic figuration.

Note that in measures 10-11 (see example I.6b), the clarinet is several times voiced under the bassoon, in much the same way as Varese does so often; for example, the frequent voicing of the piccolo under the Eb clarinet in the second movement of Octandre, and in the final measure voicing of the clarinet under the bassoon in that same movement. Example I.7 shows this same type of voicing in a common chord from Intégrales. Much later on, in "A History of

Example I.6a

Musical notation for Example I.6a. The top staff is labeled 'Bassoon' and the bottom staff is labeled 'Cello'. The Bassoon part starts with a dynamic marking of *f* and includes markings for *mp* and *f*. The Cello part starts with a dynamic marking of *f* and includes markings for *mp* and *f*. Both parts feature sustained minor seconds and melodic passages.

Example I.6b

Musical notation for Example I.6b. The top staff is labeled 'Viol.' and the bottom staff is labeled 'Cello'. The middle two staves are labeled 'Clarinet' and 'Bassoon'. The Violin part starts with a dynamic marking of *mp*. The Cello part starts with a dynamic marking of *mp*. The Clarinet and Bassoon parts start with a dynamic marking of *mp*. The Clarinet part is several times voiced under the Bassoon.

Example I.7

Musical notation for Example I.7. The notation shows a common chord with the following voicing: Picc. (piccolo), cl. (Eb) (clarinet in Eb), and Picc. (piccolo). The dynamic marking is *mp*.

'Consonance' and 'Dissonance', Tenney himself analyzes this same voicing in Varese in a discussion of Helmholtz's idea that the instrumental voicings of certain dyads affect the degree of dissonance because of the particular spectral configurations of each instrument. Helmholtz declares that, for acoustical reasons, a major third will "sound better" between a clarinet and oboe when the clarinet takes D and the oboe F# (because of the coincidence of the 5th partial of the clarinet with the fourth of the oboe). If it were voiced the other way, the clarinet's lack of even partials would alter this sonority. Tenney relates this nicely to Varese:

"Now the question as to which of these two arrangements sounds "better" than the other obviously depends on what I have called "esthetic attitudes" toward consonance and dissonance, and it is possible to cite musical examples - especially from the 20th-century literature - in which the same acoustical considerations (and perhaps, therefore, the same form of the CDC) may well have determined the composer's decisions regarding instrumentation, even though the esthetic attitudes have been reversed. Thus, for example, the wonderfully searing dissonance (in the sense of CDC-5) created by the piccolo and Eb clarinet at rehearsal number 1 (measure 16 in the revised edition) near the beginning of the second movement of Varese's Octandre would have been far less effective (assuming, as we may, that a strong dissonance is what Varese wanted here) if the parts had been arranged in the more "normal" way, with the piccolo above the clarinet, since the latter instrument has very little if any energy in its second partial (i.e. at the octave) for the production of beats with the high F, whereas most of the energy in the piccolo's tone is probably concentrated precisely in that second partial."
(p. 113)

Movement II, is, for lack of a better phrase, a kind of textural rondo. It begins with a single note being "passed" through all the instruments (horn, clarinet, bassoon, 'cello, flute, and violin), a kind of natural extension of one of the generating motifs of the piece (like the famous "single-note" movement of Carter's Eight Etudes and a Fantasy for woodwind quintet (1952)). This D above middle C is the sole pitch of the first six measures. At measure 7, there is a unison flute and violin theme, consisting of the three notes E, Bb, and Eb, and this two measure duet can be seen as either a release from the first six measures or as a separate variation in itself. The following three measures (9-11) are again middle D, with the order and rhythmic material being almost the same as the first three measures

(though the late entrances of the flute and violin are shifted in earlier, each more or less takes on the rhythm the other had before). The next section, at measure thirteen, is similar to the flute/violin variation. The 'cello's theme B-F-C descending, is the inversion of the earlier theme, and the bassoon's C#-C ascending is followed closely in canon by the 'cello. Note that when these "variations" of the unison theme occur, they are in half step relationship, or at least heavily based on half steps to the D natural. Measure 14 marks the beginning of the final section, which commences with the D being passed once again, but now all the other themes enter above it: the flute and violin theme in measure 16, the C#-C 'cello and bassoon idea of ms. 14-15. In measures 17-18, there is a sort of climax of sustained D's, earlier motives, and the use of minor ninths. At measure 19 (through 22) there is a sudden thinning of texture, and once again each instrument in its turn sounds the D natural, ending softly in the 'cello.

This movement seems to have the most transparent form of the six, yet the subtleties of rhythmic, dynamic and orchestrational manipulation are quite brilliant. An astonishing variety of musical ideas is packed into a two minute (22 measure) span, and in terms of overall elegance of design and sheer beauty of form and technique, this movement must certainly be considered one of the most interesting examples of the miniature form.

Movement III comes close to using a row, though it does not seem to employ any other standard serial techniques. The opening four-and-one-half measures (ending in ms. 5 with the C#/D sonority in the bassoon and 'cello) state the pitch sequence E-D#-G-Ab-F#-F natural-B-C, with some minor overlappings (like the bassoon repeat of E). The timbral shifts are quite beautiful and inventive, as in the first two measures between the horn and bassoon (Example I.8). Also, for the first time there seems to be a use of the "natural"

Example I.8

pairings of the instruments: violin/'cello, horn/bassoon and flute/clarinet. In contrast to the quite airy and spacious textures of the first four measures, the second presentation of the "row" happens quite rapidly, in the next two measures (5-6), beginning on the clarinet D#, in almost the same sequence. The last two measures consist of one sustained chord (Example I.9), with an underlying soft pulsating bassoon, whose intervallic structure is predominantly half-step relations. The tri-sectional form of this movement is rendered transparent by the contrasting textures of each part, yet there is an underlying coherence to it all, effected by the pitch system and by very ingenious transitional timbres at the "seams" (e.g. the violin glissando at the end of measure four and the sustained notes in the flute, 'cello, and violin arising from measure six). As in the other movements, there is an economy of rhythmic material that is easy to see in the score, and obvious to the ear, but hard to define. Certain simple motives are used consistently, as in Example I.10a,b and c, and in the midst of all the other complex contrapuntal activity this helps to retain (in all of the movements) a sense of stability and directness not unlike that achieved by the use of a fixed set of skeletal rhythmic prototypes in Webern's Concerto (opus 24).

Although the "essentials" - the germinating ideas and motives - are substantially the same, the forms of the first three movements are relatively precise and well defined, while in the last three these same primitives are used to generate larger and freer structures. Movements four

Example I.9

The image shows a musical score for Example I.9, featuring four staves: Violin (Vln.), Cello (cello), Clarinet (Cl.), and Bassoon (Bsn.). The Violin and Cello parts are written in treble clef with a key signature of one sharp (F#) and a common time signature (C). The Clarinet part is in bass clef with a key signature of one sharp (F#) and a common time signature (C). The Bassoon part is in bass clef with a key signature of one sharp (F#) and a common time signature (C). The score includes various musical notations such as slurs, accents, and dynamic markings (mp, pp, ppp). The Bassoon part has a triplet of notes in the first measure and a triplet of notes in the second measure. The Violin and Cello parts have a glissando in the first measure and a sustained chord in the second measure. The Clarinet part has a sustained chord in the second measure. The Bassoon part has a sustained chord in the second measure.

Example I.10a

Example I.10b

Example I.10c

through six are more "improvisatory" and less easily analyzed. The first two measures of Movement IV give some idea of the complex intricacies that Tenney creates out of these few ideas (Example I.11a). In the example, I have indicated "note-passing" by a line with arrows and "n.p", and half-step relations by a bracket and "1/2". It can be seen that there is not at least singly related to another pitch by these criteria (with the possible exception of the "missing" precedent for the high Eb in the violin, measure 2). I hope I can be excused for this rather extreme example of note-chasing, but my intent is to give the reader at least a small example of the type of compositional care taken in the crafting of these pieces. Although these first two measures

Example I.11

score w/ (ms. 1)

$\text{♩} = 120$

flute

clarinet (in A)

bassoon

horn (in F)

violin

'cello

(n.p. - note passing
1/2 - half-step)

show this network of relations quite clearly, such a web is to be found in almost any given place in any of the movements. Tenney is also working serially here, in a rather strict fashion. If the flute, clarinet and violin are taken as one voice, the bassoon, horn and 'cello another, then in the first six measures we can see a strict canon on the 12-tone row: E-F-G-Ab-C-Db-Eb-D- F#-B-Bb-A, using the row transforms I0 and RI7 in the top voice, I10 and R3 in the bottom. This is shown in Example I.11b, in a skeletal form. (I am indebted to Tenney for pointing this canon out to me).

Example I.11b

The image shows a musical score for two staves, likely piano and bass. The top staff is in treble clef and the bottom staff is in bass clef. The time signature is 4/8. The key signature has one flat (B-flat). The score consists of 10 measures. The first measure is marked with a '3' and a '3' below it. The second measure is marked with a '3' and a '3' below it. The third measure is marked with a '3' and a '3' below it. The fourth measure is marked with a '3' and a '3' below it. The fifth measure is marked with a '3' and a '3' below it. The sixth measure is marked with a '3' and a '3' below it. The seventh measure is marked with a '3' and a '3' below it. The eighth measure is marked with a '3' and a '3' below it. The ninth measure is marked with a '3' and a '3' below it. The tenth measure is marked with a '3' and a '3' below it. There are also some annotations like 'I10' and 'R3' in the score.

There are two other structural factors operating in the first section. First, there is a kind of density envelope over the whole section, rising to an instrumental texture in measure four that is perhaps denser than any previous section in the first three movements. Second, in measures 5-6, there is the quite interesting and natural motion of several instruments gradually settling into a rhythmic regularity, although all of the patterns actually remain independent. The combination of parametric movements in density and in what we might call rhythmic entropy, combine to produce an overall sonority and form that is decidedly subtle, and although we can clearly perceive a structural directedness, I for one had to closely inspect the score to see just how it was achieved. I am reminded of a comment made by Tenney in a roundtable discussion of Nancarrow's music (transcribed in New Performance, page 36):

"Yet they (the scores) have been extremely important, at least for me, in providing additional access to the music beyond what my ear can tell me. My ear is certainly sufficient to enjoy the music, but the scores make it possible to get inside the thing a little bit."

This gradual ordering of chaos becomes the basis for the second half of the piece, in which the introduction of order leads to the gradual "decay" of the system into the slow, sparse and quiet F-F#-E natural chord which ends the piece. Measures 7-9 are a delicately intricate connection of regular patterns in the flute and clarinet (Example I.12) against semi-regular ones in the other instruments,

producing the same sorts of "note-passings" and half-step relationships as before, in a perhaps more controlled fabric. Gradually, by measure 10, the music simplifies into only three pitches: F natural (in the 'cello, bassoon and horn), and E and F# (in the remaining high register instruments), with all but the violin, 'cello, and flute remaining at the end.

One is tempted to hear in this movement, as in much of Tenney's work, a kind of cosmological model: with the explosion at the beginning, the introduction of order, and the final decay into nothingness (or a kind of grand "clang" or "swell"). I think that these "information theoretic" ideas, which would eventually become so important to him, were early on, very present in Tenney's musical thinking. Although their more precise formulation awaits later works (MMH, the computer pieces...), they perhaps constitute one more "seed" in this work.

Movement V contains two prevalent motives, one rhythmic/melodic, and the other dynamic. They are often used in conjunction, and can both be seen in Example I.13, a reduction of the first five measures. Both of these "shapes" are closely related to and are special configurations of the generating ideas of the previous movements, but here Tenney focuses on these motives and develops them orchestrally to a greater degree. Sometimes the motive's intervals are octave reduced (as in the resultant between the clarinet, horn and bassoon in the first three measures, Example I.14), or inverted, and sometimes they are combined and interwoven, as in the flute and clarinet passage shown in Example I.15. This type of complex resultant sonority is precisely the sort of thing that led Tenney into some of the theoretical thinking of META/HODOS and subsequent work, which provide a kind of post facto theoretical basis for works like Seeds. Note that there is a sort of serial presentation in this movement as well. The opening

Example I.12

The image shows a musical score for two instruments: Flute and Clarinet (in C). The Flute part is on the top staff, starting at measure 7 (marked '(ms. 7)') and playing a melodic line with a dynamic marking of *mp*. The Clarinet part is on the bottom staff, starting at measure 7 and playing a more rhythmic line with a dynamic marking of *pp*. Both parts feature complex rhythmic patterns, including triplets and sixteenth notes, and are marked with '2' and '3' indicating specific rhythmic groupings. The score is handwritten and includes various musical notations such as stems, beams, and accidentals.

Example 1.13

Handwritten musical score for Example 1.13. The score is in 4/8 time with a key signature of one flat. It includes parts for piano (p), strings (str.), and woodwinds (cl., vn., cello). The piano part features a melodic line with dynamics like *pp* and *p*. The strings provide harmonic support with chords and textures. The woodwinds have specific parts, including a clarinet (cl.) and violin (vn.) with dynamics like *pp* and *p*. The score is marked with "(ms. 1)" and includes various performance instructions.

Example I.14

Handwritten musical score for Example I.14. The score is in 4/8 time with a key signature of one flat. It includes parts for clarinet (cl.) and bassoon. The clarinet part features a melodic line with dynamics like *pp* and *p*. The bassoon part provides harmonic support with chords and textures. The score is marked with "(ms. 15)" and includes various performance instructions.

Example I.15

Handwritten musical score for Example I.15. The score is in 4/8 time with a key signature of one flat. It includes parts for flute and clarinet (in C). The flute part features a melodic line with dynamics like *mf* and *p*. The clarinet part provides harmonic support with chords and textures. The score is marked with "(ms. 6)" and includes various performance instructions.

pitch sequence is G-A-Ab-D-Eb-Gb-C/F-Bb/E/B, with some note-passing between the initial five and subsequent seven note group (in measure 5). Once again, this quasi-row is, I think, generated out of a simple desire not to repeat pitches, rather than out of any pre-existent dogma.

The second section has a clear figure and ground structure, with the half-note motive occurring between the four

winds in various interconnected ways, and with the 'cello and violin presenting a rhythmic unison accompanied in vertical half-steps. One interesting thing about the winds is that here the motive is dovetailed in every incident. That is, the first note of any three note figure is also the middle of another. The third section is a return to the ideas and textures of the first, ending on a rather unique type of chord for this piece, composed of the notes Eb-C-Gb-D-Ab-F, which stands out in this context because of its more triadic tendencies, in spite of its unusual voicing.

Movement VI, the last, is the most extended, and in a traditional way, the climax of the work. Many of the ideas of the previous movements are quoted, combined, extended and embellished to produce a movement that is more musically dramatic than the others. Its form is more rambling, through composed and less determined, but in its five "sections" there is a kind of abstract rondo (as in II).

It begins in much the same way as several of its predecessors, with a presentation of a non-repeating pitch sequence (in the context of minor second jumps and unison timbral shifts). There is a lyrical quality to many of the instrumental lines which contributes to a more spacious polyphonic texture than in previous movements. Minor ninth leaps (Example I.16) abound, and Tenney recalls certain themes from earlier movements (compare Example I.17 to the opening flute motive in Movement I, Example I.2). In the second "section", the tempo is increased (quarter note = 88 to quarter = 112), and there is a more linear, stratified feel. There is also an important use of klangfarbenmelodie, as an E natural is passed from the horn to the bassoon, then to the violin, clarinet and 'cello. In measure six, the flute and clarinet recall the accompanying violin/'cello passage in the previous movement, playing in rhythmic unison

Example I.16



Example I.17



at the half-step. The third section (ms. 8-11), is introduced by an ascending, complex arpeggio in the horn, clarinet and flute up to a sustained flutter-tongued/tremolo chord in strings and flute, breaking into a miniature inverted canon at the half step for flute and violin (Example I.18), (which is at the same time the half-step accompaniment figure). This section ends in a restatement of the opening pitch material (Ab-Gb-F-G#/A-Eb-D-Bb-E-C#). The fourth section is characterized by a greater polyphonic and rhythmic complexity and the continuation of the flute and violin rhythmic unison, now joined by the clarinet at a third half-step (Example I.19). Note that for five measures the flute and violin play as one instrument, with a minor

Example I.18

Handwritten musical score for Example I.18, showing Flute and Violin parts from measure 8 to 11. The score includes dynamic markings such as *ff*, *mp*, and *mf*, and features complex arpeggios and sustained chords. The Flute part starts with a *ff* dynamic and includes a flutter-tongued/tremolo effect. The Violin part mirrors the Flute's complex arpeggio structure.

Example I.19

Handwritten musical score for Example I.19, showing Flute, Clarinet (in C), and Violin parts from measure 11. The score includes dynamic markings such as *mf* and *ff*, and features complex polyphonic and rhythmic patterns. The Flute and Violin parts play in unison, while the Clarinet (in C) joins the texture.

second timbre, on only a very few pitches (C and B for three measures; A, Bb, E, C# and D for two more). This section dovetails into the closing passage, almost a coda, with a remarkable one measure open horn solo (Example I.20). The activity gradually winds down, with brief unison intersections from the clarinet and the bassoon. The entire piece ends on a major/minor sonority (C-E natural-Eb, in the 'cello, flute and clarinet). In general, this movement makes more use of tertial relationships than the others, and so this final sonority, which combines the half step motif with the two types of thirds, is quite expected by the ear.

Of course, no analysis/description can adequately capture the musical interest of such a work as Seeds, and it deserves much finer and more detailed attention than space allows me here. It is curious that the work has never been published, and very rarely played (no disc recording exists), for it is a classic of its genre, and an extremely important work in the evolution of Tenney's style.

Example I.20



II. Collage #1 - ("Blue Suede") and Monody (for solo clarinet)

Although these two works are of widely different character and medium, both were written at about the same time, 1959-1961, around Tenney's stay at the U. of Illinois, which he attended, he says, because it was one of the few places where electronic music facilities were available at the time. Perhaps the vast cornbelt had a kind of cultural influence on him, for in these two pieces we can see a departure from the more European style of Seeds and a new embracing of "indigenous" elements: in this case a Rugglesian sense of line, and the music of Elvis Presley.

Collage #1 - ("Blue Suede") 1961, a tape collage of Elvis Presley's Blue Suede Shoes (by the great American guitarist/singer Carl Perkins), has become something of an American electronic music classic, and is one of Tenney's better known works. It is short (three minutes, eighteen seconds) and with respect to techniques available today, uses a very simple set of technological resources. Most of the "classical" tape manipulations are used: speed changes, reversal, tape head echo, multitracking, splicing and some filtering, but the combinations and the techniques are nothing short of virtuosic. Particularly impressive is the editing, which in its rapid, arhythmic but pulsating effect resembles a speeded up version of Tenney's second collage Viet Flakes (1966). There is a sense of time here, in the way that jazz players use the word, that is uncommon in tape music. The edited phrases seem to fall right around the perceived, implied beats, in the same way in which a jazz rhythm section and soloist interact around a steady pulse. The overall effect is that the piece "swings". Tenney is sensitive to the music he is paying homage to; R+B, or rockabilly, in which the concept of the "backbeat" is crucial. Collage #1 never sacrifices the backbeat to its other transformations, and the piece resembles early rock'n'roll in its rhythmic drive. Yet, intentionally, it never quite finds the "groove" (of steady time divisions) - it is continually frustrated by quick silences, aborted beats, and unexpected returns to the beginnings of phrases. It is perhaps Elvis' physical and musical gyrations and expressions taken to their perceptual extreme, an attempt by Tenney to capture some essence of the music.

"I had been deeply moved by Varèse's Déserts and Poème Electronique, and by his vision of the new musical possibilities realizable through electronic technologies. In 1959 I began graduate work at the University of Illinois, attracted there by the fact that courses were being offered in electronic music (perhaps for the first time anywhere). Under the generous tutelage of Lejaren Hiller, I began to work in the new medium, but with absolutely no success at

first. In spite of all my earlier expectations, the synthetic character of the electronically produced sounds seemed to resist my every effort to use them in a way that was musically satisfying to me. Collage #1 - "Blue Suede" arose, initially as an act of desperation in the face of these difficulties, but once begun, it was completed in one feverish week in the studio. I consider it a celebration of Elvis Presley, and I like to think that it would have pleased him."

(from Tenney's In Retrospect, notes to Reich Foundation concerts in N.Y.C., Dec. 1978)

The piece consists essentially of four sections, each short. The first (about 25-30 seconds long) is comprised almost exclusively of slowed-down tape sounds, focusing on the instrumental background on the record, particularly the drums, leaving out the voice. It is not obvious at this point what the sound source is, although the feel more than the content seems to express rock'n'roll. There is a use of tape head echo here, which has the effect of producing a rich, sustained, phase-shifted type of processing on the low, already complex sonorities. The quick splicing, and the texture, which seems to be virtually monaural (that is, one-track, though in Tenney's terms it might be called "compound monophonic") makes the rhythmic movement quite clear and transparent, never becoming muddy. The second section (about 45 seconds) introduces some very beautiful higher-pitched timbres over the low bass. These sounds seem to be the results of various filterings, reversals, editings and speed increases (in various combinations) of the higher pitched sounds on the recording (although it is hard to tell, I think the voice, lead guitar and higher pitched drums are used). They have a grainy quality which might suggest that they are actually lower pitched sounds played at a higher speed, maybe even those of the first section. There is a complex contrapuntal relationship (high/low) developed during this section, and it is developed for about 15 seconds longer than the first. Near the end (the last ten seconds or so), a marked increase in density and tempo occurs, as well as an obvious crescendo, leading into the third section (now about 1:15 through the piece). Suddenly, all that is heard are quick splices of more or less unadulterated voice, but the transition is smoothed by the crescendo into the section and by the fact that the accompanying instrumental sounds are spliced, of course, in conjunction with the voice, and so the resulting sonority is still fairly rich. Many of the quick splices, it seems, are just slightly dovetailed (on separate tracks) and so the effect is one of quick, seamless shifts of attention. From experience in playing this piece for many students, friends, etc., I can say that when this section begins, a smile almost invariably comes to the listener's face, for the recognition

of Elvis' voice is rather sudden, and quite wonderful, as we realize we've been listening to it all along! This section is also about 45 seconds long, and at about 1:58 through the piece, the low sounds from the first section, and shortly after, the higher sounds from the second join in. The last minute and a quarter or so of the piece is a three part contrapuntal "jam" of the three textures, and it may well be that the material used in this section is identical to all the "component" material used previously. It is certainly not much different, and this gives the piece a characteristically economical and transparent form (like its source!).

In a larger sense, a few other things about this piece are worth noting. First, like much of Ives' music (as in the Emerson movement of the Concord, with which Tenney is so familiar), the development scheme is "backwards". The source material is not heard until the third section, unrecognizable and highly transmogrified material presented first. This is not specific to the music of Ives and Tenney, but I think that if it is not a peculiarly American fixation, it is at least one with which the music of the U.S. has always concerned itself. It reminds me very much of the way traditional fiddlers will play highly ornamented versions of a simple fiddle tune, and then, somewhere in the middle of a performance, play the tune very simply and straightforwardly, almost as a way of taking a breath, allowing the listener to revel in the simple beauty of the revealed "pure" version. Tenney's use of this relatively subtle aesthetic and compositional trait of Ives is characteristic of some of his later music as well, in which his various tributes and homages are often related to an aspect of a given composer's work which is below the surface and not immediately obvious.

The choice of material, was I think, very unusual for the period. (Malcolm Goldstein has told me that "a lot of people were doing collages at the time, but Jim was the only one who used rock'n'roll"). Whether Tenney was the only one or not is not so important, but it is important that he treated it with a sensitivity and love that is uncommon to this day. He has since used several "indigenous" musics, and I think that they are all used primarily because he simply likes them so much, and in some way wants to contribute to the tradition itself.

Monody, for solo clarinet (1959), is the earlier work of this pair, and is surprisingly similar to Blue Suede in both its rhythmic and compositional feel, and in the fact that it is as obvious a bow towards Ruggles as Blue Suede is to Elvis.

"While at Bennington I began learning to play Ives' Concord Sonata, and this surely had an effect on my musical ideas, but no obvious "influence" seemed to show up in my own work until sometime later,

(perhaps with Collage #1 - "Blue Suede", in 1961). I also had the great good fortune to meet Carl Ruggles, beginning a friendship that lasted until his death in 1971. This early contact with Ruggles inspired in me a desire to develop the melodic aspect of my work, though - with the exception of Monody (1959) - this has remained a lesser concern to me, secondary to timbre, texture, and (more recently) harmony".

(from In Retrospect, notes to N.Y.C. concerts)

Monody is the only work of Tenney's with the possible exception of the rags, and in a different sense, the Chorales, that concerns itself with melody, and it is interesting that after Monody he seemed to lose interest in the idea. The few melodic examples in his work (we must include Hey When I Sing... as well) are quite beautiful, and all evidence a very sophisticated sense of melodic formation very much like Ruggles' own, in which ornamentation is sparse, and the tunes are direct, directed, well-conceived, and very tight. This can even be heard, though not quite as successfully, in the very early work Poem for solo flute (1954).

Monody, like the earlier Seeds, shows the very direct influences of Ruggles, Varese, Webern, and is to some extent similar to the work of Stefan Wolpe (though Tenney was not familiar with the latter's work at the time). Monody is almost entirely a study in intervallic relations, and in the creation of a melodic line with very definite rhythmic and pitch goals. Avoidance of pitch class repetition is on the average, 7-8 notes, if immediate repetitions are not taken into account. In addition, several short fragments of the piece are almost serial, in the same way that Ruggles is - not by doctrine, but by a kind of ultimate expansion of the atonal idea (as in Example II.1, the first few measures of the piece). Motivic repetitions are used often, and there are, as in Seeds, just a few fecund germinating ideas. In some cases they are rhythmic (Example II.2), and in some they are intervallic, as in the opening measure and in the use of a split octave motive with equivalent intervallic content (tritones and minor seconds, with minor thirds of secondary importance). In many cases, the "germ" intervals dovetail with each other (Example II.3).

Example II.1



Example II.2



Example II.3



One way to view the motivic technique in this piece is as a continuous evolution of a simple melodic idea. For example, the opening melodic figure, after a reenforcing repetition, is quickly seen in its inversion (Example II.4). A few measures later, the same motive is octave displaced (Example II.5), and this type of transformation continues throughout. Virtually the entire piece's motivic and melodic structure is composed of some variation on this intervallic idea, whether through the means outlined above or by successive concatenations and rhythmic variation (Example II.6).

The piece is in three sections, each having a characteristic type of melodic/rhythmic development, yet each of course, closely related to the others. The first section (from the beginning until the tempo change on the second page, roughly a third of the piece), is split both texturally and motivically, in a very conventional yet effective

Example II.4



Example II.5



Example II.6

way by the pause right before the first clear occurrence of the theme's inversion. This inversion is repeated almost immediately, echoing the very beginning of the piece, and much of the rhythmic and melodic material of this second half is identical to that of the first. Tenney is striving for economy, and one is reminded of the passage of time in Ruggles' Portals, where the main theme (a very simple and striking descending half-step) occurs clearly whenever a new developmental section is begun. The first section ends as well, in almost a quote from Ruggles (or perhaps reminiscent of the high note climax in Varese's Density 21.5) with a flurry of rhythmic activity, increasing in tempo and rising continually in pitch until it rests on a high A#, double forte, but with a decrescendo over the duration of the pitch to double piano.

The second section is more concerned with rhythmic variation, and makes use of the relative ease with which a clarinet can change register quickly and easily. In this section, the intervals are dovetailed continuously as in Example II.7, where minor third, tritone, and minor seconds proliferate in a complex implied polyphony. The form of this section is breath-like: gradually building up in density, then suddenly releasing to its frenzied climax, as in the first section (this time a major second higher - C natural). In a sense, this type of macrodensity structure imitates the microstructure of the melodic ideas themselves, which are continually "climbing over themselves".

The third section is a kind of combination of rhythmic and melodic variation. Beginning lyrically, it moves into a shifting quintuplet pulse-like figure (like a similar passage in the second section), becoming lyrical once again before moving to its unusual climax. Here, the piece ends, on of all things, a low F#.

Example II.7

What is striking about Monody, aside from the obvious skill and beauty of the composition, is its disarming lack of cliché, and above all, the very direct and elegant use of the clarinet (though the piece remains quite difficult to play well). There are no "extended instrumental techniques" (so tempting to use on the instrument), and very little rapid, virtuosic passagework. Complex rhythms are used to ensure a simpler lyrical quality, rather than to create a complex effect. The listener gets the feeling that the rhythmic interest of the score (at least from a visual standpoint) is there because of a desire to make the instrument sing in almost speech/song rhythms, and indeed, a comparison with the rhythms of Three Indigenous Songs might bear this out. This is one of the few pieces of Tenney's where he is unabashedly trying to be lyrical, and one in which this lyricism is the primary context, for even in the rags there is a strong sense of history and parody (in the best sense of the word), which, in an interesting way, focuses our attention to other realms besides the "tune" itself.

III. Computer Music

During the years 1961-64, Tenney worked at Bell Laboratories in New Jersey, and was, I believe, the first composer to utilize the music synthesis programs (MUSIC IV) that Max Mathews had been developing. It is curious that even though Tenney's articles (such as the one in the (Yale) Journal of Music Theory, 1963) were really the first technical explanations of digital synthesis procedures available to composers, he is not often cited as one of the pioneers of the field in the literature I have seen. Only two of his computer pieces, Noise Study and the Stochastic String Quartet are available on record, and a rather obscure one at that. I have observed that among composers, he seems to be better known for his work in computer music than any other field, yet few know the music itself (how could they?). These pieces are, if not the first computer generated works, at least among the first, and the astonishing fact is that in terms of compositional intelligence, they are still rather advanced. They age well, especially in light of the trend toward building better and better hardware and synthesis/processing software, and the virtual lack of interest in compositional algorithms (one has only to pick up a copy of the Computer Music Journal or attend a computer music conference to realize this). The tremendous advances of Tenney's music in the early sixties have yet to be properly acknowledged or appreciated.

Luckily, Tenney has written at length about his work at Bell Labs ("Computer Music Experiences," 1969), and good tapes exist of all the pieces (I believe that there is a strong possibility of putting several of the pieces on a CRI record, but at this writing this is still in the works). In this regard, I don't need to analyze the pieces themselves in any detail, for Tenney has already done so in the above mentioned paper, which should be required reading for anyone interested in computer music. However, I would like to offer some reactions to the work in general and say a few words about each of the pieces.

There are several philosophical currents running through this music. One is that Tenney felt that the computer should be used to show him new things about music, perception, and the nature of composition, rather than to simply execute a set of pre-composed musical-dramatical ideas. In this respect, all the pieces are, like much of his later music, tasks for the listener given a set of known compositional criteria. The computer provided Tenney with a means to create perceptual domains whose environment he could predict and structure, but whose detail, and even middle level characteristics could in turn structure him, teaching him about his own perceptual processes. This seems to be essential to the very nature of artificial

intelligence, as well as its primary interest. Tenney was not primarily interested in the computer as a powerful synthesizer, although his many experiments with timbre made full use of that exciting technical domain. Rather, he deeply felt Cage's influence, and the way in which he responds to Cage's ideas, through his compositional programs, is fascinating. In these pieces, for the first time in his music, he chooses to relinquish control over various aspects of the music, and by doing so opens up a rich new area for musical experiment. Another somewhat peculiar aspect of Tenney's music that surfaces in these pieces is his love of all things noisy. This is evident not only in the Noise Study, but in the particular timbres and structures he chose to experiment with - structures which would produce, and did result in, ungainly, dense and noisily unpredictable sonorities. Even in his experiments with vibrato, he comes to the conclusion that random elements must be introduced into several parameters of the timbral synthesis, and only in this way will "more natural" sounds be produced. He has always sought to in some way emulate things not directly musical in his forms and timbres, believing, I think, that the most interesting manifestations of the various musical parameters (rhythm, timbre, pitch, and even structure) occur not by human design, but as part of some natural process. He has in particular, always been interested in the human voice and in speech, and many of his compositions either show this directly (like the Three Indigenous Songs) or indirectly (like the rhythmic "feel" of Monody or Seeds). Noise, in either its simplest timbral connotation or in its more abstract one involving the ordering and transmission of information, is ever present in the environment, but its occurrence there is often the last thing we imitate when we imitate nature. For Tenney, it has usually been one of the first.

A third idea of importance in this music is the use of stochastic processes, in rather sophisticated ways, to structure each of the pieces. Tenney had already written META/HODOS at this time, and so had at his disposal a rich and complex theory of musical form which lent itself naturally to the use of stochastic methods in composition. The full ramifications of that paper, and of the later ones in the "series" (META/HODOS and "Hierarchical Gestalt Perception...") have yet to be realized compositionally, though many composers have felt their influence (Charles Ames' recent string orchestra work, Crystals, is a good example). Briefly, the concept of a stochastic process is one in which certain parameters of a random distribution are specified, and these parameters can be shifted to affect the general shape (or color) of the random events. In this case, Tenney found that by specifying the mean and range of various parametric levels over given time intervals, he could create large and complex forms whose overall structure was determinate, but whose microstructure at any given moment was

indeterminate. Tenney implemented this in a hierarchical fashion, in which large-scale means were used to randomly select smaller scale means within them, and thus a hierarchically nested gestalt structure is created (more about this in the discussion of his theoretical work, in Chapter XVI). All of the pieces that he composed at Bell Labs use these ideas in some way, and it should be noted that along with Iannis Xenakis (who was exploring somewhat similar ideas in Europe at about the same time) and Lejaren Hiller, with whom Tenney had studied at Illinois (but who used the notion of stochastic distributions in a completely different way), Tenney is one of the first composers ever to seriously deal with these ideas in a formal and compositional setting. They have since become, more through the influence of Xenakis than anyone else, part of the common parlance of contemporary composition, but at the time they were quite revolutionary and radical concepts, no less so than the aleatoric ideas with which Cage shocked the musical establishment.

Tenney describes the context of his work at Bell Labs in the following excerpt from "Computer Music Experiences" (better than I possibly could):

"I arrived at the Bell Telephone Laboratories in September, 1961, with the following musical and intellectual baggage:

1. numerous instrumental compositions reflecting the influence of Webern and Varèse;

2. two tape-pieces, produced in the Electronic Music Laboratory at the University of Illinois - both employing familiar, 'concrete' sounds, modified in various ways;

3. a long paper ("~~Meta~~Hodos, A Phenomenology of 20th Century Music and an Approach to the Study of Form", June, 1961), in which a descriptive terminology and certain structural principles were developed, borrowing heavily from Gestalt psychology. The central point of the paper involves the clang, or primary aural Gestalt, and basic laws of perceptual organization of clangs, clang-elements, and sequences (a high-order Gestalt-unit consisting of several clangs).

4. A dissatisfaction with all the purely synthetic electronic music that I had heard up to that time, particularly with respect to timbre;

5. ideas stemming from my studies of acoustics, electronics and - especially - information theory, begun in Hiller's class at the University of Illinois; and finally

6. a growing interest in the work and ideas of John Cage.

I leave in March, 1964, with:

1. six tape-compositions of computer-generated sounds - of which all but the first were also composed by means of the computer, and several instrumental pieces whose composition involved the computer in one way or another;

2. a far better understanding of the physical basis of timbre, and a sense of having achieved a significant extension of the range of timbres possible by synthetic means;

3. a curious history of renunciations of one after another of the traditional attitudes about music, due primarily to a gradually more thorough assimilation of the insights of John Cage.

In my two-and-a-half years here I have begun many more compositions than I have completed, asked more questions than I could find answers for, and perhaps failed more often than I have succeeded. But I think it could not have been much different. The medium is new and requires new ways of thinking and feeling. Two years are hardly enough to have become thoroughly acclimated to it, but the process has at least been begun."

(pp. 23-24)

In my discussion of Tenney's computer music, I will follow this paper's sequence and will quote freely from it (citing page numbers where a direct quote is used). Hopefully, someday soon these pieces will be put on record, and the listener will be able to fully enjoy and experience this remarkable music.

Noise Study (Dec. 1961)

This was Tenney's first piece at Bell Labs, and he describes its genesis below:

"For several months I had been driving to New York City in the evening, returning to the Labs the next morning by way of the heavily traveled Route 22 and the Holland Tunnel. This circuit was made as often as three times every week, and the drive was always an exhausting, nerve-wracking experience, fast furious,.... The sounds of the traffic - especially in the tunnel - were usually so loud and continuous that, for example, it was impossible to maintain a conversation with a companion. It is an experience

that is familiar to many people, of course. But then something happened, which is perhaps not so familiar to others. One day I found myself listenening to these sounds, instead of trying to ignore them as usual. The activity of listening, attentively, to 'non-musical', environmental sounds was not new to me - my esthetic attitude for several years had been that these were potential musical material - but in this particular context I had not yet done this. When I did, finally, begin to listen, the sounds of the traffic became so interesting that the trip was no longer a thing to be dreaded and gotten through as quickly as possible. From then on, I actually looked forward to it as a source of new perceptual insights. Gradually, I learned to hear these sounds more acutely, to follow the evolution of single elements within the total sonorous 'mass', to feel, kinesthetically, the characteristic rhythmic articulations of the various elements in combination, etc. Then I began to try to analyze the sounds, aurally, to estimate what their physical properties might be - drawing upon what I already knew of acoustics and the correlation of the physical and the subjective attributes of sound.

From this image, then, of traffic noises - and especially those heard in the tunnel, where the over-all sonority is richer, denser, and the changes are mostly very gradual - I began to conceive a musical composition that not only used sound elements similar to these, but manifested similarly gradual changes in sonority. I thought also of the sound of the ocean surf - in many ways like the traffic sounds - and some of the qualities of this did ultimately manifest themselves in the Noise Study. I did not want the quasi-periodic nature of the sea-sounds in the piece however, and this was carefully avoided in the composition process. Instead, I wanted the aperiodic, 'asymmetrical' kind of rhythmic flow that was characteristic of the traffic sounds."

(pp. 24-25)

How similar this is to Varese's love for the noises of the city (as in Amériques, Déserts, Ionisation, ...) and to so many of the ideas implicit in Cage's use of noise. It is interesting that the very first "instrument" Tenney constructed at Bell Labs was the very thing that much of electronic music tries to eliminate: a complex noise generator. The instrument itself is of the amplitude modulation type, with the ability to select a center frequency, amplitude, and bandwidth, and to interpolate over a given duration

between selected initial and final values for these parameters. The tape has up to fifteen of these instruments at some points, though this is a result of the combination of three different speeds of an initial tape (on which only five instruments are used). Tenney described the large scale structure as follows:

"The piece is divided into five sections, the durations of the sections decreasing, progressively, from the first to the fifth. The piece begins slowly, with relatively wide noise-bands whose center frequencies are distributed evenly throughout the pitch range, approximating a white noise. As the average intensity and temporal density increase (in the second and third sections) the noise bandwidths decrease, until the sounds of each instrument are heard as tones with amplitude fluctuations, rather than as noise-bands. The beginning of section 4 is marked by a sudden change to a lower temporal density (i.e., longer note-durations), wider bandwidths, and a new amplitude envelope is introduced, with percussive attack followed by a decreasing - then increasing - amplitude. During this fourth section the average intensity is maintained at a high level. The fifth section begins at a lower intensity, which decreases steadily to the end of the piece. This return to the conditions of the beginning of the piece is manifested in the other parameters also, except for the temporal density, which increases during the last two sections from a minimum (like the beginning) to a maximum at the end. Thus, except for this note-duration parameter, the over-all shape of the piece is a kind of arch."

(p.28)

Temporal density is, in Tenney's usage, roughly equivalent to tempo. More precisely, the temporal density of a given "temporal gestalt unit" is the number of lowest level ("element") events it contains "per unit time", so that, for example, a phrase that contains ten notes over ten seconds has a higher temporal density than one which contains eight over the same duration.

Because Tenney's own description of these pieces is so complete, I will refer the reader to his own paper for details. The following chart (Example III.1, from page 31) shows the way in which the three tapes were timed and mixed together to form the total piece.

Noise Study is quite an effective, short piece, in which Tenney was just getting started in some of the aesthetic directions which he would later develop more fully in pieces like Phases.

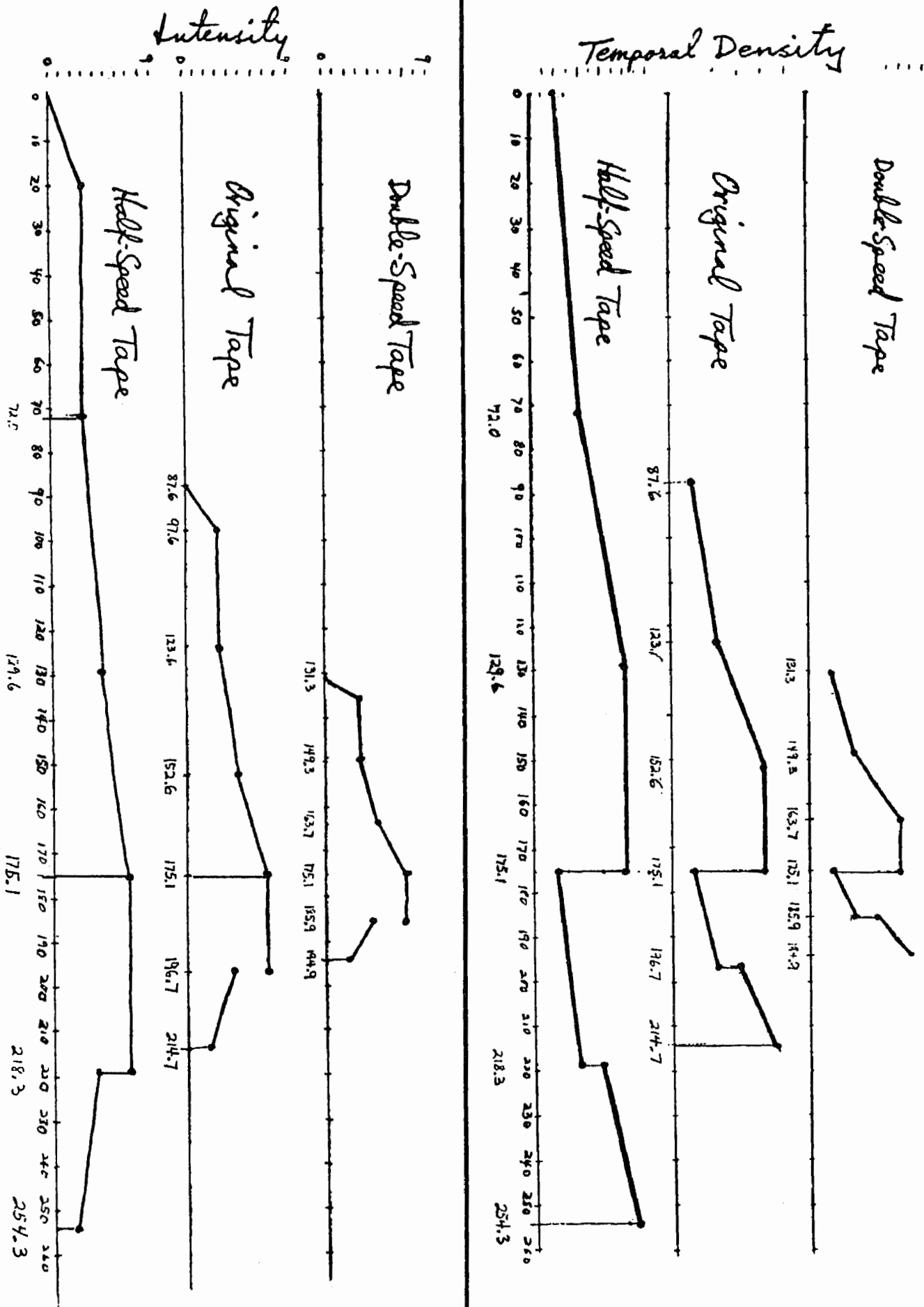


Figure 4. Superimposition of the three analog tapes in the Noise Study.

Psychoacoustic Experiments

Since most of Tenney's later music in some way or another involves an exploitation of psycho-acoustic phenomena, the nature of his early research in this area is interesting to consider. Although we would expect that it would in some way concern itself with either intonation and spectral information, speech, or the perception and distinction of form, it does not. Instead, he made a careful exploration of two aspects of timbre: modulation and rise-time. In particular, he became interested in those factors of amplitude and frequency modulation which would most likely produce "natural" sounding envelopes and timbres. To do this, he rather meticulously isolated several factors in the creation of a digitally synthesized vibrato (or frequency modulation), in the hopes of better understanding the relationships between particular uses of FM and resultant timbral perception. Subsequently, he investigated the use of random amplitude modulations to add life to tones. Some of Tenney's conclusions about the way FM and AM might be applied to various segments of a spectrum, and the higher level fluctuations in the rates of modulation are, to my knowledge, quite ahead of their time, at least in the musical community. Though timbral experiments with computers have indeed come a long way since then with the greater ease and accuracy in synthesis techniques, Tenney's experiments still stand as interesting and important early ventures in the field, and are notable for the fact that he was one of the only people at the time interested in what later became such a popular experimental realm. After some experiments with standard values for rates and ranges of frequency modulation, and then some experimenting with the use of time-variant values and envelopes for these, Tenney began to investigate the use of random fluctuation:

"A sort of 'mechanical' quality still persisted in these tones, however, and in order to overcome this I began to experiment with random frequency modulation, both with and without some amount of periodic modulation. The nature of the interpolating random number generator is such that, in order to give the impression of a modulation of a range and rate similar to the periodically modulated tone, higher values in both parameters are necessary (+/- .5 % to 2.0 % at 16-20/sec.).

Using random modulation by itself produces an interesting tone, but it does not sound like a conventional 'musical tone' with normal vibrato. The combination of random with periodic modulation, with enveloping (as described above) on the ranges of each, does, however, produce an effect so 'realistic' that I felt I had achieved one of the partial goals I had set for myself in these tests, when I heard the results. The relative proportion of the

range allotted to the two modulation sources does not seem to make very much difference, just so long as there is a 'perceptible' amount of each, and the sum of the two ranges does not exceed the range considered 'good' for a periodic modulation (about $.5 + .5 = 1.0$ % in my work).

With amplitude modulation, I found that the effect of a periodic modulation was not very interesting, did not even seem to be needed with the more interesting random amplitude modulation, to simulate the kind of fluctuations of amplitude that give 'life' to most instrumental and vocal sounds. Only with such sounds as those of the flute, vibraphone and bell does a periodic modulation of amplitude seem perceptually important."

(pp. 33,35)

Tenney's rise-time experiments led him to a rather different conclusion, in short that his scientific experiments with the rise-time of a tone were not as useful as his own more or less subjective ability to classify this timbral parameter.

"It is questionable whether such tests as the one described, carried out in very artificial laboratory conditions, and divorced from any musical context, can ever be of much use to the composer. And for this reason, primarily, I have not done any more experiments of this kind. Instead, I have tried to gain an understanding of such physical-to-psychological correlations more directly - by listening to the sounds in a musical context. What this approach lacks in precision (and - sometimes, unfortunately - communicability), it more than makes up for in efficiency. Only after giving up all intentions of dealing with these problems in the strict ways of the psycho-physical laboratory has it been possible for me to produce compositions with any degree of fluency."

(pp. 39-40)

Four Stochastic Studies and Dialogue (1962)

"If I had to name a single attribute of music that has been more essential to my esthetic than any other, it would be variety. It was to achieve greater variety that I began to use random selection procedures in the Noise Study (more than from any philosophical interest in indeterminacy for its own sake), and the very frequent use of random number generation in all my composing programs has been to this same end. I have tried to increase this

variety at every Gestalt 'level' - from that of small scale fluctuations of amplitude and frequency in each sound (affecting timbre), to that of extended sequences of sounds - and in as many different parameters of sound as possible (and/or practicable). The concept of entropy has been extremely useful as a descriptive 'measure' of variety, and several important laws of musical structure have been derived in terms of entropy relations (see the memo "On Certain Entropy Relations in Musical Structure" included with my articles). The composing programs described below represent various attempts to combine the clang concept developed in Meta/Hodos with more recent ideas about these entropy relations and stochastic processes in general."

(p.40)

In the programs written for these pieces, Tenney for the first time constructs the compositional model for the gestalt formation processes outlined in META / HODOS. This motivated the first use of compositional subroutines in the MUSIC IV context, an idea which has proved invaluable ever since. Simply put, the basic MUSIC IV and all subsequent sound synthesis programs of its genre are primarily "performers" - their main function is the generation of sound given certain parameters, in much the same manner as an analog synthesizer. The composer does this, rather tediously in most cases, by specifying values for all the parameters of his software-constructed computer instruments - each set of values constituting a "note". While this procedure gives the composer the type of control that he is perhaps most accustomed to in the traditional manner of writing a score, it does not take into account the use of the computer as an aid to compositional intelligence. Tenney very quickly saw the need for this, and with Max Matthews, developed the necessary software for incorporating compositional subroutines written in high-level languages (which at the time was FORTRAN, of course) into the MUSIC IV system. The synthesis program would then get the data it needed from the compositional program, where this data was "composed" by composer-specified and written algorithms.

The basic compositional idea Tenney was interested in was the ability to specify mean and range values for certain parameters (in this case note duration, amplitude and frequency), and have the computer select random values around these fixed ones. Given a fixed (or variable) begin-time and end-time, such a statistical specification creates what Tenney calls temporal gestalt units (TGs). The means and ranges would of course vary from TG to TG, and this specified progression of values in a sense determines the piece. He called a TG comprised of small level (element) values a clang. He also specified that at least one of the three parameters in any clang should "be variable over its entire

range, whereas the other parameters might be varying (temporarily) over a narrower range" (page 42). Tenney also gave the program the total number of "clangs" it was to generate, along with extreme values for their durations (or an overall duration range), the number of voices to be generated per clang, the rest probability for each voice, and the FM range for each voice. By changing values for the above, four different pieces were generated, called the Four Stochastic Studies.

Dialogue (1963) represents certain improvements or extensions to the program he used for the studies. One such modification was to make it possible for a larger hierarchical form to be superimposed on the clang by clang chain of events. To do this, Tenney specified initial and final mean values for a given "sequence" (which was composed of clangs in the same way that clangs are composed of elements), and then the computer used interpolated values (from the clang starting times) to stochastically compute means for the clangs. This in a sense replicates the choice process within the clangs themselves, and ensures "that some sense of 'direction' could be given to longer sequences, while still allowing the smaller details to vary randomly" (page 44). The actual instruments used in Dialogue were of a different sort as well, in that they either produced noise bands or tones in response to a given probability input. Three more parameters are also added to the instruments' repertoire.

"These are amplitude-modulation rate (which becomes noise bandwidth for faster rates), amplitude-envelope function-number, and waveform function-number. The two types of stored functions are arranged in arbitrary 'scales' and controlled in essentially the same way the other parameters are. (The arrangement of the function-number scales is not entirely arbitrary: for wave-form, the spectra with more energy in the lower harmonics were given the lower scale-values, and for amplitude-envelope, those with the shorter rise-time were given the lower values. Thus, a sequence could change, gradually, from less to more 'penetrating' and/or 'percussive' timbres, for example.)"

(p. 44)

The piece is, in form, a dialogue between noise-bands and pure tones. The diagram (Example III.2a,b; pp. 47-48) shows the complete form of the piece, and accurately reflects the input to the computer program. The first diagram shows the graphs for the mean values of tonal parameters, and the second shows similar parameters for the "noise-tones". One thing of interest in this program, is that we see a very early usage of what has become an important technique in modern digital sound synthesis, the use of

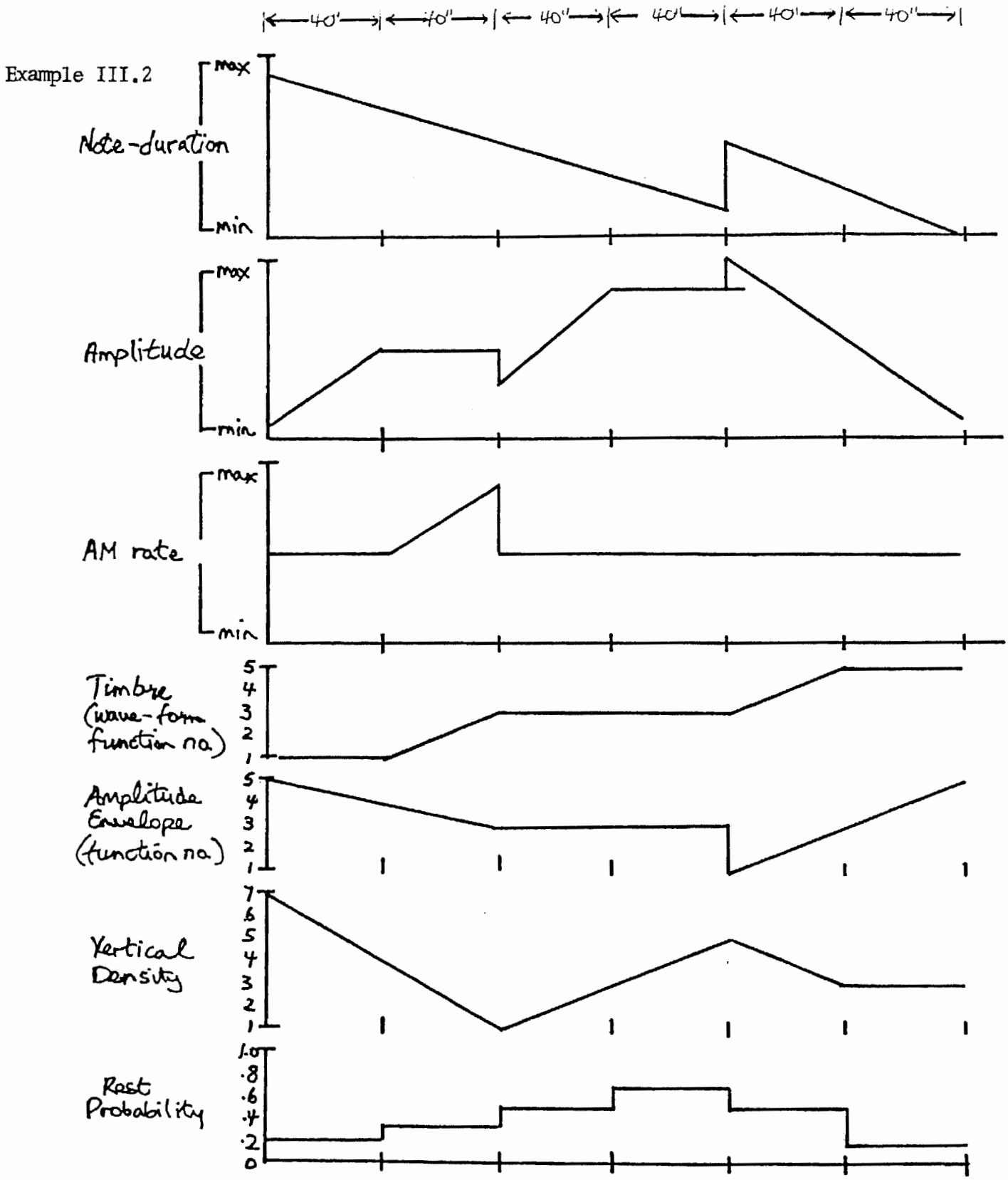


Figure 11a. Parametric Means for "Dialogue" (tonal stratum).

2b

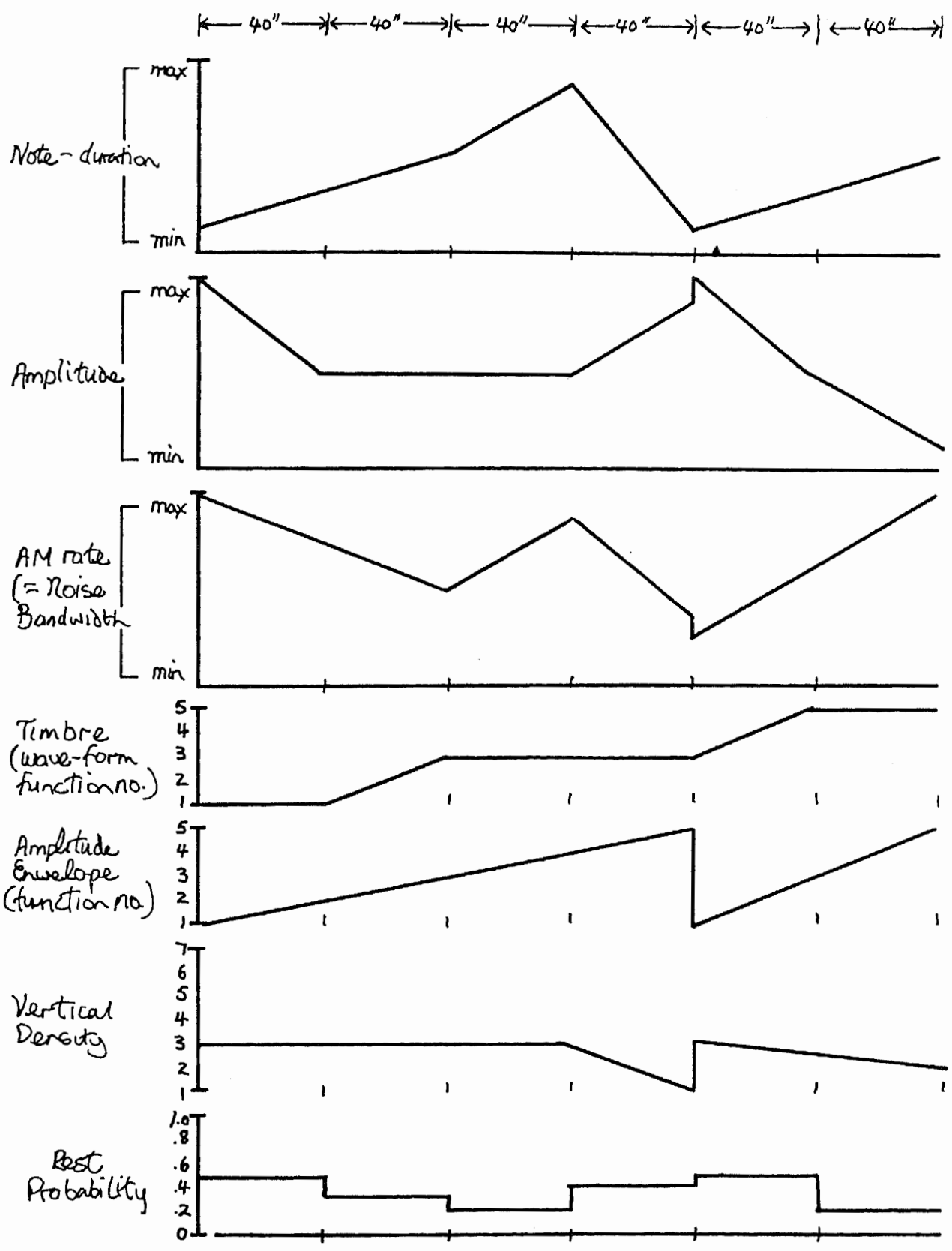


Figure 11b. Parametric Means for "Dialogue" (noise stratum)

wave-tables - preset functions that a composer can call up himself to use in a variety of ways. Intelligent structuring of systems of these functions, that is, how to order them perceptually, remains a fruitful field for investigation (note that Tenney's ordering of the timbral space is quite ingenious, and this type of thinking at such an early stage is quite striking to those of us who are just now beginning to deal with these same questions!).

Stochastic (String) Quartet

It is difficult, as usual, to improve upon Tenney's own description of the composition of this piece. The work was a "request" from a professional string quartet, and Tenney seized the opportunity to use the computer to compose a piece for traditional instruments, along the same lines as Hiller's Illiac Suite (which really has little in common with Tenney's music other than the use of stochastic processes). He devised some means for translating the clang generation process into a program which would output values readily translated into musical notation. The real problem, as he describes at some length, occurs in the time parameter, and he developed an algorithm which would deal with successive subdivisions of beats to produce complex but notationally feasible rhythms.

His later problems with the piece's performance and players' reactions to it led him to some wonderfully candid and philosophical musings about his own work, computer music, and miscellaneous musical items which should be quoted here in full:

"Since the first quartet was completed I have twice begun a new program for instrumental music, and twice abandoned the work before a piece was finished. The reasons for this were not clear to me until recently, and involve not only the experiences in writing the programs and listening to the (synthetic) results on tape, but also the experiences in trying to get string-players to play the first quartet, and other, more general, changes in my musical attitudes in these last several months.

In the first quartet the complexities of the notated parts were such that a string player would have had to practice his part diligently, and even then the ensemble would probably have needed a conductor to keep it together. Now if every detail in the score were part of some 'musical idea' (in a 19th century sense) that needed to be realized precisely, such a situation might be justified. But this was not the case. Each detail in the score was the result of a random selection process that was being used only to insure variety, and might thus have been - within limits - anything else than what it was and still

have fulfilled the conditions I had set up in the beginning. (At Bennington, I tried to explain this, and to assure the players that their 'best approximation' to the part as notated was really sufficient. But the very appearance of the score itself contradicted me!)

Thus, it began to be clear to me that there was an enormous disparity between ends and means in such a piece, and I have more recently tried to find a way to get that variety - in the 'human', instrumental situation - in ways more appropriate to the situation itself, in terms of the relationship between what the player sees and what he is expected to do.

Another problem arose with this quartet which has led to changes in my thinking and my ways of working, and may be of interest here. Since my earliest instrumental music ('Seeds', in 1956), I have tended to avoid repetitions of the same pitch or any of its octaves before most of the other pitches in the scale of 12 had been sounded. This practice derives not only from Schoenberg and Webern, and 12-tone or later serial methods, but may be seen in much of the important music of the century (Varèse, Ruggles, etc.).

In the programs for the Quartet and the Dialogue, steps were taken to avoid such pitch-repetitions, even though this took time, and was not always effective (involving a process of recalculation with a new random number, when such a repetition did occur, and this process could not continue indefinitely). In the Quartet, a certain amount of editing was done, during transcription, to satisfy this objective when the computer had failed.

But certain things about all this began to bother me: (a) it represented a kind of negative aspect of a process that was supposed to make 'everything' possible; (b) it was a constraint applied only to one parameter - pitch, whereas almost all other operations in the program were common to all parameters; and finally, (c) it used up a lot of computer-time (that might have been used to make more music, rather than less). Also, I had noticed that in the Dialogue, where the pitches are selected from a continuous scale (as opposed to the quantized scale of the Quartet), the pitch repetitions (two pitches within a very small interval of each other or of one's octave) that got by the exclusion-process in the program did not seem to decrease the variability of the music, or interrupt the flow in

the way they did in the Quartet. This suggested that the unison-octave avoidance was needed only when the pitch-scale was quantized as traditionally - only, that is, when the entropy of the pitch distribution had already been severely limited by such quantization. Accordingly, I no longer find it necessary to avoid any pitch, at the same time that I intend never to leave undisturbed - even when working with instruments - the traditional quantized scale of available pitches. It is not too difficult to get around this with instruments (except for such as the piano) - it's mainly a matter of intention and resolve."

(pp. 50-52)

Ergodos I (for John Cage) (1963)

The concept of an ergodic information domain, one in which (put rather simply) any given slice of the material is equivalent statistically to any other slice, has become of great importance to contemporary composers since the early work of people like John Cage, LaMonte Young, and Tenney. The effects of such an environment on our perception, and the choice of how to create such an auditory phenomenon has remained an idea of tremendous interest. In a way, the current use of the term minimalism (as usual, to describe a trend that peaked several years before the term took hold among critics, academics, etc.) is a special case of music whose large form often has no real direction, or at least an extremely simple one, but whose intricate (or even simple) microstructure is of immediate sonic importance. Justifiably, composers and listeners have been fascinated by such works, and have experimented both with the concepts of apparent change along specific parametric axes (like Cage's Music of Changes), or with very slow and steady modification of one parametric axis. Tenney's characteristic response to these ideas, was to first try to more or less scientifically explain it to himself, and then to create music which utilized that property of ergodicity which removes any vestiges of "dramatic intent" from its resultant structures.

"Both the String Quartet and Dialogue made use of programming facilities enabling me to shape the large-scale form of a piece in terms of changing means and ranges in the various parameters in time. Now my thoughts took a different turn - an apparent reversal - as I began to consider what this process of 'shaping' a piece really involved. Both the intention and the effect here were involved in one way or another with 'drama' (as in Beethoven, say) - a kind of dramatic "development" that inevitably reflected ('expressed') a guiding hand (mine), directing the course of things now here, now there, etc.

What seemed of more interest than this was to give free reign to the sounds themselves, allowing anything to happen, within as broad a field of possibilities as could be set up. One question still remained as to the possible usefulness of my controls over the course of parametric means and ranges: are there ways in which the full extent and character of the 'field' may be made more perceptible - more palpable - by careful adjustments of these values?"

(p. 52)

The structure of Ergodos I is simple: two ten minute monaural tapes which may be played in either direction, alone or together, or in any combination (there are 10 such possible). The outside two minute sections of each tape were given some statistical shaping - an increase (or decrease) of both tempo and intensity towards the mean (midrange) levels for these parameters. The resultant shape is thus a kind of trapezoid with a six minute static section.

"During the middle six minutes of sound on each tape, all the parametric means are constant near the middle of their respective scale-ranges, and these ranges are at their maximum. Thus, the sounds on each tape are nearly ergodic, and thus the title - 'ergodos'".

(p. 53)

In addition, certain measures had to be taken so that the various versions of the piece (that is the various tape combinations) would also be ergodic - that one would not result in a greater statistical distribution of any given parameter than any other. This included ensuring that all envelopes occurred with the equal probability of their retrogrades. Great care was taken to determine the proper time length of the ergodic section ("did the field of possibilities get used up?") and to slightly juggle the means and total ranges of the various parameters, which are the same as those used in Dialogue. Tenney did this by setting the parameters for the first ten minute tape on the basis of some preliminary tests, and then listening to the entire ten minute piece and adjusting the parametric values slightly according to his own perception of what was needed. The final ten minute tapes are combinations of the two sets of computer runs and in this way the changes in the parametric values are "balanced out".

The table below gives the values for the initial parametric means, and the values to which Tenney felt he had to change them. Note that these values are meant to produce a certain effect: that of a random distribution of sonic events over our perceptual space, and so the magnitude of

the changes is of some interest.

	<u>First Run</u>	<u>Second Run</u>
Minimum note duration	1/16 sec.	same
Maximum note duration	4 sec.	5.3 sec.
Mean values for note duration (log scale)	1/2 sec.	same
Note/rest probability	.33	.5
Average vertical density (# voices)	less than 3	3
Noise probability	.5	.67

(Note that a duration value of 1/2 second is, on a base 2 log scale, exactly the mean of 1/16 and 4).

Phases (for Edgard Varese) (Dec. 1963)

To me, Phases is the most beautiful and interesting of the works of this period. It is impossible to describe the ungainly, almost other-worldly effect that it has, but it often seems as if it were not composed by either man or machine, but by some goblin-hybrid of the two. It remains, as well, one of the strangest and least accessible of Tenney's compositions, as it seems to exist for its own purposes entirely. Listening to it, I often feel that I am in the position of eavesdropping on a strange and beautiful conversation. It has not become a well-known piece, but this is not surprising, for it makes few compromises to any of the criteria yet formed for "good" music - it goes its own way with a deep sense of inner coherence, but coherence on a larger level than we are yet able to easily perceive. I think that in this piece, and also perhaps in Ergodos II which followed it, Tenney realized his goal at Bell Labs, to have the computer-produced work do things that he could not foresee, and as such to advance his own musical thinking.

On another level, the sheer sound quality is equally exciting. The word that comes to mind when I hear it, and a word that I seldom use with respect to computer music, is "funky". The subtle use of noise, pitches just on the level of audibility, miniscule glissandi that remind one of the inner patterns in rice paper, are all in their own ethereal way, quite moving. It is as if Phases is a window on a perceptual and sonic space that is always going on, but one that we are seldom allowed to hear.

A lot of this has to do with the further extensions Tenney made to his instrumental repertoire in Phases:

"One of the most obvious aspects of many of these environmental sounds was their frequency instability - 'glissandi' and 'portamenti', as well as faster modulations. The sounds in Dialogue and Ergodos I had some frequency modulation, but no frequency 'en-

veloping', and this now seemed a necessary extension of the list of variables. Filling in the gap between tones and noise-bands was achieved simply by allowing intermediate values to occur in the parameters affecting the noise - the range and rate of random amplitude modulation. In addition, it seemed desirable to envelope the AM rate so that the bandwidth of the noise could vary within each sound."

(pp. 55-56)

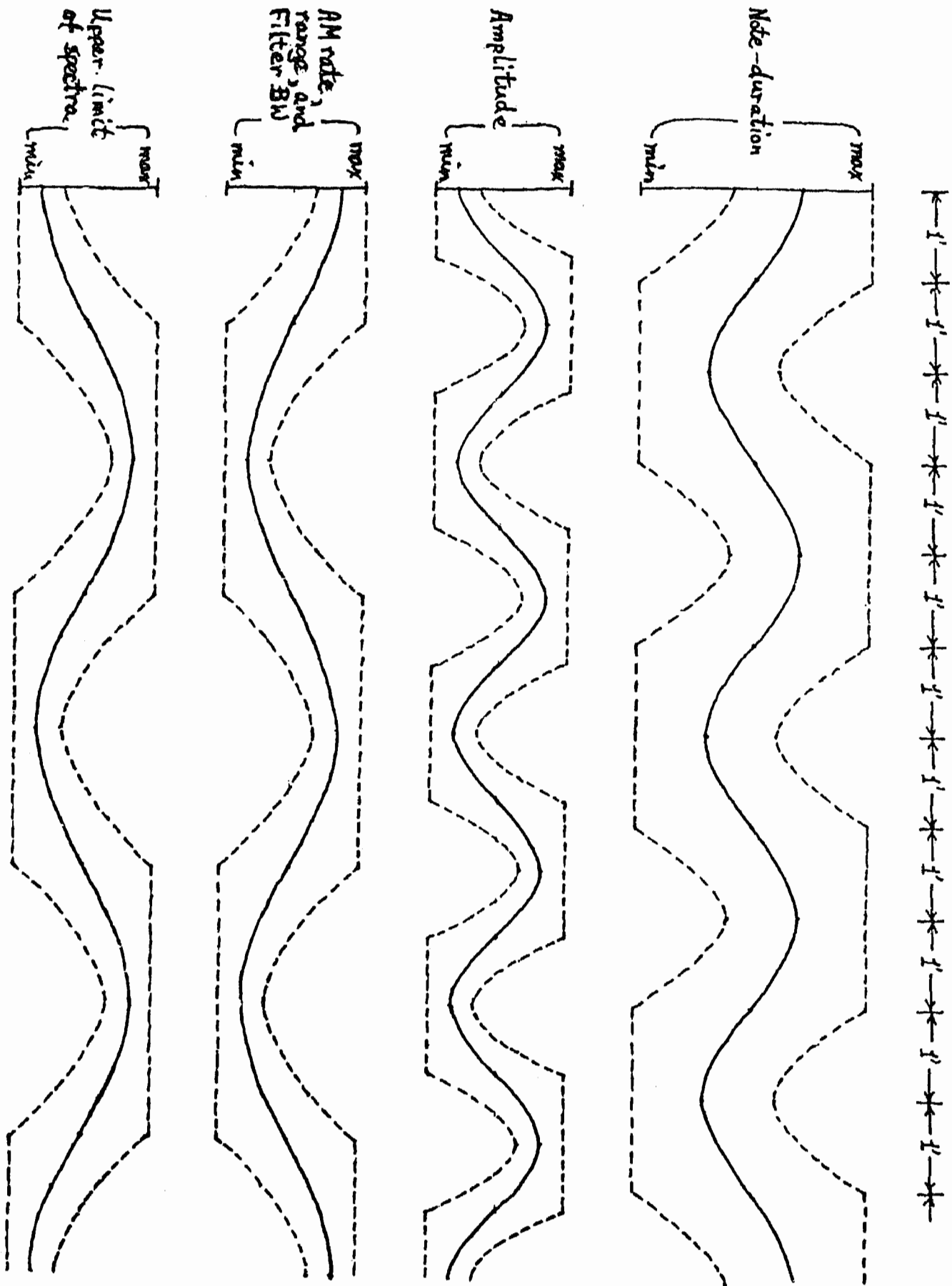
Another important factor in the generation of more complex and varied tones was the use of a rather complex amplitude compensating band pass filter in the stored functions, to produce an enormous range of spectral variation on a limited set of basic waveforms. The complexities of this filter have more to do with the mechanics of digital sampling than anything else (and indeed seems quite simple when compared to the digital "comb" filters in use today) but what is important is that its bandwidth and center frequency could be modified continuously in time, independent of the fundamental frequency, creating a powerful instrument for spectral shaping and manipulation. (It is interesting to note that Tenney refers to this as a formant filter, a term that has more to do with the acoustics of speech than the current term "band-pass"). Thus, Tenney was searching out each timbral parameter and more or less applying the same idea: that their functions should be controlled by the stochastic processes that govern TG formation.

Formally, the Phases program incorporates still one higher level of TG determination, what Tenney calls the section, and so now not only parametric means of clangs are determined by the machine, but also the parametric means and ranges of sequences, which previously had to be input by the composer. This extends the hierarchical process to four levels (element, clang, sequence, section). Tenney's graph (Example III.3) shows the shapes which the parametric variables took in several of what he considers to be the most important parameters. One can easily see both the simple elegant form and the genesis of the title, for the functions are each sinusoids of varying wavelenths, and as such change phase with each other. These slow moving sinusoids create the perceptual effect of a clear overall movement but imperceptible change, and only if the listener focuses his attention on a given parameter (and this is difficult to do!) can he perceive the direction and nature of the parametric evolutions.

Ergodos II (for John Cage) (1963-64)

This was the last work Tenney completed at Bell Labs, and it is a fitting, zen-like conclusion to the nature of his formal and aesthetic investigations. It is eighteen minutes long, and may be played in either direction. The

Figure 13. Parametric Means and Ranges (dotted lines) for "Phases."



tape "might be subdivided into two or more segments of approximately equal length, and these segments played simultaneously (over one to N pair of loudspeakers, for N segments)". Tenney later used Ergodos II with the Tone Roads ensemble as the tape basis for the piece Instrumental Responses. In addition, Ergodos II is the first piece to use the stereo facilities that had recently been programmed into the music language. Predictably, Tenney adds the spatial distribution of the sounds into the list of parametric variables that are subject to stochastic distribution. The instruments and algorithms are almost identical to Phases, and it has the same rich and beautiful quality, but there is finally complete ergodicity. There is, in any way that we might reasonably define it, no form. The musical effect is quite startling. Ergodos II seems to have been an almost required piece, the final step in a series of investigations into the perceptual unknown. In this regard, I have always been curious about the last sentence in Tenney's paper, where he somewhat cryptically states:

"Another piece was begun after its completion, but abandoned when my dissatisfaction with the early test results made it clear that I would not have time to complete it before leaving."

(p. 60)

Though the reader might wonder, as I did, what could possibly follow Ergodos II, Tenney has informed me that it eventually became Fabric for Che' (see Chapter IV).

IV. New York City 1964-1970

After leaving Bell Labs, Tenney had several different jobs, among them: a teaching position at the Polytechnic Institute of Brooklyn (where I believe he taught acoustics, computer music, and some standard music theory), and a research position in theory at Yale (where he had access to the Ives archives). During this period, Tenney was also an active part of several musical movements in N.Y.C. Aside from his role in Tone Roads (see Chapter XV), he was deeply involved in the Annual Avant-garde Music Festivals, and an "original" member of both the Steve Reich and Phillip Glass ensembles. In these six years, up until the time he left N.Y. for California, his work is characterized by a new interest in what might be called performance art, electronic music, an exploration of political and social principles, and a trend away from the virtuosic and technical, both in instrumental and electronic music. The music of this period includes three very fine tape pieces: Fabric for Ché (1967), Collage #2--("Viet Flakes") (1966) and For Ann (rising) (1969) (the instrumental version, For 12 Strings (rising), was written two years later, after he stopped composing electronic music). If For Ann (rising) is seen as a kind of ultimate expression of the ideas of ergodicity, lack of drama, and exploration of psychoacoustic perceptual ideas, then the ensuing Three Piano Rags and Tenney's sudden turn from electronic to instrumental music makes more historical sense.

Also from this period were at least eleven "theatre" or "performance" works, in which (with the possible exception of Maximusic) there is little or no requisite of instrumental technique. These works include:

Chamber Music Events (1964; for George Brecht)
Audience Piece #1, #2, #3 (1965)
Thermocouple #1 (1965)
For Two (gently) (1965; originally for Charlotte Moorman and Nam June Paik)
Maximusic (1965; for Max Neuhaus)
Metabolic Music (1965)
Choreogram (1965)
Thermocouple #2 (1965; with Carolee Schneemann)
Redbed (1966)
Swell Piece (1967)

Many of these pieces show the influence of the FLUXUS movement, the Judson Dance Theatre (for which Thermocouple #1 was written), and the various art "happenings" which were part of the N.Y. scene at the time. There is a definite presence of politicization in them as well, and this is the last time that this overtly appears in Tenney's music (with the possible exception of Listen). However, this political

bent, even at its most explicit, often takes the form of almost romantic studies in human interaction, rather than in explicit references to political events (unlike Viet Flakes and Fabric for Ché, the former composed for a Carolee Schneemann film on the Vietnam war). Maximusic and Swell Piece eventually became postal pieces, and are described in Chapter VII. Of the others, several are of interest in their early use of ideas, albeit in a rather simple (or, perhaps a better word is straightforward) way that would later become almost cliché in the avant-garde. Metabolic Music specifies that electrodes "be attached to the skin at various points found to be good sources of fluctuating voltages". These signals are then used, in a freely improvisational way, to control oscillators, amplifiers, or even lights; the idea being (with respect to Cage) that the low frequency, low amplitude sounds encountered in the physiological realm, when manifested in the perceptual (via control of some carrier signal, as in some recent work of David Rosenboom, Jerry Hunt and others) can be a source of artistic interest. In Thermocouple #1, static electricity is used in a way that in a simple fashion resembles much of the work of Alvin Lucier. Choreogram is one of the most interesting of these pieces. In it, Tenney describes rather wonderfully how the various acoustic parameters of the music might be translated into the kinaesthetic ones of dance, and vice versa. Though this concept is no longer of any particular novelty after so many years of use, Tenney's short verbal score remains impressively elucidating and fresh, perhaps because even at this early stage, he was interested in sound and movement parameters that were somewhat unusual - a sophisticated result of his many years of acoustical and perceptual research. These parameters included intensity and pitch modulation, vertical density and excitation (sound); and inclination, angularity and orientation (dance).

Fabric for Ché is at once beautiful and ugly, a relentless and noisy evocation of the revolutionary political energy of the time. (The work's composition is contemporary with Guevara's ill-fated attempt to establish a continent-wide revolutionary movement in Central Bolivia). Tenney explains it musically as an attempt to create a continuous sonic event with no beginning and no end. Like much of his other music - "the whole piece conceived as consisting of but a single sound, more or less complexly 'modulated'". The individual microscopic sonic events are "noisy" and the density of texture, intensity, and general timbre are relatively static. Viet Flakes is one of Tenney's simplest pieces. It consists of snatches of popular rock'n'roll songs from the mid-sixties (We Can Work it Out, Sunny, 96 Tears, etc.), Asian musics (probably Vietnamese) and western classical music, all more or less randomly spliced together. The snatches range from about one second to about five seconds, and there does not seem to be any structure to it

at all, except that none of the little bits are used more than once (though the internal repetitions of the songs themselves make this hard to determine). I have never seen the film for which this was composed, so cannot comment on any relationships between film and music, but I have heard the tape played in concert, and it works surprisingly well by itself. This has much to do with the extreme simplicity of the idea and total lack of contrivance in its execution.

For Ann (rising) is to many people the Tenney signature piece, and a kind of essential symbol of his aesthetic. Its genesis lies in what has now become known as a "Shepard tone" (named for the great experimental psychologist, R.N. Shepard, pioneer of multi-dimensional scaling and associate of Tenney's at Bell Labs). This is a sound that, like an Escher woodcut, seems to continuously rise. There has been some debate as to who first created the illusion, but that is unimportant here. The piece is about twelve minutes long, and consists of continuously rising glissandi, each about a minor sixth from the next. They begin in the subaudio range and gradually, over the course of about half a minute, climb above the audio range. Each glissando has a fade in/fade out amplitude envelope on it, so that they enter and leave imperceptibly. The total effect is of a complex, almost contrapuntal gestalt. It is a rather breathtaking piece, and still continues to interest me after at least a hundred hearings, for the listener's attention is constantly shifting, both between various bands of the spectrum and the various levels of his own perception (in much the same way as Steve Reich's Come Out, composed about the same time). At any given point, there are between 12 and 15 glissandi present, and the continual overlapping actually creates the desired illusion.

I have heard Tenney consider a possible modification of this piece which would, I think, be an interesting exploration. He suggests that each glissando be related to the one on either side by the ratio which is the limit of the ratios of successive Fibonacci terms (2:1, 3:2, 5:3, 8:5, 13:8, 21:13...), or about 1.618033988749894 (etc.), a minor sixth. This interval (quite a nice one - about 833 cents, as compared to 813.7 for the 8/5, 840.5 for the 13/8, and 800 for the tempered) which the current version of the piece only approximates, would result in the property of all first order difference tones of any given glissando pair being already present in some lower glissando. That is, all resultant tones would simply replicate existing ones, and the piece might conceivably be smoother, or more "perfect". This rather simple yet surprising result of the Fibonacci numbers, or more accurately of the "golden mean", can be seen visually in the common representations of it as a sequence of inscribed rectangles with sides proportioned in this fashion. What Tenney describes is an important acoustic ramification of this very popular concept. A "fine tuning" of the piece, with today's digital technology, would

not be too difficult, and would be a worthwhile experiment.

There are several other works that might be mentioned in connection with this period. Music for Player Piano (1964) is a computer generated piece, punched onto a piano roll, whose form springs directly from the later computer pieces. The roll may be played in any combination of its four possible directions/orientations, and as such the piece can be heard in various permutations of its prime, retrograde, inversion, or retrograde-inversion. Each such orientation is two minutes long, and its structure derives from the type of hierarchical gestalt manipulations already described in detail for works like Ergodos II and Phases. Three other "graphic" scores were written as performance additions of Ergodos I and II. They are called String Complement (1964) String, Woodwind, Brass and Vocal Responses (seperate scores, 1964) and Percussion Complement (1964). These were performed on at least one Tone Roads concert that I know of, and have not, I believe, been played since.

V. Three Piano Rags

Sometime in the late 60's, after many years of a rather explosive and eventful artistic (and emotional) life, Tenney became extremely interested in ragtime. It is understandable, after a period of intense political and artistic upheaval, and after some profound changes in his personal life, that he was attracted to a music whose elegance was immediately apparent, and whose charm and attraction reflect basically a joyous outlook on life and art. Also, Tenney's deep and long-standing interest in American music, as well as his personal friendship with the great blues and traditional music scholar, producer, writer and performer Sam Charters, led him to consider in depth what is after all one of America's truly unique and indigenous musics.

Ragtime also gave him a chance to "flex his muscles" as a pianist and as a composer. There is a tremendous amount of craft in these rags, of a particular type that his earlier music (after Monody) seldom required. One senses that the writing of these rags was a kind of personal and artistic release for him. Most of Tenney's music is, as I've mentioned, basically good-natured, in a serious way. All of it is more of an affirmation of things he believes in than arguments with things he doesn't. The rags mark a kind of turning point for Tenney: the music after this point tends to be quieter, more lyrical, and even prettier than that which preceded them. Consider, for example, Fabric for Ché or Viet Flakes in comparison to Hey When I Sing... and Quiet Fan. After Seeds, little of Tenney's music, with the possible exception of For Ann (rising), reflects the gentle side of his nature, and as he matured it could be that he felt the need to put more of this into his work. I think also that Tenney was anxious to leave electronic music, as he did quite decisively soon after, and the writing of the rags was a kind of gentle exorcism of some of his previous ideas. He felt the need to move on, and the rags provided a comfortable and congenial transition.

These three pieces are squarely in the style of classical ragtime. One example of this, aside from the obvious formal and pianistic traits, is the use of melodic figures which are essentially broken chords - as in the various presentations of the "theme" of "Milk and Honey" (Example v.la,b,c) or in the introduction to "Tangled Rag" (Example v.ld).

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Example V.1a

(Milk Hounds; section 1; ms. 1-2)

Example V.1b

(Milk; sect. 1; ms. 5)

Example V.1c

(Milk; sect. 2; ms. 15)

Example V.1d

(Tangled Ram; intro; ms. 1)

But there are several stylistic traits peculiar to Tenney's rags: economical motives which are remarkably prevalent - so much so that the rags could almost be three movements of the same work. One such motif is the harmonic idea of suspending a given pitch over a changing chord. This is present in each of the rags, and entire sections (like the second theme from Raggedy Ann, and the second section from Milk and Honey) are based on this simple but effective idea. This technique is common in traditional ragtime as well, but in these rags it becomes a kind of trademark.

A second common theme is the use of the interval of the second (or ninth), though in this case, unlike its use in Seeds, it is diatonic. A third is the heavy use of chromatic passing and ornamental tones to make what are in reality simple harmonies sound far more interesting. This is of course one of the generative ideas for Tangled Rag, but it is common in the other two as well. One last characteristic, which would not even be worth mentioning were it not for the predominance of its use here, is the prevalence of sequential material in a way that is not quite so frequent or extended in classic ragtime.

Raggedy Ann, is dedicated to Sam and Ann Charters, the latter one of the earliest and finest modern pianists to explore ragtime. (She is also a well-known writer on various American topics, including a biography of Jack Kerouac).

This piece makes by far the most extensive and frequent use of the suspended top note effect, as well as the use of the intervallic second. Also, Tenney seems to be interested in breaking up the rhythmic line in a kind of "hocket" fashion: all of these motives may be seen in the introduction (Example V.2).

The structure of Raggedy Ann is the most sectionalized of the three in the way that it consists of many, small segments rather than a few large ones. After the introduction, there is an eight bar statement of the rather sad,

Example V.2

Introduction

(not too fast)

descending theme (Example V.3) lyrically flowing into its disintegration in the final two measures (Example V.4). After a repetition, the second section begins with a more "annunciatory" theme (based on the "suspended" top note), and with a more strongly felt harmonic sense (note that in Example V.5, the tonic appears in root position as opposed to the second inversion, as in the first section). This

Example V.3



Example V.4



Example V.5



entire section is itself tertiary, composed of three sets of repeated four measure themes, the second being a kind of interlude (in the dominant), the first and third exactly the same. The first section then returns (not indicated in the published score, but to my knowledge Tenney has always played it this way), with a final chord modulating to the subdominant. The last section of the work is a full statement of the material of the second section, sixteen measures long, with repeat, that does not include the previous interlude and in other ways differs from the initial "seed", ending on the tonic seventh (or the dominant of the new key). Finally, there is a wonderful eight measure chorale-like coda, reminiscent of the Alcott's movement of Ives' Concord, but in close simple harmonies, which makes use once again of the suspended top note (Example V.6, right hand only).

Example V.6



Milk and Honey, subtitled "Mielle's Rag" for Tenney's daughter (the name related to Romance language words for honey) is perhaps the easiest to play of the set, and structurally the closest to classic ragtime. Its use of what might be called "extended diatonicism" is quite unusual. Even the first chord in the introduction presents a series of suspensions based on the IV chord that are not quite resolved until the last chord (Example V.7).

The piece is in three sections (the last subtitled "Blue Jig"), and it does not return to the first between the second and third. Throughout, there is a successful use of

Example V.7



various techniques for the prolongation, elision or suspension of cadences, as in the alteration of bass lines to delay the subsequent tonic chord (Example V.8a) or the use of deceptive cadences (Example V.8b). In addition, subtle transformation of simple sequences is used to give this piece a flowing, continuous quality. The use of the second, obvious in the very first measure, is also the "theme" of the jig, and is found all through the harmonic texture. The harmonic material, although seemingly quite simple, often conveys a great amount of information in a short space of time and in very few notes, in a way that reminds me of Joplin's great Heliotrope Bouquet (Example V.9a,b). Note the use of a suspended top pitch in the first section (Example V.10) and in the rapid chain of suspensions and harmonies in ms. 8, which later prepares the listener for the basic texture of the second section, in which this becomes the theme. Example V.11, from the Trio (ms. 7-8) is another example of this unusual harmonic motion, both in the Maj 7 to dom 7 progression in measure 7, and in the chromatic movement of measure 8.

Tangled Rag is the most developed and distinctive of the set, and is the closest to being what might be called a modern rag. It is an elaboration of three ideas: the use of

Example V.8a



Example V.8b



Example V.9a

(ms. 14, section 2)

(I VI II V)

Example V.9b

(ms. 19, Scott Joplin "Hokitape Bouquet")

I₄ II₄ IV₄
III of I

Example V.10

(ms. 6)

Example V.11

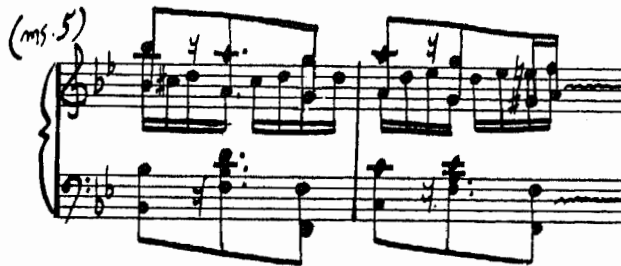


(1) a simple diatonic three note melodic figure suspended over a (2) continuous triadically related chromatic sixteenth note figure, all in a context of a (3) "latin" (beguine) rhythm:



I have not seen this rhythm used often, if at all, in classical ragtime, but it works well and gives the rag a very distinctive character. Tangled Rag is also the longest of the set. After an introduction which makes use of all the above ideas, the first section states the three note melodic figure (Example V.12a) (note here the frequent use of harmonic suspension as well). This type of three-voice polyphony is a common sonority in classic ragtime, as in the following from Joplin's Elite Syncopations (Example V.12b - first few measures, last section). In Tangled Rag, the first part (in Bb) is divided into two eight bar segments, with the second theme using a sixteenth note descending figure as an elaboration of the first. The second section, also in two parts, begins with a cadenza-like passage (Example V.13), alternating with an intervallic variation of the first theme. Note that the ascending theme of this section is composed of chromatic anticipations, as are most of the melodic figurations in the piece. The second sixteen bar section, like the first, is repeated, and then the first section returns, without a repeat; intact, except for the final measure modulation to the trio (in Eb, but beginning

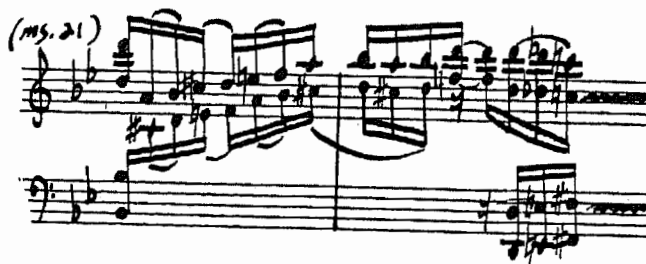
Example V.12a



Example V.12b



Example V.13



on the dominant). The trio is a rhythmic variation on the main theme, with a related dotted rhythm now in the top voice only, and placed slightly out of phase with the steady chromatic bass line accompaniment (Example V.14). In its

Example V.14



rhythmic usage, this is the most complex section of all the rags, and is unusual for ragtime in general (Example V.15). Harmonically, like the other sections (and indeed the other rags), a chordal analysis would show a rather simple progression, while the extensive use of chromatic passing tones, anticipations and suspensions creates a more complex aural effect.

The final section, after the repeat of the Trio, explores the "filling in" of the dotted rhythm in a conventional way, with the top voice supplying the unaccented notes (Example V.16a,b). The example (V.16b) shows the "resultant" rhythm as well. Here, the melody has been moved into the left hand, and it is almost the same as the initial theme of the first section. It ends quite dramatically, descending from high Ab to low G three octaves below in two and a half measures, and then quickly rising to the final Eb chord.

Example V.15

Example V.16a

Example V.16b

VI. Quiet Fan for Erik Satie and Hey When I Sing These Four Songs Hey Look What Happens

These two pieces, written between the end of 1970 and March, 1972, are the incipients of a new period for Tenney. Having just left N.Y., and taken a job at California Institute of the Arts, he perhaps felt it necessary to make certain changes in his musical personality. One very important development was a new aversion to things electronic, and a renewed interest in instrumental music, and he has not since used electronics in his music (except for the use of some simple tape delay in Saxony, the Harmonia, and Symphony). Tenney's main interest in technology since that time has been in the use of the computer for analytical and compositional purposes.

This aversion to electronic music was, I think, part of a larger effort to imbue his music with a greater simplicity, and to introduce softer and more human elements. At about this time, Tenney also "discovered" the work of Conlon Nancarrow (and has remained one of Nancarrow's more important advocates to this day), and it is curious that though he eschewed that kind of dramatic and mechanical complexity in his own work (except for perhaps Spectral Canon and the Pieces for Mechanical Drum) Tenney became very interested in it in the work of another composer. However, Quiet Fan and Hey When I Sing..., and the several pieces that follow are an attempt on his part to explore the intricacies of a quieter, simpler music, and to integrate these with his own radical change of habitat, situation and perception. It may well be that Tenney is responding with particular sensitivity to his environment and change of times, or to the new influence of people like Harold Budd and Jerome Rothenberg, to name just two who had seriously explored a quieter, less assuming style in music and poetry. In any case, in these pieces we can see a clear stylistic break in the evolution of Tenney's musical development.

Quiet Fan for Erik Satie is scored for english horn, two clarinets, bass clarinet, bassoon, trombone, flute, alto flute, oboe, violin, viola, 'cello and bass. It is possibly the longest instrumental piece Tenney had composed up to this point, but in its very simple and direct form, it has much in common with many of his previous pieces. The idea is simple: beginning with the minor second (B above middle C, to C above that), the intervals gradually "fan out" in half-steps around this center, to the major tenth, and then close back. (Example VI.1 shows the range of the fan). This happens several times over the course of the piece. Example VI.2 shows a few selected measures of this process in one instrumental pair. Orchestrationally, it is a little more complex, with various instrumental "echoes" and doublings (note the violin and oboe in Example VI.3).

Example VI.1



Example VI.2



Example VI.3



The piece is clearly sectional (see Example VI.6 for a "graph" of the piece). The first complete "unfolding" of the fan, up to A (measure 65), uses only the higher strings, flutes, clarinets, oboe and english horn. The oboe and english horn alternate throughout, a measure apart and in canon with the clarinets, and after a few measures the flutes and soon the strings enter with the melodic figure in rhythmic delay (refer again to Example VI.3), producing a soft texture of quiet, repeated attacks. This texture continues up to measure 65, at which point the lower instruments (bass, 'cello, trombone and bassoon) enter with long, sustained pedal points at the enharmonic G# (lower "edge" of the fan). The pedal is maintained until measure 125. The remaining instruments begin "closing in" the fan in the same manner as before, except that the meter change at A (from 3+3+2/8 to 3+3/8) results in a shortening of the durations (Example VI.4 shows several rhythms before and after). The general dynamic level increases from $p < mp > p$ to mp .

At B, (ms. 125), the fan begins to open up once again, with another new meter (2+3/8) with proportionally altered durations. At this point, the bass line begins to move slowly, in three measure durations. According to Tenney, the particular selection of pitches in the basses was determined mostly by ear, in an attempt to fill out the resulting chord in a way that would "sound like Satie's harmonies". This often results, as in the first five or six notes, in some pitch a fifth below one of the fan's outside pitches, and because of the ever-present B-C in the top voices, the major seventh sonority is predominant (as in Milk and Honey). The glissando down to the low E in the basses at measure 125 comes as a wonderful surprise after several minutes of interrupted minimal activity. Once more, the dynamics increase:

$mp < mf > mp$

Example VI.4

The musical score for Example VI.4 consists of four staves: English Horn (E.H.), Oboe, Violin (Vln.), and Viola (Vla.). The top staff (E.H.) has a treble clef and a key signature of one sharp (F#). The second staff (Oboe) has a treble clef and a key signature of one sharp (F#). The third and fourth staves (Vln. and Vla.) have a bass clef and a key signature of one sharp (F#). The score is divided into two sections by a box labeled 'A'. The first section is in 3+3+2/8 time, and the second section is in 3+3/8 time. Handwritten annotations include '(ms. 63)' at the beginning, '(1)', '(2)', '(3)', and '(4)' above notes in the E.H. staff, and '(1)' and '(2)' above notes in the Vln. and Vla. staves. Dynamics markings include p , mp , and mf .

At C (ms. 170), the tempo is increased by a factor of 5/4 (to $\overline{4/8}$), and as the fan closes up once again, with a decrescendo in dynamic level to

p < *mp* > *p*

the bass, which had up to this point been quiet (*p*), crescendos suddenly to forte and then back down to mezzopiano, announcing the new section. The vertical density increases slightly, with the low winds having fewer measures of rest, but otherwise nothing else changes. Tenney is gradually and subtly increasing the rate of movement, through tempo changes and slight polyphonic density increases (like the introduction of movement in the low instruments at B). Around ms. 179, a noticeable accelerando and crescendo begins to occur in the basses, with successive shortening of durations. At D (ms. 197), the basses are heard as a melodically ascending line up to the work's big surprise quote section (ms. 200 through 211 where the quote finally disintegrates), comprised of loud musical references from Satie interspersed with the previous soft texture. The quotes are based on the well known tune from Three Pieces in the Form of a Pear, which Tenney had performed in N.Y.C. with Philip Corner. Example VI.5 is an excerpt from this section. This short passage is one of the more memorable in all of Tenney's music, both because of the skill in which the fabrics and melodies are interwoven in an Ivesian fashion, but also for the wonderful audacity of placing the quotations right in the middle of this almost hypnotic context. The quote takes place during the final closure of the fan. At the next section, E (ms. 215), the meter changes again to 2+3/8 (this time the durations are augmented as the volume increases to

mp < *mf* > *mp*

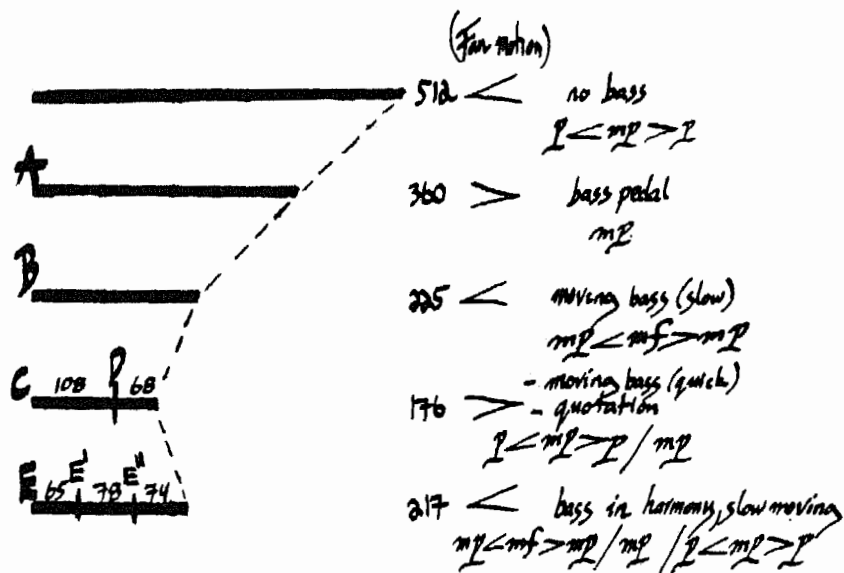
once again) and the fan begins to open again. For the first time, the bass instruments play in a harmonic fashion,

Example VI.5

mostly thirds with each other, and so this closing section is vertically quite rich in comparison to the rest of the piece. The meter and durations gradually increase in accelerated retrograde of the first half of the work (2+3/8 at ms. 215; 3+3/8 at 227; 3+2+3/8 at 239 until the end), as the volume gradually decreases to its initial level. The piece ends on the chord Eb-B-C-G# (alternating minor sixths) in the top voices and a partially enharmonic Ab-C-Eb in the lower (the resultant a Rugglesian major triad with a minor third added).

The temporal form of the work can be seen at a glance in Example VI.6. Note that, until the last, each successive opening or closing of the fan is shorter, and so the overall structure is in itself a kind of closing in, and then opening near the end, or a higher level fan. The numbers in the

Example VI.6



example (VI.6) indicate the number of beats (an eighth equals approx. 104, making the total length a little over 14 minutes). We can see as well that there is an overall dynamic "envelope" over the piece (<>) which also is self-replicating at lower levels (as in the last section).

In Quiet Fan, we can see clearly Tenney's interest in careful, consistent hierarchical structuring of simple processes, not unlike his formal procedures in the computer works. Like a large snowflake, Quiet Fan can be seen to have the same shape in several levels of detail. It is a more complex work, upon inspection, than I'd thought after an initial hearing or two, and its particular place in the chronology and history of Tenney's music reveals much about the development of many of his musical ideas and techniques.

Hey When I Sing These Four Songs Hey Look What Happens, (SATB), is my personal favorite of Tenney's music, and in many ways it is one of the simplest pieces he has written. It is also one of the most joyous, and it contains many of the more interesting characteristics of all his work: a stripping away of unnecessary dramatic materials to produce an even greater, starkly dramatic effect; a very simple and predictable form; and the probing, sensitive, and imaginative use of indigenous materials.

The whole score is printed in Example VI.7. Analytically, only a few things need be said aside from the fact that it deserves to be performed more often (I don't know of any recent performances). The technical aspects of the rhythm and melody are similar to much of his later work: the rhythms are derived from the natural speech rhythms (this may be most clearly seen in the last line of the basses), and the pitch materials are derived from a limited set, a pentatonic closely related to the harmonic series (in this case: C-D-E-G-Bb, or 1,9,5,3,7 - the first five odd numbers of the harmonic series). This latter is a simple, early usage of the type of harmonic thinking that would become the predominant tonal theme in virtually all of his later music. The "swell" and "clang" ideas are also present here, in the sustain and phrasing of the upper voices from the initial attacks of the bass.

I cannot overstate the need to hear this short but powerful work - music more illustrative of James Tenney than any analysis or description could ever aspire to be.

Example VI.7

Hey When I Sing These 4 Songs Hey Look What Happens
 (the text is a translation from the Troquois by Jerome Rothenberg)

$\text{♩} = 112$

James Tenney
1971

S/A *f* *p* *f* *p* *p* *f*
 4 hey ----- hey ----- (ce...) yeah yeah so $\frac{3}{8}$ strong
 8
 T (almost a shout) hey! hey! (ord.) (ce...) yeah! yeah! so strong
 B hey when I sing hey ----- it can help her yeah it can yeah it's so strong

S/A *f* *p* *f* *p* *p* *f*
 4 hey ----- hey ----- (ce...) yeah yeah so $\frac{3}{8}$ strong
 8
 T hey! hey! (ce...) yeah! yeah! so strong
 B hey when I sing hey ----- it can raise her yeah it can yeah it's so strong

S/A *f* *p* *f* *p* *p* *f*
 4 hey ----- hey ----- (ce...) yeah yeah so $\frac{3}{8}$ strong
 8
 T hey! hey! (ce...) yeah! yeah so strong
 B hey when I sing hey ----- her arm gets straight-er yeah it can yeah it's so strong

S/A *f* *p* *f* *p* *p* *f* *pppp* (2nd time only)
 4 hey ----- hey ----- (ce...) yeah yeah so $\frac{3}{8}$ strong
 8
 T hey! hey! (ce...) yeah! yeah so strong
 B hey when I sing hey ----- her body gets straight-er yeah it can yeah it's so strong



Note: tenors and basses sing each line through twice; sopranos and altos join in the second time only.

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VII. Postal Pieces

The postal pieces, written between 1965 and 1971, but actually produced in 1971 (with the help of Alison Knowles and Marie McRoy at Cal. Arts), are a series of ten short works printed on post cards. Several of the pieces were written in and around 1971 for a few of Tenney's friends at Cal. Arts. His explanation of the set is that he hated to write letters, and since he had a number of very short compositions, what could be easier than to make postcards out of them. Whether this was an idea original to Tenney or not is rather academic (Pauline Oliveros' wonderful postcards are the only other example I know), but musically, I think that the series is certainly unique. The set consists of:

- Scorecard #:
- 1 Beast (7/30/71)
 - 2 A Rose is a Rose is a Round (3/70)
 - 3 (night) (8/6/71)
 - 4 Koan (8/16/71)
 - 5 Maximusic (6/16/65)
 - 6 Swell Piece (12/67)
 - 7 Swell Piece #2 and Swell Piece #3
(March 1971)
 - 8 August Harp (8/17/71)
 - 9 Cellogram (8/17/71)
 - 10 Having Never Written a Note for
Percussion (8/16/71)

(The entire set is reproduced in the following pages). Seven of the ten pieces were written in 1971 (the same year as Quiet Fan and Hey When I Sing..., with the second two "swell" pieces in the same month as the latter), and of these, Beast, (night), Having Never Written a Note..., (two percussion pieces written on the same day), Koan, August Harp and Cellogram (the latter two again written on the same day, Koan the day before) are all written within about two weeks of each other. On the back of each is the indication 1954-1971 for the set, which is somewhat confusing since none of the pieces seem to have been written that early. He had originally intended to include two small songs written on short poems by the important experimental filmmaker Stan Brakhage, but that was never completed.

Most of the pieces deal with one of three fundamental ideas: intonation; the swell idea, which we have seen earlier but which here becomes explicit; the unadorned use of musical structures which will produce meditative perceptual states. In these latter, the listener, and to some extent the performer have to create their own "dramas" and interpretations (in this sense, Tenney and others sometimes refer to all the pieces as "koans", although only one is so named). None of these ideas are new in the context of Tenney's work, but in these pieces he is presenting them almost as theorems, and leaves no doubt as to their intent.

Tenney elucidated these ideas at some length in an interview (1978) with Canadian composer, writer and instrument builder Gayle Young:

"GY: How do you deal with musical form, in that light? You obviously wouldn't be concerned with the release of tension which is the conclusion of the usual type of classical music?

JT: No. I think of form as the same thing, on a larger temporal scale, as what's called content on a smaller scale. That old form/content dichotomy is, to me, a spurious one, because they involve the same thing at different hierarchical levels of perception. What we take to be the substance or content of some sound - say, a string quartet - is really the result of forms - formal shapes and structures at a microscopic, or 'microphonic' level: particular envelopes, wave-forms, and sequences of these - details in the signal. All form is just the same thing at a larger level, involving spans of time over, say, five or ten or twenty minutes or more. It's precisely the same thing physically. When you begin to see it that way, you can begin to feel it musically. So my interest in form is identical to my interest in sound (LAUGHS).

GY: Your postcard pieces, for example, are essentially a single musical gesture that continues until it's over.

JT: Those pieces have a lot to do with this attitude toward sound, but also with something else, which is the notion of the avoidance of drama. They involve a very high degree of predictability. If the audience can just believe it, after they've heard the first twenty seconds of the piece, they can almost determine what's going to happen the whole rest of the time. When they know that's the case, they don't have to worry about it anymore - they don't have to sit on the edge of their seats...

GY: Waiting for the big bang.

JT: What they can do is begin to really listen to the sounds, get inside them, notice the details, and consider or meditate on the overall shape of the piece, simple as it may be. It's often interesting how within a simple shape there can be relationships that are surprising. It's curious - in a way, the result in this highly determinate situation is the same as in an indeterminate one, where things are changing so rapidly and unpredictably that you lose any sense of drama there, too. Now people react to that in two different ways: some are angry about it, because they expect, and demand, meaningful drama. But if you can relax that demand and say 'no, this is not drama, this is just 'change' (LAUGHS) -

then you can listen to the sounds for themselves rather than in relation to what proceeded or what will follow.

GY: Would you go so far as to say, 'Sound for the sake of sound'?

JT: It's sound for the sake of perceptual insight - some kind of perceptual revelation. Somehow it seems to me that that's what we're all doing - searching to understand our own perceptual processes. In a way, science is about the same thing, but its enterprise seems to understand the nature of reality through thought and intellection. It seems to me art is about understanding reality to the same extent, and as singularly, but through a different modality - through perception.

(p. 16 "Only Paper Today" - June 1978)

Beast, written for Buell Neidlinger, the great jazz and classical bassist, is one of the most well known and performed of the set. It is a study in rhythm, using the low frequency first order difference tones (or slow beats) produced by the simultaneous sounding of two bass strings whose relative intonation is constantly changing. The bass low E-string is tuned to Eb, and assuming an A=440 c.p.s (55 c.p.s. three octaves below), a little calculation shows that, as Tenney says, the open tritone below it has a frequency of about 38.8 c.p.s.. The maximum amount of beats produced, or the "quickest" tempo of the piece is about 16 per second. (In comparison, a just tuned E below would have a frequency of 41.25 c.p.s., producing 13.75 beats per second). One can see that the number of beats per second produced is directly proportional to the distance from the unison, since the frequency differences increase accordingly. (This should not of course be confused with the relative consonance of an interval, which might be related more closely to the entire system of beat frequencies between the spectra of two tones. See Tenney's "consonance-dissonance" theory for more on this). Beast, whose title is a double-entendre on the word "beats" and on jazz vernacular (in homage to Neidlinger's virtuosity), is seven minutes long, and its form is rather simply related to the Fibonacci series and to the idea of recursive replication of inner forms (as in so much of his other music, like Quiet Fan, and the computer pieces). Incidentally, this type of thinking predates by many years the recent interest of many composers in the use of fractals, functions whose "shape" is replicated at infinitely many levels of detail. The score indicates the "target" values for the beat frequencies, connecting them sinusoidally, with each of the four large humps made up of smaller ones which resemble the "swell" type shape. The durations of the four large humps, whose respective target beat per second values are 3,6,10, and 15, (in a roughly exponential series); are 1 minute, 1 minute, 2

minutes and 3 minutes (as in the Fibonacci series). In addition, the intermediate values in each of these larger shapes are 1,3,6,10 and 15. The intervals that roughly correspond with these target values are: a 53 cents flat major third ($55/45 = 11/9 = 10$ beats per second); a 32 cents flat major second ($55/49 = 6$ beats per second); a 3 cents flat semitone ($55.52 = 3$ beats per second); and a sixth-tone ($55/4 = 1$ beat per second). In performance, this is all done of course by the players' ear, who need not be versed in the intonational arithmetic manipulations. I have now heard Beast several times, and my impression is that of a stark and unassumingly beautiful sonic meditation, that like the other pieces, asks more questions than it answers.

A Rose is a Rose is a Round is written for Tenney's old friend Philip Corner who, for a short period in the late 1960's, composed rounds almost exclusively. Tenney's postcard (the only one in color - rosy pink) is a very direct homage to his friend's interest. (Corner has told me that originally the intention was that of an exchange of pieces - a Tenney round for a Corner rag, but Corner has been delinquent in his end of the trade). It is, I think, meant as a kind of amusement, and is a clever use of simple diatonic melody that cycles out of phase with itself. It is written in circular notation for reasons more visual than musical, and could just as easily be written conventionally. Each successive musical phrase starts on a different word of the three word pattern, resulting in the three repeating lyrics (A ROSE IS/ ROSE IS A/ IS A ROSE), since the melody has 11 notes in it (non-divisible by three until it is repeated three times). The only remaining "trick" is the traditional canonic requirement of finding the best place to start the repetition (I use the word "start" loosely here). Tenney's solution, beginning the "inner" melody six beats behind the outer, minimizes the number of vertical seconds in the melody and emphasizes a conventionally consonant contrapuntal texture. The second best solution (Example VII.1, beginning on the third eighth), will not observe the metrical and lyrical structure and will also result in two fourths. There are other reasons why Tenney's is the "optimal" solution. As Philip Corner has pointed out, Tenney's canon is also interesting in terms of its harmonic (tonic-dominant) implications, symmetry, contrapuntal obliquity, and textual alignment. What can be seen from this is how carefully Tenney explored someone else's idea, and I think this meticulousness is central to the idea of proper homage prevalent in so much of his music.

(night), for the composer Harold Budd, whose lush and lyrical music made a deep impression on Tenney at Cal. Arts, and who became a good friend, is a piece about which little can be said. It seems to be a kind of musical poetic evocation of the nature of Budd's music, and is rather singular

Example VII.1

BEAST FOR STRING BASE (for Small Handlagers)

Turn the E-string down to Eb. The piece begins with a unison (arpeggio) on the open A-string and the (stopped) E(4)-string. The graph indicates changes in frequency of the beats produced by these two strings sounding together, as the pitch of the lower string is very gradually changed. (A perfect unison would have a beat frequency of zero; the augmented fourth between the open A-string and the open E(4)-string should have a beat frequency of approximately 16 beats per second.) The sound should be as continuous as possible, and very resonant, though not necessarily loud.

James Tenney
7/20/71

Example VII.2

A ROSE IS A ROSE IS A ROUND
for Philip Corner

James Tenney
March, 1970

Tenney's: percussionist, composer, sculptor, etc., Max Neuhaus. This piece is an inversion of the swell idea, with the attack happening in the middle. It is the earliest of the postal pieces, and I think that the era in which it was written (the middle 60's, when Tenney was involved in various artistic movements in N.Y.C. like FLUXUS and the "art happenings") has something to do with the form and nature of the piece. (Tenney has said that it is also a "parody on European music of that period").

Swell Piece for Alison Knowles, N.Y. artist, sculptor, composer and poet, is perhaps the expression of the swell idea in its simplest form. It is an early example of what is currently called "minimalism", though I think Tenney would likely reject that description of any of his work. It was about this time, 1967, that Alison Knowles created the famous House of Dust, a computer aided poem/sculpture, with Tenney's assistance. (The poem/computer program actually grew out of an informal "course" in FORTRAN Tenney gave to several of his friends, including Philip Corner, Dick Higgins, Alison Knowles, Jackson MacLow, Max Neuhaus, Nam June Paik, and Steve Reich).

Swell Piece #2 and #3 were written for Pauline Oliveros and LaMonte Young respectively, two composers whose work Tenney admires. These are two lemmas (or variations) on the swell "theorem". The first stresses personal sonic/perceptual processes (with respect to Oliveros' sonic meditations), and the second is a "parody" of LaMonte Young's famous "B-F# (hold for a very long time)".

August Harp was written for the harpist Susan Allen (in August), a study of possible pedal combinations of an adjacent diatonic tetrachord. Each one of the combinations is to be played four times, until the harpist feels she has run out of combinations. Since each of the four strings can take three possible values, there are 81 possible combinations (thus 324 notes at a slow tempo). Note that many of the pedal combinations produce enharmonic octave doublings, with seconds being the most predominant interval, as a kind of secondary statistical resultant.

Cellogram, written for Joel Krosnick the same day as August Harp, is similar to Beast in its use of resultant tones, similar to Koan in instrumental technique, and strangely similar to Quiet Fan in its use of a kind of aborted coda at the end. Once again, the ideas of inner canonical form and replication of small shapes at large levels are present.

Having Never Written a Note for Percussion is my favorite of the postal pieces, and extremely popular among many percussionists I've known. Written for John Bergamo,

Example VII.4

For Percussion Perhaps, Or

(night)

for Harold Budd

very soft

very long

nearly white

James Tenney
8/6/71

Example VII.5

KOAN for solo violin

for Malcolm Goldstein

(very slow glissando)

mp

pp

gradually more toward bridge, until nothing but noise is heard.

James Tenney
8/16/71

MAXIMUSIC

Example VII.6

for Max Neuhaus

- (1) Soft roll on large cymbal; constant, resonant, very long.
- (2) Sudden loud, fast improvisation on all the other (percussion) instruments except the tam-tam(s)—especially (but not only) non-sustaining ones; constant texture; continue until nearly exhausted from the physical effort, but not as long as (1); end with tam-tam(s) (not used until now)—just one blow, as loud as possible.
- (3) Same as (1), but now inaudible until all the other sounds have faded; continue ad lib but not as long as (1) or (2), then let the cymbal fade out by itself.

Example VII.7

James Tenney
6/16/65

Swell Piece

for Alison Knowles

To be performed by any number of instruments beyond three, and lasting any length of time previously agreed upon.

Each performer plays one long tone after another (actual durations and pitches free and independent).

Each tone begins as softly as possible, builds up to maximum intensity, then fades away again into (individual) silence.

Within each tone, as little change of pitch or timbre as possible, in spite of the intensity changes.

James Tenney
12/67

Example VII.8

SWELL PIECE NO. 2 (for any five or more different sustaining instruments):

for Pauline Oliveros

Each performer plays A-440, beginning as softly as possible, building up to maximum intensity, then fading away again into (individual) silence. This process is repeated by each performer in a way that is rhythmically independent of any other performer, until a previously agreed-upon length of time has elapsed. Within each tone, as little change of pitch or timbre as possible.

SWELL PIECE NO. 3 (for any eight or more different sustaining instruments):

*with respect to LaMonte Young and his
COMPOSITION 1960, No. 7*

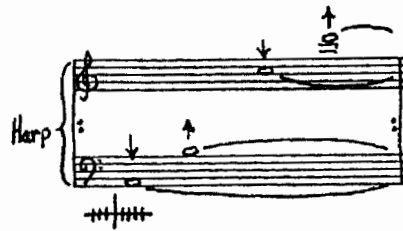
Divide the instruments into two approximately equal-numbered groups, primarily on the basis of a treble-bass distinction. The higher-pitched group plays the F-sharp a tritone above middle C, the lower-pitched group the B a fifth below. Play as in Swell Piece No. 2, but "for a long time".

James Tenney
March, 1971

Example VII.9

AUGUST HARP

for Susan Allen



Let the tempo be determined by,
and synchronous with the breath
(↓ = exhalation, ↑ = inhalation)

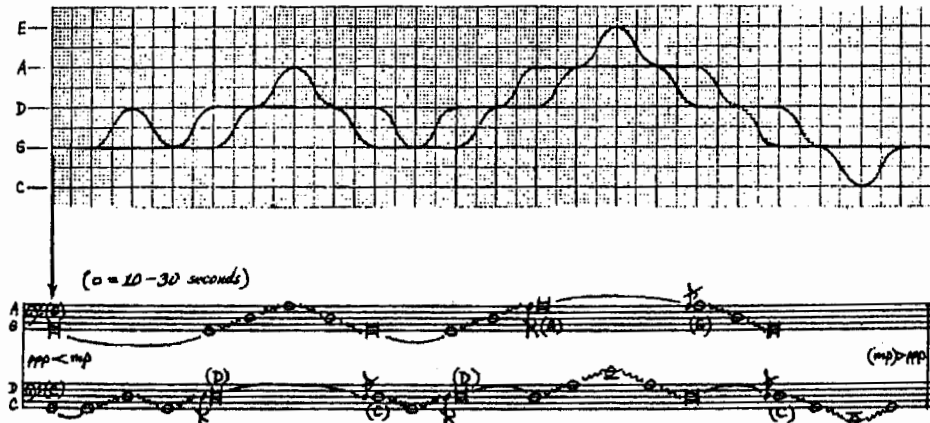
Play this figure four
times with each pedal-
combination. After
every fourth repetition,
improvise a new pedal-
change for one or more
of these four strings.
Try not to repeat a
pedal-combination already
used. Continue as long
as any variation still
seems possible.

James Tenney

8/17/71

Example VII.10

CELLOGRAM for Joel Krosnick



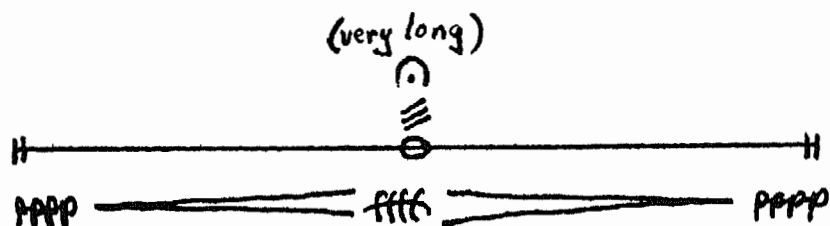
James Tenney
8/17/71

percussion teacher at Cal. Arts, the piece (and the multiple entendre) usually consists of one continuous roll on a tam-tam (although that instrument does not appear on the score, and I think it would be interesting to perform the piece occasionally on another instrument), with a crescendo from quadruple piano to quadruple forte and then back down again. The only duration indication is "very long", and the several performances I've heard range from eight minutes to about 20. All are quite astonishing, as the gentle inaudible hum of the instrument builds into a complex and somewhat

frightening chaos of non-periodic spectra, room resonances, illusory tones, and indescribable concurrences with the listener's psyche. I think it is fitting that it is the last of the scorecards, for in a way it most clearly expresses the intent of the whole set. Incidentally, the titular claim, as far as I know, was true.

Example VII.11

HAVING NEVER WRITTEN A NOTE FOR PERCUSSION
for John Bergamo

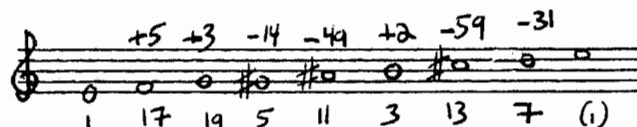


James Tenney

8/6/71

VIII. Clang

In Clang, we see Tenney's first use of the "diminished" mode made up of the first eight primes of the overtone series: 1,3,5,7,11,17,19. In ascending scale order (octave reduced) it is as follows (Example VIII.1).



This scale, though not this particular justification for it perhaps, has been of some importance in the music of the twentieth century, in everything from Stravinsky, Ives and Lou Harrison to Herbie Hancock and jazz. Harrison calls it the "octaphonic mode" and has used it often, most recently in the riveting second movement of his Double Concerto for violin, 'cello, and gamelan. It is also called the "octatonic", and jazz players know it as the "altered dominant" or the alternate mode of the diminished scale (which is whole/half step rather than half/whole step). Its interesting property of containing two major triads a tritone apart has been of some harmonic consequence in modern music, and in the music of Chopin, Scriabin, and many others. Tenney's thoughts on the ramifications of these chords and this scale are best left for him to express, but it clearly ties in with many of his thoughts on the nature of consonance and dissonance, and the acoustical foundations for these concepts. Since Clang, most of his music has concerned itself with the overtone series, and this scale in particular. Clang is the first statement of the idea, and is extremely straightforward and elegant in this regard.

Tenney borrows the title from his own earlier reference to gestalt theory, and as in Fabric for Che, conceives of the piece as "one single modulated sonic event". That it is itself a "swell" is no surprise, and like many other works (August Harp, Chorales) it concerns itself both on the large and small scale with the single breath.

"... each player chooses, at random, one after another of these available pitches... and plays it very softly (almost inaudibly), gradually increasing the intensity to the dynamic level indicated..., then gradually decreasing the intensity again to inaudibility... this crescendo-decrescendo sequence

should be timed so that both segments of the tone are of approximately the same length, and so that the total duration of the tone is as long as it may comfortably be within one breath..."

(- from Instructions to Clang)

Clang is scored for orchestra, and the score consists of available pitches for each instrument in a set of temporal sections, gradually building up the entire scale (sections 1-7) and then breaking it down over the course of about fifteen minutes (sections 8b-). The buildup is achieved by gradually widening the "bandwidth" around the initial E natural, until the entire orchestral range is filled. The rate of density increase is of course exponential, as is the decay after about ten and a half minutes, and the timbral manipulation achieved by the choice of instrument entrances is done with great care to achieve a smooth textural transition throughout. The decay is a rather interesting octaval canon, beginning with the higher primes in the lowest octaves. At section 8b, the pitches F and G drop out (17th and 19th harmonic) in the lowest register. In the next section, these same pitches drop out in the next highest register while A# and C# (11th and 13th) drop out in the lowest. In the following section, the pattern continues up into the next highest register (17 and 19, 11 and 13, 5 and 7 for the three lowest octaves starting from the top) and so on until we perceive an approximation of the actual harmonic series, since the highest partials are only present in the higher octaves. Eventually, they drop out as well, and the piece ends with a six octave unison E. Note that the rate of "pitch-loss" is also exponential.

Clang, one of Tenney's finest and clearest works, awaits a valid performance. It has been played only once, to my knowledge, in a kind of reading by the L.A. Philharmonic, and one senses from the recording that the musicians were not entirely committed to the act of playing simple, sustained tones. With the growing acceptance of new music by more conservatively trained orchestral musicians, we might hope to someday hear the piece as it is intended, and I think this will be quite an experience, though we should have waited ten years for it.

In the Aeolian Mode (reproduced in full in Example VIII.2) is one of Tenney's simplest pieces, and was also written about this time (along with a few other experiments along the same lines). It was written for the California New Music Ensemble, an excellent group of Cal. Arts student performers. Like many of the postal pieces, it very simply expresses Tenney's continued interest in soft, continuous, and unassuming textures. Tenney has never been particularly interested in improvisation, and this piece is one of the few cases where he allows the musicians to improvise

melodically, though in a very limited way.

IN THE AEOLIAN MODE

James Tenney

3/73

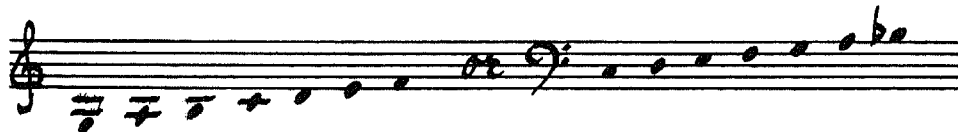
(for the California New Music Ensemble)

for prepared piano, marimba, vibraphone, flute and alto voice (this ensemble may be augmented by harp, clarinet, muted violin or viola, and/or other similarly gentle instrumental timbres).



Each player improvises a continuous melodic line on these pitches (always beginning on A, and using the G and F as neighboring tones only) -- legato, mp, mostly in eighth-notes at about mm = 180, with all players synchronous on the eighths. Let a performance begin with the prepared piano, the other players entering freely. Occasionally any player may drop out for a short time, but this is to be preceded by a "cadence" consisting of a sequence of different A's (in any octave), at any higher multiple of the eighth-note unit (i.e. quarters, dotted quarters, half-notes, etc.).

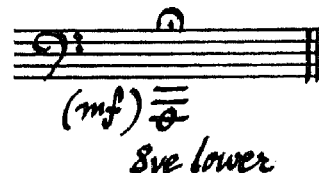
The pianist should prepare the following strings in such a way that the aggregates produced each contain a prominent pitch at the octave (or the twelfth). The damper-pedal should be held down throughout the performance.



The vibraphone pedal should be held down, with motor off.

Soft mallets should be used for both vibraphone and marimba.

The performance may be of any duration, but the longer the better. The end will be signalled by the pianist playing (for the first time) his lowest A, thus:



The other players then play their own "cadences", sustaining the last note until a cut-off cued by the pianist.

IX. Quintext (Five Textures for String Quartet and Bass)

The five movements of Quintext are individual studies in the abandonment of melody and drama, the exploration of certain "essential" characteristics of string instruments, and in the creation of static textural environments in which microstructural motion is undetermined, but whose macrostructure has a clear, precise, and powerful unification. In three of them, this unification is an harmonic idea derived from the harmonic series, in the two others it is mainly textural. Each is dedicated to a different composer, and in much the same manner as Koan and A Rose is a Rose is a Round, reflect some aspect of that composer's ideas, though all pay quite different sorts of homage.

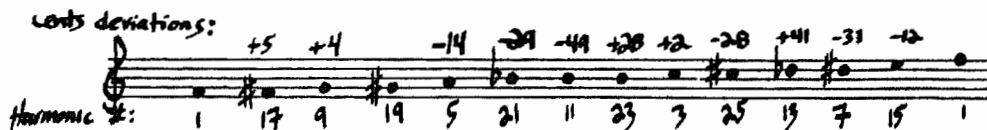
Quintext #1, Some Recent THOUGHTS for Morton Feldman, takes both its title and much of its texture from Feldman's own pieces. Tenney has said that "it's the closest I've ever come" to stasis, and therein lies the nature of the experiment (though I might point out Ergodos II along the same lines). The harmonic scale is clearly defined, and it is much the same as was described above for clang. The precise scale here is the first 13 odd harmonics, or in order of their appearance in the harmonic series on F:

F	C	A	D#	G	B	Db	E	F#	G#	Bb	B	C#
1	3	5	7	9	11	13	15	17	19	21	23	25

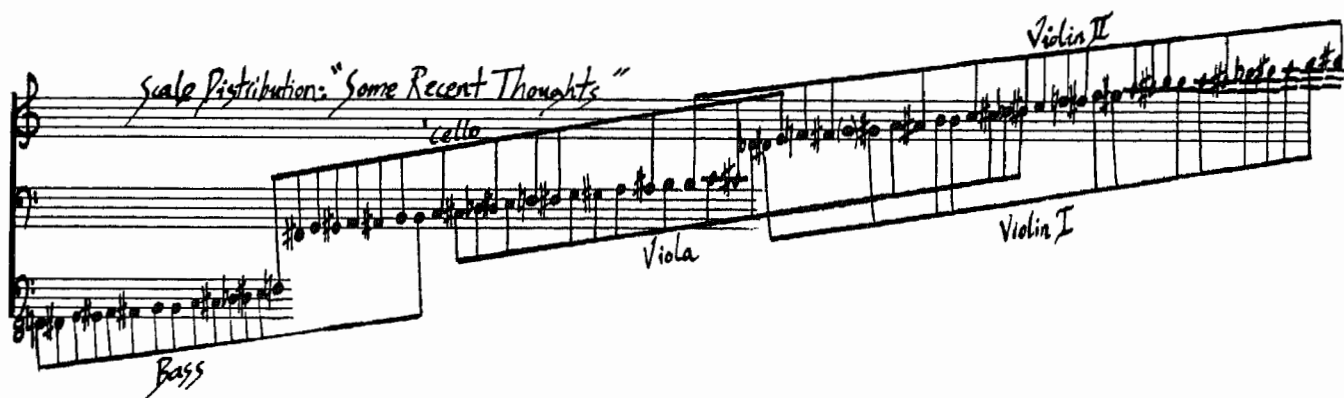
Example IX.1 shows the pitches placed in scale order and with the cents deviations from tempered tuning added above. In Some Recent THOUGHTS.., the total range (from triple low F to double high F#, or about five octaves) is partitioned among the five instruments as shown in Example IX.2. In the piece, each instrument plays those notes only (with one exception), and just once. The exception is that both the second violin and the viola play the D# (seventh harmonic) above high C, though at different times - because Tenney wanted to end the piece on a spread out dominant seventh chord (or the first four primes of the harmonic series).

Note that there are 67 pitches used in the piece (14 in the 'cello, bass and second violin; 13 in the viola; 12 in the first violin), though one note (G above middle C, or the 9th harmonic) is omitted, while the first pitches of another octave are included. The reasons for this are not clear to

Example IX.1



Example IX.2

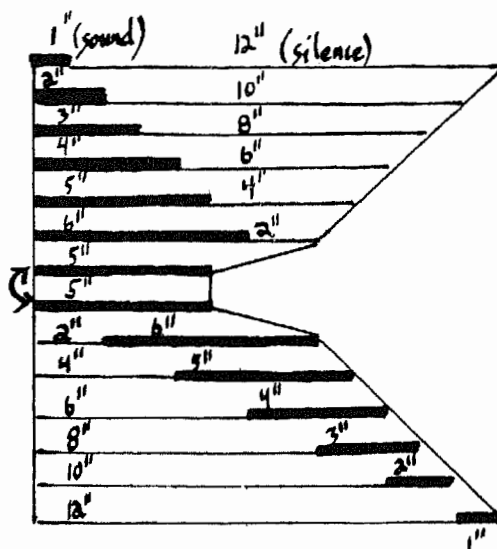


me, and probably insignificant, as the piece was composed using some random procedure (according to Tenney "coin-tosses, dice or telephone numbers, etc...."). The durations and the particular partition of the total range was I think selected by Tenney in a rather simple way - by ear. Certain things which recur a few times and give much of the movement it's characteristic form (like successive octaves in the same instrument and quasi-canonic passages) are probably happenstance. What he is aiming for (through vastly different techniques) is an evocation of the soft, static, vertical, and almost inexplicably beautiful harmonic structures that are somehow peculiar to Feldman's music.

Quintext #2, CLOUDS for Iannis Xenakis, is structurally one of the simplest of the set. The piece is diagrammed in Example IX.3, with the second half the exact retrograde of the first.

In each successive section (sound plus silence), the sound portion increases by one second while the silence decreases by two. After six such, there are five seconds of

Example IX.3



sound and no silence, and then begins a perfect retrograde. At this point the piece "rotates" upon itself, and the seven-second sections are created by the juxtaposition of the mirrored five second sound segments with the two second silences surrounding them. Another way to explain it is that each silent section combines with the sound preceding and succeeding it, creating two different ordered sound/silence combinations. The effect is that of, say, a cloud gradually covering the sun and then moving on. It is, though extremely simple, quite an exhilarating work. The pitches are only approximately indicated (one problem is that the notation seems to encourage players to only play "white notes"), and are plotted randomly along what seem to be sinusoidal paths. The pitch configuration in the second half is also the exact retrograde of the first. Example IX.4 shows an entire page of the score (the first).

Quintet #3, A Choir of ANGELS for Carl Ruggles, is a textual parody of Ruggles' short masterpiece Angels (usually performed with four trumpets and three trombones,

Example IX.4

System 1: A five-staff musical score. Above the staves, a dimension line indicates a 1" interval for the first measure and a 12" interval for the remaining measures. The notation includes various notes and rests across all five staves.

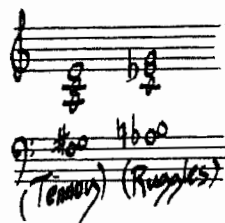
System 2: A five-staff musical score. Above the staves, a dimension line indicates a 2" interval for the first measure and a 10" interval for the remaining measures. The notation includes various notes and rests across all five staves.

System 3: A five-staff musical score. Above the staves, a dimension line indicates a 3" interval for the first measure and an 8" interval for the remaining measures. The notation includes various notes and rests across all five staves.

System 4: A five-staff musical score. Above the staves, a dimension line indicates a 4" interval for the first measure and a 6" interval for the remaining measures. The notation includes various notes and rests across all five staves.

although there are other versions, including one for violins and 'celli). #3 begins on the same close position min/maj chord with an added seventh as does Angels (though in a different key - Example IX.5), and there are several more subtle stylistic homages embedded in the work. The distinctive melodic writing in Angels (Example IX.6, shows the first eight measures in the top trumpets), characterized by major and minor third leaps which wind slowly back upon themselves, is seen in rhythmic augmentation in each of the voices in #3 (though generally the intervals are wider - fourths and tritones). Example IX.7 shows this in the pitches of the 'cello line (without rhythms). The contrapuntal texture also recalls the parent work in the way the registers are used so that each instrument's range is about the same as any other (the violins play in their low

Example IX.5



Example IX.6



Example IX.7

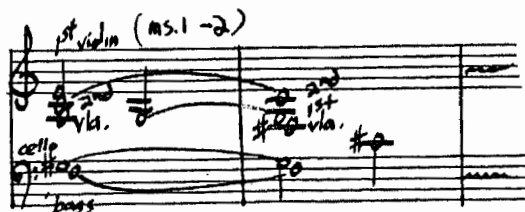


register, 'celli and basses in their high). Though in Angels, the voices/instruments almost never cross (except as brief suspensions), Ruggles always scores the lines as close as possible, resulting in an almost constant texture of minor seconds. In #3, this orchestrational technique is taken further, to the point where registral interweaving is quite common. Example IX.8 shows this in the first two measures, and Example IX.9 shows the last chord, which contains the closest possible minor-second network, as well as several voice crossings (incidentally, this is reminiscent of a Varesian orchestral nuance that we saw in Seeds). Note that the final chord of Angels (spelled Ab-C#-Eb-E natural-C-E natural) is just another version of the initial "Ruggles chord". If we take C# as the root, the chord can be seen as a minor triad with an added major seventh, and an additional diminished third degree, creating the same ambiguous third relationship (this time in the "other direction").

The timbre of #3 is quite unusual and ethereal (sul ponticello throughout), possibly another reference to Angels, which calls for muted brass. Even the number of measures is similar (45 in Tenney; 47 in Ruggles). Once again, the pitches used are intonations derived from the odd harmonics.

But perhaps the clearest aspect of this homage inherent in #3 is the almost brutal "rawness" of the sonority and form. Tenney extracts this New England personality from

Example IX.8



Example IX.9



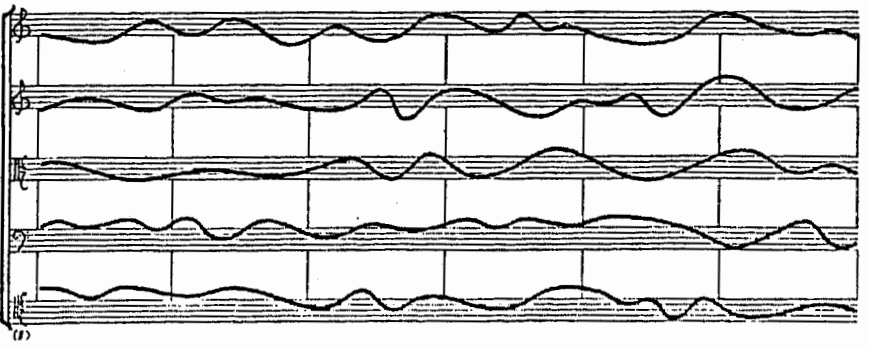
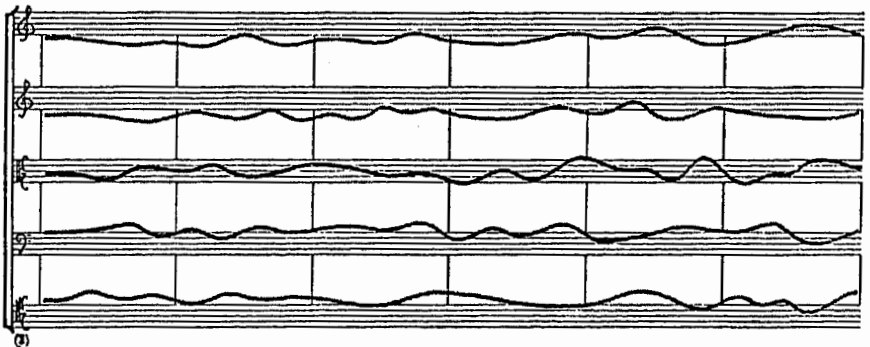
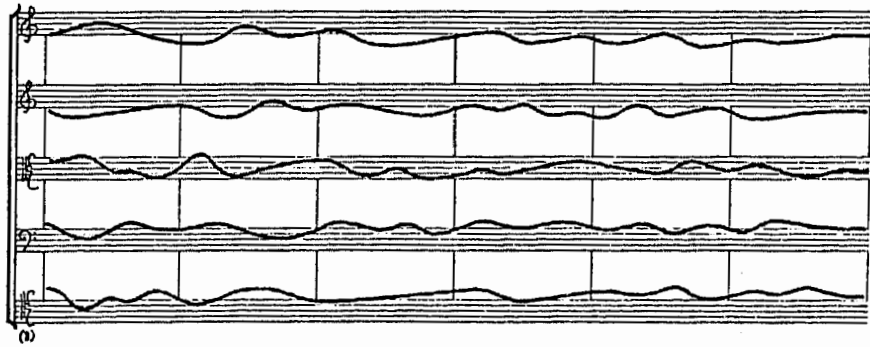
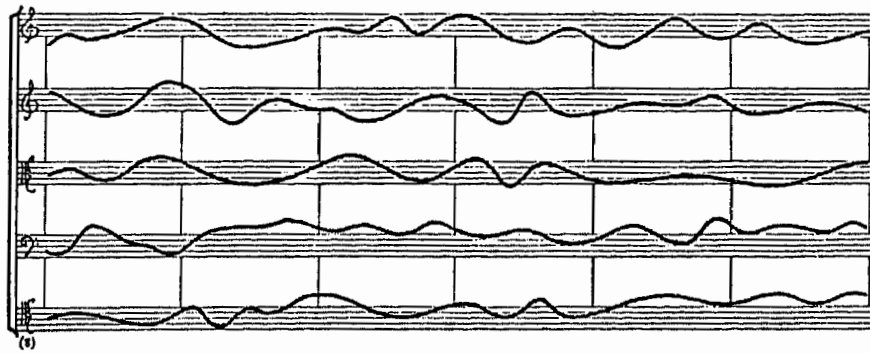
Ruggles' music, and sets it on a new and rather beautifully parallel path. #3 is, in the final consideration, a simple kind of poetic remembrance of a great American composer.

Quintext #4, PARABOLAS and HYPERBOLAS for Edgard Varèse is similar in form and simplicity to Clouds. In it, Tenney is to some extent experimenting with the various "thresholds" of our harmonic perception (the last chord, for example, is an approximate dominant seventh). The compositional process consisted of drawing random points on the staff for each instrument within a continually decreasing vertical range, in which all of the instruments are eventually assigned to the small region around middle C, Tenney then "connected the dots" via hyperboloid and paraboloid line segments. The piece is 5 minutes and 36 seconds long, with the second half (2'48") the exact mirror image of the first. This process is a primitive version of the stochastic computer programs written at Bell Labs, with the "mean value" taken to be the same for each instrument (though in reality what this does is skew their distributions slightly) so that the total string quintet range of possibilities converges stochastically to a fixed point (zero range). Not only the title, which is a paraphrase, but the sound itself is reminiscent of Varèse, especially of his early and revolutionary use of instruments like the siren and the natural occurrence of industrial sounds in his music. Example IX.10 shows the second page of the piece.

Quintext #5, SPECTRA for Harry Partch is at once the simplest and most complex of the five. It makes the most extensive use of harmony and the ability of strings to produce complex just intonation in a simple way (by natural harmonics), yet aurally, it is the most free and formless.

I think that the use of scordatura and natural harmonics here merits some detailed explanation - the piece is quite visionary in its approach and important in light of its early solution to the problem facing composers today who are interested in just intonation. What Tenney does, by the careful scordatura and the use of the harmonic nodes up to seven on each string (higher than that would be risky in performance) is produce a total harmonic spectrum of 23 different pitches, the highest being the 105th term in the harmonic series (the seventh node of the string tuned to the 15th partial). Example IX.11 shows the scordatura and the available pitches as natural harmonics up to the seventh on each string. Roman numerals indicate the string number, and the smaller arabic numerals under certain pitches (including the open strings - the scordatura) indicate the harmonic number (irrespective of the octave placement) of the given node. Tenney selected as open nodes the first eight odd harmonics, (1,3,5,7,9,11,13,15) so that the first seven in each of their resultant series might be produced as well, as "secondary" harmonics (e.g., 3 of 3, 5 of 7, etc.). This is of course inspired in part by Partch's method of compound

Example IX.10



Example IX.11

scale construction, ("otoneality") though Tenney utilizes it in a vastly different way. Note that there is quite a bit of duplication in the pitches produced (for example, the seventh node on a string tuned to five is equal to the fifth node on a string tuned to seven, and so on). On the bass, only the E string is used, tuned to F (the fundamental), which functions as a drone throughout, and resonates wonderfully with the higher partials of its spectrum being sounded. No string is tuned up more than a major second, and most are tuned down (in the case of the second violin's E string, as much as a small minor third). All tuning can be done from higher harmonics sounded on the bass's low F (which can quite easily produce partials well past the thirteenth). The notation is simple and one I have also found to be effective in this usage: sounding pitches are notated, but the nodes of the untuned strings are given in parentheses as a sort of tablature. If the player simply knows the nodes for producing the natural harmonics (octave produces the second, fifth the third, fourth the fourth, major third the fifth, minor third the sixth, and diminished third the seventh), he/she can play the piece perfectly without understanding the first thing about just intonation!

The complete scale of pitches, without octave equivalences and in their harmonic series order, is displayed in Example IX.12. Numbers below the pitches are their harmonic series numbers, and those above are their

Example IX.12

respective deviations from tempered tuning, and are easily computed for the higher harmonics by considering them to be complex ratios, simply summing the smaller ratio's deviations. (For example, $75 = 5 \times 15$, or a major seventh above the major third, yielding G#. The cents deviation is computed from the sums of the deviations of its components. The fifth harmonic is 14 cents shy of a tempered major third, and the 15th is 12 cents shy of a major seventh - thus the resultant "compound" minor third is 26 cents shy of its tempered neighbor.) One interesting aspect of this tonal system, besides its being one of the earliest manifestations of what would become one of Tenney's main interests, is that all first order difference tones produced are members of the set (though they may be octaves of some other pitch). This has the positive aural effect, as in the idealized version of For Ann (rising), of ensuring that unwanted dissonances will not be produced by such combination tones, maintaining a "purer" harmonic sonority.

#5, Spectra..., has a simple, direct form. It is nine minutes long, with the first and last minutes being a kind of outer border for the piece. In the opening minute, only open strings are used (first harmonics on the given strings) and they gradually enter from lowest to highest harmonic until an eight-part chord made up of the odd harmonics 1-15 is sounded. Over the next seven minutes, several things happen. The temporal density of pitch change (event) becomes greater and greater, beginning with about one per four second measure and ending in about six per measure. Note that since no instrument ever "sits out", (all pitches are sustained until they are changed), the texture (vertical density) remains constant, but the rate of change increases. Each possible node of each string is used at least once over the seven minutes, with the lower nodes in general used more often (though some higher nodes, like the sixth on the 'cello G string, are used as much as the lower ones). The general direction is from lower nodes to higher nodes or from simpler harmonic ratios to more complex ones. That is, first the second (octave) harmonics appear, then the third (perfect twelfth), etc., though this is not a precise system. There seem to be two general stochastic envelopes which are subjected to more or less random processes: the height of a node on a string (upper pitch range), and the rate of change. Thus, as the piece progresses, it moves faster and gets harmonically richer. The last minute is almost the mirror image of the first, as the harmonic motion gradually builds into a recurrence of the open string chord at the eight minute mark, and fades out in much the same way as the piece begins, over the course of the last minute.

This movement (#5) might almost be a separate work in itself, for its effect on the listener is quite different from that of the others. For one thing, it is longer. The next longest, #1, is only a little shorter but moves much more rapidly. #2, #3, and #4 are about 2, 3, and 5 minutes

respectively. Another distinguishing feature is that though it shares its harmonic motivation with Clang, and #1 and #3 (to some extent), it is a more developed use of that idea, and in some way presages the complexities of a piece like the string trio. I think that Tenney is a little uncomfortable with the overall length of Quintext. My suggestion might be to occasionally perform #1 or #5 by themselves. In that situation, Spectra... especially might be heard as one of his finest and most successful works.

X. Chorales

Perhaps no piece of Tenney's is easier to explain, yet whose aural effect is more difficult to describe than the Chorales for Orchestra. While its construction is childishly, or elegantly, simple, its musical and emotional impact is rather awesome. Though many of the pieces of this period have this same quality of being discovered rather than composed, Chorales is the most transparent. Once again, Tenney is exploring the ramifications of the octatonic scale, made up of the odd harmonics. Chorales is the one piece, however, where the melodic aspects (the diminished mode) of this scale are explored, and indeed the only piece since Monody where Tenney has shown a real interest in melody per se. Here, the harmonic series is built on A, and the scale of alternating half steps and whole steps can be seen in Example X.1, where the first half of the melody is transcribed.

Chorales for Orchestra is in four movements, each exactly the same in form but differing in instrumentation. The first is scored for strings, piccolo and contrabassoon; the second for brass, two vibraphones and harp; the third

Example X.1

Melody, measures 1-32, 1st trumpet, Chorales (II)

for woodwinds with harp; and the last (marked "tutti") for the whole orchestra, with a percussion section consisting of celeste, chimes, tam-tam and harp. Each movement is sixty-four measures long, with the last thirty-two more or less the mirror image of the first.

(I should note here in passing that several other versions of this piece exist, all realizations of the same harmonic/melodic idea for different instrumental combinations. I think that these are all more or less experiments, and though I have heard one or two performed, I have not seen a final score for any of them. One very beautiful version is for viola and piano, and this was performed by Tenney and Ann Holloway as part of *Maple Sugar* in Toronto).

Each movement is completely determined by two things: the melody (which is the same for each), and the initial voicing of the first chord. Each vertical chord in all four movements is an "inversion" of the first chord, composed of the eight notes in the scale, with doublings only in non-sectional instruments (like the vibraphones in the brass movement, and the piccolo and bassoon in the first movement). Given the first chord voicing, the set of "inverted" chords and the "leading voice" melody, the remainder of the piece is predetermined. It is a kind of extreme organum, but using (ideally) the properties of the harmonic series to bring about certain complex consonances, and, what Tenney expects, the feeling that we are really listening to the spectrum of one pitch, in two dimensions. The melody itself is simply a horizontal realization of any given vertical sonority, and so there exists a wonderful ambiguity between melody and harmony, movement and stasis.

The melody itself has certain shaping factors. As one can see from Example X.1, it winds slowly upward, stopping periodically to breathe, and with the four minor thirds of the diminished seventh chord as its preliminary goals before reaching the octave. Because it does not have any intervallic leaps, and because of pervasive inner repetition, it seems to ascend interminably, yet ever propulsive (like the glissandi in *For Ann (rising)*). The melody, listened to by itself, is quite beautiful and mysterious, and it must have taken Tenney some considerable care, effort and skill to work it out. In its shape and modal use, it reminds one a little of Lou Harrison's music, with which Tenney is quite familiar, and its gradual perceptual ascension bears more than a little resemblance to *Ruggles*.

The initial voicings for each movement are shown in Example X.2. Each represents a simple orchestrational concept. The strings are spread-voiced approximately in fifths, the brass are voiced in the closest possible cluster (with the vibes replicating this), and the woodwinds are more or less in thirds. In the final movement, the melody starting on A is played by the entire string section in octaves, second trombones, third horns, first trumpets, contrabassoon, bassoon, first clarinet, first piccolo, and the

Example X.2

The image shows three musical staves labeled I, II, and III. Staff I is labeled 'Initial voicings' and 'strings'. Staff II is labeled 'Brass' and 'Woodwinds'. Staff III is labeled 'strings', 'Perc.', and 'Woodwinds'. Each staff contains musical notation with notes and rests, and some have additional markings like 'I.', 'II.', and 'III.' above them.

percussion inner voices. The other pitches in the eight-part chord are divided among the remaining instruments so that higher harmonics tend to sound in the higher registers, with the greatest harmonic density in the middle register. The brass play in parallel dominant seventh chords, while the woodwinds sound the higher extensions in close voicing.

In the first movement, the melody on A is reinforced on both registral ends by the piccolo and contrabassoon, and in each of the other movements there is the added "dramatic" effect of a "punctuating" instrument about every four measures. In the second, the harp and tuba sound a low A, usually under the sustained pitches. In the third movement, which is in the key a tritone higher (for reasons of range, though it has the same harmonic construction, and in some sense is still in the same "key"), the contrabassoon and harp are the punctuating instruments. In the final movement the punctuations are made by the tuba, harp and tam-tam. In all movements, these become more frequent towards the midpoint of the piece, accompanying the melodic ascension and continual crescendo, and then less frequent from the midpoint (as everything is in retrograde). For some reason, it is the "unnecessary" aspect of this device which attracts me so much to this work, for these punctuations are in no way determined, as is the rest of the work, but are in every way consistent. It is such a straightforward and simple effect that it can only be seen as evidence of the composer's good will towards the listener!

One anomaly exists in the second movement. The initial chord has no G natural (or seventh harmonic) in it. This is the only incomplete chord in the piece, though of course, every chord in that movement has, consequently, one pitch missing (not always the seventh). This absence may be due to the particular cluster voicing of the brass, where the A is in the lead trumpet, so that the G below it would tend to obfuscate the direction of the melody. Because of this simplified harmony, the second movement is unique in that its seven voices move in complete parallel motion throughout.

Chorales for Orchestra, like Clang, has I believe seen only one performance, and only a mediocre homemade recording exists. Neither of these pieces is at all difficult to perform, and one has to wonder at the reluctance of orchestras to play truly contemporary music - music that completely transforms our notion of the ensemble itself.

XI. Spectral CANON for CONLON Nancarrow for Harmonic Player Piano (1974)

Although I believe this work was composed, or at least conceived in 1972, it was not realized until a little later because of the various technical difficulties involved. First, the roll had to be punched, and because of the very precise durational algorithms involved (worked out on the computer), it most likely presented an arduous task. Nancarrow himself punched the roll on his custom-built machine, as a favor to Tenney, and Gordon Mumma helped him record the piece on an old player piano found somewhere near Santa Cruz, Cal. In the recording that now exists, one can even hear the electric pump faintly in the background.

The player piano is tuned to the harmonic series on triple low A, up to the 24th harmonic double high E. For the first time in his harmonic series-related works, Tenney was able to use the overtones in their natural octave placement. There are accordingly, 24 voices in the canon, each having the same durational structure, and the nature of the canonic configuration is interesting to explore. The key is to understand the analogy Tenney draws between durational ratios and harmonic ones (as in Henry Cowell's Rhythmicon). The successive durations for any given voice in this piece are determined by the logarithm of the *i*th superparticular ratio in the harmonic series:

$$D_i = k \log_2 (i+8)/(i+7)$$

(where D_i is the *i*th duration in the sequence)

In other words, starting with the ratio 9/8, durations decrease exactly as do the pitch intervals in the harmonic series between "successively higher terms". "k" is a constant chosen to make the initial duration in any given voice 4 seconds, and can be determined by simple algebra:

$$\begin{aligned} k \log_2 (9/8) &= 4 \\ k &= 4/\log_2 (9/8) \\ &= 4/.1699 \\ &= (\text{approx.}) 23.54 \end{aligned}$$

One rather startling ramification is that this durational series, primarily because of the logarithm (which maintains the relationship to frequency, or at least our psycho-acoustic perception of frequency) forms temporal octaves at the same places that the pitch series would - 8, then 16, 32, 64 durations/pitches etc.. Put another way, the sum of the first eight durations is equal to the sum of the next sixteen and so on, just as it takes "more and more" superparticular ratios to add up to an octave the higher in frequency one goes. This fact is the basis for all the simultaneities in the piece. An intuitive way to see it is to look at the sum of certain simpler higher ratios, for example:

$$\log_2 17/16 + \log_2 18/17$$

$$\begin{aligned}
&= \log_2 17 - \log_2 16 + \log_2 18 - \log_2 17 \\
&\quad (\text{by the properties of logarithms}) \\
&= \log_2 18 - \log_2 16 \quad (\text{simple algebra}) \\
&= \log_2 18/16 \quad (\text{log properties}) \\
&= \log_2 9/8
\end{aligned}$$

- so that the first two durations at the "higher" temporal octave are equal to the first in the "lower". This indicates how the successive voices enter, the equation for the starting time for any given voice being:

$$ST(n) = k \log_2 V(n)$$

- where ST is the starting time of voice n, and k is as before. Looking at this more closely, we see that the starting time of the second voice (n=2) is $ST(2) = k \log_2 2 = k$ (since $\log_2 2 = 1$), and that successively higher octaves (4,8,16) begin after 2,3, and 4 times the value of k ($\log_2 4 = 2$; $\log_2 8 = 3$; etc.), or at the temporal octaves corresponding to their durational octaves. Note that at any point in the first part of the piece the first voice is moving twice as fast as the second, three times the third, and so on; and that these ratios are true for any pair of voices corresponding to their harmonic number. The same thing holds for other intervals (the third voice enters after a durational "twelfth", the fifth after a durational "double octave and major third", etc.). To see these non-octave relationships, we can examine the relationship of the durations of a higher voice to that of the first, as follows (leaving out k):

For voice 3, the starting time is $ST(3) = \log_2 3$, and this is equal to a sum of successive durations in the lowest voice which can be expressed as:

$$\sum_{i=1}^j \frac{(i+8)}{(i+7)} = 3$$

this can be proved by writing out the successive terms in this series, and remembering the property of logs:

$\log_2 a/b = \log_2 a - \log_2 b$, thus (again leaving out k):

$$\begin{aligned}
&\log_2 9/8 + \log_2 10/9 + \log_2 11/10 + \log_2 12/11 \dots + \log_2 24/23 \\
&= \log_2 24/8 = \log_2 3
\end{aligned}$$

- because any number which is in both a numerator and a denominator gets cancelled out by the occurrence of opposite signs, and only the "outer" two, 8 and 24, are left. This means that after 16 terms (an "octave and a half", since the 2nd voice enters after 8 terms and the 4th after 16 more, or 24 terms of the lowest voice), the third voice enters. At this point the duration of the third voice is $k \log_2 9/8$. The k "cancels", and we have the following equation:

$$\log_2 25/24 + \log_2 26/25 + \log_2 27/26$$

(the first three durations of the first voice at the entrance of the third voice)

$$= \log_2 27/24 \quad (\text{by explanation above})$$

$$= \log_2 9/8 \quad (\text{first duration of}$$

any voice)

- and so at this point the first duration of the third voice is equal to three durations of the first. We could prove the same thing for all voices with relation to the first and with relation to each other (for example, at that point the third voice stands in the duration ratio 3:2 with the second, and so forth). Example XI.1 shows these relationships in the first page of the score.

The upshot of all this algebra (of which I am no fonder than the reader), is that a remarkably beautiful integrity is constructed using the very simple and elegant idea of the analogy of pitch and duration harmonic ratios, in a way unlike any I've ever seen. Like many of Tenney's ideas, it is remarkable in its simplicity but wonderfully complex and multilayered in its ramifications (perhaps this is what Philip Corner meant when he referred to Tenney's music as "resonant suchness").

The form of the piece is simple. Each voice goes through 192 terms of its series (always increasing in tempo), and then retrogrades. The 24th voice enters precisely when the first voice is beginning its retrograde ($192/8 = 24$). The piece terminates when the 24th voice ends its forward motion, which is, for some reason I can't quite determine, a point of total synchrony for all voices. This is preceded by some breathtaking "parabolas and hyperbolas" (see Example XI.2, page 15 of the score), whose evolution I understand even less, but are somehow a natural result of the logarithmic cross rhythms. Note that no voice except the first completes its retrograde, so there is a kind of asymmetry to this aspect of the work.

Nothing I could say in this short description/explanation could ever substitute for the pure joy of listening to this marvel, which is heard once again more as a fact of nature than as a composed piece. It is, like most of Tenney's music, nearly impossible to come by, and a commercial recording done under good technical circumstances would be very welcome indeed!

Example XI.1

Spectral CANON for CONLON Nanassarow
for Harmonic Player-Pians

James Tenney
1974

The musical score is presented in 12 systems. Each system consists of two grand staves (treble and bass clef). The notation is minimalist, featuring vertical stems and horizontal lines on the staves, with some notes indicated by small circles. The score is divided into measures by vertical bar lines, and each system ends with a double bar line and a measure rest symbol. The title and composer information are written in a cursive script above the first few systems.

Example XI.2

The image displays a complex musical score for Example XI.2, consisting of 21 staves. The notation is dense and includes various rhythmic and melodic elements. At the top right, there is a marking '210'' with a downward-pointing arrow. At the bottom of the score, there are three vertical bar lines, each with a small character (possibly a '子' or similar) centered below it. The score is presented in a traditional Western musical notation style with multiple systems of staves.

XII. The Drum Quartets

These three pieces, which are probably Tenney's most frequently performed ensemble works, were an outgrowth of the music he wrote for Stephan Von Huene's mechanical drum. The drum's construction and means of reading its "program" (encoded on large plastic disks) encouraged pieces with canonical and cumulative structures, and the three pieces Tenney wrote for it all have these structural traits in common. These three works for the drums are titled Wake, The Popcorn Effect, and Tempest, and are still to be heard regularly on the drum itself at the Exploratorium in San Francisco, where it now resides. Although I do not have access at present to the "scores" (large plastic disks) for these works, I can offer some general description (Von Huene's drum is described in more detail in the A.R.C. Edition of Michael Byron's Pieces I). Wake for the drum is almost identical to the setting for four tenor drums in the quartets, and will be described below. Tempest, besides having much in common with Hocket, is difficult for me to describe at present, not having the score. It is a study, like Hocket, in gradually evolving tempi, and in Tenney's own words,

"achieved within the mechanical constraints of the drum...i.e., everything was cyclic (once begun, a rhythm for a particular beater repeated exactly until it was turned off again). A gradually changing tempo could only be achieved by a kind of 'trick' (since the actual speed of the control mechanism for the drum was unchanging)...",

- the "trick", as in the bass drum setting involves consistently changing durations which suggest changing tempi.

Wake for Charles Ives is the first and best known of the Three Pieces for Drum Quartet. It has a certain appeal to professional percussionists, amateurs, handclappers and kitchen table beaters alike. Its rhythmic concept is so simple, yet its resultant structure so interesting, that it has almost a childlike wonder to it. It is at the same time clearly a memorial tribute to Ives, with its evocation of the ostinato snare drum material of the last movement of his Fourth Symphony (Example XII.1). The title itself is a typical Tenney double-entendre, for not only does it describe a joyous remembrance of a loved one but also the musical effect of the piece, whose rhythms move like ever accumulating waves, swells and breakers, with smaller echoes left in their wakes.

Example XII.2, an excerpt from the first page, shows the gradual accumulation of beats toward the full rhythmic

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Ed. note: the examples in this chapter are reproduced by the author from the composer's original ms., instead of from the published scores. Permission for this was kindly granted by the publisher.

Example XII.1

9 (Ives 4th Snare; 4th Move) 10

Snare drum

line in any given voice (here it is the first voice, the beginning of the piece). The complete phrase is two measures (eight beats) long, and each voice canonically repeats this accumulation in its respective entrance. No voice enters until the preceding voice has reached its full construction, and when a new voice enters it is displaced one beat behind the preceding voice, so that a complex pattern of waves, echoes, and gradual filling in of the rhythmic space is created in what very quickly becomes completely predictable. This predictability is quite exciting, and as I have explained above, is essential to Tenney's musical intent. Listening to each of the four drums enter one can play a kind of guessing game as to what the next "gestalt" will sound like. Example XII.3 shows the point of the piece where all four drums have finally grown to their full rhythm, and the "wake" is readily visible from the score. The next few measures end the piece, and Example XII.4 shows the final "wave", which is a slight alteration of the rhythmic process, resulting in a wonderfully powerful unison rhythmic climax.

Hocket for Henry Cowell is the only piece of Tenney's that I know of, (except for some of the computer pieces) which uses spatial location as a structural parameter (though I have also heard him conjecture in this regard about For Ann (rising), truly turning it into a "barber pole" piece). The four bass drums are placed around the audience, often creating some performance problems (being able to see and hear each other) and necessitates a conductor (though I have heard this piece performed without one).

The piece is in three main sections, each being canonical, and in some way a hocket. The first section consists of rolls which gradually "move" around the room by means of crescendo/descrescendo in adjacent drums. From the time that all four drums have entered, each one maintains its roll and the hocket illusion of circular movement is effected by a canon in dynamics. Tenney has long been interested, I believe, in the famous second movement of Ruth Crawford's String Quartet, in which only the dynamics change. (He has experimented with this further in a little-known piece entitled Canon for bass quartet, written just a little earlier than the drum quartets). The canon increases both in volume and in tempo, and then rather quickly softens at around measure 25, in anticipation of the next section, beginning at measure 28 with a single stroke (mezzoforte) of drum I.

Example XII.2

WAKE for Charles Ives
for four Tenor Drums

James Tenney
8/74

Note: Each system except the last is to be played through twice before proceeding to the next one; the notes with downward-pointing stems are to be played only at the end of the second time through a given system.

Example XII.3

Musical score for Example XII.3, consisting of four staves. The notation includes various rhythmic values, including eighth and sixteenth notes, and rests. The music is written in a key with one flat (B-flat) and a common time signature. The first staff begins with a dynamic marking of *(f)*. The score shows a complex rhythmic texture with overlapping patterns across the staves.

Example XII.4

Musical score for Example XII.4, consisting of four staves. The notation includes various rhythmic values, including eighth and sixteenth notes, and rests. The music is written in a key with one flat (B-flat) and a common time signature. The first staff begins with a dynamic marking of *(f)*. The score shows a complex rhythmic texture with overlapping patterns across the staves.

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The sections are dovetailed, or overlapped, as the other drums maintain the crescendo/decrescendo texture while underneath the roll-canon continues first in three voices, then in two, as they gradually move on to the new texture. The next section, from ms. 28 to ms. 49, is a kind of fragmentation, or incomplete (anticipation) version of the full rhythmic canon to follow, and gives a rather ungainly and

disjointed feel to the middle of this piece that is quite striking in performance. Obviously intentional, the musical and structural motivations for this section have always mystified me a little. We can find, of course, musical precedents for this "awkward" rhythmic feel in the stop/start motions of Blue Suede, Seeds, Quiet Fan, Viet Flakes, etc.. Each voice in this section gradually states some of the material of the following canon, three measures apart, but plays it for an abortive nine measures and then resumes the roll, also in canon with the other rolls. Thus, by measure 46, all drums are rolling once again, in rapid imitation. At measure 49, what is to become the complete canon begins. The leading voice of the canon is composed generally of successively shorter durations, as follows:

(in quarter notes) $7, 8+15/16, 5+35/48, 5+1/3, 3+1/2, 2+5/6...$
 Once again, the entrances are three measures (12 beats) apart. This leads to a resultant total rhythmic complex monophonic gestalt pattern of:

$7, 5, 3+7/8, 3+1/8, 2+2/3, 2+1/3, 1+7/8, 1+5/8, 1+1/2, 1+1/3, 1, ...$

(where durations are measured from one stroke to the next considering all four drums as one voice). Example XII.5 shows the exponentially decreasing curve that represents this duration series, the carefully planned result of the four voice canon. Slight pathologies in the curve arise from the approximations that were needed to transfer this curve from its original form in Tempest (where it could be realized rather accurately on the mechanical drum) to traditional rhythmic notation. The canon more or less ends at measure 61, cutting the series of the fourth voice short, and becomes a kind of study in hocket and accents, as shown in Example XII.6. Subsequently, the "tempo" is gradually decreased once again and at measure 70, begins to decay by augmentation into the main canonic material, over which the rolls are gradually superimposed. Measures 76 through 84 are a kind of mirror image of the introduction of the canon itself (ms. 49 -), with the voices entering into the roll canon from the top down. Note that in the score, this circular motion looks like a kind of "sawtooth" wave:

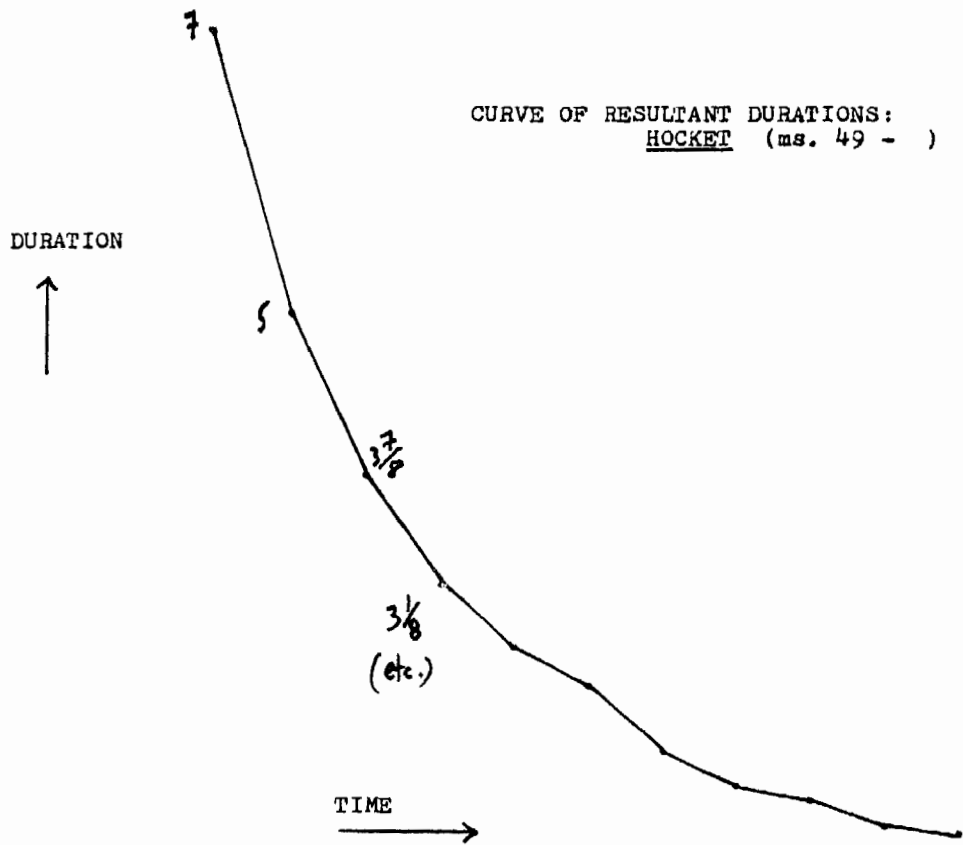


-the circular spatial effect caused by the immediate transference of the canonic material from voice 4 to voice 1 (which are adjacent in the room). At measure 89, a curious and beautiful thing happens in the score - the "sawtooth" changes to a "triangle" wave, and the spatial effect is that the canon alternates direction:



The similarity of this section to so much of Tenney's other music which utilizes the "swell" idea should not be

Example XII.5



Example XII.6

61

I

II

III

IV

(mf) cresc.

(mf) cresc.

(mf) cresc.

(mf) cresc.

64

I

II

III

IV



overlooked. The voices drop out, at triple piano, from the top down.

Hocket has a rather complicated arch structure. Measures 1-48 constitute the first section (rolls and aborted canon); measures 49-(approx.)73 the second, being the full statement of the canon with a hocket at the end; and measures 73 to the end being the inverse of the first section: first the aborted canon (or in this case the decay), and then the rolls. The idea once again is that the "swell" structure is replicated at several hierarchical levels, in both the durational and dynamic parameters.

Crystal Canon for Edgard Varèse is scored for four snare drums. The title of this third quartet puns on both the structure of the piece (the gradual cumulative nature in which the theme is built in the four voices resembles the formation of crystals), and on the fact that it is all based on the famous snare drum theme from Ionisation (Example XII.7 shows the full theme as it appears in Tenney). The quartet is in three sections, the first a canonic, gradual building up of the theme, with a little bit of the phrase added on each iteration. Unlike Wake, the four voices follow immediately, and build the phrase simultaneously, displaced a beat each (Example XII.8 shows one "sample" displacement). At measure 13, they begin the complete statement of the theme for the first time (still in canon). The second section of the piece begins at the end of measure 16

Example XII.7



Example XII.8

(though the fourth voice has a few beats to complete its statement), with an inverse of this process. With the snares off, and the rather distinctive idea of using a rim shot on the accent (dividing the theme more or less in half), the four voices in canon progressively state the theme in retrograde, shortening it each time. Each voice, after a few iterations, turns into a short ostinato, "out of phase" with the others, and while voices II and IV hold this, voices I and III commence the third and concluding section. It is similar to the first, except that the theme is built more quickly, with each voice adding its part, and each voice cumulatively including the increment of the previous voice. The first and third voices are spaced four beats apart, as in the beginning, and by the time the other two voices enter, the theme is nearly complete. The last few statements are shortened in successive voices (other than the first), so that they gradually come into alignment by measure 54, where the theme is stated once in unison (with a nice added touch in the final measure).

Crystal Canon is, along with Spectral CANON, Tenney's most extended and successful canonic study up to this point, and as such provides us with a glimpse into the way he would progress, especially with pieces like the string trio.

XIII. Harmonia

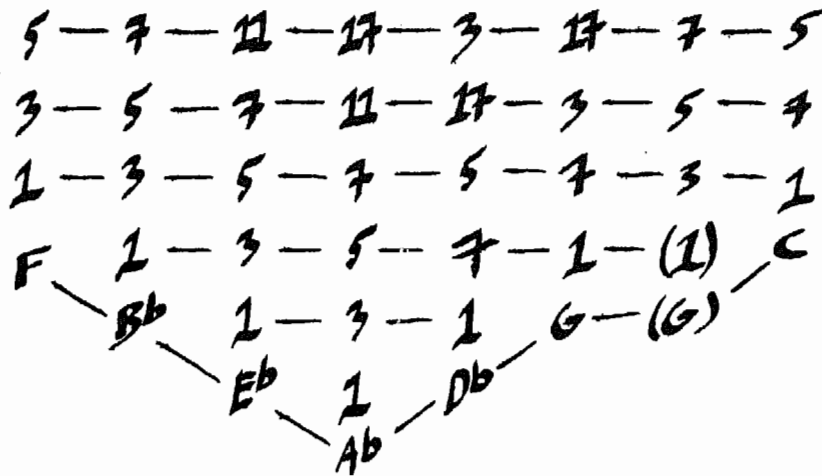
The four Harmonia, along with some related pieces (Saxony, Band and Chromatic Canon) represent in a way the current stage of Tenney's thinking (although there are several later pieces: Septet, Listen, Glissade, Voices, deus ex machina..., see Appendix II); all of which I am omitting from this article because I have simply not had enough time to "live" with them). The Three Indigenous Songs was actually written prior to many of the Harmonia, but was copied and premiered later.

Although in many ways, the Harmonia are clearly related to the Chorales, Clang and other earlier works, there is a kind of unity to the set that distinguishes them. For one thing, they are even more economical than most of Tenney's previous works, and their avoidance of musical drama, and strict adherence to canonical and harmonic formulations is taken almost to a compositional limit. They are each different solutions to a certain harmonic/canonic/formal puzzle, and the ways in which each solves this puzzle is unique and fascinating. There is some confusion about their numberings, since there have been several revisions. Acting on Tenney's wishes about the set, I have omitted #1 (later revised to be what is now #2), and retained the current numerical ordering even though it does not necessarily correspond to the chronological.

#2 is, as Tenney calls it, the "ur" version, in that it clearly states the harmonic idea without any artifice of orchestration, melody, rhythm, etc.. It is for any sustaining instruments, and is simply a chorale of available pitches. The piece is dedicated to the great American composer, theorist, teacher, instrument builder, etc., Lou Harrison, whose long interest in intonation has been an influence on Tenney.

In discussing its form, we can provide a basis for the other Harmonia as well. It consists of a steadily growing and then decaying chord, based on the primes of the harmonic series, which modulates roughly in the circle of fifths. The voice leading can be seen in the diagram of Example XIII.1, in terms of the number of the partial in relation to the new root. The basic principle is that of closest voice movement, with each successive chord in the first half containing one higher harmonic, and each in the second half one less. Tenney's idea seems to be one of an extended dominant, since in the Harmonia he tends to omit the 13th and 19th partials, basing the pieces on a chord that might be called an aug11 b9. (In the key of C: C-E-G-Bb-F#-Db). The first half of the piece is highly ordered, with a kind of canon by partial in each voice (1,3,5,7...; see Example XIII.1). The second half upsets this symmetry to some

Example XIII.1



VOICE LEADING SYSTEM FOR HARMONIA (from #2)

extent, mainly to facilitate the desired C dominant ending (so that the piece might be "cyclic"). Another interesting aspect of the piece is that in the first half (up to the Ab "tonality") the series is built up over a phantom root, suggesting the "tonic" before it actually enters. In the second half, the tonic enters under the old "tonality", and the higher pitches return to the new bass note. A look at the score shows the extremely smooth and clear voice leading, with no voice (except the bass moving in fifths) having a range of more than a major third. Example XIII.2 is the entire score for this piece.

#3 is a remarkable hoquet for three harps dedicated to Susan Allen, and is the one in the set that I have not heard in its completed version (though I am familiar with it in an earlier sketch). Each of the three harps is at a different pitch, harp I being 14 cents sharp of harp II, and harp III 14 cents flat. In this way, many of the intervals of the harmonic series primes can be approximated quite closely. For example, the just third (fifth harmonic) is exact between harps I and II, and between III and II, and the wider deviations from tempered tuning (like the 31 cents flat seventh and 49 cents flat 11th) are approximated by the pitch distance of the outer harps (28 cents). The most common usage of this, from "sections" IV through X (Bb through A in the modulatory scheme) shows the way in which the full

Example XIII.2

HARMONIUM #2

JAMES TENNEY
9/76

for LOU HARRISON

The score of HARMONIUM #2 consists of seven sections (indicated by double "bar-lines"), each of which is divided into two to five segments (single "bar-lines"). The notation shows available pitches for each segment, with numbers above notes indicating deviations from the tempered pitch in cents.

Each performer chooses one after another of the available pitches in the current segment, and plays it as follows: $ppp \leftarrow X \rightarrow ppp$, where "X" is the dynamic level notated for that pitch. Each tone may be from four to twelve seconds long, but its duration should be equally divided between the crescendo and decrescendo portions of the tone. After a pause at least as long as the previous tone, this process is repeated with the same or any other available pitch in that segment. Non-sustaining instruments with fixed intonation (e.g., keyboard and mallet instruments) may play only the lowest pitch in any segment, letting the tone fade away completely before sounding it again.

The transition from one segment to another may be initiated by any player, simply by introducing the newly available pitch for the next segment (a "white" note). These transitions should be timed so that the total duration of each section is somewhere between one and three minutes in length.

The musical score is presented in three systems, each containing four staves. The notation includes notes with dynamic markings such as $\langle mp \rangle$, $\langle mf \rangle$, and $\langle pp \rangle$. Above the notes, numbers indicate pitch deviations in cents, such as -14, -31, +2, +5, and -49. The score is divided into sections by double bar lines and into segments by single bar lines. The first system shows a sequence of notes with dynamic markings $\langle mp \rangle$. The second system shows notes with dynamic markings $\langle mf \rangle$ and $\langle f \rangle$. The third system shows notes with dynamic markings $\langle mf \rangle$ and $\langle pp \rangle$. The score is divided into sections by double bar lines and into segments by single bar lines.

"ur" chord is intoned (Example XIII.3).

Example XIII.3



The Eb tonality (1,3,5,7,11) is distributed among the three harps in such a way that the intonations of the partials are as follows:

<u>Pitch</u>	<u>Harmonic #</u>	<u>Harmonic Series Intonation (cents)</u>	<u>Harp Tuning (cents)</u>	<u>Deviation from "Natural Intonations"</u>
Eb	1	0	0	0
Bb	3	702	700	-2
G	5	386	386	0
Db	7	969	972	+3
A	11	551	586	+35
E	17	105	86	-19

Note that while these pitches perhaps derive from the harmonic series, a secondary result is that the use of this intonational adjustment creates a slightly different just fabric, for the tuning of the tritone (Eb-A) is almost exactly that of the 7/5 ratio, and the minor second (Eb-E) is surprisingly close to the 21/20. In fact, over the course of composing the Harmonia, Tenney began to consider the tritone and minor second as the "extended just" ratios 7/5 and 21/20, respectively, rather than the "harmonic series" intervals 11/8 and 17/16. The 7/5 is 583 cents, and so the "A" in the above chart becomes only 3 cents wide. The 21/20, 84 cents, also improves the approximation, making the E natural only 2 cents wide. (A close look at the cents deviations in the score for #2 will reveal that these ratios

are being used there as well). In the remaining Harmonia, where the intonation is not so specified, Tenney probably considered the ideal intonation to be a 7-limit one, but the structural motivation is, I believe, still strongly related to harmonic series primes. The use of seventh partial relations is something that has become important in Tenney's thinking (as we shall also see in Chromatic Canon), especially in the approximation of the harmonic series. Ironically, this is similar to some of the 7-based tunings that Lou Harrison has been working with recently (in the Gamelan Si Darius among others), but it also suggests that these systems of the "7 limit", (as Partch would call them), are fundamental to the extended tonalities of modern harmony.

The form of #3 is similar to #2: a continuous modulation of this chord, which is the result of two major triads superimposed a tritone apart (sometimes called the "Petrouchka chord", and an harmonic relationship common in the music of Ives as well), through different keys a fifth apart. These modulations are made gradually, often by small shifts in intonation between the "same" note on different harps (as in the Bb in Example XIII.4). The first four sections of the piece build up the chord and the temporal density, beginning in eighth notes and working up to the sixteenth note quintuplets that become a durational ostinato. The voice leading in the buildup of the six note chord is identical to that of the first half of #1, with the same resultant voice canons. The center sections of the piece (the bulk of the work) are simply modulations from one chord/six-note tonality to the next a fifth below, and as such there are eleven sections of the piece (the next would be back in the initial key, G). The quintuplet pattern is also a kind of phase pattern, in which the upward and downward arpeggios pivot around the highest pitch (21/20) so that each measure starts on the tonic (see Example XIII.3). Much of the modulation, as in Example XIII.4 from the beginning of the piece, sounds like the change from major to minor, because of the minor seventh of the new key (7th

Example XIII.4

The musical score for Example XIII.4 consists of three staves. The first measure is marked with a circled '2' and '(x3)'. The second measure is marked with '(x4)'. The third measure is marked with '(x5)'. The fourth measure has a tritone symbol (two flats) above it and a '3' with a horizontal line underneath, indicating a three-measure rest. The fifth measure also has a tritone symbol above it. The notation includes notes, rests, and dynamic markings such as 'mf'.

partial) replacing the major third (5th partial) of the old. This modulatory motif shows up in many of the Harmonia and related works (like the Chromatic Canon). The final section takes the tempi up to sextuplets forming a rather difficult hocket (Example XIII.5) in which the chord is finally stated as the octatonic scale of Chorales and Clang without the 13th or 19th harmonic.

#4 (for 10 instruments and tape delay) is in many ways the clearest exposition of certain of the Harmonia-related ideas. It is scored for clarinet, alto sax, tenor sax, vibraphone, piano, two violins, viola, 'cello, and bass. Certain devices are spelled out here more precisely than in any of the others. The piano, for example, is assigned the fundamental of each new tonality, and so it is assured that all the intonational adjustment must be made to an absolute pitch. The idea of a continuous, ever-modulating sound is also stated explicitly in the notes to the piece:

"Rather, a player's choice of which pitch to play at any moment should be governed by an awareness of the over-all sonority, which ought to have all of the available pitches in a segment sounding simultaneously and continuously, even though the timbre of each tone will be changing."

The tape delay (also used in Saxony, in an earlier piece seldom performed anymore called Symphony, and in Glissade,

Example XIII.5



one of his newest pieces) helps to create this idea of a single gestalt. One of the central ideas of all the Harmonia, and one that is also prevalent in such works as Beast, is the sonority of harmonic interference. Because of the tape delay ("delay time of 10-12 seconds, and a fade out time of about 45 seconds") and the overlapping of tonalities, the

"transition from one segment to the next will thus include a period of about 45 seconds, during which there may be considerable interferences between new and old pitches. Each segment should last long enough for this interference to subside, and the new pitch to become clearly established in the texture"
- (from the instructions to the piece)

The amplitude envelope of each pitch is specified as (~~ppp~~ ^x) or a swell from nothing to the current dynamic level of the whole piece and back. In addition, as in the first harmonium, the entire piece has a similar envelope. In this version, the dynamic level rises from piano to forte over the first four sections, and then remains there for sections IV and V. In the last section, there is a decrescendo to "niente". Another refinement occurs in the use of natural string harmonics to provide the proper intonations to which all the wind instruments might tune, and the viola is slightly scordatura to facilitate this. Harmonics up to #11 (approximating the 7/5) are used, as the remaining one (the 17th) is both too high a node and too close to tempered intonation to be concerned with.

The form of #4 closely resembles #1, and in many ways #4 is simply a specific realization of #2 (in a different "key"). The first four sections build the "1-3-5-7-11-17" chord in the same way as before, with the higher partials entering before the fundamental. At section V the new fundamental (F) enters below the old series. Its partials gradually replace those of the old one, and at section VI the same process occurs with the tritone-related key. This use of the tritone is a simple device for shortening the number of harmonic steps through which the piece must pass, (in this case 7; in #3, 12), and also a horizontal referent to the vertical sonority. During section VI, the higher ratios/harmonics drop out one by one until only a full dominant seventh chord is sounding (1-3-5-7). In the final section, this chord "resolves" to a dominant seventh in E without its fifth (third partial). The resolution is done according to the "rules" of traditional harmony (D#-D; A-G#; B,F#-E) and in this we can catch a glimpse into a sort of grand musical pun inherent in the whole set.

#5, for John Cage (the string trio), takes its place alongside of the Chorales, For Ann (rising), and a few others as what Tenney might call his "ur" pieces - those in

which an idea is presented in a manner so essential and clear that it seems to be more of a revelatory process than a composed piece of music. It is dedicated to Cage, because, among other things, Tenney inadvertently perhaps invokes the famous "square root" method (as in Cage's First Construction, String Quartet, and several other pieces; see glossary in Appendix) in its canonical structure. The canonic, rhythmic and harmonic structure of this work are quite complex, and deserve at some future date a more detailed analysis than time and space allow me here. Harmonically, the trio is similar to the others in the set. The movement here traverses 10 "keys", the final two somewhat anomalous with respect to the previous Harmonia schemes. The tritonal chord is constructed slowly - not until the sixth 11 measure section (in F) are all the six pitches sounding. As before, they enter in the order of their partial number - 1,3,5,7, 11,17. The final two sections (X and XI) do not, as far as I can see, correspond exactly to the general Harmonia idea, rather, they provide a distinctive and beautiful ending to this particular version. Section X, which "should" be the "Harmonia chord" in Db tonality, is only partially so, for the upper voice contains the notes: G-D-A-E, which incidentally suggest the use of the "missing primes" 13 and 19. However, I don't think this is the primary intent. Instead Tenney is effecting a general disintegration of the previous harmonic texture into a kind of C pentatonic in which the piece ends. This is then the only one of the Harmonia that does not travel full circle to the dominant of its initial key. In other words, instead of completing the cycle through the Gb and then B, the last two sections settle into a kind of harmonic stasis in the simple C pentatonic mode. This is more of a timbral decision than an harmonic one, for it gives Tenney the chance to use the bare, skeletal sound of the open strings and natural harmonics. (Example XIII.6).

A remarkable rhythmic canon occurs in the string trio! The piece is eleven sections of eleven measures long (thus the "square root method"). In each section, there is a different rhythmic arpeggiation aggregate which is the result of the canon. These aggregates are the resultants of the "Harmonia chord" (in partial and full harmony) arpeggiated in the various rhythmic configuration caused by the canon. The note duration values within each section for the leading voice (the violin) in divisions of the measure are:

$3/2, 1/2, 1/8, 1/12, 1/16, 1/24, 1/12, 1/16, 1/8, 1/12, 1/8.$

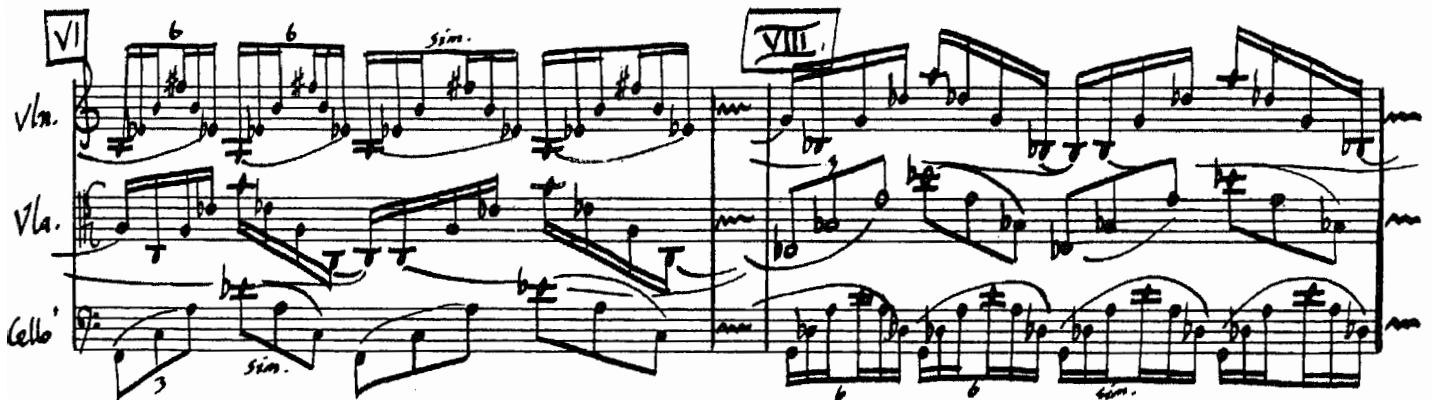
In addition, the rhythmic arpeggios are carefully crafted to coincide with the distribution of the chord in the three voices (Example XIII.7). Note that for the first six sections there is a kind of exponential decrease in duration (rounded to convenient metrical values), and that during the second half of the piece there is a kind of sinusoidal shape in this parameter. The aural reasons for this become obvious upon hearing the resultants of the superimpositions of

Example XIII.6

XI (measures 5)



Example XIII.7



the three canonic voices. During the first half, the temporal density of the piece exponentially increases (as in Hocket), and the second half represents not so much a decay

as a settling into a single sonorous gestalt, one that is continually "modulated" by the shifts in the vertical placement of the rhythmic material. Example XIII.7 shows this in two selected measures from the latter half of the piece. With the exception of the very beginning of the work, in which the violin and 'cello present a clear example of Tenney's "swell" devices (Example XIII.8), and in which the 'cello is a kind of leading voice, the violin is the imitated voice. Note that the canon is applied not only to rhythmic material, but also to the arpeggio voicing in each line.

On a different level, the string trio represents a degree of internal consistency and integrity that is quite astonishing. The instruments play nothing but arpeggios throughout, and so the piece has the feel of a kind of contrapuntal study, yet once the listener becomes aware of the fact that the texture will not change significantly, he is free to experience and appreciate the small changes in rhythm, harmony and texture that happen constantly. As in so much of his other music, the intent is to free the listener from the notion of surprise, and to present ergodicity in at least one dimension so the perception of the others might be more complete. In this way, the string trio succeeds like few other pieces of music that I have heard.

Band, for concert band, is a kind of appendix to the Harmonia. The main harmonic structure is the construction of a chord of all those pitches not in the "1,3,5,7,11" chord, and then a gradual modulation to the latter. Example XIII.9 shows the two chords whose fundamentals are a minor sixth apart. Note that the first chord, the complement of the "Harmonia chord", is simply two minor triads a tritone apart. The score itself is two pages of music and about five of instructions, with notes for the conductor on the tuning of the instruments (in a manner similar to #3), the

Example XIII.8

The image shows a musical score for two instruments: Violin (Vln.) and Cello. The Violin part is written on a treble clef staff with a tempo marking of $J=80$ and a dynamic marking of *pizz (on E)*. The Cello part is written on a bass clef staff with a dynamic marking of *p*. Both parts feature arpeggiated figures. The Violin part starts with a quarter note followed by a half note, then a quarter note, and continues with a series of eighth notes. The Cello part starts with a quarter note followed by a half note, then a quarter note, and continues with a series of eighth notes. The two parts are in a canon relationship.

Example XIII.9



various articulations (which are a nice glimpse into the kind of attacks, envelopes, etc., that Tenney favors), and the performance structure of the piece. One gets the feeling that it is intended for a high school band, and I recall that once Tenney mentioned to me that he felt he should at some time write music that could be played by "amateurs", though this of course does not suggest that the piece is any less serious. I think in one sense Tenney is happily tapping into the tradition of American high school bands, which is often the first place that young musicians get any real training in this country (at least it was in my case), and where they first encounter notions of ensemble. Tenney is exploring in the *Harmonia* and in this piece a more refined meaning of ensemble, and this is perhaps the marching band music of the future!

The temporal structure of the piece is a Fibonacci series from long to short (in seconds: 233, 144, 89, 55, 34, 21, 13, 8, 5, 3, 2) adding up to a little over ten minutes. The instruments are divided into three categories (see Example XIII.10, the tuning page for *Band*), and are tuned to make the same sort of 5th harmonic approximations as in #3. Each new note is assigned to instruments from a specific intonational group, and there is the same kind of aural/orchestrational meticulousness that we can hear in *Clang*, though we have not yet had the good fortune to hear *Band* played. The full chord which is the complement of the major tritone chord is built up more or less in fifths, and is complete at 9'15". In the next minute or so that follows, it changes into the "Harmonia chord" (Example XIII.11 shows this modulation). The pure sound of this piece will, I think, when we finally hear it, be quite fantastic, and will reveal strong influences of both Ives and Varèse.

Chromatic Canon, for two pianos (Example XIII.13), is dedicated to Steve Reich, who is a close friend of Tenney's and someone with whom, over the years, he has enjoyed a mutually supportive musical relationship. Tenney was one of

Instrumentation and Tuning System for BAND

	<u>group 1 (14 cents flat)</u>	<u>group 2 (± 0)</u>	<u>group 3 (14 cents sharp)</u>
4 flutes		# 1-3	# 4
2 oboes		# 1-2	
7 clarinets	# 1	# 2-6	# 7
3 bass clarinets	# 1		# 2-3
2 bassoons	# 1	# 2	
2 alto saxophones	# 1	# 2	
2 tenor saxophones	# 1		# 2
8 trumpets (or cornets)	# 1-2	# 3-6	# 7-8
4 horns	# 1	# 2-3	# 4
4 trombones	# 1	# 2	# 3-4
1 baritone horn	x		
1 euphonium		x	
4 tubas	# 1-2		# 3-4
1 <u>percussion</u>			
45 <u>instruments</u>	<u>12</u>	<u>(Glockenspiel)</u> 21	<u>12</u>

Example XIII.11



the original performers in Reich's groups in the sixties, and the latter was responsible for two very important concerts of Tenney's music in N.Y. a few years ago.

Although Tenney refers to it as a "minor" work (no pun intended), simply a "communication" to a friend, it remains a rather complex investigation into serialism, canon, and just intonation, drawing on the harmonic concepts of Band and the Harmonia. The "row" of the piece is as follows in Example XIII.12, (taken from the instructions to the piece). A little inspection shows that the inversion at the major seventh is the retrograde of the prime, and that the first six pitches (D, A, F, B, D#, G#) spell out the extended minor tonality of Band, in which minor triads a tritone apart are superimposed. The second half of the row is the "Harmonia chord" (major triads, or the prime partials without 13). Although the piece may be performed in tempered intonation, the suggested just tunings imply the harmonic series as well. Each of the two minor triads is the simple just (1/1, 6/5, 3/2) as are the major triads (1/1, 5/4, 3/2), with the tritone relationships 10/7 and 7/5, respectively (thus the necessary ratio transpositions in the example for the C major and G# minor triads). The 7/5 and 10/7 tritones used to split the triads are not particularly close to the 11th harmonic (7/5 = 593 cents, 10/7 = 617 cents, 11/8 = 551 cents), but since the other ratios are based on 3, 5, and 7, the harmonic series is approximated somewhat by this "just row". Note also that the complex tuning allows for considering either the B \flat or the D as the tonic 1/1, depending on the major/minor perspective. The tonics of the four chords are reinforced by holding down the same pitches a few octaves below with the sostenuto pedal down (a suggestion of Tenney's wife, Ann Holloway).

Example XIII.12



Chromatic Canon
for two pianos

Example XIII.13

for Steve Reich

James Tenney
1980/83

$\text{♩} = 288$

mp Ped.....*

(mf)

(f)

(mf)

(mf)

(mp) Ped.....*

Example XIII.14

An earlier work, Saxony, for multiple saxophones (one player) and tape delay, is related to the above pieces in its simple harmonic sonority and its use of the harmonic series, but is less complex in the latter. Here, only the harmonic series in its unadulterated form is used (on Eb). The piece has the usual "swell" dynamic envelope, and uses the first fifteen harmonics, in their natural octave spacing (Examples XIII.14) in the first half, and a selected set of the first 32 (one octave extended) in the second. The highest Eb (either 16 or 32) acts as a pivot, and the decay of the harmonic series in the second half of the piece is to the Eb an octave lower than the initial note. This low Eb, out of range of the baritone sax, is a result of the first order difference tones created by the tape-delay, as are the reinforcements and phantom "pre"-occurrences of many of the other pitches. It is one of Tenney's simplest pieces, and could almost be a postal piece. It is also quite beautiful (I have been lucky enough to hear it played several times). The use of the ability of most sax players to play the standard sax choir (soprano, alto, tenor, baritone) is quite ingenious, and the visual effect of one player using all the horns, creating the dense and shimmering harmonic structure, is a startling theatrical device. There exist several later realizations of Saxony for different instrumental combinations (see Appendix I), including a "generalized" version which Tenney says might be called a "stochastic canon." Each of the versions is almost exactly the same as the original, though in different keys. The title pun here is not perhaps so obvious as in Band and some of the other pieces, for it refers to a particular type of woven linen (fabric), and the reader is left to form his own conclusions.

XIV. Three Indigenous Songs

The Three Indigenous Songs are a rather remarkable acoustical/musical experiment, in which Tenney attempts to "simulate" the human voice through natural instrument sounds. It is a wonderful comment on the nature of technology, artistic experiment, and the current zeal for complex electronic sound generation, but also on the nature and meaning of approximation.

It is scored for two piccolos, flute, bassoon or tuba, and two percussionists (3 wood blocks, two suspended cymbals, and three tom-toms played with either stick or wire brush). The songs are "settings" of three characteristically American texts/musics: No More Good Water (a slow blues with harmonica accompaniment recorded by Jaybird Coleman of Alabama in the late twenties), Walt Whitman's Kosmos, and Hey When I Sing These Four Songs Hey Look What Happens (the same as in the earlier setting from Jerome Rothenberg's translation of an Iroquois chant). In each song, Tenney attempts to "synthesize" the sounds of the human voice by using the instruments to simulate the various formants and noise transients of the different speech sounds. They are transcriptions in the strictest sense, and there is a wonderfully disarming lack of "compositional" technique other than the audacious decision to actually do it. In the first, flutes are used to imitate the antiphonal harmonica interludes that Coleman plays between sung lines. In the second, Tenney recorded himself reading the Whitman poem and presumably used both his own speech rhythms and the timbral idiosyncracies of his own pronunciation for the transcription. In the third, the rhythm of the earlier SATB setting is used, with instrumental interludes added between each line, corresponding to the soprano "interludes" in the original.

In a way this piece resembles some of the work of Alvin Lucier in its strict adherence to a very simple scientific principle, but of course the particulars of the realization are pure Tenney. The instruments are presumably chosen because of the relatively simple spectra (very little harmonic content) so that each instrument may sound a particular formant region. Tenney's research into the acoustics of instrument tones is far-reaching, and though it most directly relates to Three Indigenous Songs, the effects are felt throughout his music. It can be seen musically in the attention to orchestral detail previously noted in Seeds, Chorales, Clang, and so many other works. In his theoretical works it is also prevalent (e.g., his computer-timbral research, or his analysis of Helmholtz's harmonic theory in "A Natural History of Consonance and Dissonance"). What occurs is not so much an accurate imitation of the voice, but a composition that is solely determined by the

microstructure of speech acoustics. The lines are quite intricate, but are completely analysable in terms of the shifting formants. The percussion is used to imitate various consonants, especially the fricatives and plosives, and the text is written out in the International Phonetic Alphabet in the score. I refrain from printing any examples from the work because of its imminent publication in another issue of Soundings Press.

Tenney's relationship to "indigenous" materials is a complex one, and he has stated it rather provocatively in Gayle Young's interview:

"GY: Do you think your style has been influenced by American folk music?

JT: No, not an influence so much as a conscious use, a conscious connecting up with, but not an influence in the sense of absorbing aspects of style, aesthetic, or intention, so that, after absorbing it, one's own music comes out determined by those characteristics."

The distinction between "use" and "influence" is important. Tenney is not interested in creating what Henry Cowell called "hybrid" music. The occurrence of traditional elements, as well as materials from other composers (Ives, Varèse, Satie, etc.) are almost always a kind of integrated juxtaposition of a "found" content with Tenney's own elaborate formal systems. He has never appropriated what might be called the style of another music, rather he has used familiar musical referents as "seeds" to his own compositional imagination.

What Tenney is after in these songs, aside from the musical/cultural interest (note that there is one black, one white, one Native American song), is the creation of a perceptual domain which we can be in some sense part of and in another sense relieved of the scientific nature of the musical experiment. We can simply enjoy the very interesting exploration of the question "what if...?". I don't think Tenney is particularly interested in the piece succeeding as voice synthesis, there are simpler ways to go about that, but rather as a kind of sound gestalt which comes from the scientific and artistic at the same time, a theme that has been present in much of his work. To Tenney, as shown by this piece, the artistic experience is both intellectual and emotional, and he is interested in blurring the boundaries in such ingenious ways that we might perhaps cease to simplify those distinctions with such ease. The voice, with its manifold acoustic complexities, is to him as beautiful as the Whitman poem and Iroquois song, and in such a piece he can express that embracing appreciation.

XV. Nancarrow, Ruggles, Ives et. al.

Over the years, Tenney's theoretical and critical work on the music of other composers has had a profound impact on the contemporary music community. In addition, he has energetically supported the work of his peers, and that of younger composers. Documentation of these activities is beyond the scope of this paper (though the reader can perhaps catch a glimpse of it in the selected references in the appendices), except in those efforts which have resulted in "formal" manifestation, for much of Tenney's work in this regard is simply a result of his ever vital activity in contemporary music, and justifiably resists annotation.

The Chronological Development of Carl Ruggles' Melodic Style is an attempt by Tenney to use the computer, in a purely statistical way, to quantitatively shed some light on the singular nature of Ruggles' approach to melody and the way it evolved throughout his compositional life. This analysis was facilitated by the fact that in all of Ruggles' music (only eight pieces, if the four Evocations are counted as one work) there is a clearly discernable melodic line. Tenney extracted the melody from each and subjected them to several rather simple statistical analyses, dealing with two significant factors in Ruggles' melodic style: the avoidance of consonance and pitch class repetition. A third, rather simple measure is the general intervallic distribution in the music.

"Significant changes in Ruggles' melodic style are manifested in my statistical results in three ways: (1) a gradual shift in the distribution of melodic-interval frequencies, (2) a more and more effective avoidance of early pitch-class recurrences, and (3) an increase in the frequency and proximity of dissonant relations within his melodic lines."

(from page 1 of Ruggles article)

A detailed analysis of Tenney's results would be superfluous here, and the reader is referred to the paper itself (see Appendix II for a reference), which presents these analyses in some detail. However, it might be instructive to briefly summarize Tenney's method. The computer program was written to provide five different measures for any given piece:

- 1) the interval-frequency distribution (percentage of total intervals of any given interval)
- 2) length of strings of different pitch classes (LSDP)
- 3) average of above for each piece (ALSD)
- 4) length of strings of consonant intervals (LSCI) - or number of pitches prior to the current pitch that are not related by minor second or its

equivalents.

5) the average length of such strings for a piece. (ALSC). The majority of the paper is an analysis of the way these statistics change through the course of Ruggles' music. Example XV.1, the final graph from the paper, shows the approximately inverse relationship of the functions mapped by Ruggles' forward trend in avoiding pitch class repetition (ALSD) and the use of intervals other than the minor second. Note that even an average decrease of about one unit in average length of string where a minor second does not occur (from 3.8 to about 2.8 in this case) is of statistical significance considering the quantity of data, and clearly represents a stylistic trend of importance. (The ALSD function in this graph is even more convincing). The measures and graphs of this article chronicle in a rather precise and objective way the continuous trend in Ruggles' music towards the kind of pure atonal chromaticism that he clearly sought, and the measures that Tenney selected seem to be an accurate way of describing, at least in part, the way Ruggles sought to achieve this effect. The method is also useful in that it provides strong formal and statistical evidence for our intuition regarding Ruggles' music. What I think is equally interesting as Tenney's careful illumination of the work of one of America's greatest and least understood composers, is the way that it relates to his own music, which except for Monody and a few other early pieces, has very little to do with melodic development. It is implicit in Tenney's study that although Ruggles chose melody as one of his principal expressive dimensions, what is important is the consistency of the search for its refinement, and the great care taken to produce a surface structure which is an integral manifestation of large generative ideas. In this way, the nature of Tenney's thoughts on Ruggles' music say much about the parallel development in his own music, which also seems ever to be engaged in a process of refinement.

Very little can be said about Conlon Nancarrow's Studies for Player Piano, mainly because of my respect for the pitfalls of the kind of recursion that might result with this present article. Until Tenney's work on Nancarrow, very little had been written on him (with the notable exception of Gordon Mumma's fine liner notes to the now out of print Columbia record). Tenney's thoughts on the Studies for Player Piano are more than a first step and an introduction, they go a long way towards providing a large view of that remarkable body of work which is Nancarrow's music, and provide a necessary bridge for both listener and scholar between the music and its comprehension. Recently, Nancarrow's music has been getting more of the kind of attention it deserves, and Tenney's share in the responsibility for this cannot be questioned. Once again, I would refer the interested reader to the article itself, which contains many in-depth "studies" of the Studies themselves.

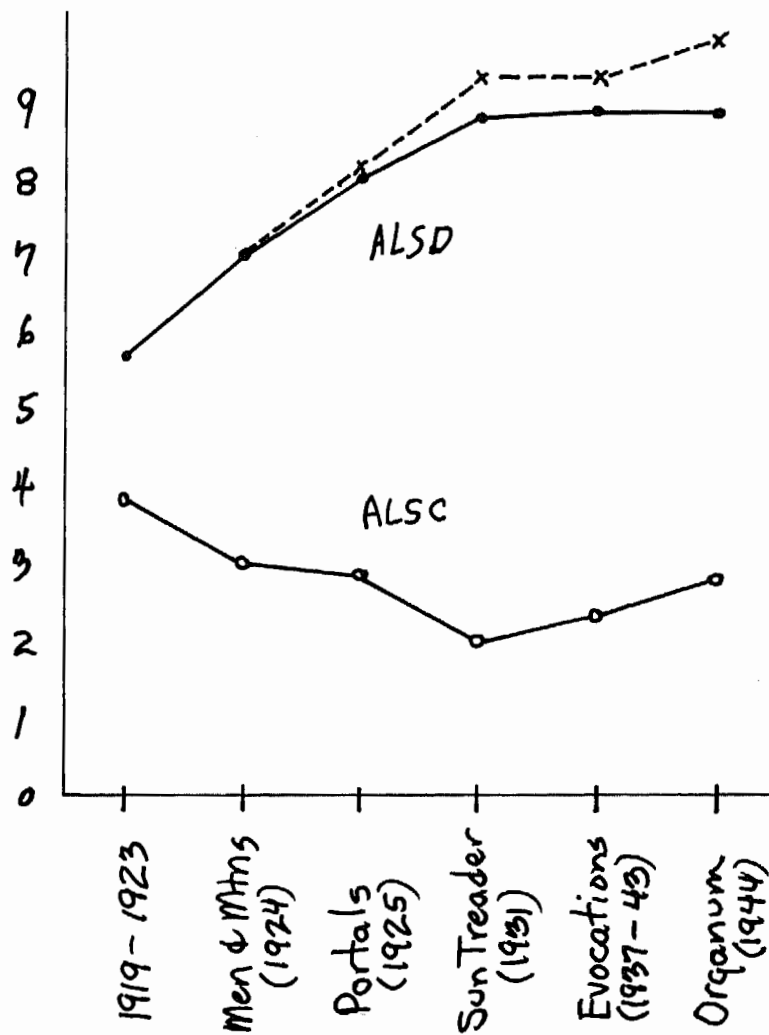


Figure 27 ALSD and ALSC as a function of chronological sequence.

(Example reprinted from *Perspectives of New Music*, Fall-Winter 1977.)

One of the introductory paragraphs in the article, does, however, say quite a bit about the nature of Tenney's own musical personality, his interests, and his conception of contemporary music:

"Over the last three years it has been my good fortune not only to meet the man, but to acquire a nearly complete collection of scores and tape recordings of the Studies. It is a dazzling experience to listen to the whole set in numerical sequence - an experience not unlike the one many of us had a decade or so ago when we heard the first recordings of the complete works of Webern. And on the basis of my own growing familiarity with the Studies for Player Piano, I predict that the 21st-century historians will rank Conlon Nancarrow - with Edgard Varèse, Olivier Messiaen, John Cage, Harry Partch, Karlheinz Stockhausen, Iannis Xenakis, and perhaps a very few others - as one of the most important composers of this third quarter of the 20th century. Moreover, I believe that Nancarrow's Studies will stand with the most innovative works of Ives, Schoenberg, Stravinsky, Webern (and "a very few others") as the most significant works composed since 1900, in terms of their ultimate influence on the progressive development and evolution of our powers of musical perception. I am aware that these predictions may seem extravagant to some, but I am convinced that, when Nancarrow's music is as accessible and widely known as that of his contemporaries and immediate predecessors, its importance will be just as widely recognized, and there will remain no room for doubt."

Tone Roads...

In the early 1960's, Tenney along with Philip Corner and Malcolm Goldstein (and with the help and frequent participation of many others, including Carolee Schneemann and Elizabeth Monroe who did several beautiful posters and programs, soprano Norma Marder, Burton Kaplan, composer/publisher Dick Higgins, George Flynn, Max Neuhaus...) "formed" the Tone Roads Ensemble. Initially the intent was to play the then little-performed music of Ives, and subsequently a few other radical American composers (Ruggles, Cage, Feldman, Varèse, etc.) were added. The group later began to include the work of several younger composers on its concerts, and eventually some of Tenney's music was played. The group was important in its initial response to what was at the time a serious lack of contemporary music in N.Y. (not to mention outside of N.Y.). The performances, of which a few tapes are still around, are extraordinary, both in their tremendous attention to detail,

and in their real sensitivity to a music which had almost never been heard. In his program notes to the Dec. 1963 concert, Tenney describes both the nature of Ives' music and perhaps his own thoughts on American music:

"Ives' image of diverse but intersecting "tone roads", so aptly characterizing the form and spirit of the two pieces of that name on our program, may also serve as a symbol of the vital experimental tradition in American music since 1900. Sometimes convergent ("All roads lead to the Centre - in a race to Town Meetin'", Tone Roads No. 1), sometimes not ("There are many roads, you know, besides the Wabash", Tone Roads No.3), they were indeed "rough and rocky". Hewn in the very process of moving from one vantage-point to another, and not meant to be travelled too often (either in style or in comfort), they have nevertheless altered the modern musical landscape irrevocably. It remains a lonely territory, but the younger composer today may feel a little less lonely in discovering these paths carved out so firmly by others."

Earlier, in the notes for the all-Ives concert of May 11 (1963), Tenney succinctly states his feeling for Ives' music:

"But the music of Charles Ives represents both the culmination of one era and the beginning of another, and although the full significance of his contribution is far from being realized, we believe that this is due primarily to a lack of sufficient opportunities to actually hear the music. It has a vitality that speaks for itself, far better than any words can, and more frequent performances - especially of those pieces that have not yet been played at all - will be all that is needed to demonstrate its significance. And as his work becomes a more integral part of our common musical experience, that experience will be greatly enriched, and Ives' name will be given its rightful place in the living history of music."

The Tenney/Corner/Puffer recordings of the Ives songs (on Folkways) remains to this day one of the finest and most sensitive presentations of the Ives pieces, and anyone who has been fortunate enough to hear Tenney perform the Concord Sonata will attest to the fact that Tenney's understanding and devotion to the music of Ives is unsurpassed. Since the days of Tone Roads, Tenney's activities as a conductor, pianist and educator of this music have not subsided, and indeed he seems to get more energetic in these activities every year.

But perhaps the most important musical and personal relationship of Tenney's career has been to Varese and his music. This can be seen in Tenney's frequent references to the importance of Varese's work on his own, and also in the obvious lasting effect that the friendship has had on his own music, life and career.

"If I speak here of the man, more than the music, it is only because of my absolute certainty that the music will take care of itself - such is its inherent vitality and durability. The only danger is that it may be too quickly absorbed by the academies - those funereal institutions dedicated to the "proper" burial of a man's lifework, when they have not been allowed to bury the man himself. And this will be done with blatant disregard of the central esthetic premises of the work. Music "must resign itself to the rigours of creative unrest, to the discipline of constant tension, to plunge again into its normal state of permanent revolution." Again, "...the word 'evolution' is generally used when the startling changes that have taken place in the past are discussed in the present, for they have ceased to startle. But radical changes in music written today are considered not evolutionary, but dangerous and destructive. And they are. Dangerous to inertia and destructive of habits." All this may be drawn from the music, of course, but what will happen when "Integrales," say, has become as familiar to our ears as a symphony by Beethoven? Will we remember this most essential lesson - that every truly creative act is "dangerous and destructive," that music's "normal state" is one of "permanent revolution"?...

"...He loved the City, and its sounds, and it was from him that we learned to hear such sounds as musical material. "I have always looked upon the industrial world as a rich source of beautiful sounds, an unexplored mine of music in the matrix...whole symphonies of new sounds have come into the modern industrial world and have been all our lives a part of our daily consciousness." As we learn to listen to these sounds, we may also learn new ways of listening to music. "The public to whom music is addressed should shake off its apathy and allow itself to be taught to discern the true nature of music and the necessity for a constant revision of values." That is, not just once, or once every few years, but constantly. Otherwise, such "values" are utterly useless to us. They become stagnant, and the vitality of our perceptions dies with them."

(from Edgard Varese, by James Tenney)

XVI. META / HODOS

The three papers that explore Tenney's ideas of hierarchical gestalt perception (although two are more or less book length), form a body of theory that is essential and unique in the twentieth century, and one of the most profound expositions of Tenney's thought. The first, Meta / Hodos was written in 1961, while Tenney was still a student of Ken Gaburo's at the University of Illinois. The second, META Meta / Hodos evolved about fifteen years later as an "outline" for a course in Formal Perception and Analysis at Cal. Arts, and the third, Hierarchical Gestalt Perception in Music, over a period of about three years beginning while Tenney was at UC Santa Cruz (around 1976), and ending in 1978 at York University in Toronto, where he is currently on the faculty. The third (HGPM) is an extension of the first two, and the second (MMH) more or less a condensation of the first (MH).

META / HODOS, though it has never been published in any accessible fashion, has an extremely wide following among composers and theorists, especially those of the younger generation, and has had a tremendous impact on the musical thinking of composers far in excess of its popular acclaim. It is always astonishing to me how many people I run into who say they've read it, and that it was an important influence on their musical thinking, when the fact is that it is only circulated hand-to-hand, and that at present new copies are only available by reproducing older ones or by writing to Tenney (which does not necessarily get you one). Yet it has a wide circulation in certain circles, and I think this is because of the relative paucity of real music-theoretical, non-textbook work that exists. MH is a difficult work, but is one of the clearest attempts by a contemporary musician/theorist to lay a formal basis for much of contemporary music. In this it takes its place alongside Partch's Genesis of a Music, Cage's Silence, and other seminal works of modern theory.

The following is an attempt to comment on and very briefly describe these theoretical formulations, and relies chiefly on quotations from the three papers themselves. (Page numbers should not be considered to be authoritative, as there are more than one pagination of the papers in circulation). The reader should consult the works themselves for a full statement of the theories.

META Meta / Hodos basically presents the same material as MH, but in highly concise and abstracted form. While MH is full of musical examples and long, detailed descriptions of certain processes, these same ideas are presented more as theorems and postulates in MMH. The two papers can be read and studied as one, with the second being a kind of "abstract" to the first.

The fundamental motivation for the "theory of hierarchical perceptual gestalt formation" as outlined in these two papers is the failure of modern theory to account for what Tenney calls the "new musical materials". To deal with the music of Webern, Varèse, Schoenberg, Ives, Ruggles, etc. in a manner which represents an extension of older formal ideas is of course partially justified, for their music is steeped in tradition, and though revolutionary, it also bespeaks a complete mastery of the music of past generations. Yet Tenney argues that with this new revolution in music - the breakdown of functional harmony, the focus of attention on musical parameters (timbre, density, intensity) which were, in the past, secondary - new means for formal distinction need be developed. Theory must not only analyze what has happened, it must also provide a perceptual basis for the listener to start from. With this in mind, Tenney's theory is an attempt to formalize musical theory from a new standpoint which draws considerably more from gestalt psychology and an abstract notion of formal perception than it does from classical music theory.

Basic to the theory is the consideration and codification of the multidimensional space in which musical "points" exist. Each musical event, whether it be a single note or a larger grouping of notes, phrases, or even the entire piece, can be quantified in various ways that reflect its perceptual impact. These values are called the state of a temporal gestalt unit, and are expressed simply as the means and ranges (and possibly other similar statistical measures) of various parameters over a given temporal span. For instance, the pitch state of a single note might be just its frequency (or more likely a logarithmic expression of same), whereas the pitch state of a phrase (which we'll call clang after Tenney's terminology; see glossary) might be expressed as the mean of all the single pitches occurring in that clang (or next higher level TG). These kinds of measures are applicable to all parameters, and all levels of TG formation, but are not necessarily defined in mathematical detail in these two papers (that formulation is explored in the third of the set). Once these values are taken into account, however, it is easier to explain how the gestalt notions of segregation and cohesion become factors in our musical perception, for these depend to some degree on the notion of a difference function in the temporal input stream, and by computation of these states, even if it is done by the ear and brain, such a difference function becomes reasonable. Another, equally important factor of perceptual grouping in TG formation is that of the temporal (or statistical) proximity of two TGs - those most proximate will tend to form higher level TGs. (It is interesting to note that these measures become integrated into one metric in the later mathematicization of the model).

Perhaps less formally developed, but just as important an area for investigation, is the notion of shape, or the

set of parametric values in which the sequence of events is important. In statistical measures of the mean and range variety, a given set of values is unordered for quantitative purposes, but this obviously does not take into account the important function of various types of motivic recognition processes in our perception. The definitions from MMH show this difference in Tenney's own words:

"DEFINITION 16: State refers to the statistical and other "global" properties of a TG, including the mean values and ranges in each parameter, and its duration.

DEFINITION 17: Shape refers to the "profile" of a TG in some parameter, determined by changes in that parameter with respect to either of the distributive parameters, epoch and pitch-height (or their acoustical correlates, "real" time and log-frequency)."
(p.4, MMH)

Each "aspect of form", state and shape (though Tenney also discusses a third, structure) is involved in the formation of the hierarchical gestalt "map" of a piece. The notion of hierarchical gestalts is a rather simple one - successively higher level TGs are composed of lower level TGs, ranging perhaps from the "sub-element" level (the spectra and envelopes of single tones) to the highest level, a piece itself, a composer's entire work, or even a musical-historical epoch.

Tenney's description of the various dimensions of the musical space is one of the more interesting realms of the theory, as it draws heavily from his research into acoustics and the psychophysics of sound. It tends to support those descriptions of music which would be least susceptible to the type of subjective discussion in which theory and criticism is often confused. As an example, it is perhaps worth an extensive quotation from MMH on these parameters:

"B. On Musical Parameters.

DEFINITION 9: A parameter will be defined here as any distinctive attribute of sound in terms of which one sound may be perceived as different from another, or a sound may be perceived to change in time.

COMMENT 9.1: This definition refers to "subjective" or musical parameters (e.g., pitch, loudness, etc.), as distinct from "objective" or acoustical parameters (frequency, amplitude, etc.).

COMMENT 9.2: There is not, in general, a one-to-one correspondence between musical and acoustical parameters. Where there is such a correspondance, the

relation is more nearly logarithmic than linear.

PROPOSITION III: Pitch, timbre, and (musical) time are not simply one-dimensional parameters, because each includes at least two relatively independent "sub-parameters".

COMMENT III.1: Similarities and differences between any two pitch intervals are perceived in two different ways, depending on their relative magnitudes and their interval qualities. These, in turn, result from differences in what will be called (1) pitch-height, and (2) pitch-chroma.

DEFINITION 10: Pitch-height refers to that aspect of pitch-perception which depends on the existence of a continuous range of pitches, from low to high.

DEFINITION 11: Pitch-chroma refers to that aspect of pitch-perception which depends on the phenomenon of "octave equivalence", and the fact that the continuous range of pitches is also cyclic, virtually returning to its starting-point in each transition from one octave to the next.

COMMENT 11.1: These two sub-parameters may be related to the fact that there are two distinct mechanisms of pitch-perception involved in hearing - a "place" mechanism (determining pitch-height) and a "time" mechanism (determining pitch-chroma). The place mechanism is most effective for high frequencies, the time mechanism for lower ones, but the two overlap over a fairly broad range in the middle register, and it is here that our pitch-perception is the most acute (and the most bi-dimensional).

COMMENT 11.2: The multi-dimensionality of timbre is due to the fact that it is determined in a complex way by our perception of a large number of acoustical features, which may be subsumed under three categories:

- (1) the steady-state spectrum,
 - (2) various kinds of steady-state modulations,
- and
- (3) transient modulations or envelopes.

COMMENT 11.3: The sub-parameters of (musical) time will be called (1) epoch, (2) duration, and (3) temporal density.

DEFINITION 12: Epoch refers to the moment of occurrence - in the ongoing flow of experienced time - of any musical "event", compared to some reference

moment such as the beginning of the piece.

DEFINITION 13: The temporal density of a TG is the number of its component, next-lower-level TG'S per unit time; ("duration" will be used in its usual sense).

COMMENT 13.1: The average temporal density of a TG at a given hierarchical level will thus be equal to the reciprocal of the average duration of its component TG's at the next lower level.

COMMENT 13.2: "Tempo" is a special case of temporal density, referring to an expressed or implied pulse or "beat", rather than to actual durations, and it is only relevant to lower-level TG's.

DEFINITION 14: Pitch-height and epoch (which correspond most closely to the acoustical parameters, log-frequency and "real" time) will be called distributive parameters, because a difference in at least one of these is necessary for two sounds to be perceived as separate.

DEFINITION 15: All other parameters (including loudness, pitch-chroma, duration, temporal density, and the several sub-parameters of timbre) will be called attributive parameters. Note that a difference in any of these is insufficient, by itself, for two sounds to be perceived as separate - there must also be a difference in one of the distributive parameters."

(pp. 2-3, MMH)

Note that Tenney is careful to make a clear distinction between acoustical and perceptual parameters (e.g., frequency and pitch), and that the subclassifications (for example, pitch-height and pitch-chroma) are somewhat unorthodox in terms of conventional "musical" thought. The temporal parameters are, I think, especially interesting and illuminating, and this became of tremendous importance in the computer model of the TG formation process.

Tenney is interested in an objective theory, one which has little room in it for judging one piece against another. There are some things which the theory does not include, like a description of the mechanics of "vertical perception" (harmony, rhythmic counterpoint, aggregate formation...), and an investigation into the perception of musical shape, but these are left as areas for further thought which will later fill in the gaps in the broader superstructure. Tenney has already begun a rather extensive examination of harmony (as we will see in the next chapter), and has made tremendous advances in the modeling of hierarchical gestalt

formation (see below). An equally in-depth discussion of "shape" from him is something that many look forward to.

The conclusion of MMH represents an extension of MH, in that it attempts to include some of Tenney's thoughts on information (or entropy) theory in relation to TG formation and perception. Once again, I refer the reader to the paper itself for the clearest exposition of this. In this final section lies a theoretical statement for the perceptual ideas underlying many of Tenney's pieces (with the computer works being the most obvious examples), as well as, I believe, a fertile area for compositions yet to come. Each of the definitions and propositions in this section seems to me to be a "proposition" for a piece, some realized already, some not yet composed.

The final installment (or maybe just the most recent) is entitled somewhat ominously: Hierarchical Gestalt Perception in Music, A Metric Space Model, and the first version was completed in Toronto in 1978. (The published version, "Temporal Gestalt Perception in Music", in the Journal of Music Theory, is a shortened version of the first manuscript. My references are to the original). Here, Tenney models the statistical TG formation process by means of a relatively simple (just a few hundred lines of straightforward FORTRAN code) computer program in a powerful way. The algorithm is very direct: given a set of parametric values (and later, multiparametric "distances"), the resultant difference function is analysable in such a way as to be able to determine at what point TG's will be formed. Tenney himself paraphrases the theory and algorithm outlined in MH as follows:

"...in a collection of sound-elements, those which are simultaneous or contiguous will tend to form clangs, while relatively greater separations in time will produce segregation - other factors being equal... those which are similar (with respect to values in some parameter) will tend to form clangs, while relative dissimilarity will produce segregation - other factors being equal."

(from MMH, quoted on p.6 of HTPGM)

"First, the principles, as stated, were not "operational", but merely descriptive. That is, although they were able to tell us something about TGs whose boundaries were already determined, they could say nothing about the process by which that determination was made. They described the results of that process, but not its mechanism. Second, "similarity" was not defined in any precise way, except by reference to "values in some parameter". The assumption here, of course, was that the similarity of two elements is an inverse function of the magnitude of the interval by which they differ in some parameter.

This remains a plausible assumption, though it was never made explicit - but even such a correlation of similarity/dissimilarity with interval-magnitude does not, by itself, allow the simultaneous consideration of more than one parameter at a time. This rather profound difficulty was implicit in the "other factors being equal" clause appended to the two statements. At the time, this qualification seemed necessary, in order to rule out cases where two or more parameters vary in conflicting ways, or where two or more "factors" function independently. Although this was a useful device for isolating and studying some important aspects of temporal gestalt perception, it imposed a very severe limitation on the range of musical examples whose gestalt structure might be predicted. In most real musical situations, other factors are manifestly not "equal", and our perceptual organization of the music is a complex result of the combination and interaction of the several more-or-less independent variables.

Third (and finally), these early formulations referred to one hierarchical level only - the grouping of elements into clangs - although it was obvious to me even then that the similarity-factor, at least, was of great importance in the perceptual organization of TGs at all higher levels."

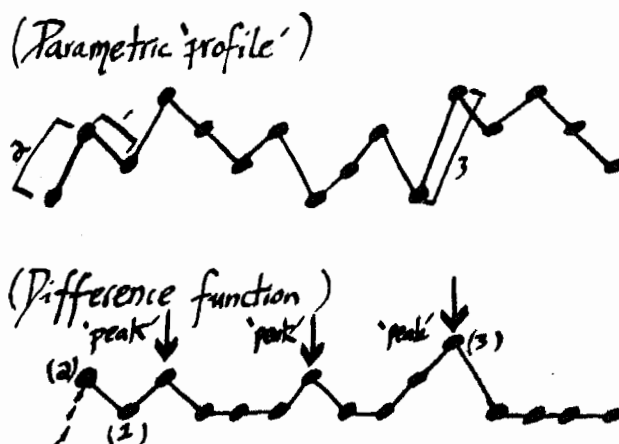
(p.6-7

HTGPM)

The "mechanism" can be illustrated visually as follows: The top function is simply a "parametric profile" or plot of the functional values in some arbitrary parameter. This could, for example be a set of pitches, intensities, or even timbres. The bottom function is a first order difference plot, in absolute values, of the parametric profile. Note that it always has one less value than the top. We can easily see where the TGs are formed - where there are peaks in the difference function, and this rather simple algorithm is the basis for the computer model.

It was clear that the perception of TGs is not based on

Example XVI.1



single parameters by themselves, but rather on a perceptual integration of all relevant parameters, and to this end the resulting metric space model was developed. A metric is a single-valued distance function which has certain minimum criteria (always positive, zero implies identity, reflexivity, and the "triangle inequality" - all mathematical notions that are not germane here). A metric space is a set of points in which we can determine the distance between any two points by some assigned "distance function", or metric. In a topological sense, the nature of the function and the characteristic property of the points defines the "nature" of the space. For example, in ordinary Euclidean 2-space (the set of real valued pairs) the simple Euclidean metric:

$$d(A,B) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

- where A = (x₁,y₁); B = (x₂,y₂);
 (A and B are points - ordered pairs - in Euclidean 2-space).

reflects to a large extent our normal perception of the physical (non-relativistic) realm, or would if this were carried out into three dimensions. There are of course infinitely many metrics in infinitely many spaces, and experimental psychology (as in the pioneering work of Roger Shepard) has long been interested in what ways metric spaces model perceptual spaces. Tenney's model is simple, yet elegant. The multidimensional parametric values are mapped onto Euclidean n-space (the set of real valued n-tuples), and the metric used, after some experimentation, is a simplified version of the Euclidean - one called the city block or taxicab metric (because the distances it produces are similar to the way one must travel around, say, the streets of (midtown) Manhattan). It is beyond the scope of this paper to go into the mathematical motivations for this essentially topological decision other than to say that there were empirical and perceptual motivations as well, based on evidence from the literature and on the results of preliminary program runs.

By using such a metric, we can obtain a single-valued difference function (exactly like Example XVI.1) from a multi-valued parametric profile. The metric gives us the means for integrating various musical parameters in a way that is likely to be similar to our own perceptual processes. Various details come into play, e.g., how should different parameters be weighted and scaled in the metric function? For a more thorough discussion of this the reader should refer to the paper. The precise algorithm for multiparametric TG formation is given in the paper as follows:

"A new clang will be initiated in perception by any element whose distance from the previous element is greater than the inter-element distances immediately

preceding and following it."
(p. 16 HTGPM)

Using this metric and decision making procedure for "peak formation", we can for example partition the set of elements (multidimensional note values) into a set of clangs. By computing the means of these clangs (parametrically), the same process can be applied to that level to parse clangs into sequences, and so on up the hierarchical ladder. It is interesting to note that the actual computer program reflects this: the code is the same for all levels, and simply loops back at the end of each. There is no distinction made in the algorithm between TG formations at different levels, and this seems to me to be quite elegant, and an interesting sidelight on our perception.

The program accepts as input the notes for a given piece (however, only monophonically), and outputs an analysis of that piece into its constituent TGs at all levels, with some relevant information as to the "strength" of TG initiations, and statistical means and ranges of higher level TGs. Much of the paper deals with detailed examples from standard literature (Varèse's Density 21.5, the melodic line from Webern's Concerto, and Debussy's Syrinx), so that the results might be tested against our own perceptual analyses of this same music. Some inspection of these results will, I think, surprise the reader in its ability to accurately model the perceived form and structure of the piece on this simple statistical data alone, where harmonic and motivic considerations are not even used.

The model is still a primitive one, even if its results are quite "slick". As yet, there is no means for formally determining weightings, nor is there any allowance for these weightings to shift during the course of the music (as our attention shifts from say the melody to the rhythm). Harmony and motivic recognition, when integrated, would make this model an even more striking example of musical artificial intelligence, as would the ability to consider polyphonic input streams. However, the algorithm and model even now seem to be of revolutionary importance in the understanding of musical form and perception, and one hopes that others will see fit to continue Tenney's work.

XVII. Harmony

Tenney's first installment in his investigation of the theory of harmony is a lengthy, primarily historical paper entitled A History of 'Consonance' and 'Dissonance'. The main thrust of this work is to provide an historical and developmental background for the formal notions of harmony that he is interested in, and as such attempts to show the development of the semantic and theoretical consonance/dissonance concept (CDC).

"It seems obvious that our first problem is indeed a semantic one, and that - among many other difficulties which ensue from this - until this semantic problem has been solved any speculative theory that might be developed in an effort to explain the nature of consonance and dissonance in musical perception is doomed to failure from the very start, since there is no common understanding about what it is that such a theory ought to "explain". What is perhaps not so obvious is that the semantic problems associated with consonance and dissonance are rooted in the complex historical development of what I will call the "consonance/dissonance concept" (or CDC) in western musical culture, and that a careful analysis of that historical development is the only hope we have of unravelling the tangled network of meanings and interpretations which so confuse the issue today."

(p.4 A History of 'Consonance' and 'Dissonance')

The paper is primarily composed of citations from historical theorists, outlining what Tenney calls the five stages of CDC. He is not so much interested in the compositional practices of consonance, but rather the theoretical and compositional "conceptions" of consonance/dissonance. As he says:

"First, it is absolutely essential that we distinguish between conceptions of consonance and dissonance, on the one hand, and on the other, explanatory theories of, esthetic attitudes toward, and practical uses of consonance and dissonance. In spite of the obvious and intimate interrelations between the various aspects of the larger problem of consonance and dissonance, they have each followed a relatively independent course of historical development. Thus, for example, the debate which raged in the early 17th century between Artusi and the brothers Monteverdi involved disagreements regarding the

proper use of dissonance - and thus also esthetic attitudes toward consonance and dissonance - but no essential disagreement regarding the meaning of these terms - and thus of the conception of consonance and dissonance. This paper is not intended to be a history of consonance/dissonance "treatment" as such, or a history of theories of consonance and dissonance, but rather a history of the underlying conceptions of consonance and dissonance, and these other aspects of the problem will be dealt with only to the extent that they may be helpful in clarifying the nature of these conceptions in a given historical period."

(p. 6)

The five historical stages can be briefly described as follows:

CDC-1. The consonances are thought of as those pitch intervals directly tunable using simple string-ratios, in particular those ratios which are found in the Pythagorean tetraktys:

.

 .

 .

 .

 .

(4/3, 3/2, 2/1, 3/1, 4/1). The octaves, fifths and fourths are the only pure consonances. This is essentially (according to Tenney) a melodic consideration, "referring to a sense of affinity or relatedness between the pitches forming an interval" (p. 119). This earliest form of the CDC begins around the third century B.C.E and continues up until the Ars Antiqua at about the ninth century.

CDC-2. From about the ninth to the thirteenth century, the advent of polyphony and the resultant compositional techniques led theorists and composers to consider the "sonorous qualities of certain dyads" (p. 120). The rank ordering of the intervals was now made on the criterion of the tendency of a given dyad to merge into a single tone, but Tenney observes that at the beginning the particular intervals which were considered consonant did not change much. Later, thirds began to be included, and a major concept of this period is the introduction of a well-ordered rank to the intervallic set - the notions of perfect and imperfect consonances and dissonances, though of course different theorists had their own rankings. The important shift in thinking from the previous period occurs in the new concern with the vertical properties of pitches and intervals.

CDC-3. Tenney describes this stage as follows:

"This form of the CDC seems to have been shaped by two factors: (1) a tendency to reduce the number of distinctly labelled categories to a smaller set which would have an operational correspondance to the rules of counterpoint, and (2) the emergence of a new criterion for the evaluation of consonance and dissonance. As a result of the first of these factors, the five or six perceptually distinct categories in CDC-2 were reduced to three operationally distinct categories: "perfect consonances" (octave and fifth), "imperfect consonances" (thirds and sixths), and "dissonances" (all others, including the perfect fourth). Although in most other respects the new classification system looks simply like a reduced version of those in the 13th century, the change in status of the fourth cannot be explained in this way, and thus the second factor listed above is invoked - the emergence of a new criterion, involving another aspect of the sonorous character of simultaneous dyads."

(p. 121)

CDC-3 is the roots of functional harmony, and of the exploration of the functionality of the dissonance. The period of the CDC-3 was roughly the Renaissance.

CDC-4. In this Tenney sees the beginnings of a formulation of a theory of functional harmony, root relatedness, and the notions of resolution and harmonic motion, beginning in the early Baroque, and, in some sense, lasting until the present day. Here the notion of the triad becomes paramount, and consonance/dissonance relations revolve around that.

CDC-5. This "final" form of the CDC is based almost entirely on the "theory of beats" postulated in the nineteenth century by the great German scientist Hermann Helmholtz. "Helmholtz equates the dissonance of a simultaneous aggregate with the "roughness" of the sensation caused by beats between adjacent partials (and to a lesser extent, between combinational tones") in the combined spectrum of the tones forming the aggregate." (p. 107). Tenney tries to show that since Helmholtz's CDC involves "generally dyads or other simultaneous aggregates isolated from any musical context" (p. 109), it is essentially different from the four CDC's preceeding it and constitutes an entirely new form (CDC-5). Tenney discusses at length some of the interesting ramifications of this form of the CDC, particularly the current psycho-acoustical controversy surrounding it, since so many of today's notions of harmony and consonance/dissonance are derived, at least in part, from Helmholtz's revolutionary work. In particular, CDC-5 is the only version which accounts for, or at least tries to incorporate to some extent, other musical parameters than "pitch", like timbre and intensity, which play an equally important role in the "spectra" of a simultaneous dyad.

Tenney relates this to the historical process of integrating other acoustical parameters more significantly into the musical domain, with a concurrent loss of importance (or maybe predominance) of harmony.

"CDC-5 was not 'invented' by Helmholtz, of course. It is conceivable that it was always present, in some degree, as a component in earlier forms of the CDC (excluding CDC-1, of course), and merely obscured by other, momentarily stronger components. But it seems to have developed gradually during the first half of the 19th century, as a result of (or in parallel with) several of the stylistic and other innovations characteristic of that period. Its emergence as a dominant component may have only become possible after the appearance of new factors - new aspects of the musical experience - that were unique to this half of the 19th century. Several such factors suggest themselves immediately: the increasingly dramatic rhetoric of Beethoven, and the radical experiments of Berlioz, had created a new discipline - "orchestration" - in which the specific characteristics of each instrument acquired a new importance in the compositional process; the development of the modern "piano-forte", improvements in certain instrumental mechanisms, the invention of new instruments, and the rapid growth in the sheer size of the orchestra - all these had resulted in a considerable extension of range in several parameters (pitch register, timbre, dynamics - precisely those parameters that are of such importance in CDC-5); in addition, with the increasingly chromatic character of the harmonic language, some of the expressive and formal harmonic devices available to the 18th-century composer were undermined by assimilation or "absorption" into the ongoing texture, harmony became less and less effective as a means of formal articulation, and some of the functions of formal articulation formerly carried by harmony alone now had to be taken over by other factors, including dynamic and timbral or textural contrasts, etc."

(p. 116-117)

Tenney distinguishes early in the paper between the "entitive" and "qualitive" referents for the CDC. The qualitive refers to "the property, attribute or quality associated with a sound or aggregate of sounds" while the entitive "refers to the sound or aggregate itself which manifests that quality" (p. 6). Tenney's summary of the whole historical process is quite interesting, and is stated below, with Tenney's Figure 6 reproduced here (Example XVII.1).

Example XVII.1

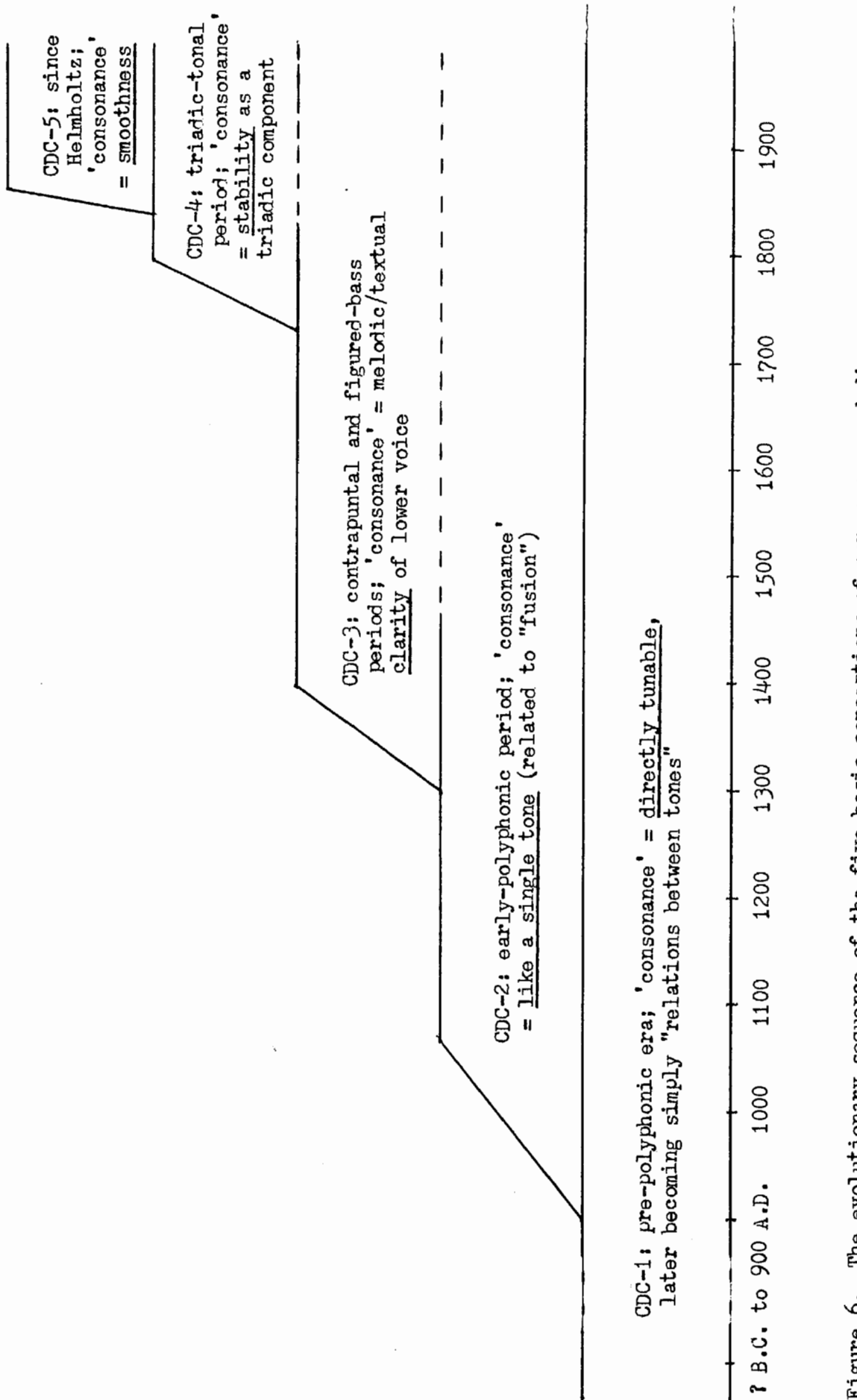


Figure 6. The evolutionary sequence of the five basic conceptions of consonance and dissonance.

"Thus, in the course of the two-and-a-half millennia since Pythagoras, the entitive referents for 'consonance' and 'dissonance' have changed from melodic intervals (in CDC-1) to simultaneous dyads (in CDC-2 and CDC-3 - eventually extended to larger aggregates as well), and then to individual tones in a chord (in CDC-4), and finally to virtually any sound (in CDC-5). The qualitative referents have changed correspondingly from relations between pitches, through aspects of the sonorous character of dyads (and then larger aggregates), to the tendencies toward motion of individual tones, and then again to still another aspect of the sonorous character of simultaneous aggregates. The implicit definition of "consonance" has gone through a sequence of transformations from directly tunable (in CDC-1), to sounding like a single tone (in CDC-2), to a condition of melodic/textual clarity in the lower voice of a contrapuntal texture (in CDC-3), to stability as a triadic component (in CDC-4), and finally to smoothness (in CDC-5) - with 'dissonance' meaning the opposite of each of these. In only one instance did the semantic transformation involved in the transition from one form of the CDC to another result in a clear replacement of one set of meanings by another, and that was with the shift from an essentially "horizontal" orientation in CDC-1 to a "vertical" one in CDC-2. In all other cases the process was cumulative, with the newly emergent set of meanings simply added to the earlier ones, and thus contributing to the current confusion. This brief summary of the general evolution of the CDC is represented schematically in Figure 6."

(pp. 124,125)

All of this, it should be said, stands by way of prelude towards a "new terminology" for consonance and dissonance:

"That a new, more precise terminology is urgently needed, however, is beyond dispute, and the distinctions that have been made here on the basis of a historical analysis might be useful in developing such a terminology. The inelegant acronyms used in this paper to designate the different conceptions of consonance and dissonance ("CDC-n") were chosen quite deliberately for their neutral and essentially uninformative character, and I never expected or intended that they should be adopted for use outside

of the present context. But the distinctions between the qualitative referents in the various forms of the CDC - and between their implicit definitions of 'consonance' and 'dissonance' - suggest one possible approach to the solution of this problem of terminology. That is, qualifying words or phrases might be used which reflect the different meanings more clearly, and I will suggest the following: for CDC-1, monophonic or melodic consonance and dissonance; for CDC-2, diaphonic consonance and dissonance; for CDC-3, polyphonic or contrapuntal consonance and dissonance; for CDC-4, triadic consonance and dissonance (this form is often called "functional", but this is not altogether accurate either, and might better be reserved for the more purely functional conception articulated by Riemann - although his might also be called tonic consonance and dissonance, if not simply "stability/instability"), and finally - for CDC-5 - timbral consonance and dissonance."

(p. 127-128)

In an earlier form of the paper, Tenney proposed a rather detailed set of what might be called "acoustical correlates" for the five forms of the CDC. These took the form of equations which would measure the relative consonance/dissonance of a dyad according to certain mathematical criteria corresponding to the theoretical criteria he outlines in the paper. This entire section of the paper was withdrawn and Tenney says that the complete treatment of this subject will await a later, more detailed treatise. If these early results, along with some of the other surprising conclusions of "John Cage and the Theory of Harmony" (a recent work which I will not examine in this current paper), are any indication of what is to come, I would venture to predict that Tenney's "theory of harmony" will have rather important resonances in the musical world.

Introduction to Appendix I.A.

The following annotated list by no means represents an exhaustive or complete description of performances and/or recordings of Tenney's music. Rather, I have mentioned many of the performances with which I am familiar in the text, as a documentation of my remarks on them and as a preliminary guide for the interested reader. I have also included some pieces mainly for their historical interest, certain works whose unavailability might suggest Tenney's own continued lack of interest in them. (Many of these might better be called experiments). Though this list is drawn in large part from Tenney's own records, I have made many additions, comments and even deletions.

Abbreviations:

(rec.)- unofficial, usually "bootleg" recording of a specific performance of interest.

(pub.)- published in

RFC- Reich Music Foundation Concerts; Dec. 17, 18, 1978 at Paula Cooper Gallery and Carnegie Recital Hall, N.Y.C. Organized and directed by Steve Reich. I have tried, in most cases, to give the musicians' names as well. Good recordings of these concerts exist.

Appendix I.A.

Interim

Piano /1952 /Denver

- Written for a film of that title by Stan Brakhage.

Three Inventions

Piano /1953 /Denver.

Poem

Solo flute /1953 /N.Y.C.

- (rec.) Jill Shires, flute.

Two Christmas Songs

1954 /NYC

- Texts by Stan Brakhage.

Seeds

Fl., cl., bn., hrn., vln., vc. /1956-61 /NYC.

Essay for Chamber Orchestra

1957 /Bennington, Vt.

- (rec.) Henry Brant, cond.

Dance Trio

Fl., ob., cl. /1957 /Bennington

- (rec.) J.T., cond.

"Thirteen Ways of Looking at a Blackbird"

a) Tenor voice, 2 fl., vln., vla., vlc. /Bennington /1958

b) Bass voice, alto fl., ob., vla., vlc., cb. /1971 /Valencia, Ca.

- (rec.) Marvin Hayes, bass voice.

Sonata for Ten Wind Instruments

1958 /Bennington

- (rec.) J.T., cond., U. of Ill. student ensemble.

- Dedicated to Carl Ruggles.

Monody

Solo clarinet /1959 /Urbana, Ill.

- (pub.) Pieces: An Anthology; Michael Byron, ed.;
Vancouver, A.R.C. Publications; 1975.

- RFC, Virgil Blackwell, cl.

Improvisations for "Medea"

Concrete tape piece /1961/Urbana

- Written for a production of Jeffers/Euripedes play.

- Mostly tape manipulation of piano improvisation.

Collage #1--("Blue Suede")

Concrete /1961 /Urbana

- RFC.

The following pieces (up to String, Woodwind....Responses) were composed while Tenney was at Bell Labs (1961-64):

Analog #1: Noise Study

Computer-generated tape /1961

- On Music from Mathematics; Decca; DL 9103.

Entrance/Exit Music

Comp.-gen. tape /Aug.1962.

- In collaboration with George Brecht.

Stochastic Studies

Comp.-gen. tape /Dec.1962.

Stochastic (String) Quartet

a) Comp.-gen. tape or b) String Quartet /Feb.1963.

- On Decca record, 1963.

Dialogue

Comp.-gen. tape /April,1963.

Radio Piece

Comp.-gen. tape /July,1963.

- A short computer music demonstration piece.

Ergodos I

Two 10 minute comp.-gen. tapes to be played together or separately /Aug.1963.

- To be played with or without the String or Percussion Complements or the Responses (see below).
- For John Cage.

Phases

Comp.-gen. tape /Dec.1963.

- For Edgard Varese.

Music for Player-Piano

Comp.-gen. piano roll /Jan.1964 /2 minute long piano roll, may be played in any or all of its orientations.

- (rec.) Feb.22,1969 at Aeolian Piano Co. by J. Lawrence Cook.

String Complement

Any number of string instruments /Feb.1964.

- Graphic score to be played with Ergodos I or Ergodos II, or any other "ergodic" sound source.
- (pub.) Notations, John Cage and Alison Knowles, eds.; Something Else Press; N.Y.;1969.

Choreogram

Any number of musicians with dancers /Feb.1964.

- Verbal score.
- (pub.) Soundings #1, Peter Garland (ed.), Valencia, Ca., 1971.

Ergodos II

Comp.-gen. tape /March, 1964

- "...one 18-minute, 2-channel tape, which may be used as the material for a performance of any duration, any density, etc., with or without the Complements or Responses".
- For John Cage.

String, Woodwind, Brass, and Vocal Responses

March, 1964

- Graphic scores, to be used like String Complement.

"Chamber Music"

Any number of instruments, players, objects, or events /May,1964.

- Poem/score.
- For George Brecht.
- Performed on Fluxus concert, 1964.

Percussion Complement

Aug. 1964.

- Similar to String Complement.

Maximusic

Solo percussionist /June, 1965.

- (pub.) a) Percussionist Vol.XIII, No.3, Spring, 1975, p.100.
- b) Scores: An Anthology of New Music; Roger Johnson; N.Y.; Schirmer Books; 1981.
- For Max Neuhaus.

Metabolic Music

Performers, 'bio-feedback' and audio equipment /July 26,1965 /NYC.

For two (gently)

Man woman /Aug.4,1965 /NYC.

- Theatre piece originally for Charlotte Moorman and Nam June Paik.

Thermocouple #1

Aug. 1965

- Theatre piece
- "Judson Hall assumed".

Audience Piece #1, #2, #3

#3: solo/duo /Sept.24,1965 /NYC.

- Poem/performance score.

Thermocouple #2

Dec. 1965

- Theatre piece.
- (pub.) Some/thing II/I, winter, 1966.
- With additions by Carolee Schneemann.

Couplings

Concrete tape /Dec. 1966 /NYC.

- Written for the kinetic-theatre piece "snows" by Carolee Schneemann.

Collage #2--("Viet Flakes")

Concrete tape /Dec. 1966.

- For a film by Carolee Schneemann.

Redbed

Various theatrical materials: (red bed, red paint, doves, knives...) /Jan. 1966 /NYC.

Fabric for Ché

Comp.-gen. tape /Nov. 1967 /Polytechnic Institute of Brooklyn.

Swell Piece #1

Any number of sustained-tone instruments /Dec. 1967 /NYC.

- Verbal scores
- (pub.) Scores...p.139
- For Alison Knowles.

For Ann (rising)

Tape /March, 1969 /Poly. Tech. Inst. Brklyn.

- RFC.

Three Rags for Pianoforte (Raggedy Ann, Milk and Honey,

Tangled Rag

1966 /NYC

- (pub.) a) "Raggedy Ann"; Caterpillar 10; 1969.
- b) "Milk and Honey"; Caterpillar 11; 1970.
- c) Entire set; E.C. Kerby Ltd.; Toronto; 1981.
- (rec.) 20 reel-to-reel copies of Tenney performing the rags issued privately by Sam Charters; NYC; 1969.
- "Raggedy Ann" for Sam and Ann Charters; "Milk and Honey" for Tenney's daughter Mielle; "Tangled Rag" dedicated in the memory of Tenney's father, Carl Tenney (1908-1970).
- There is also a string quintet arrangement (1974) of "Tangled Rag"; (rec.) RFC.

A Rose is a Rose is a Round

Voices /March, 1970 /NYC.

- (pub.) Scores...p. 60.
- For Philip Corner.

Quiet Fan for Erik Satie

Thirteen instruments /April, 1970, (revised, July, 1971) /Santa Barbara, Ca.

- (rec.) Gerhard Samuel, cond.; Cal. Arts.

Swell Pieces #2 and 3

Verbal instructions /March, 1971 /Saugus, Ca.

- (pub.) Scores... p.139.
- For Pauline Oliveros and LaMonte Young.

Hey When I Sing These 4 Songs Hey Look What Happens

SATB /March 1971 /Saugus.

- From Jerome Rothenberg's work on Native American poetry.
- (pub.) Scores... p.62.

Beast

- String bass /July, 1971 /Saugus.
- (pub.) Scores...p.164.
- For Buell Neidlinger.
- Beast has also been given fine performances by Richard Myron and Don Palma in NYC.

(night)

- "for percussion perhaps, or..." /Aug. 1971 /Saugus.
- (pub.) Percussionist XII/3, p. 106.
- For Harold Budd.

Koan

- Solo violin /Aug. 1971 /Saugus.
- (pub.) Scores...p.162
- For Malcolm Goldstein.

Cellogram

- Solo 'cello /Aug. 1971 /Saugus.
- (pub.) Scores...p.165
- For Joel Krosnick.

Timbre Ring

- "for any five or more instruments" /Aug. 1971 /Saugus
- Verbal score.

August Harp

- Solo harp /Aug. 1971 /Saugus
- (pub.) Scores...p.165
- For Susan Allen.

Koan: Having Never Written a Note for Percussion

- Solo percussionist /August 1971 /Saugus
- (pub.) Percussionist XII/3; p.103
- For John Bergamo
- RFC, James Preiss
- William Winant (California) has also given numerous fine performances of this piece.

For 12 Strings (rising)

- Strings /Nov. 1971 /Saugus
- (pub.) Scores...p. 171.
- "Orchestration" of For Ann (rising).

Clang

- Orchestra /June, 1972 /Saugus
- (pub.) Soundings 3/4, Peter Garland, ed., 1972.
- (rec.) Clang was given a reading by the L.A. Philharmonic.

Quintext: Five Textures for String Quartet and Bass

- I. Some Recent Thoughts for Morton Feldman
- II. Clouds for Iannis Xenakis
- III. A Choir of Angels for Carl Ruggles
- IV. Parabolas and Hyperbolas for Edgard Varèse
- V. Spectra for Harry Partch

Dec. 1972 /Saugus

- (pub.) Soundings 6 ; 1973
- (rec.) Sequoia Str. Quartet (Cal. Arts); and RFC.

In the Aeolian Mode

Prepared piano and variable ensemble /March, 1973 /Saugus.

- (pub.) Scores...p. 172
- RFC; J.T. piano.

Canon

Contrabass quartet /Sept. 1973 /Saugus.

Chorale for Viola and Harp

Nov. 1973 /Saugus

- Another version, Chorale for Viola and Piano, was performed by J.T. and Ann Holloway on a Maple Sugar concert at the Music Gallery, Toronto, Oct. 1977.

Chorales for Percussion

Dec. 1973 /Saugus.

Chorales for Orchestra

Jan. 1974 /Saugus

- (pub.) Pieces: A Second Anthology; Michael Byron, ed., Vancouver; A.R.C. Publications; 1976.
- (rec.) Gerhard Samuel, cond., Cal. Arts; 1974.

Three Pieces for Mechanical Drum (Wake, Tempest, The Popcorn Effect)

For a work by soundsculptor Stephan Von Heune /1974 /Saugus.

- Now on permanent display at the Exploratorium, San Francisco, where the pieces are played periodically.

Spectral CANON for CONLON Nancarrow

"harmonic player-piano" /April, 1974 /Cal.

- (pub.) Pieces...(1975).

Orchestral Study: The "Creation Field"

June, 1974 /Cal.

- After Fred Hoyle.

Three Harmonic Studies

Small orchestra /July 1974 /Cal.

- (rec.) Univ. South Florida student orchestra.

Three Pieces for Drum Quartet

- 1) Wake for Charles Ives /4 tenor drums
- 2) Hocket for Henry Cowell /4 bass drums
- 3) Crystal Canon for Edgard Varèse /4 snare drums

1974-75 /Toronto

- There have been many fine performances of these quartets, and recordings of all of them exist. Among them:
 - a) RFC; Ben Harms, James Preiss, Richard Schwarz, Glen Velez.
 - b) Center of the Creative and Performing Arts, Buffalo, N.Y., March, 1978; Jan Williams, directing.
 - c) Toronto, 1977; J.T. cond.
 - d) U. of Illinois; Urbana, 1977; Thomas Siwe; Director U. of Ill. percussion ensemble.
- In addition, Blackearth Percussion Ensemble and several groups directed by William Winant perform the pieces regularly.

Symphony

Woodwind quintet and tape-delay system /Jan. 1975 /Cal.

Blues for Annie

Viola solo /June, 1975 /Cal.

- Transcription of "No More Good Water" by Jaybird Coleman (see Three Indigenous Songs).
- For Ann Holloway.

Harmonium #1

Large, orchestra /Sept. 1976 /Toronto

- Original version of Harmonium #2.

Harmonium #2

Variable ensemble /Sept. 1976 /To.

- For Lou Harrison.

Saxony

One or more saxophone players and tape-delay system /May 1978.

- Commission by Ontario Arts Council for Don MacMillan, who premiered it at the Music Gallery, Toronto, April, 1978.
- RFC, Richard Cohen, Virgil Fox, and Mort Silver.
- Other versions of Saxony exist:
 - a) For Brass Quintet and tape-delay (in B^b); June, 1978.
 - b) Saxony #2 For 3 Saxophone Players (B^b soprano, E^b alto, B^b tenor /E^b baritone) and Tape-Delay System /May, 1978 /in E^b.
 - c) For string trio or string quartet with tape-delay /in C /June, 1978.
 - d) "stochastic canon" - "a generalized score of the Saxony 'concept'." - realizable in many different ways. (This version has been performed by the Mills College Contemporary Music Ensemble; David Rosenboom, director.)

Harmonium #4

Ten instruments and tape-delay system /May, 1978 /Toronto.

- RFC, J.T. cond.

Harmonium #5

String trio /June, 1978 /Toronto.

- Ontario Arts Council Commission, for the Galliard Ensemble (who premiered it).
- RFC: Shem Guibbory, vln., Barbara Harrison, vla., Larry Rawdon, 'cello.
- For John Cage.

Three Indigenous Songs

2 piccolos, alto flute, bassoon or tuba, 2 percussion /Dec. 1979.

- Ontario Arts Council Commission for New Music Concerts (premiere).
- Recently performed at Cal. Arts New Music Festival, Valencia, Cal.
- For Lionel Nowak.

Harmonium #3

3 harps /Aug. 1980 /To.

- Two harps scordatura.
- For Susan Allen.
- Replaces an earlier version for two guitars.

Chromatic Canon

Two pianos /Aug. 1980 /To.

- For Steve Reich.

Band

Concert band /Aug. 1980 /Buyck, Minn.

"Listen...!"

Three sopranos and piano /Dec. 1980-June, 1981 /Minneapolis and Santa Fe

- In memoriam John Lennon (and Wilhelm Reich).
- For Jacqueline Humbert and David Rosenboom.

Septet

Six electric guitars and bass /Dec. 1981 /To.

- Harmonic series related piece.

Glissade

Viola, 'cello, contra bass with tape-delay system /Jan. 1982 /To.

- Five movements:

I. Shimmer

II. Array (a'rising)

III. Bessel Functions of the First Kind

IV. Trias Harmonica

V. Stochastic-canonic Variations

- Ontario Arts Council Commission for the Array Ensemble.

Glissade (cont.)

- Glissade appears to be one of the more complex pieces Tenney has written. Each movement is an in-depth study of a different compositional "kernel", some ideas which he has used before (eg., For Ann (rising) in II.) It also calls for a great deal of microtonal adjustment from the players.

deus ex machina (theos ek mekhanes)

Tam-tam player, tape-delay system (technician , and unwary audience /1982 /Toronto.

- In two parts:
 - I. For Alvin Lucier
 - II. For John Cage and David Tudor
- "in a room, concert-hall or other enclosed space with its own natural resonance"
- deus... is a kind of extreme conceptual extension of Having Never Written a Note...

Voices

Female voice and multiple tape-delay systems /1982 /To.

- For Joan La Barbara and Morton Subotnick.
- Voices is also a "microtonal" piece, and the score resembles the Harmonia, Band, etc.

Appendix I.B. Writings

Meta / Hodos: A Phenomenology of 20th Century Music and an Approach to the Study of Form; June, 1961; published by the Inter-American Institute for Musical Research; Tulane U.; New Orleans, 1964.

M H has long been out-of-print, but is available from Tenney and is rather widely circulated.

"On Certain Entropy-Relations in Musical Structure"; privately printed, Bell Telephone Labs; Feb. 1962.

"On the Discriminability of Differences in the Rise-Time of a Tone"; J. Acoust. Soc. Amer. 34/5 (abstract); 1962.

"Sound-Generation by Means of a Digital Computer"; Journal of Music Theory 7/1; 1963.

This was one of the first, if not the first explanation of computer synthesis available to composers and musicians. It is of tremendous historical importance in this regard.

"Sound and Cinema" (with Stan Brakhage); Film Culture #29; 1963.

Program Notes on the music of Ives, Feldman, Cage, Ruggles, and Varèse: Tone Roads Concert, Dec. 20, 1963; NYC.

"The Physical Correlates of Timbre", Gravesaner Blatter #26 (studio Hermann Scherchen, Gravesano, Switzerland), 1965.

"Edgard Varèse", East Side Review, Jan. 1966; reprinted in Soundings: Ives, Ruggles, Varèse, 1974.

Tenney was Music Editor of the Review, 1966.

"Computer Study of Violin Tones" (with Mathews, Miller and Pierce); J. Acoust. Soc. Amer. 38/5 (abstract), 1966.

"An Experimental Investigation of Timbre---The Violin"; unpublished report to the N.S.F.; 1966.

"Music and Computers"; in 1967 McGraw-Hill Encyclopedia of Science and Technology.

A House of Dust (computer poetry with Alison Knowles)
See Alison Knowles in Appendix IV.

"Computer Music Experiences, 1961-64"; Electronic Music Reports #1; Institute of Sonology, Utrecht; 1969.

"Form"; in Dictionary of Contemporary Music; John Vinton, ed.; N.Y.; E.P. Dutton; 1971.

"Some Notes on the Music of Charles Ives"; liner notes for Folkways recordings; 31 Songs by Charles Ives (1966); reprinted in Soundings: Ives, Ruggles, Varese: 1974.
(Earlier version in Program notes to May, 1963 all Ives Tone Roads concert.)

"META Meta ≠ Hodos"; Journal of Experimental Aesthetics 1/1; A.R.C. Publications; Vancouver; 1977.

"Conlon Nancarrow's Studies for Player Piano"; in Conlon Nancarrow: Selected Studies for Player Piano; edited by Peter Garland; Soundings Press; Berkeley, Cal.; 1977, Portions of this have been reprinted as liner notes for the 1750 Arch recordings of the complete Studies.

"The Chronological Development of Carl Ruggles' Melodic Style"; Perspectives of New Music 16/1; fall-winter; 1977.

Program notes to Evenings for New Music Concert; Three Pieces for Drum Quartet; Albright-Knox Art Gallery; Buffalo; 1978.

Program notes to "Two Evenings of Music by James Tenney"; Reich Foundation Concerts; 1978; N.Y.C.
Useful autobiographical commentary.

"Temporal Gestalt Perception in Music"; (with Larry Polansky); Journal of Music Theory 24/2; Fall, 1980.
This is a condensed version of the paper I call HGPM (chapter XVI).

A History of 'Consonance' and 'Dissonance'; June, 1980; as yet unpublished.

"John Cage and the Theory of Harmony"; April, 1982; to be published in Soundings, Fall, 1983.
This is a remarkable paper concerned with the "theoretical" bases for Cage's works, relating them to a theory of aggregate and harmonic space formation.

"Introduction" to Americas; Peter Garland; Soundings Press, Santa Fe; 1982.

Appendix I.C. Selected Performances, Recordings, Activities, etc.

(Tenney's performances of the works of other composers and of his own works are far too numerous to list here. The selections below are just a few "standouts".)

Charles Ives, 31 Songs with Ted Puffer and Philip Corner; two records; Folkways record produced by Samuel Charters.

Co-founder, conductor, pianist "Tone Roads Ensemble", NYC; 1963-70. (see Appendix II)

Organized and participated in the first continuous public reading of the complete Finnegan's Wake by James Joyce, NYC, 1968.

Co-organizer, composer and performer in Annual Avant-Garde Music Festivals, N.Y.C., 1963-69.

Early member of Steve Reich (1967-70) and Phil Glass (1969-70) ensembles; NYC.

Founder and Musical Director "Tone Roads West"; L.A., 1973-75.

Frequent composer and performer in "Maple Sugar", Toronto. His own pieces included: Chorales for Viola and Harp, Collage #2-- ("Viet Flakes"), Collage #1-- ("Blue Suede"). As a performer in music by other composers: Jacqueline Humbert's Daytime Viewing, John Cage's Dream. As a participant in group pieces: Avanti Poppolo and Thaddeus Cahill, Deceased).

John Cage Lecture on the Weather; American Premiere (speaker); Albright-Knox Gallery; Buffalo, N.Y.; 1976.

Appendix I.D. About Tenney

Anderson, Ruth (ed.); Contemporary American Composers: A Biographical Dictionary, G.K. Hall, 1976.

Band, Ellen: Allos; Ken Gaburo, Editor; Lingua Press, La Jolla, Ca., 1980; p.37-44; Astrological study of J.T.

Corner, Philip; "Resonant Suchness: The Computer Music of James Tenney";
Notes for WBAI broadcast, Sept.11,1974;N.Y.C., privately circulated.

Gaster, Adrian (ed.); International Who's Who in Music and Musician's Directory; 8th and 9th editions; Cambridge, England; International Biographical Centre; 1980.

Hiller, Lejaren; "Music Composed with Computers--A Historical Survey"; in Harry B. Lincoln (ed.), The Computer and Music; Ithaca, N.Y.; Cornell U. Press; 1970; pp.68-71.

La Barbara, Joan; "New Music"; High Fidelity; April,1979.
Excellent review, description of RFC.

Marshall, Ingram; "New Music at Cal Arts: The First Four Years (1970-74)"; Nu Mus West; Seattle.
Interesting account of Tenney's activities at Cal. Arts.

O'Connor, Michael (ed.); New Performance; Volume III, Number 1; "Conlon Nancarrow: Composers Forum"
Roundtable discussion with Tenney, Gordon Mumma, Peter Garland, Roger Reynolds, Charles Amirkhanian, Eva Soltes and Conlon Nancarrow.

Ornerian, Khaleef; In Case of Beer Call Jim Tenney; Soundings #6.
Composition by a Cal. Arts student which contains some profound insights into Tenney's musical personality.

Polansky, Larry; 4 Violin Studies (What to do when the night comes); 1981.

Polansky, Larry; interviews with Malcolm Goldstein(taped, NYC, Jan.1981); Philip Corner (taped, NYC, Nov. 1980); Alison Knowles and Michael Byron (notes only).

Rockwell, John; Review; "Music: By James Tenney"; N.Y. Times;
Dec. 20, 1978.
Review of RFC.

The List; 1st through 5th editions; N.Y. Independent Curators
Inc.; 1976-80.

Van Riper, Peter; "The Tangled Case of Tenney's Concerts";
Ear Magazine (East); Vol. 5#2.
Another review of RFC, with some interesting considerations of
Tenney's music.

Vinton, John (ed.); Dictionary of Contemporary Music; N.Y.;
E.P. Dutton; 1971.

Young, Gayle; Interview with Tenney; Only Paper Today 5/5;
June, 1978; p.16.
An extremely interesting, all too short interview by this
fine Canadian composer.

Zimmermann, Walter; Desert Plants; Vancouver; A.R.C. Publications,
1976; pp. 221-230.
Phone interview.

I. Seeds

1. Varèse Déserts; mm. 14-15; fl., horns, trombones, piano.
2. Movement 1; opening flute motive.
3. Movement 1; mm. 7-8; clarinet, flute; motivic variations.
4. Varèse Octandre; first measure.
5. Movement 1; harmonic reduction of measure 5; "vertical" manifestation of half-step motive.
- 6a. Movement 1; ms. 7; 'cello and bassoon.
- 6b. Movement 1; ms. 9; 'cello and violin.
7. Varèse Intégrales; frequent chord (mm. 5,8, etc.); showing "Varesian" inverted voicings.
8. Movement 3; mm. 1-3; horn, bassoon.
9. Movement 3; ms. 7.
- 10a. Movement 3; ms. 5; fl., 'cello.; motivic variations.
- 10b. Movement 3; mm. 3-4; cl.; motivic variations.
- 10c. Movement 3; ms. 5; cl., bassoon; motivic variations.
11. Movement 4; mm. 1-3; full score with analysis showing "note-passing" and half-steps.
- 11a. Movement 4; mm. 1-6; reduction showing serial canon.
12. Movement 4; mm. 7-8; fl., clarinet.
13. Movement 5; mm. 1-5; reduction, main motives for V.
14. Movement 5; mm. 15-18; cl., bassoon; motivic variation.
15. Movement 5; mm. 6-8; cl., fl.; motivic interweaving.
16. Movement 6; mm. 1-3; flute.
17. Movement 6; mm. 2-3; clarinet.
18. Movement 6; mm. 8-10; flute, violin; canon.
19. Movement 6; mm. 11-12; flute, clarinet, violin.
20. Movement 6; ms. 13; horn solo.

II. Monody and Collage #1 -- ("Blue Suede")

(all examples from Monody)

1. mm. 3-6; opening measure and motives.
2. mm. 29-31; rhythmic variation.
3. mm. 6-8; dovetailing of motives.
4. mm. 10-11; motivic inversion.
5. ms. 19; motivic octave displacement.
6. mm. 42-43.
7. mm. 31-34; intervallic combinations.

III. Computer Music

1. page 32 of "Computer Music Experiences"; (graph); structure of Noise Study.
2. (Examples a and b.) Pages 47-48 (Figures 11a, 11b); "Computer Music Experiences"; form of Dialogue.
3. page 59 (Figure 13); "Computer Music Experiences"; parametric shapes for Phases

V. Three Piano Rags

- 1a. Milk and Honey; mm. 1-2; section 1.
- 1b. Milk and Honey; ms. 5; section 1.
- 1c. Milk and Honey; ms. 15; section 2.
- 1d. Tangled Rag; ms. 1; Introduction.
2. Raggedy Ann; Introduction; showing hocket, use of the second, and "suspended" top note.
3. Raggedy Ann; ms. 6.
4. Raggedy Ann; first ending; section 1.
5. Raggedy Ann; ms. 1; second section; second theme.
6. Raggedy Ann; first few measures of Coda; right hand only.
7. Milk and Honey; mm. 1-2; Introduction; use of suspensions.
- 8a. Milk and Honey; ms. 14; section 2; showing extension of bass lines.
- 8b. Milk and Honey; mm. 11-12; section 1; deceptive cadence.
- 9a. Milk and Honey; ms. 14; section 2; high density of harmonic movement.
- 9b. ms. 19; Scott Joplin (with Louis Chauvin); Heliotrope Bouquet; ms. 19.
10. Milk and Honey; ms. 6; "suspended top note" effect.
11. Milk and Honey; trio; mm. 7-8.
- 12a. Tangled Rag; mm. 5-6; three note main theme.
- 12b. Joplin; Elite Syncopations; first two measures; final section.
13. Tangled Rag; mm. 21-22.
14. Tangled Rag; mm. 1-2; Trio.
15. Tangled Rag; mm. 9-10; Trio.
- 16a. Tangled Rag; mm. 1-2; final section; melody in left-hand.
- 16b. Tangled Rag; mm. 1-2; final section; "resultant" rhythm of accents.

VI. Quiet Fan for Erik Satie and Hey When I Sing...

1. extreme range of fan.
2. oboe, english horn; three selected measures of fanning-out process.
3. mm. 9-12; orchestrational "elaborations" of fan.
4. mm. 63-65; english horn, oboe, vln., vla.; metrical and durational changes from one section to another.
5. mm. 203-205; clarinets, trombone; Satie tune fragments.
6. diagram of large "fan"--overall structure of piece.
7. full score for Hey When I Sing...

VII. Postal Pieces

1. Beast
2. A Rose is a Rose is a Rose
3. Alternate canonic solution for A Rose is a Rose...
4. (night)
5. Koan
6. Maximusic
7. Swell Piece
8. Swell Piece #2 and #3
9. August Harp
10. Cellogram
11. Having Never Written a Note for Percussion

VIII. Clang

1. scale for Clang, with harmonic numbers and intonations.
2. full score for In the Aeolian Mode.

IX. Quintext

1. "scale" for I, with intonations and harmonic series numbers.
2. Scale distribution for I.
3. Diagram of 'sound vs. silence' in II.
4. First page of II.
5. First chord (reduction) of III, and first chord (reduction) of Ruggles' Angels.
6. Ruggles Angels; first eight measures; trumpets 1 and 2; melodic line.
7. 'Cello line, pitches only, in III; melodic line.
8. First two measures, reduction, of III, showing registral overlapping.
9. Final chord in III; reduction.
10. Second page of IV.
11. "Available pitches" in V; first seven harmonics on all strings with harmonic numbers.
12. "Available pitches" in scale order (without duplicated octaves) with cents deviations from tempered tuning above and harmonic number below.

X. Chorales

1. First half of Chorales melody (second half is retrograde); from first trumpet; Movement II.
2. Initial "voicings" for each movement.

XI. Spectral CANON for CONLON Nancarrow

1. First page of the score.
2. Fifteenth page of the score- showing resultant "paraboloids and hyperboloids".

XII. Three Drum Quartets

1. Ives Fourth Symphony; fourth movement; snare drum ostinato.
2. First page of Wake; showing one-voice accumulation.
3. Final system, third page, Wake; point at which all voices have accumulated fully.
4. Last system, Wake.
5. Graphic representation of duration series in canon of Hocket (beginning at ms. 49).
6. mm. 61-69; Hocket; accent study after the canon of Ex. XII .5.
7. Theme from Ionisation/Crystal Canon in full (as stated in the latter).
8. Rhythmic displacement of voices II and IV in Crystal Canon (ms. 35).

XIII. Harmonia

1. Root movement/voice leading scheme for Harmonia #2 (and, with some changes of detail, the whole set).
2. Score for Harmonia #2.
3. ms. 22; Harmonia #3.
4. mm. 2-7; Harmonia #3; showing intonation "adjustment" and major/minor transition.
5. Final measures Harmonia #3; showing sextuplet hoquet.
6. Section XI (final); ms. 5; Harmonia #5; extended diatonic tonality.
7. First measures of Sections VI and VII; Harmonia #5.
8. First four measures; Harmonia #5; showing "swell/clang" idea.
9. Minor "complement" chord, and major tritone chord used in Band (and Chromatic Canon), with horizontal representation.
10. Tuning instructions for Band (page five of score).
11. Schematic of final modulation (minor to major) in Band.
12. "Row" and tunings in just ratios for Chromatic Canon.
13. Score (without title/instruction page) for Chromatic Canon.
14. Harmonic series from Saxony.

XV. Nancarrow, Ruggles, Ives, Varese, et al

1. Final graph from Ruggles paper (Figure 27), showing chronological development of the avoidance of pitch class repetition; and the use of the minor second as predominant interval.

XVI. META / HODOS

1. Example of parametric profile and resulting first order "difference function".

XVII. Harmony

1. Figure 6 from harmony paper, showing evolutionary development of CDC.

Appendix III: Glossary of Selected Terms

(Roman numerals following each term are chapters in which the term is especially relevant.)

aggregate (I, II, III, XVI, XVII)

The term used by Tenney, Cage and others to signify combinations of sounds which are used in composition, or are perceived as 'sonic primitives'. For example, the prepared piano sounds of Cage's Sonatas and Interludes or the 'palate' of pitch combinations in the String Quartet. Tenney's concern with aggregates is manifested in Meta/Hodos and in his harmony research, notably "John Cage and the Theory of Harmony."

beats (IV, VII)

(see also difference tones) Low frequency 'pulsations' heard as a resultant of two or more different frequencies. Beats are simply low frequency first order difference tones (see below, and Helmholtz/Ellis and/or Partch) caused by pitches that differ by less than about 16-20 cycles per second.

cents (IV, VII, VIII, IX, X, XIII, XVII)

A logarithmic unit of pitch, one cent is equal to 1/1200 of an octave. Cents are convenient units for the comparison of different intonations. The 12-tone tempered scale is simply the even hundred-multiples (100, 200, ...). See Helmholtz/Ellis for a more precise explanation on the calculation of cents from ratios and vice versa (especially Appendix XX); Partch for a useful list of common ratios and their cents equivalents, (Partch: Appendix 1); and John Chalmers' excellent "Conversion Tables for 1200 tone temperament", available from Chalmers but regrettably unpublished, for an exhaustive source of cents values of practically any interval.

clang (Intro, I, III, VIII, XVI)

(from Meta/Hodos "Glossary") "A sound or sound-configuration which is perceived as a primary musical unit or aural Gestalt. The clang-concept constitutes the nucleus and core--in fact, the essential "heart and soul" of the entire "conceptual framework" proposed in this paper."

I also use this term to describe a slightly different but related compositional technique which Tenney often uses (see Introduction).

difference function (XVI)

An ordered set of values derived from another set (e.g. parametric profile) in which the values of the former are point by point differences of the latter. The particular form of the difference function is dependent on the type of metric used (see below), but a simple one might be the set of absolute value integer distances of a melody, also expressed as integers.

ergodicity

(Intro, III, IV, VI, XVI)

A particular statistical condition in which certain parameters remain static with respect to certain perceptual measures. In mathematics, ergodic functions have a more complex formulation, but Tenney uses the term to describe musical forms in which certain parametric statistics will not change appreciably over time; thus a kind of structure is created in which the order of events is not particularly significant in any conventional sense.

harmonic series, intonations

(VIII, IX, X, XI, XIII)

The following chart can be used as a reference for the 'natural' intonations of the first eight odd harmonics. All values are rounded to the nearest tenth of a cent. All harmonic series ratios are reduced to within one octave.

<u>Harmonic #</u>	<u>Cents</u>	<u>Deviation from nearest tempered interval</u>
1	---	---
3	702	+2 (perfect fifth)
5	386.3	-13.7 (major third)
7	968.8	-31.2 (minor seventh)
9	203.9	+3.9 (major second)
11	551.3	-48.7 (tritone)
13	840.5	+40.5 (minor sixth)
17	105	+5 (minor second)

Hierarchical gestalt formation

(III, XVI)

A system of 'nested' TG's on several hierarchical levels. This is analagous in some sense to the ways that notes are traditionally grouped into phrases, phrases into sequences, sequences into sections, etc.; although Tenney's terminology and formation criteria differ significantly from conventional formal analysis.

metric

(XVI)

A function which assigns a distance value between any two points. A metric must have four properties:

- 1) distances must always be positive.
- 2) if the distances are equal, the points are equal (and vice versa).
- 3) the distance between point x and point y is the same between point y and point x (symmetry).
- 4) for three points x,y,z; the distance between x and z must be less than or equal to the distance between x and y plus the distance between y and z (this is called the 'triangle' inequality).

Defining a given distance function (metric) on a given set of points defines a particular metric space. In other words, the way distances are perceived determines rather uniquely the perceptual and topological characteristics of a given space.

morphology

(XVI)

The study or characteristic of shape (as defined in MMH.) Morphology is, in other words, a consideration of the dynamics of ordered sets of values, as opposed to statistical (state) measures.

octatonic scale (octaphonic mode) (VIII,X,XIII)

A scale composed of alternating whole steps and half-steps: in "C": C-C#-E^b-E-F#-G-A-A#-C. This scale can be closely related to the prime harmonics: 1-17-19-5-11-3-13-7; and is thus kind of a primitive harmonic system. It contains two major chords a tritone apart (C-E-G/F#-A#-C#), and is sometimes called the 'Petrouchka chord' in this regard. The scale is sometimes thought of by jazz players as the alternate 'mode' of the diminished scale (which reverses the whole step - half step order), and also sometimes called the altered dominant.

parametric mean

(III,XVI)

The mean (usually weighted by component durations) of a given set of parametric values. In Tenney's theories, these means determine the state of a next higher level TG.

parametric range

(III,XVI)

The total variation of a given parameter in a TG.

shape and state

(XVI)

(see Chapter XVI)

'square root method'

(XIII)

A compositional technique used by Cage in his First Construction, String Quartet, and other works, in which the durations of larger sections are related to smaller sections in a simple, recursive manner. For example, a piece might consist of 10 large sections, each composed of 10 sub-sections, each of those composed of ten measures of ten beats each. Tenney invokes this technique in the String Trio (Harmonium #5).

superparticular ratio

(XI)

Any ratio where the numerator is one more than the denominator.

stochastic process

(III)

A process by which random distributions are subjected to 'shaping' or 'coloring' to provide a large scale determinate form with indeterminate small-scale structure. Once again, in mathematics, the idea of stochastic process is more complex, but Tenney, Xenakis, Hiller and others have used it frequently to describe many of their own compositional procedures.

temporal gestalt

(III,XVI)

A generalized term for what Tenney defines above in clang. A TG is not level specific - elements, clangs, sequences, are all

TG's, though at different hierarchical levels. TG's are formed by the processes of cohesion and segregation which Tenney discusses in MH, MMH and HGPM.

temporal density
(see Chapter XVI)

(III, XVI)