August 1968 No.5 Price 2/6

The Magazine of the Institute of Contemporary Arts

CYBERNETIC SERENDIPITY   August 2 - October 20, 1968

An international exhibition exploring and demonstrating relationships between technology and creativity.

The idea behind this venture is to show creative forms engendered by technology. To present an area of activity which manifests artists' involvement with science, and the scientists' involvement with the arts. To show the links between the random systems employed by artists, composers, and poets, and those involved in the use of cybernetic devices.

The exhibition is divided into three sections:

1. Computer generated graphics, computer animated films, computer composed and played music, and computer verse and texts.

2. Cybernetic devices as works of art, cybernetic environments, remote control robots, and painting machines.

3. Machines demonstrating the uses of computers and an environment dealing with the history of cybernetics.

There will be lectures on Tuesdays and Thursdays dealing with the theme of the exhibition.

Every day there will be a film show in the auditorium of films either made with the aid of computers or dealing with the relevance of computer technology to the humanities, the arts, and communications generally.

During the course of the Cybernetic Serendipity exhibition the opening hours will be as follows:

Tuesdays, Thursdays, Saturdays 11-6
Wednesdays, Fridays 11-9
Sundays 2-6
Mondays closed.

Admission 8/-
ICA members 4/-
Children free (special terms for school parties by arrangement with Leslie Stack)
Admission to films 2/6

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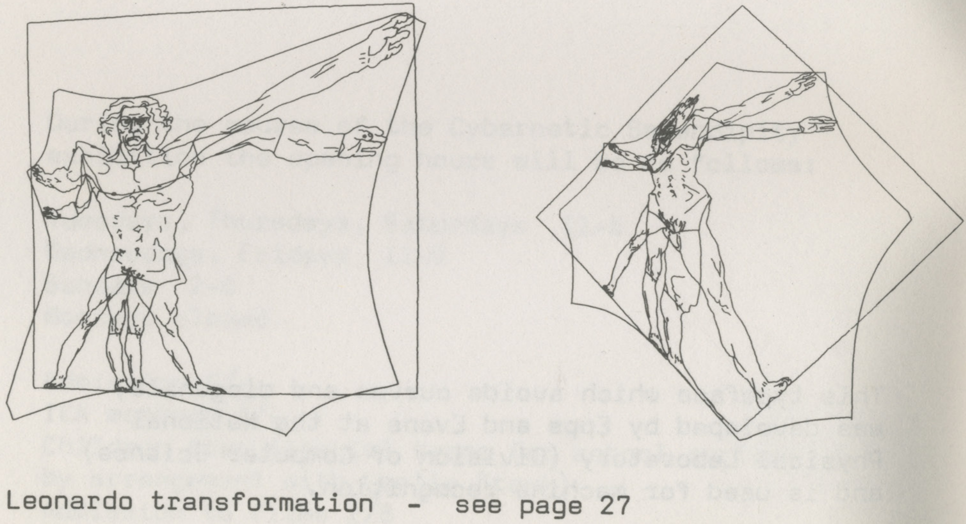
Nash House The Mall London S.W.1
839 5344

TRIBUTES TO HERBERT READ

An evening at the ICA, devoted to tributes to our late President, Sir Herbert Read, will be held on October 24th.

His last public address 'The problem of internationalism in art' will be published in the October issue of the ICA magazine, and is not included in the August issue as previously announced.



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Front cover. Lowell Nesbitt; IBM 1440 Data Processing System, 1965, oil on canvas, 60 x 60 inches.

Back cover. Lowell Nesbitt; IBM 1440, 1965, oil on canvas, 60 x 60 inches.

The Magazine of the Institute of Contemporary Arts
No. 5, August 1968

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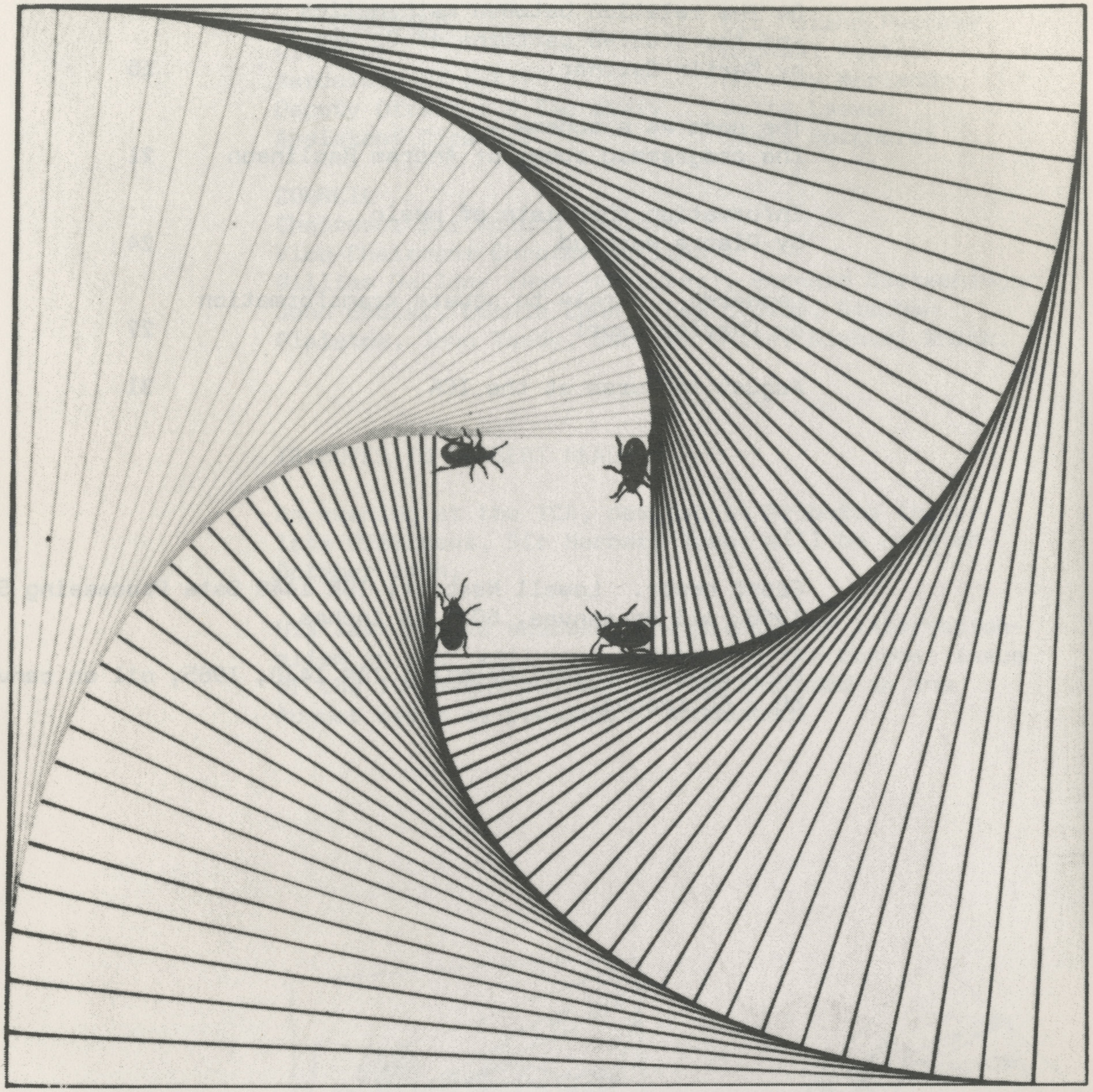


Figure 1.   Design based on the 'four-bug problem'.

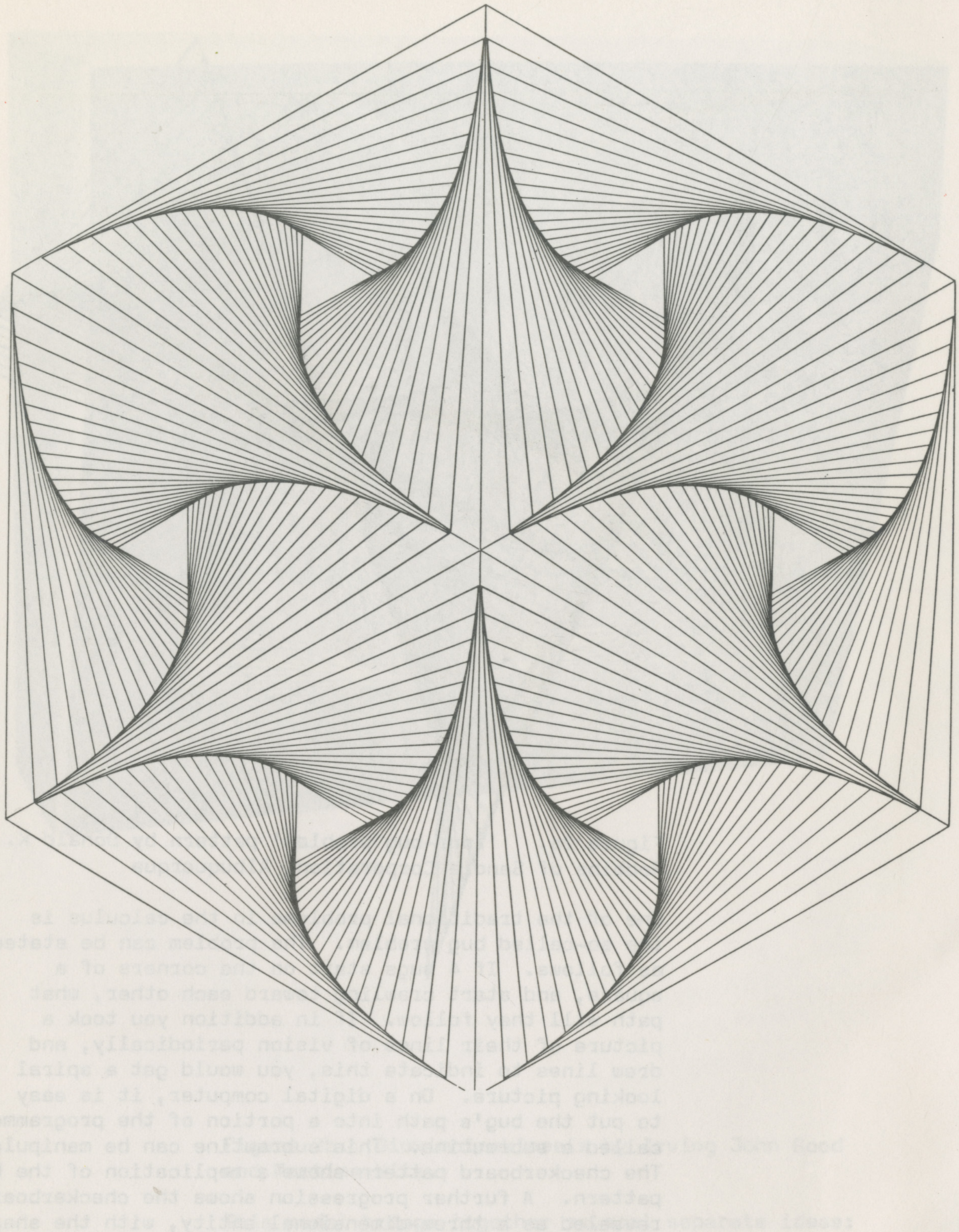


Figure 2. Design based on the 'three-bug problem'.

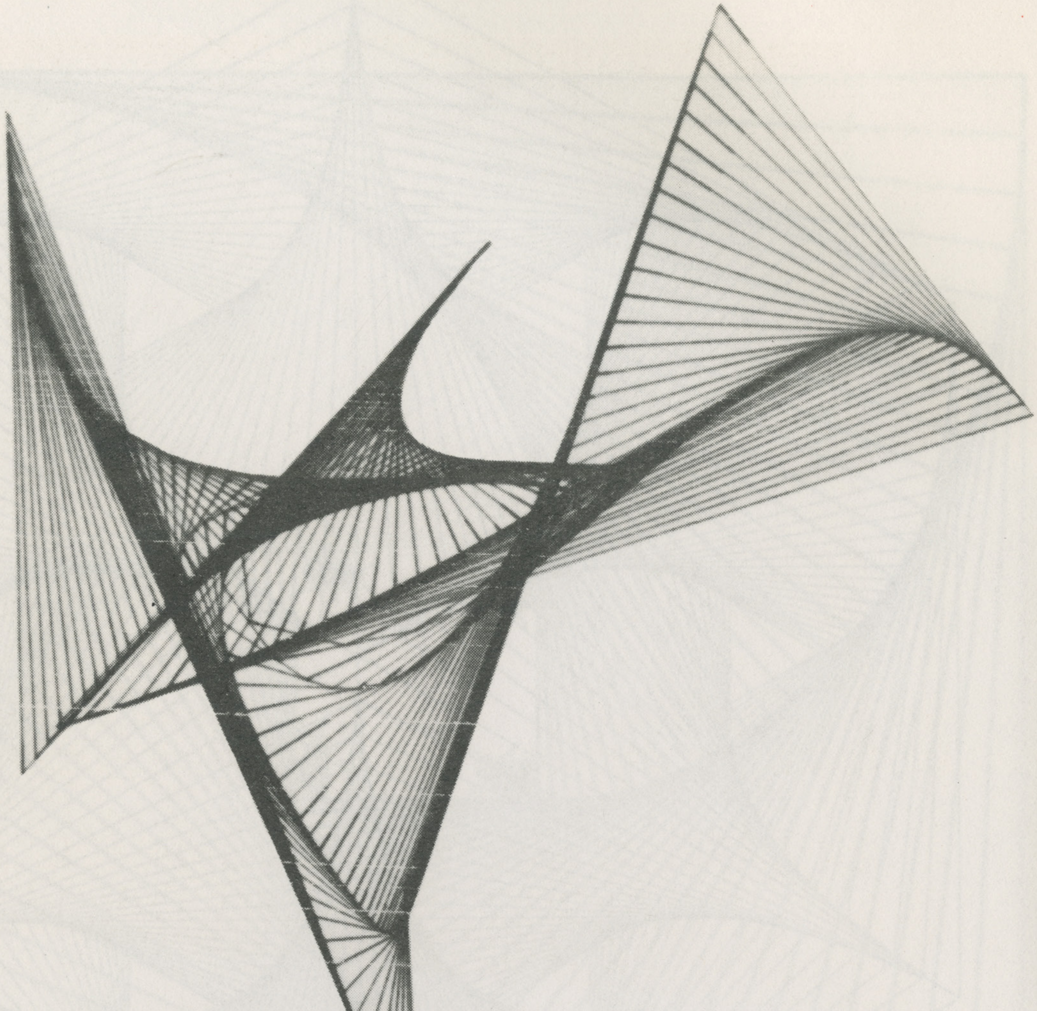


Figure 2a. 'Four-bug problem' pattern by Donald K. Robbins of Sandia Corporation, Albuquerque

One of the traditional problems in the calculus is the so-called bug problem. The problem can be stated as follows. If 4 bugs start on the corners of a square, and start crawling toward each other, what path will they follow. If in addition you took a picture of their lines of vision periodically, and drew lines to indicate this, you would get a spiral looking picture. On a digital computer, it is easy to put the bug's path into a portion of the programme called a subroutine. This subroutine can be manipulated. The checkerboard pattern shows a replication of the basic pattern. A further progression shows the checkerboard revealed as a three-dimensional entity, with the shape distorted (or perhaps made more real) by the perspective transformation. The computer, under the direction of the technological artist can readily produce these picture.

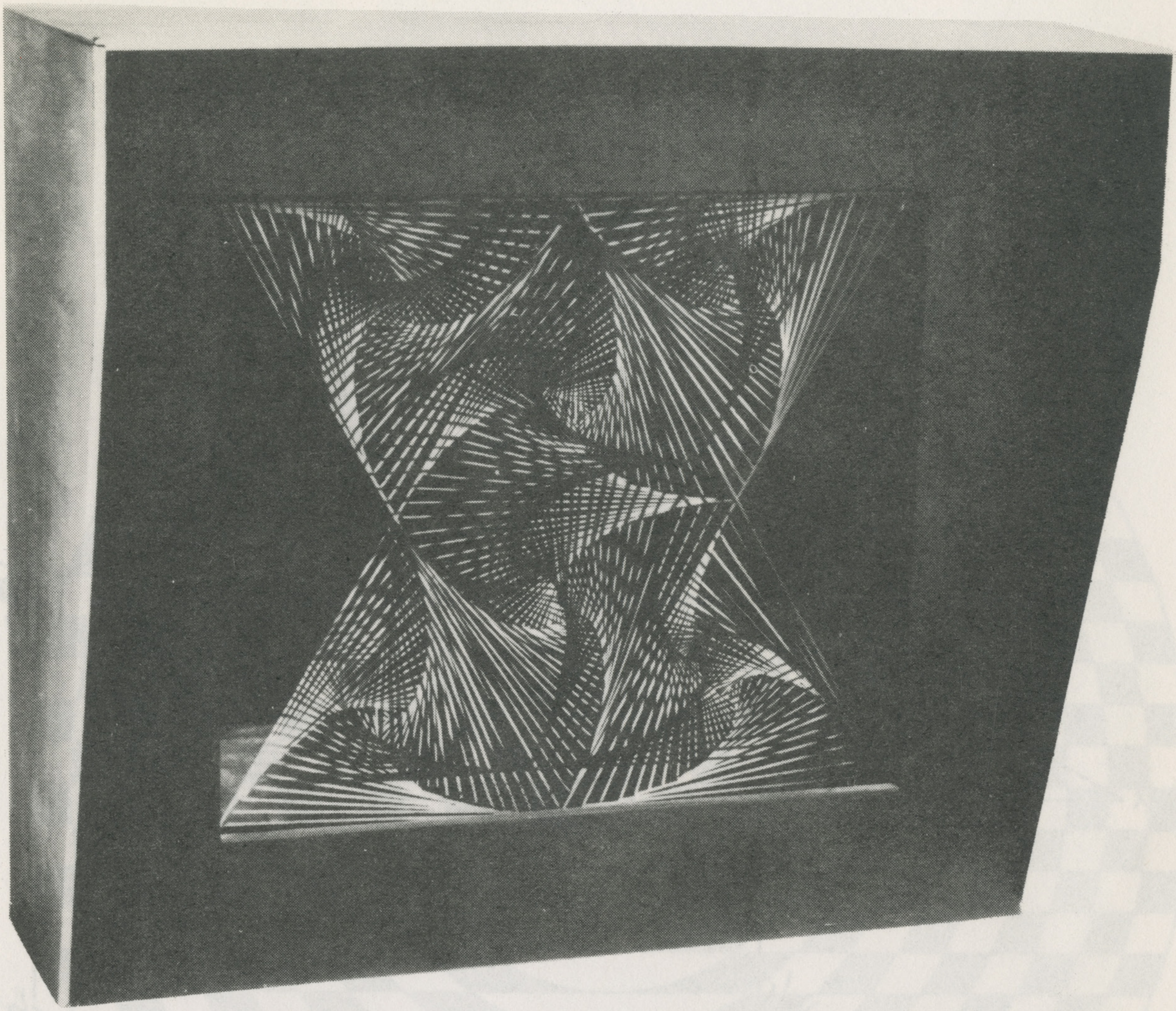


Figure 2b. Dioximoirekinesis by Irving John Good and Martine Vite.

This model brings together several separate ideas: the random combination of pursuit triangles, moire effects, and kinetic art. The result is a pulsating organism in a black box. The prefix Dioxi is Greek for Pursuit.

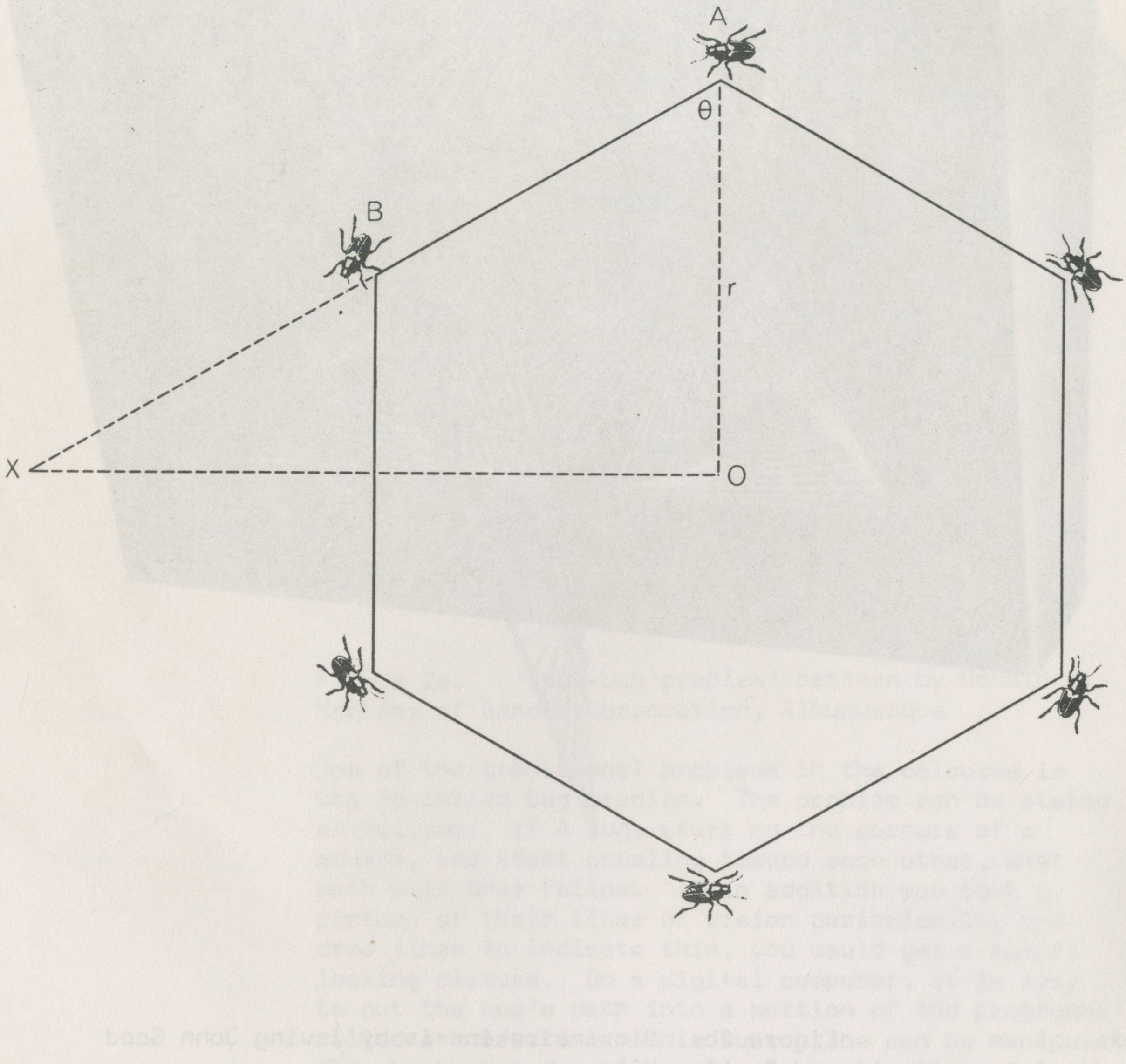


Figure 3. Calculating the length of the bug's path

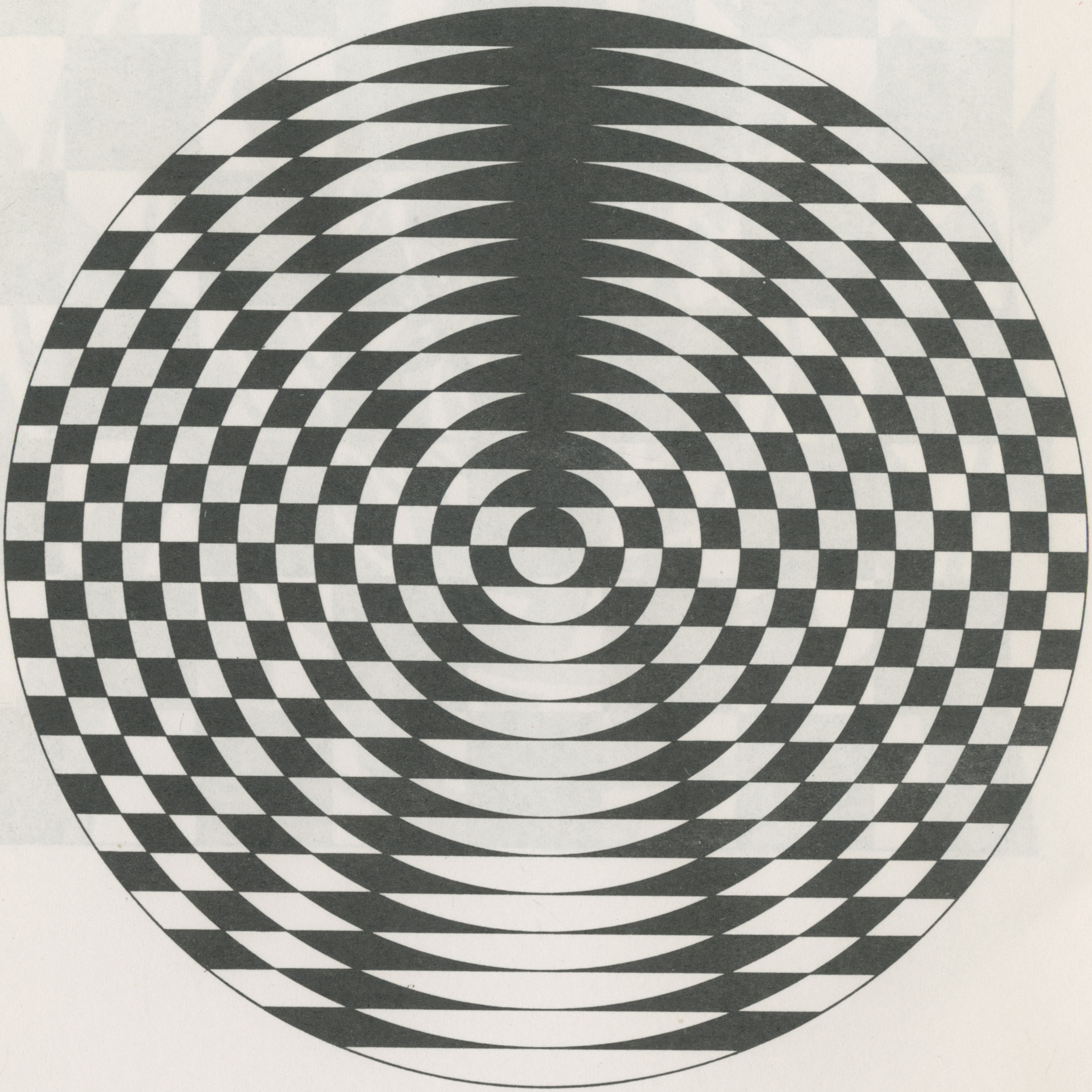


Figure 4. Baravelle's circular 'checkerboard'

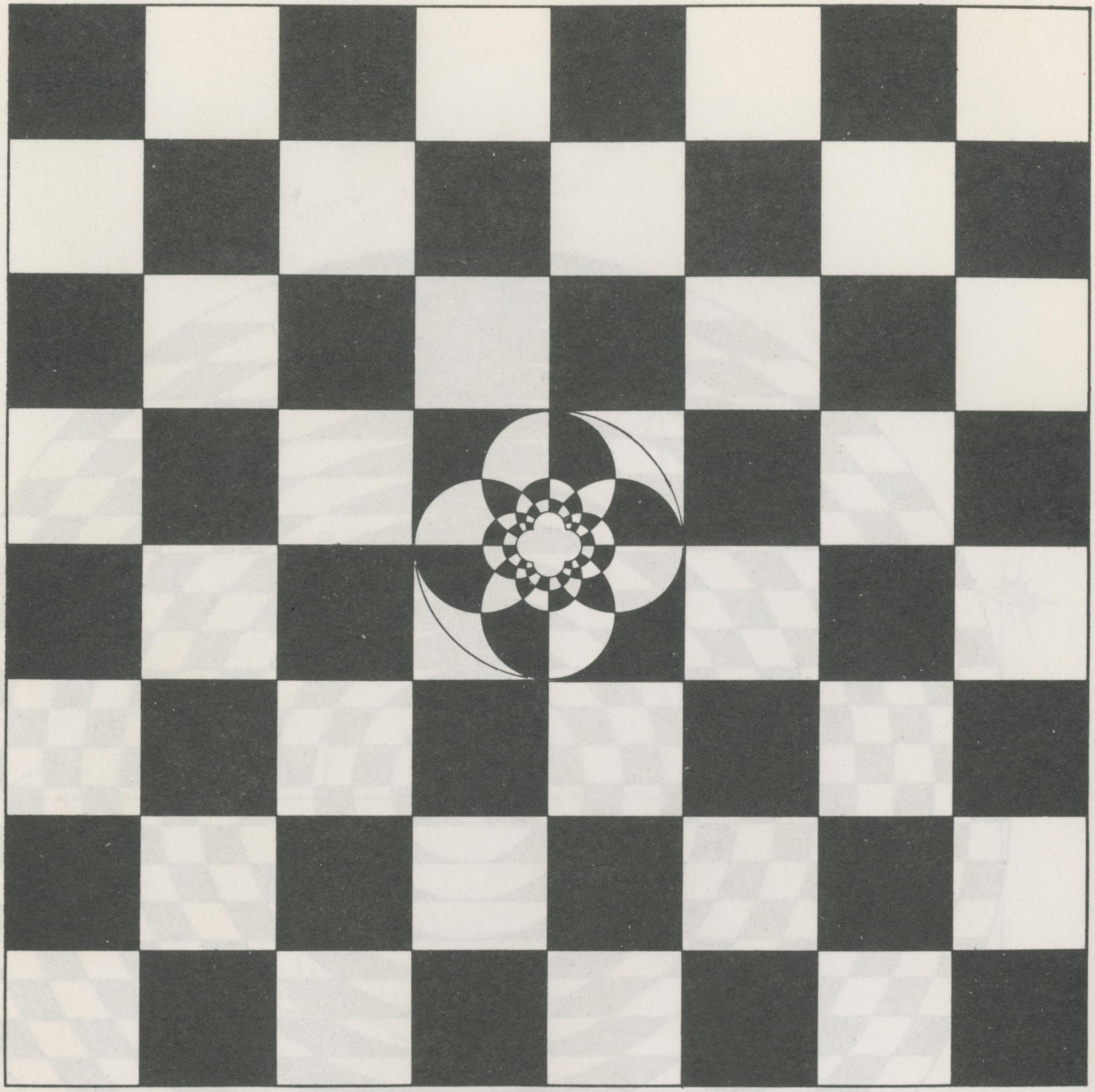


Figure 5. Checkerboard inversion pattern

Figure 6. 'Twisted cord' concentric circles

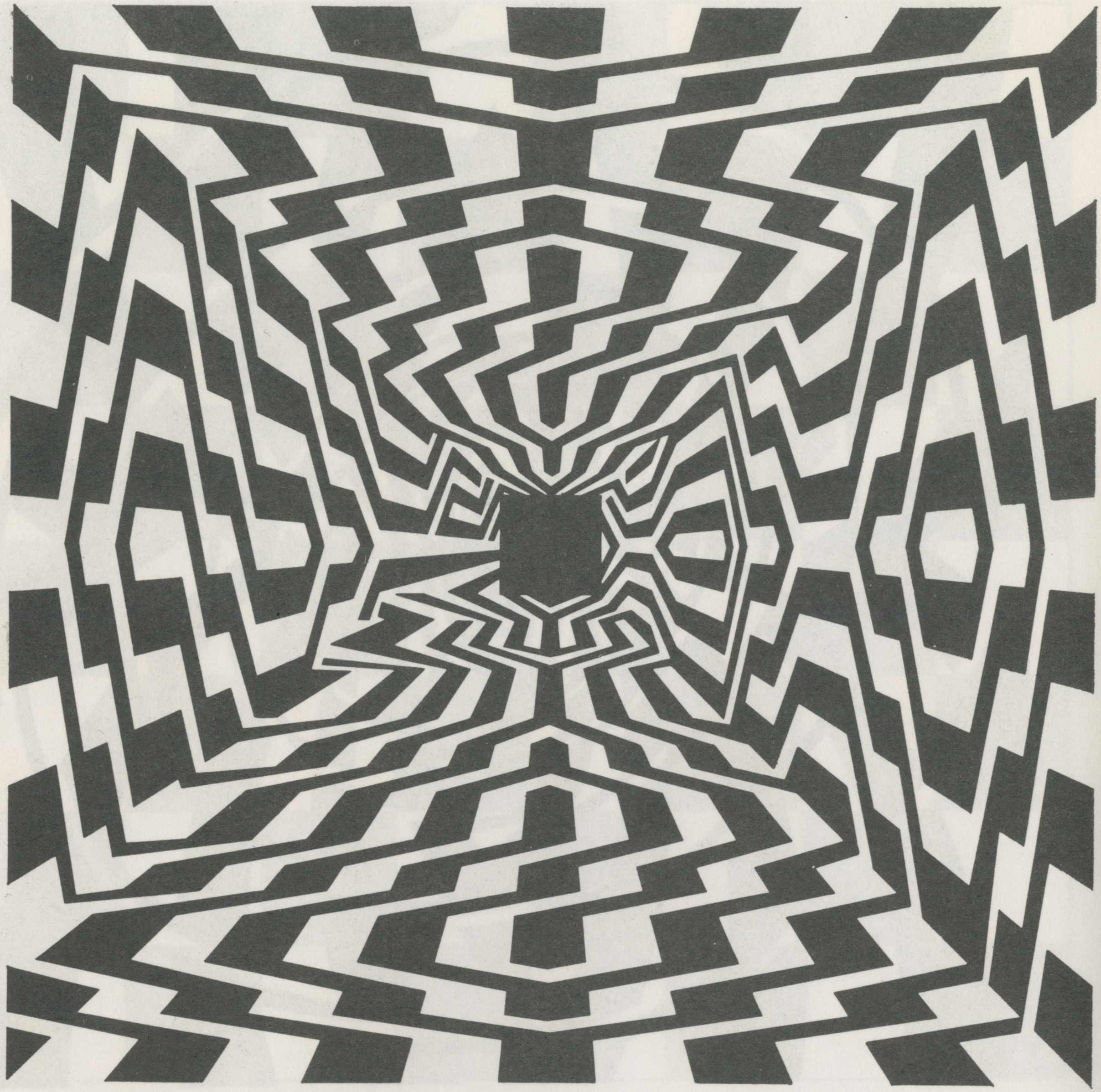


Figure 7. 'Twisted cord' spiral

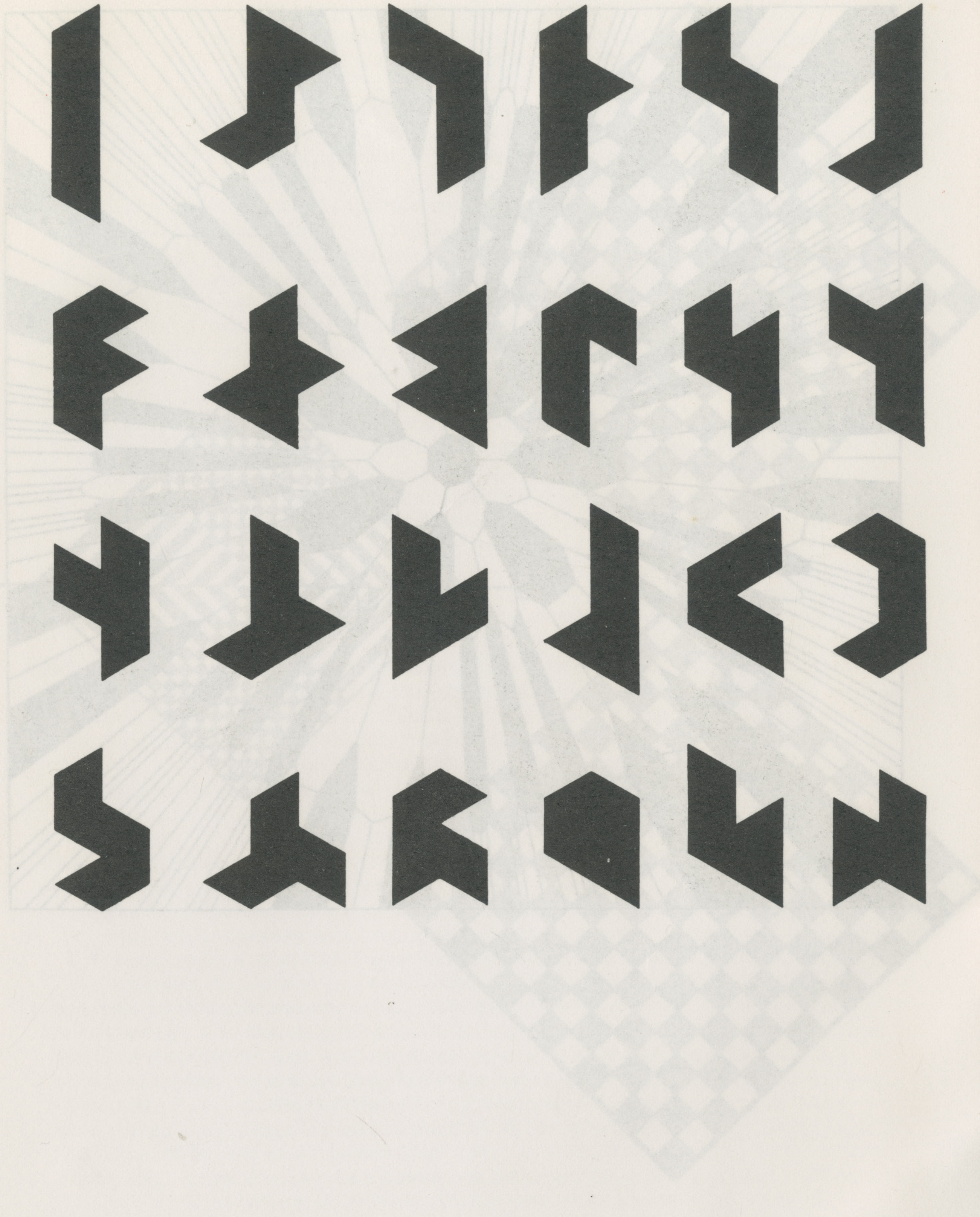


Figure 8. The 24 heptiamonds (which cannot tile a plane?)

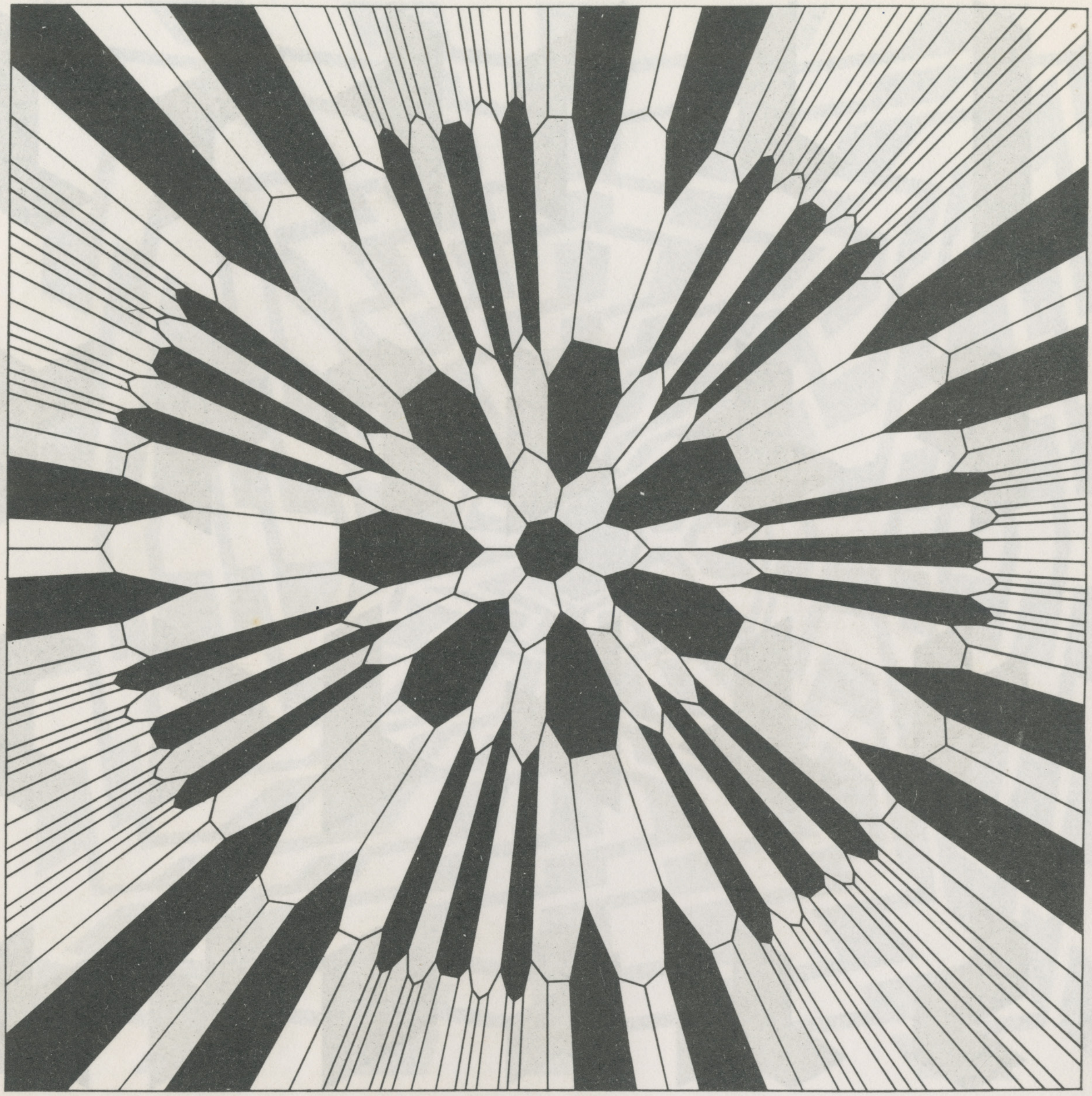


Figure 9.   Tesselation of convex heptagons

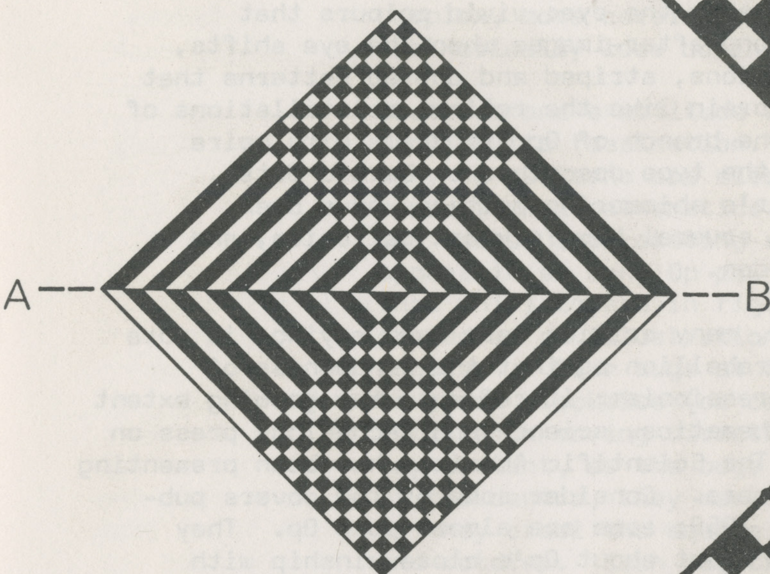


Figure 10.

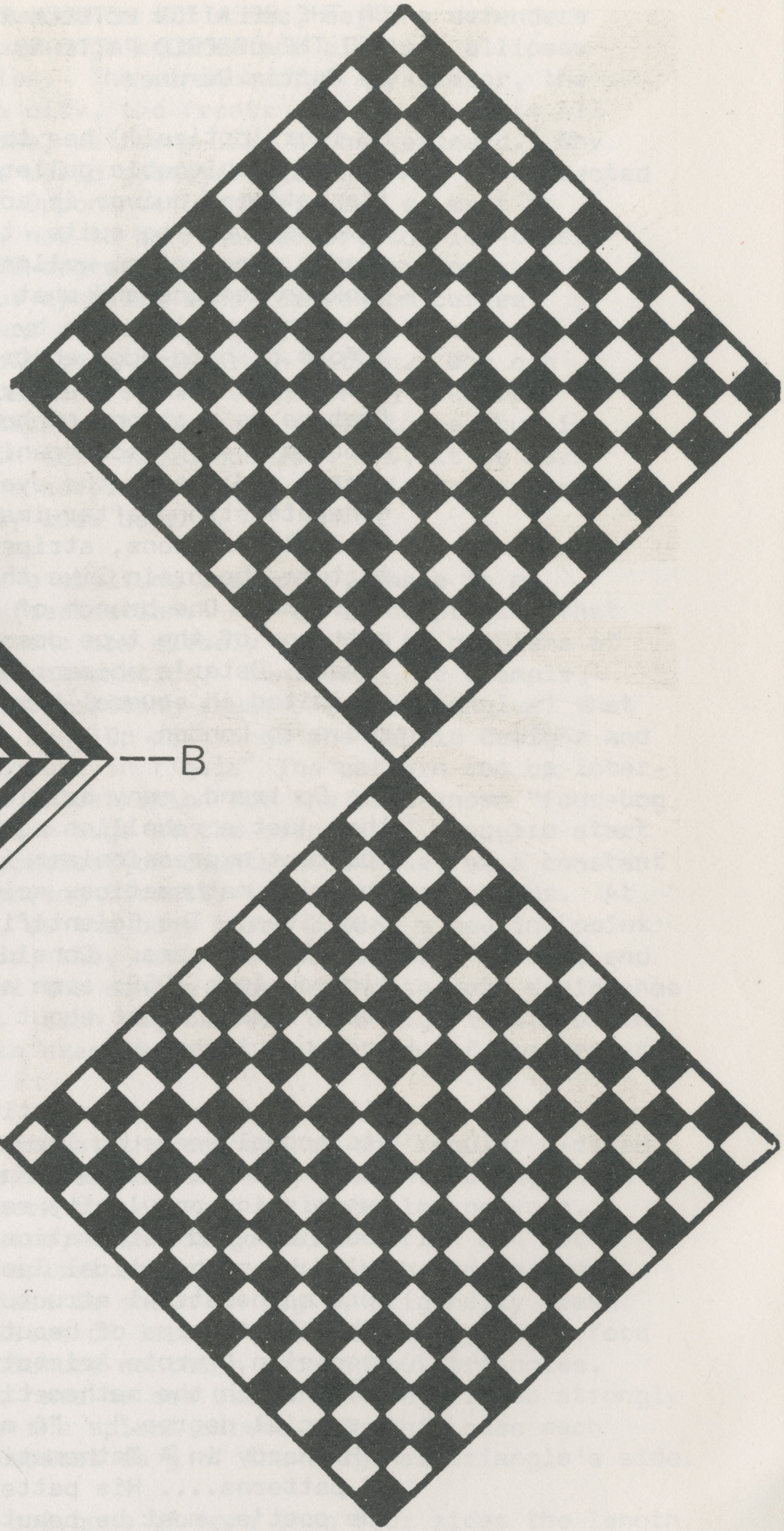


Figure 11.

ON THE RELATION BETWEEN MATHEMATICS AND THE ORDERED PATTERNS OF OP ART

by Martin Gardner

Op (for 'optical') has topped Pop (for 'popular') as the fashionable gallery art of the mid sixties; its patterns quiver in advertisements and on dresses, bathing suits, ties, stockings, window shades, draperies, wallpaper, floor coverings, package designs and what have you. Op art, as everyone surely knows by now, is the new name for a form of hard-edge abstractionism that has been around for half a century. Its distinguishing feature is a strong emphasis on mathematical order. Sometimes it is accompanied by effects intended to dazzle and wrench the eye: vivid colours that generate strong after-images when the eye shifts, optical illusions, striped and dotted patterns that torture the brain like the retinal scintillations of migraine. One branch of Op art deals with moire patterns of the type described by Gerald Oster. Indeed, Oster's shimmering patterns have been exhibited in several New York art galleries, and shown in London.

The Op trend, many critics have been saying, is more than just a rebellion against the randomness of abstract expressionism; it reflects the growing extent to which mathematics, science and technology press on our lives. The Scientific American has been presenting Op art for years. Consider some of the covers published since 1958; some are almost pure Op. They leave little doubt about Op's close kinship with modern science.

Although Op art is sometimes rich and warm with colours, its appeal seems to lie more in its cold, rigid, precise, unemotional and impersonal qualities. Its astonishing popularity revives ancient questions about art and mathematics. To what extent is art ruled by mathematical laws? To what extent can pure mathematical structure arouse aesthetic emotions? "The chief forms of beauty are order and symmetry and precision," wrote Aristotle in his Metaphysics (Book 13), "which the mathematical sciences demonstrate in a special degree." "A mathematician...," declared G.H. Hardy in A Mathematician's Apology, "is a maker of patterns.... His patterns, like the painter's or the poet's, must be beautiful; the ideas, like the colours or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics."

We are surrounded on all sides, say the defenders of Op, by hard-edge squares and circles, ellipses and rectangles. The windows of a skyscraper, the streets of a city, the fronts of file cabinets all form orthogonal patterns like a checkerboard. Why should these basic geometric designs not be reflected in our art? Opponents counter: But we want to escape from, not to be reminded of, the low-order curves and 90-degree angles of a technological culture. Our eyeballs ache for random curves, impure colours and soft edges; for the patterns of leaves and clouds and water in motion. Who can write an equation for the shape of an oak tree? The mathematical structure is still there, but in nature, as in less rigid abstract art, it is more complex, more careless, and - say Op's detractors - aesthetically less boring.

Whatever one's attitude toward Op, there is no denying its fascination. Nor is it surprising that many Op patterns are closely related to problems of recreational mathematics. Consider, for example, the nested and rotating squares (or rectangles) that appear in so many Op paintings and fabric designs and that whirl inward in fig.1. The pattern can be interpreted as an illustration for the well-known "four-bug problem". Four bugs at the corners of a square start to crawl clockwise (or counterclockwise) at a constant rate, each moving directly toward its neighbour. At any instant, as the bugs march toward a meeting point at the centre, they mark the corners of a square, and as they crawl the square they delineate both diminishes and rotates. Each bug travels on a logarithmic spiral with a length exactly equal to the side of the original square.

If n bugs start at the corners of any regular n-sided polygon, their positions at any instant during their march will mark the corners of a similar polygon. Like the square, this polygon will shrink and turn as the bugs spiral inward. A design based on the triangular case is shown in fig.2, originally drawn for an old issue of Scripta Mathematica by Rutherford Boyd. The picture contains cothing but triangles, but they are hard to see because the eye is so strongly dominated by the spiral curves. In this case each logarithmic spiral is $\frac{2}{3}$ of the original triangle's side.

For regular polygons of more than four sides the length of each bug's path is greater than a side. As J. Charles Clapham proved in the now defunct Recreational Mathematics Magazine, the length of the path of a bug starting at corner A can be found trigonometrically by extending a side AB (see fig.3) and locating on it a point X such that the angle AOX is 90 degrees. The distance AX - which is equal to r times the secant of angle θ - is the distance the bug travels. As the illustration shows, on a hexagon each bug's path is twice the length of a side.

Clapham's simple formula also applies to the square and the triangular cases, and even to the degenerate "two-sided polygon" - a straight line with a zero angle θ and bugs at each end that tramp toward each other until they bump head on. At the other extreme, the circle can be considered a degenerate "infinite-sided polygon" with bugs at an infinite number of "corners". These bugs march forever around the circle like the Pine Processionary caterpillers in a famous experiement of Jean Henri Fabre's, which trailed each other for eight days around the rim of a large vase. When we apply Clapham's right triangle to the circle, sure enough, angle θ is 90 degrees and the hypotenuse is infinite.

One suspects that Op painters both in America and Europe have yet to discover the thousands of eye-twisting patterns that lie buried in scientific and mathematical textbooks and back copies of academic journals. Early issues of Scripta Mathematica, for example, vibrate with exciting pre-Op. The illustration in fig.4 shows a striking pattern the mathematician Hermann Baravalle obtained by ruling parallel lines across concentric circles and then colouring the regions in checkerboard fashion. One might think that this pattern is topologically the same as a square checkerboard - in other words, that a square checkerboard on a rubber sheet could be continuously deformed to produce the pattern. This in fact is not the case.

In fig.5 Baravalle has inverted every point P that lies outside the circle on the checkerboard into a corresponding point P' inside the circle, such that $OP \times OP' = r^2$, where O is the circle's centre and r its radius. Every point on the plane outside the circle is thus put into one-to-one correspondence with every point inside. A line extending outward from the board to infinity corresponds to a line inside the central white space, extending inward toward the centre but never reaching it.

Inversion geometry can, of course, be applied to three-space as easily as to the plane. An old mathematical joke says that to catch a lion you just build a cage and perform an inversion operation on the beast. The cosmos itself can be inverted and compressed inside a tennis ball. In America during the 1870's a religious cult was actually founded on the belief that such an inverted three-space reflects the true state of affairs. Cyrus Reed Teed's "Koreshanity" put the entire universe inside the earth. We imagine ourselves on the outside of the earth looking out at gigantic stars scattered through an infinite space; the truth, said Teed, is that we are on the inside of a hollow earth looking in at small stellar bodies moving in a space that is the geometrical inverse of the space of orthodox astronomy. Teed defended his views in many books and articles; years later his ideas attracted a following in Nazi Germany.

Figs. 6 and 7 are examples of many vertigo-inducing patterns that were studied by psychologists more than 50 years ago. They are known as "twisted-cord illusions" because they were first discovered by twisting black and white string into a single cord that was then arranged in various ways on differently patterned background. Fig.6 consists of concentric circles (as you can prove with a compass); in fig.7 a spiral is made up of straight horizontal and vertical "cords" (as you can prove with a ruler).

Tesselations of the plane created by fitting together replicas of the same basic shape have long been used in design and are now turning up in many of the latest Op fabrics. The cross-pentomino appears on an Op dress advertised by Bonwit Teller. All polyominoes and polyiamonds (polyiamonds are formed by joining equilateral triangles instead of squares) of order six or less will fit together to cover the plane, but so far I have seen only the cross-pentomino and the L-tromino (the latter on a scarf sold by Gimbels in New York City) on Op fabrics. The reader can easily create his own new Op patterns by finding ways to tile the plane with each of the 12 pentominoes and the 12 hexiamonds.

Most, but not all, of the 108 heptominoes (for their diagrams see Solomon W. Golomb's recent book Polyominoes, pages 108-109) will tile the plane. Several British mathematicians are currently working on the difficult question of which of them are not planefillers. The corresponding problem for the 24 heptiamonds (see fig.8) was proposed by T.H. O'Beirne of Glasgow. Only one of the 24 shapes is not a plane-filler.

The Op pattern that covers the plane with convex noncongruent heptagons (fig.9) embodies a curious paradox that twiddles the brain even more than the eye. If this pattern is repeated infinitely, what is the average angle in it? Since the plane contains nothing but heptagons, and since the interior angles of any heptagon sum to 900 degrees, it follows that the average angle is 900/7 or 128 4/7 degrees. Note, however, that every point on the pattern is a meeting of three angles. This surely requires that the average angle be 360/3, or 120 degrees.

The source of this problem and its answer were given in Scientific American in August 1965, as follows: "The paradox of the heptagon tessellation was taken from Hugo Steinhaus' 'One hundred problems in elementary mathematics' (Basic Books, 1964). The paradox arises from the fact that a re-arrangement of terms in an infinite series can lead to a different calculation of the average term. Steinhaus gives as an example the series 1, 0, 1, 0, 1, 0... for which $\frac{1}{2}$ is the average. But the two infinite sets of ones and zeroes can also be arranged 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1... (where successive sets of zeroes have cardinal numbers that are squares of 1, 2, 3...), in which case the average is 0. It is easy to form other arrangements to make the average any desired integral value between 0 and 1. In the heptagon pattern two different arrangements of two infinite sets of angles are considered, and there is no reason why the calculation of an average angle should be the same in each."

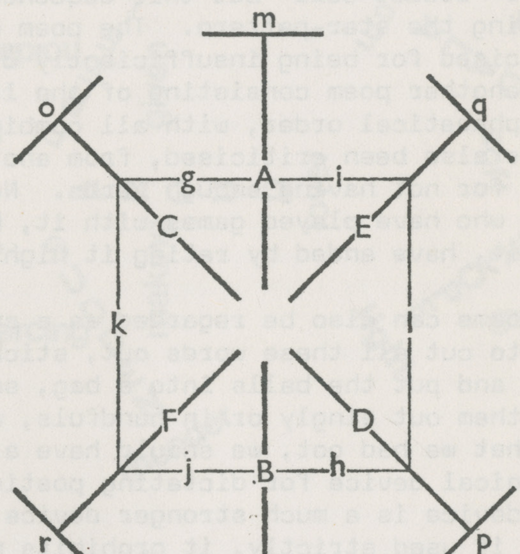
Readers were asked to make one straight cut across a circular Op pattern (fig.4) so as to divide the pattern into two parts, each topologically equivalent to a square checkerboard. That the pattern itself cannot be continuously distorted to produce a checkerboard is evident from the fact that the number of its cells, 392, is not a square. Note also that the two cells inside the bull's-eye are each three-sided; any distortion that turns one of these cells into a square would turn the other into a nonconvex figure. It is therefore necessary that the cut separate these two cells. The only straight cut that does this is one along the horizontal diameter of the large circle. Fig.10 is topologically the same as fig.4. It is easy to see that a single cut along AB produces two halves, each of which is topologically the same as a square checkerboard 14 cells on a side (fig.11).

This article has been reproduced by kind permission of Martin Gardner and Donald H. Miller of the Scientific American. It first appeared in Scientific American in July, 1965.

THE POEM AS A SCHEMA

The concrete poems by Andrew Rawlinson, of which the abstract schema is given below, consist of 18 words arranged in 19 positions, which, in the schema, are marked with upper-case or lower-case letters of the alphabet. The poet himself took the schema from the Orthodox three-dimensional cross, and developed it to make it also into a six-pointed Epiphany start.

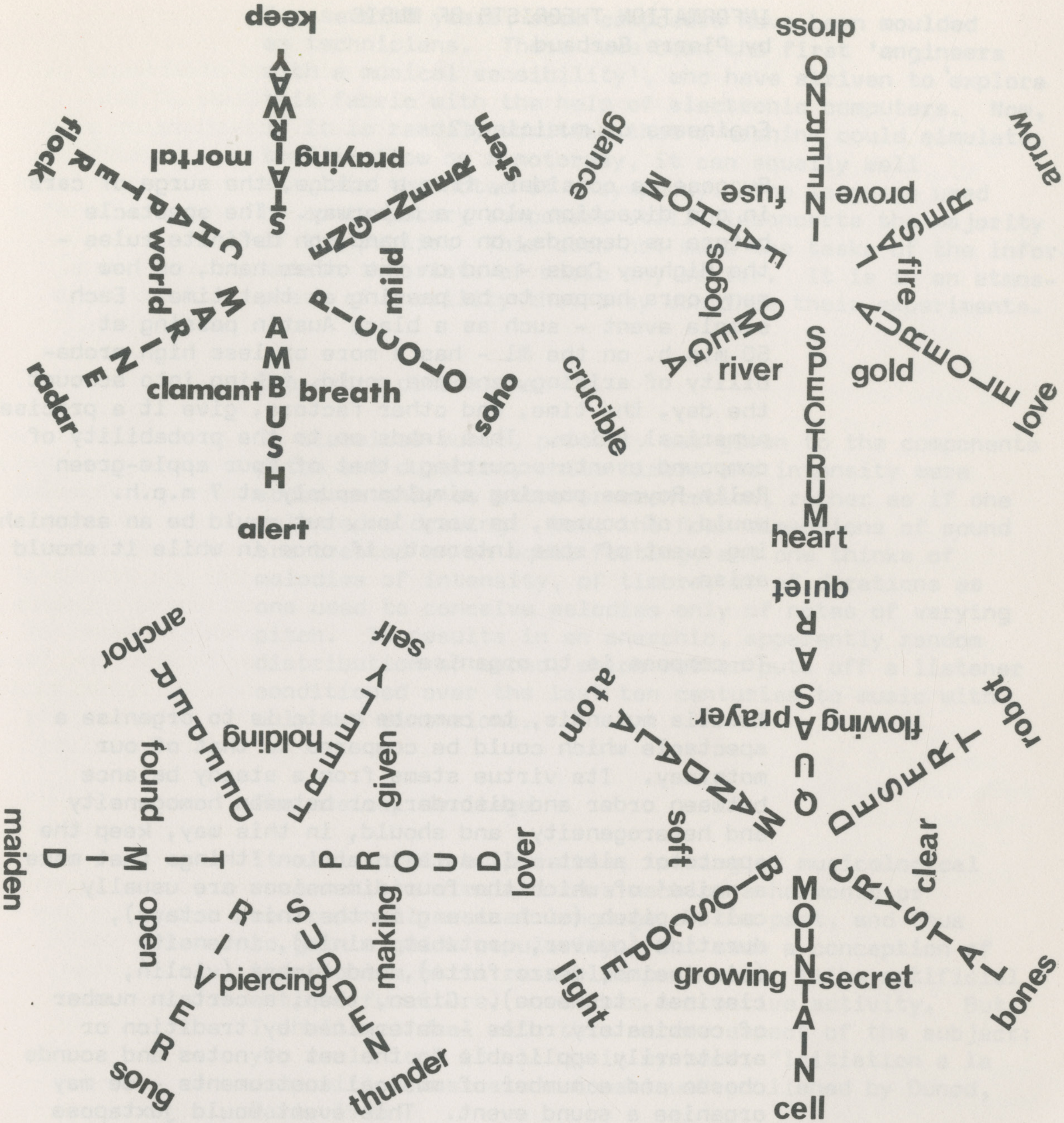
It is important to remember that any one of these poems is not a single assertion, but a schema from which poetic assertions can be drawn as the reader wishes. That is to say, the schema is not a single poem in itself, (as were, for instance, the comparable poems of the seventeenth-century emblemists). It is a complete poetic, relational totality; a whole conceptual universe, or world-treasury (or Thesaurus) from which the reader, by using the schema and being guided by the star-pattern, may construct for himself such word-sequences as he thinks fit.



The poet himself has supplied no rules as to how the cross-and-star pattern is to be used, so that the only thing the reader can do is to play star-games with the poems until he finds a word-sequence which satisfies him. Thus, if he takes the sequence DB, he will get "Crystal Mountain" whereas is he takes the sequence CD he will get "Mandala Crystal". If he takes the sequence ghij, he will get "secret prayer flowing growing" whereas if he takes the sequence mABn, he will get "quiet Quasar Mountain cell". If he takes the sequence onq, he will get "atom cell robot" whereas if he takes the sequence mrp, he will get "quiet light bones" and so on, and so on, up to factorial 18 (18!) sequences if no word in any one sequence is allowed to be repeated twice; up to 18^{18} sequences, if repetitions of words, or of sequences of words, are allowed but no total sequence is allowed to consist of more than 18 words, and up to a denumerably infinite number of sequences if both word-repetition are allowed and if the sequences are allowed to be of indefinite length.

Not all sequences which can be drawn from these poems are equally successful (take, for instance, the sequence consisting of all the 18 words in alphabetical order). The poems can therefore be criticised for incomplete richness. Likewise, the best sequences are not always gained by following the star-pattern; for instance, if you take the sequence mlghn, you get "quiet clear prayer secret cell" but this sequence is obtained by ignoring the star-pattern. The poem can thus be criticised for being insufficiently distinguishable from another poem consisting of the 18 words given in alphabetical order, with all combinations allowed. It has also been criticised, from another point of view, for not having enough verbs. Nevertheless, those who have played games with it, by taking sequences from it, have ended by rating it highly.

The poems can also be regarded as a system. If we were to cut all these words out, stick them on plastic balls and put the balls into a bag, so that we could fish them out singly or in handfuls, and then look to see what we had got, we should have a very weak mechanical device for dictating poetic meaning. The star device is a much stronger device than the bag, in that, if used strictly, it prohibits more sequences, though it still leaves a universe of "free play" which gives a very large totality of forms compared with what a conventional poem allows. We feel that we should like to be able to formulate explicitly the principles which guide us when we react to the star shape, so as to draw up clear-cut rules for constructing sequences. If we could have such detailed rules for poem-construction from the poem-frame which the star provides, then (in one of the indefinitely many current senses of "information") we should have in the poem an information-system of a simple kind.



These four poems by Andrew Rawlinson appeared on the covers of the magazine THEORIA TO THEORY edited by Dorothy Emmet and published in Cambridge

INFORMATION THEORISTS OF MUSIC
by Pierre Barbaud

Engineers or musicians?

Suppose we consider, from a bridge, the surge of cars in one direction along a motorway. The spectacle before us depends, on one hand, on definite rules - the Highway Code - and on the other hand, on how many cars happen to be passing at that time. Each simple event - such as a black Austin passing at 50 m.p.h. on the M1 - has a more or less high probability of arising, and one could, taking into account the day, the time, and other factors, give it a precise numerical value. This leads on to the probability of compound events occurring: that of four apple-green Rolls-Royces passing simultaneously at 7 m.p.h. would, of course, be very low, but would be an astonishing event of some interest, if once in while it should arise.

To compose is to organise

Mutatis mutandis, to compose music is to organise a spectacle which could be compared to that of our motorway. Its virtue stems from a steady balance between order and disorder, or between homogeneity and heterogeneity, and should, in this way, keep the spectator alert. It sets in action 'things that make a noise' of which the four dimensions are usually called pitch (such as a g in the third octave), duration (quaver, crotchet, minim), intensity (pianissimo, mezzo forte), and timbre (violin, clarinet, trombone). Given, then, a certain number of combinatory rules - determined by tradition or arbitrarily applicable to the set of notes and sounds chosen and a number of musical instruments - we may organise a sound event. This event would juxtapose compound events simultaneously: that is, their harmonic essence and continuously: that is, their melodic essence. We must thus give the traditional expressions 'harmony' and 'melody' a more extensive meaning.

Specialists in combinatory studies

This process has been performed satisfactorily for centuries by specialists - the composers, whose 'savoir-faire' is very developed and allows the superficial exploration of a very small part of combinatory material, defined by the elements which they activate.

For several years, some composers have been moulded as technicians. These have been the first 'engineers with a musical sensibility', who have striven to explore this fabric with the help of electronic computers. Now, if it is readily admitted that a machine could simulate traffic flow on a motorway, it can equally well simulate the notes of a symphony. The language used by contemporary composers still disconcerts the majority of the public. This does not make the tasks of the information theorists of music any easier. It is in an atmosphere of hostility that they continue their experiments.

Two extra dimensions

In classical music, priority was given to the components pitch and duration, while timbre and intensity were added on only as extra ornamentation, rather as if one coloured a drawing. Now, the four dimensions of sound are treated on an equal footing, and one thinks of melodies of intensity, of timbre, or of durations as one used to conceive melodies only of notes of varying pitch. It results in an anarchic, apparently random distribution of sound, which rather puts off a listener conditioned over the last ten centuries to music with only two dimensions.

The musical heritage

It will surely be possible, looking at musicological research, to simulate in a machine a harmonic or contrapuntal musical language of the past, and thus to gain a quick popularity. But such a conception of the problem still resembles past music (like artificial antique furniture) more than a creative activity. But I shall not deal with this narrow aspect of the subject: you could look it all up in my book, "Initiation a la composition musicale automatique" published by Dunod, Paris 1966

A word, now, on the notation used by such a machine. A note in the chromatic scale is denoted by its position on the stave within one octave and represented by a number between 0 and 12, writing 0, 1, 2, 3, ... as 00, 01, 02, 03, etc. This representation is prefixed by the number of the octave, for instance the fourth note in the fourth octave is denoted as 404. The sums are calculated to the base 12 and one uses the duodecimal system for all the sums containing elements of the chromatic scale before they are divided precisely into twelves. Some specific notation of durations completes this notation of sound.

An effective realization: Algom 7

In the ALGOM 7 programme I proposed to distribute all twelve notes in each of the seven octaves of the chromatic scale for four different durations on more than twenty instruments. The combinatory constraint, which is unique, is that the same sound does not arise at the same time in the same octave. Anyway, if, at a given instant I hear sound 307 (E), third octave, played on a flute, I would reject the simultaneous sounding of the same note on a different instrument. I would, however, accept simultaneously 105, 305, 405, and 605. Given a certain number of instruments $l_1, l_2, \ldots l_n$, (m where n (is equal to or less than) 20) whose limits of pitch are respectively $(P_1, P_1,)$ (P_2, P_2)... (P_n, P_n). These upper and lower limits, arranged in an increasing order of magnitude, determine over the whole range of possible sounds, a certain number of adjacent segments so that the ability to produce one of these sounds define the instruments which play it at a certain instant. When the machine has memorized the limits of the instruments it controls and defined these segments, it sorts out all the notes of the chromatic scale, of which the octaves have previously been determined, taking into account the constraint shown above, by distributing them to the different instruments within these limits. Similar operations take place to deal with durations and intensities.

The distribution of notes in octaves, of frequencies in timbres, the determination of durations and intensities are subject to fixed probabilities given in the form of stochastic matrices. The machine can change the probabilities in the course of its work at more or less distant intervals. It also brings together sequences of varying length with more or less contrasting characters.

One hopes - and experience shows that this wish is not merely Utopian - to obtain by this process a musically feasible work.

This article appeared in French, under the title "Les informaticiens de la musique" in Zero un informatique No 4, October 1966, Paris.

Translated by Peter Klein
Technical advice from Mark Dowson

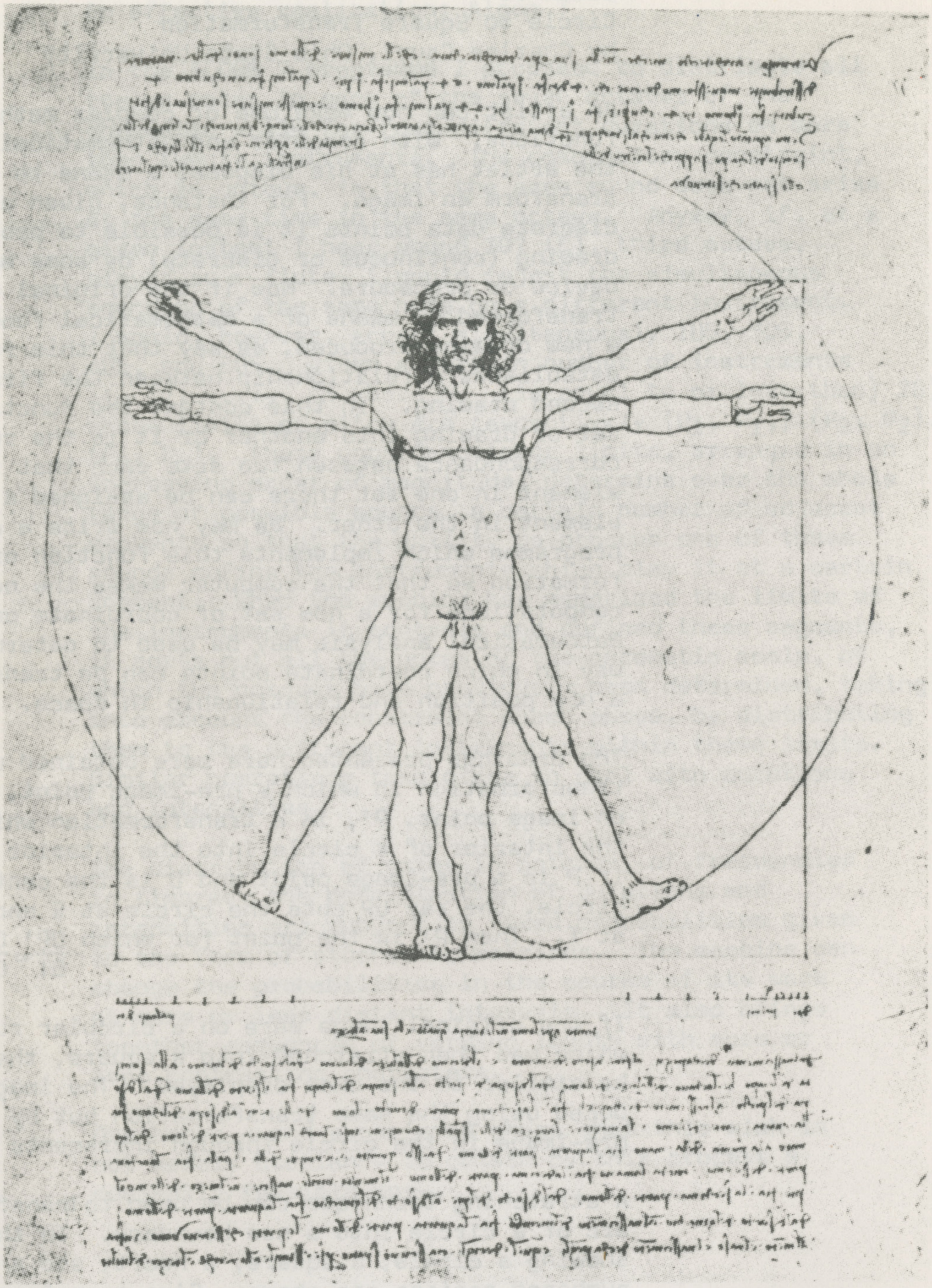
LEONARDO
Circle to Square Transformation
by Charles Csuri, Ohio State University

An artist can now make use of complex mathematical functions. With computer and mathematical technology, the artist has at his disposal a means to modify or transform an image. For instance, given a set of discrete data points it is possible to produce a drawing (continuous or discrete) by some mechanical device or procedure. Now if the original data is transformed by means of a mathematical function and a new drawing produced, we say that this function establishes a relationship between the first and the second drawing. In this context the function maps one set or drawing into another or it is the rule of correspondence between two sets such that to each element in one set there can be assigned a unique element in the other. We may now write a computer programme which implements this function or transformation so that the computer makes the necessary computations for a new set of coordinate points. Mathematical analysis may be used to determine the way in which coordinate points can be transformed to a new position and relationship in space.

The drawings presented here were obtained using a transformation in which a pre-image point, P, becomes an image point, P', in a transformation which stretches the interior of a circle into the interior of a square. If P is a pre-image point and O is the centre of the circle, the ray OP cuts the circle at S and the square at T. Then P' is the point for which $\frac{OP'}{OT}=\frac{OP}{OS}$.

If the original image were on a circular rubber sheet which was then stretched into a square, the image would be similar to the ones displayed. The images were produced using the same transformation but by rotating the pre-image in the circle through increments of 45 degrees.

A stretching technique can be used to transform any arc of a circle into a new boundary. In the diagram showing a circle, a square, a heart, and a rhombus, 8 numbered regions are shown. Five transformations can be associated with each region: the point T can be on the circle (no change in drawing), on the square, on the heart, on the rhombus, or at point O (a portion of the drawing will be eliminated). The number of such transformations is 5^8=390,625. If each transformation is used with 16 rotations the number of images is 6,250,000. Additional images can be found by adding more boundary curves or by introducing other types of transformations.



INTERPRETATION OF VITRUVIUS' THEORY OF PROPORTIONS
ca. 1500, by Leonardo da Vinci

This drawing represents the orientation of man in the universe. It gives an impression of a kinetic concept through the figure touching simultaneously both the circumference of the circle and the outline of the square.

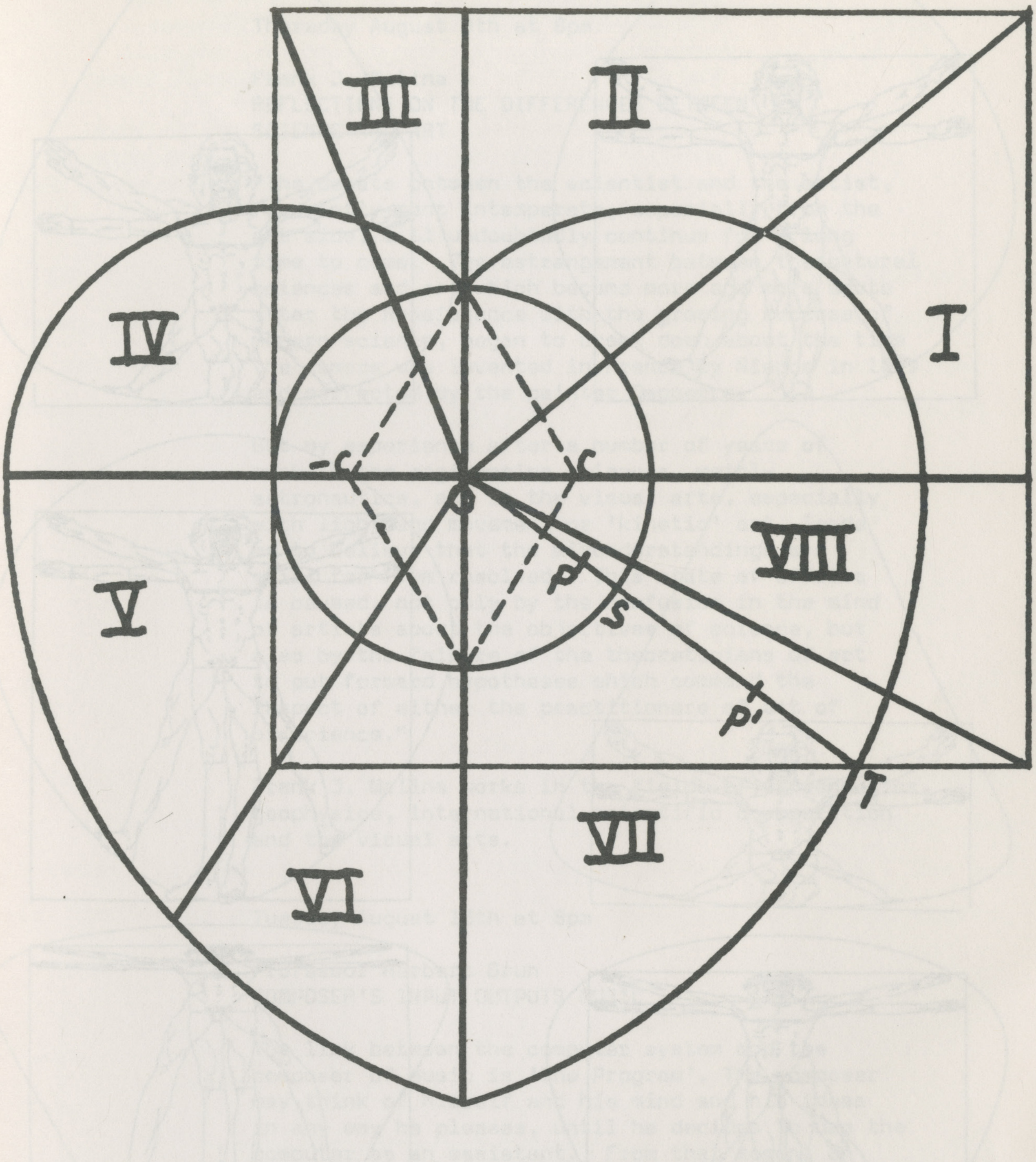
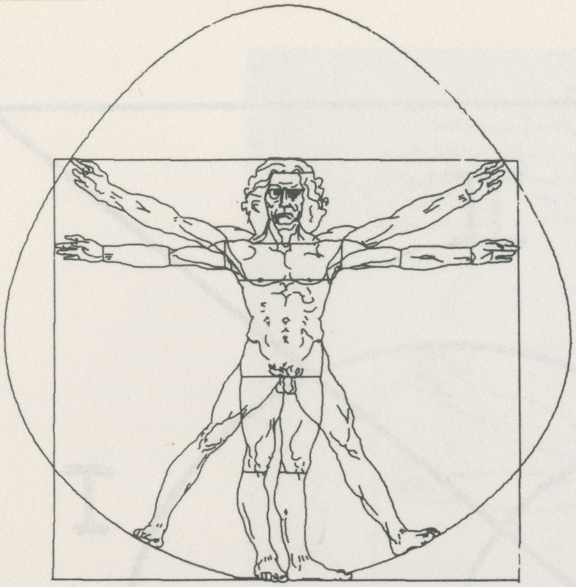
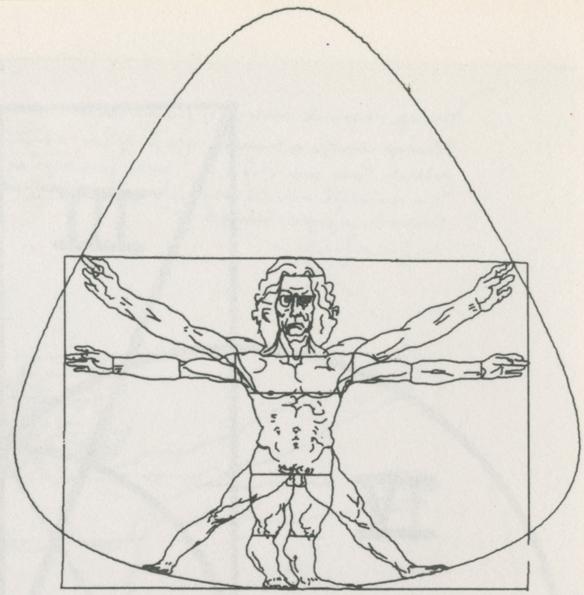
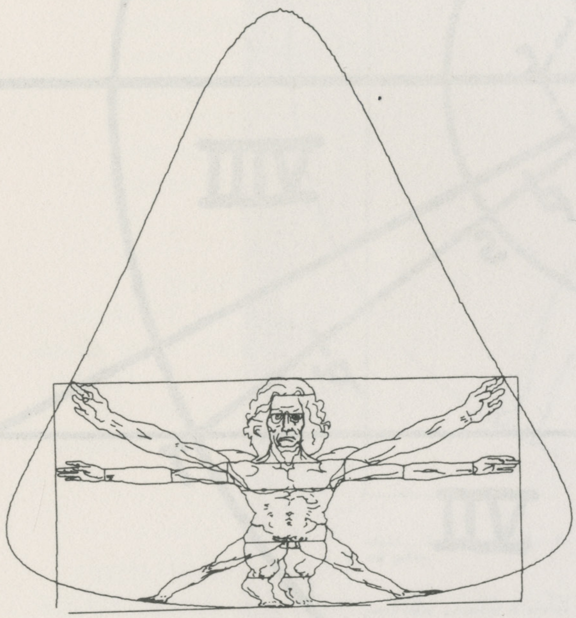
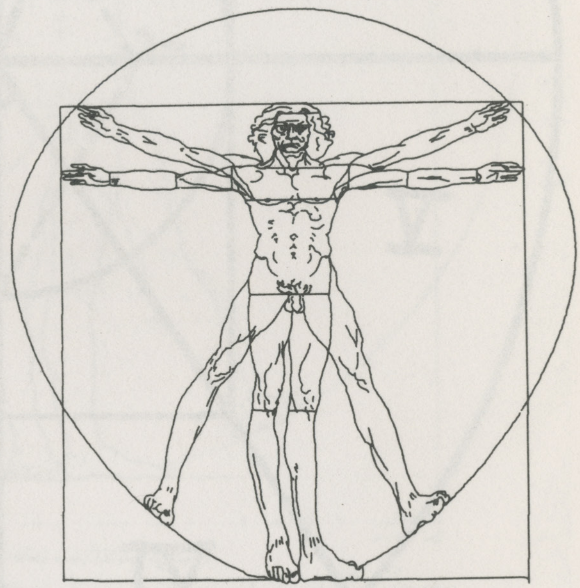
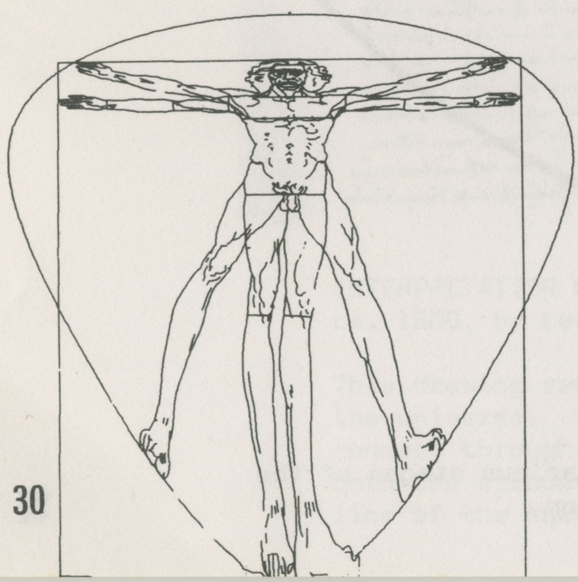
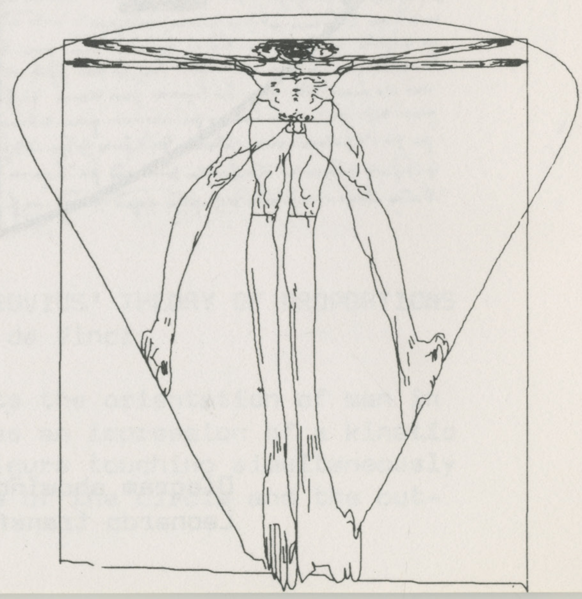


Diagram showing the various stages of the Leonardo transformation

AUGUST LECTURES AT THE ICA

Thursday August 8th at 8pm

Frank J. Malina
REFLECTIONS ON THE DIFFERENCES BETWEEN SCIENCE AND ART

"The debate between the scientist and the artist, frequently most intemperate, especially from the art side, will undoubtedly continue for a long time to come. The estrangement between the natural sciences and art which became more and more acute after the Renaissance with the growing success of modern science, began to break down about the time the camera was invented in France by Niepce in 1829 and perfected by the painter Daguerre.

But my experience after a number of years of work in the engineering sciences, mainly astronautics, and in the visual arts, especially with light and movement or 'kinetic' art, leads me to believe that the misunderstandings are still far from resolved. This state of affairs is caused, not only by the confusion in the mind of artists about the objectives of science, but also by the failure of the theoreticians of art to put forward hypotheses which command the respect of either the practitioners of art of of science."

Frank J. Malina works in the fields of astronautics, geophysics, international scientific co-operation and the visual arts.

Tuesday August 13th at 8pm

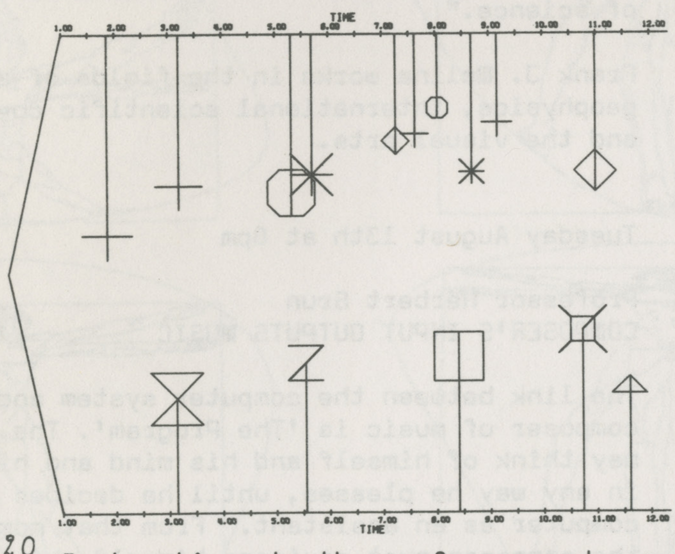
Professor Herbert Brun
COMPOSER'S INPUT OUTPUTS MUSIC

The link between the computer system and the composer of music is 'The Program'. The composer may think of himself and his mind and his ideas in any way he pleases, until he decides to use the computer as an assistant. From that moment on the composer must envisage himself, his mind, and his ideas as systems, since only systems can be translated into that language, the program, which can generate their analog appearances in the computer. Under control of a program, the computer system will simulate all the processes in and of the particular system which the program represents. The main problem thus appears at the beginning and again at the end of the entire proposition: Can the composer program musical ideas for a computer, and will the output of the computer contain musical ideas?

Another problem, especially for the more philosophically inclined composer, tends to become more acute as his work progresses: If it should be proven that everything is possible, that every sound, every constellation, every logical or random process is available - in short, if everything thinkable <u>can</u> be done, why then go ahead and still do it?

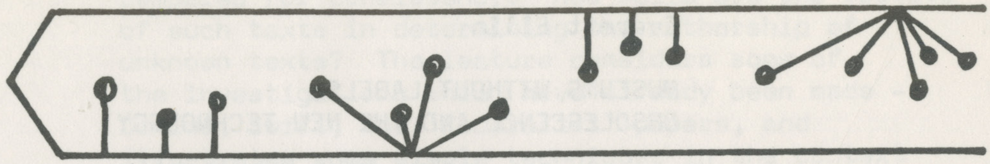
In the lecture Professor Brun will attempt to deal with some less obvious aspects of such problems to propose some methods for analysing or even solving them. He will also present a number of the computer's audible and visual outputs.

Herbert Brun, composer and lecturer, is concerned with the function of music in society, and has been teaching at the School of Music of the University of Illinois since 1963. He is primarily involved with research on the significance of computer systems for the composition of music



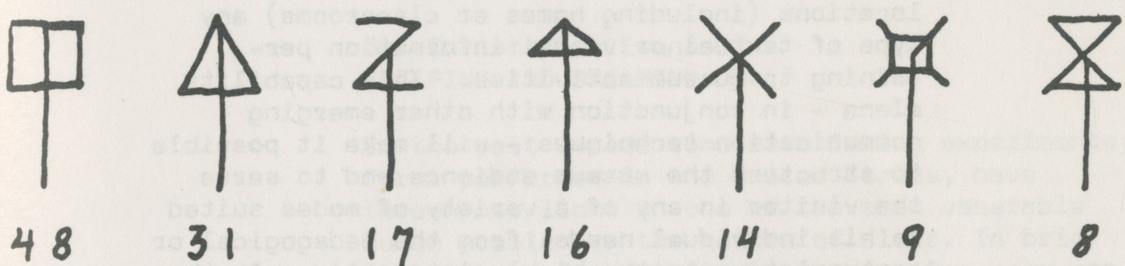
Instructions to the performer and a part of the score from Herbert Brun's 'Stalks and Trees and Drops and Clouds' 1967. The complete score consists of 31 pages, and would last about $7\frac{1}{2}$ minutes in performance. It was composed on an IBM 7094 computer.

To the performer of STALKS AND TREES AND DROPS AND CLOUDS:

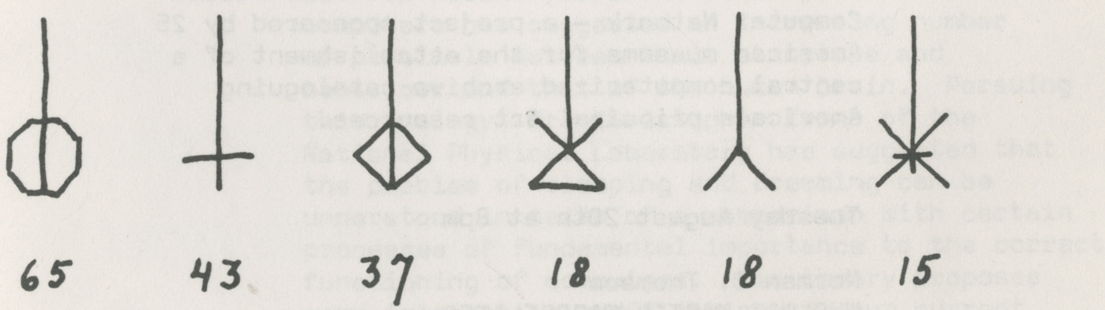


You need two sets of instruments.

Set A, for STALKS AND TREES: Seven non-reverberating instruments, dry, dead, explosive, whipping, rattling, wooden, etc. Preferably, but not necessarily, just one of each of seven very different kinds. The seven symbols for Set A, and the number of times each appears in the score:



Set B, for DROPS AND CLOUDS: Six reverberating instruments, resounding, ringing, vibrating, sizzling, noisy, whispering, etc. Preferably, but not necessarily, several of each of six very different kinds. The six symbols for Set B, and the number of times each appears in the score:



During the first preparatory stage (see General Preface) you have to determine the particular kind of instrument, which each symbol will represent throughout the piece.

Thursday August 15th at 8pm

Everett Ellin

MUSEUMS WITHOUT LABELS:
OBSOLESCENCE AND THE NEW TECHNOLOGY

As the ascending population curve, the implosion of leisure time and the public's runaway appetite for recreational/educative input close on a collision course, the classical museum experience is facing accelerated obsolescence. If museums are to continue to serve a growing audience already attuned to multi-sensory levels of reception, they must reconcile themselves to a sweeping redesign of their traditional services and facilities. Dramatic advances in computer technology will, for example, soon permit the assembly of electronic archives which can store, and deliver to even remote locations (including homes or classrooms) any type of textual or visual information pertaining to museum activities. This capability alone - in conjunction with other emerging communication techniques - will make it possible to structure the museum audience and to serve the visitor in any of a variety of modes suited to his individual needs, from the pedagogical or contemplative to the highly interactive. In the not-too-distant future, new technology promises to reshape and expand the museum environment in ways which can be scarcely imagined today, and to insulate it form the cultural overload that may presage its demise.

Everett Ellin has practised law, worked as an art dealer, curator and teacher. Recently, he has become Executive Director of the Museum Computer Network - a project sponsored by 25 American museums for the establishment of a central computerized archive cataloguing America's principal art resources.

Tuesday August 20th at 8pm

Norman D. Thomson
WHO WAS MARTIN MARPRELATE?

Computers have made possible feats of enumeration previously beyond the bounds of human patience. In the field of literature, statistics about words, sentences, parts of speech etc can be obtained rapidly and accurately, and different texts compared for consistency. How valid are the results of such texts in determining the authorship of unknown texts? The lecture considers some of the investigations which have already been made - Junius, Swift, the 'Federalist' papers, and illustrates some simple techniques in the context of Victorian and Elizabethan authors, and describes the problem of the authorship of the Marprelate pamphlets, and the work currently in progress on it.

Norman D. Thomson is a schoolmaster at Gordonstoun School in Morayshire. The application of computers to literary problems has been his hobby for some years, and his first completed work in this field was an analysis of the chronology and style of the Greek writers Xenophon and Thucydides.

Tuesday August 27th at 8pm

Dr. Christopher Evans
SLEEPING AND DREAMING

In the past decade some astonishing experiments, first performed in the United States, have thrown new light on one of the most venerable human problems - the nature of sleep. In brief it has been found that people dream for very considerable periods of the night (instead of merely in momentary bursts as had been previously thought); it has also been found that people deprived of the opportunity to dream soon became psychologically disturbed. The difficulty has been to make sense of this exciting material - what can possibly be so important about sleeping and dreaming that we spend as much as a third of our lives at it? In recent years the development of advanced computers has suggested an increasing number of parallels between their structure and behaviour and that of the human brain. Persuing this analogy, Dr. Christopher Evans of the National Physical Laboratory has suggested that the problem of sleeping and dreaming can be understood in terms of a comparison with certain processes of fundamental importance to the correct functioning of computers. His theory proposes some interesting modifications in our current conception of the nature of sleep and he will discuss it in relationship to such topics as psychoanalysis, the use of sedative and hallucinogenic drugs, and the changing of sleep requirements of the aged.

Dr. Christopher Evans is Principal Research Fellow in the Division of Computer Science at the National Physical Laboratory. His main research interests lie in the field of human visual and auditory perception. His new theory of dreaming, first published in 1964 as a speculative work, has since received interesting experimental confirmation. Dr. Evans is Psychological Consultant to the ICA.

MUSIC COMPOSED WITH AND PLAYED BY COMPUTER
Thursday 29th August 8 pm

admission 7/6 ICA members 5/-
or by exhibition season ticket

a concert of taped computer music during the Cybernetic Serendipity exhibition, from The Experimental Music Studio of the University of Illinois
Works by Lejaren A Hiller, Herbert Brun, Gary Grossman, James Cuomo, and others
with commentary by Herbert Brun

Page from a score by Lejaren A. Hiller
Random music can be composed by spattering ink from a brush onto blank music paper (top). When the spots are transcribed (bottom), the horizontal distance between them defines their time value. Meters are obtained by drawing cards from a deck.

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GALLERY ARTISTS
August

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Regular diary of activities & the ICA Magazine

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at half-price or less.
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Priority booking and reduced rates for music, dance,
poetry, lectures and other events.
Regular monthly diary of activities.

Cut off the lower section of this page and send it to the Membership Secretary, ICA, Nash House, The Mall, London S.W.1. For further details enclose S.A.E.

I would like to join the ICA for one year as a Full/Standard member, I enclose £5.5.0./£1.0.0. for my membership card & printed information.

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MATISSE
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Weekdays 10.30 - 7 Sundays 10 - 6
Admission 5/-

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