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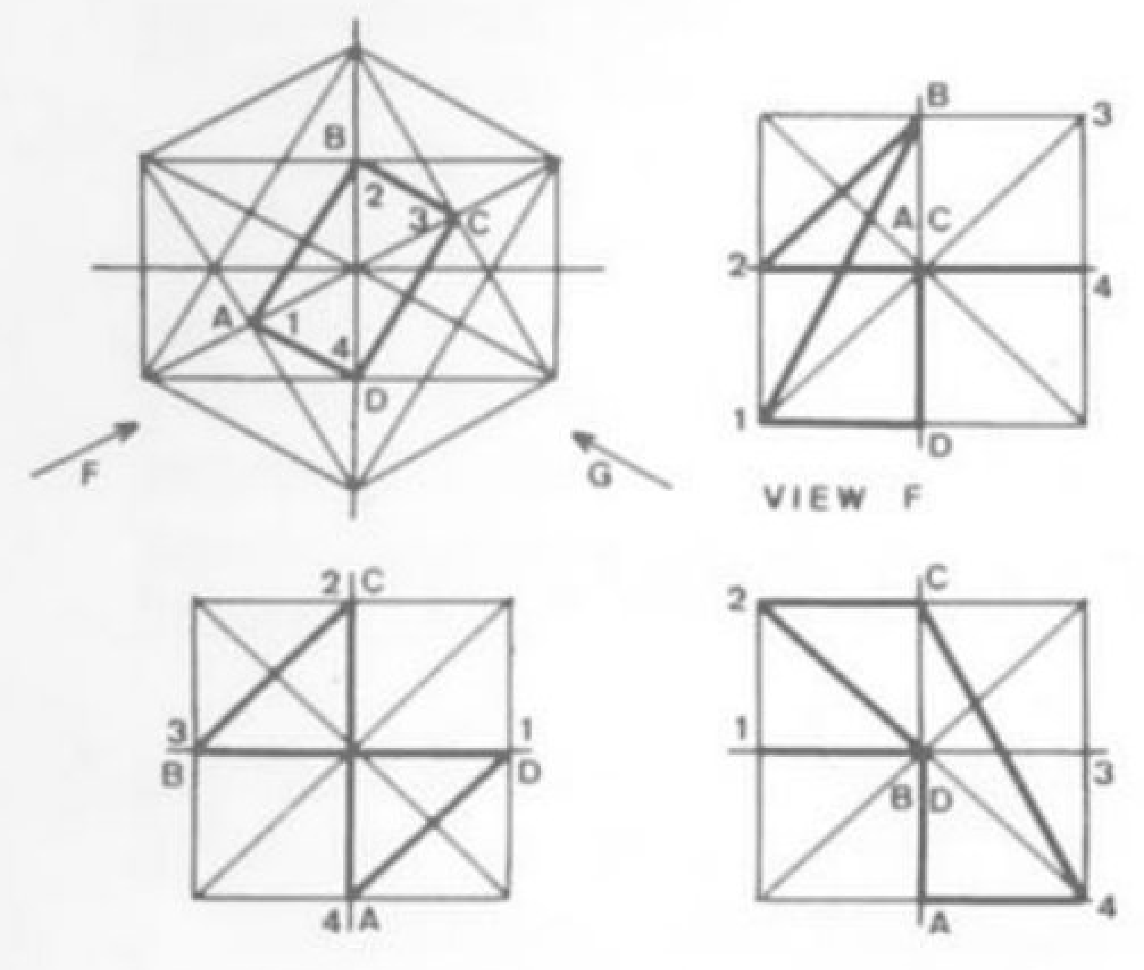
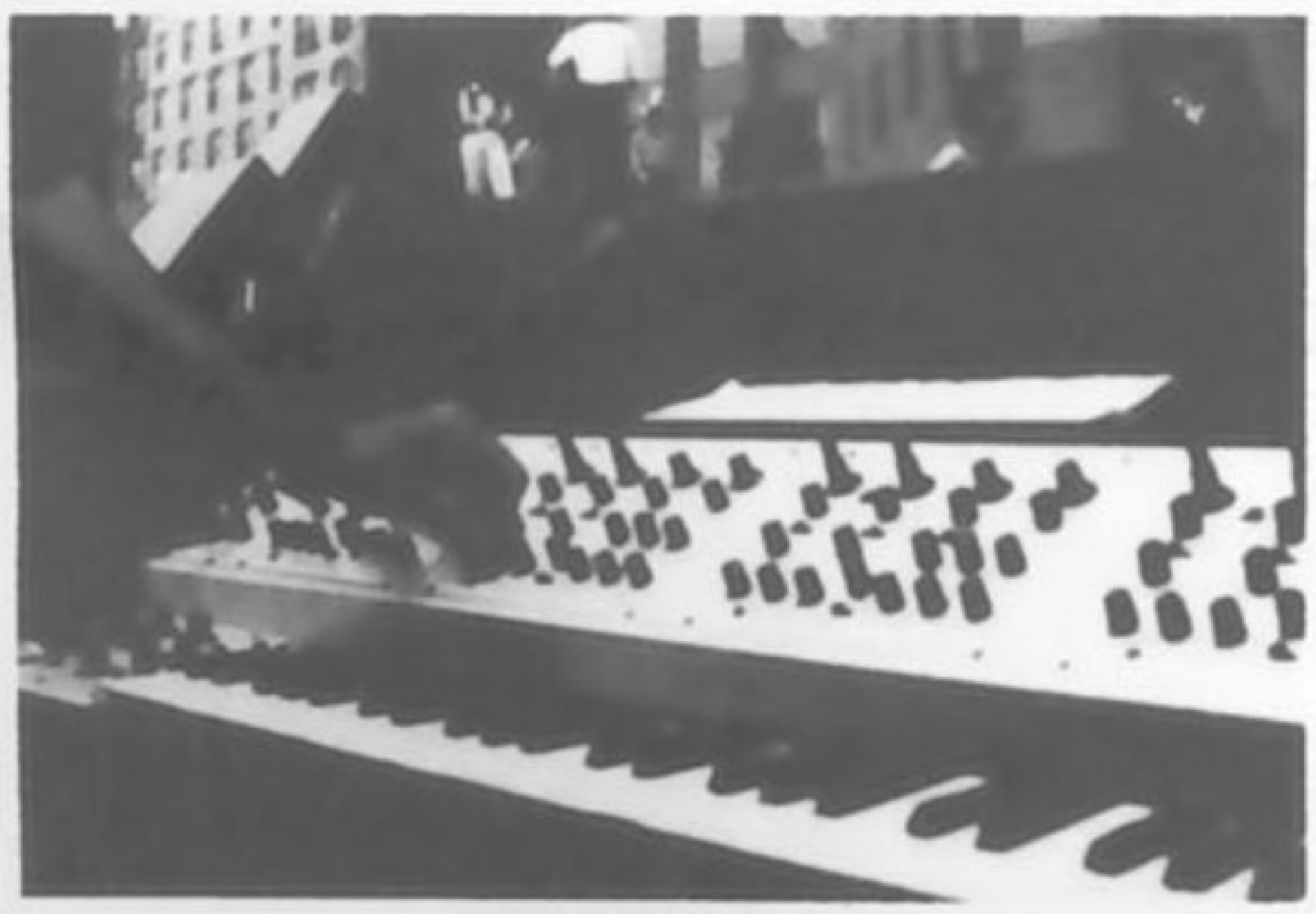
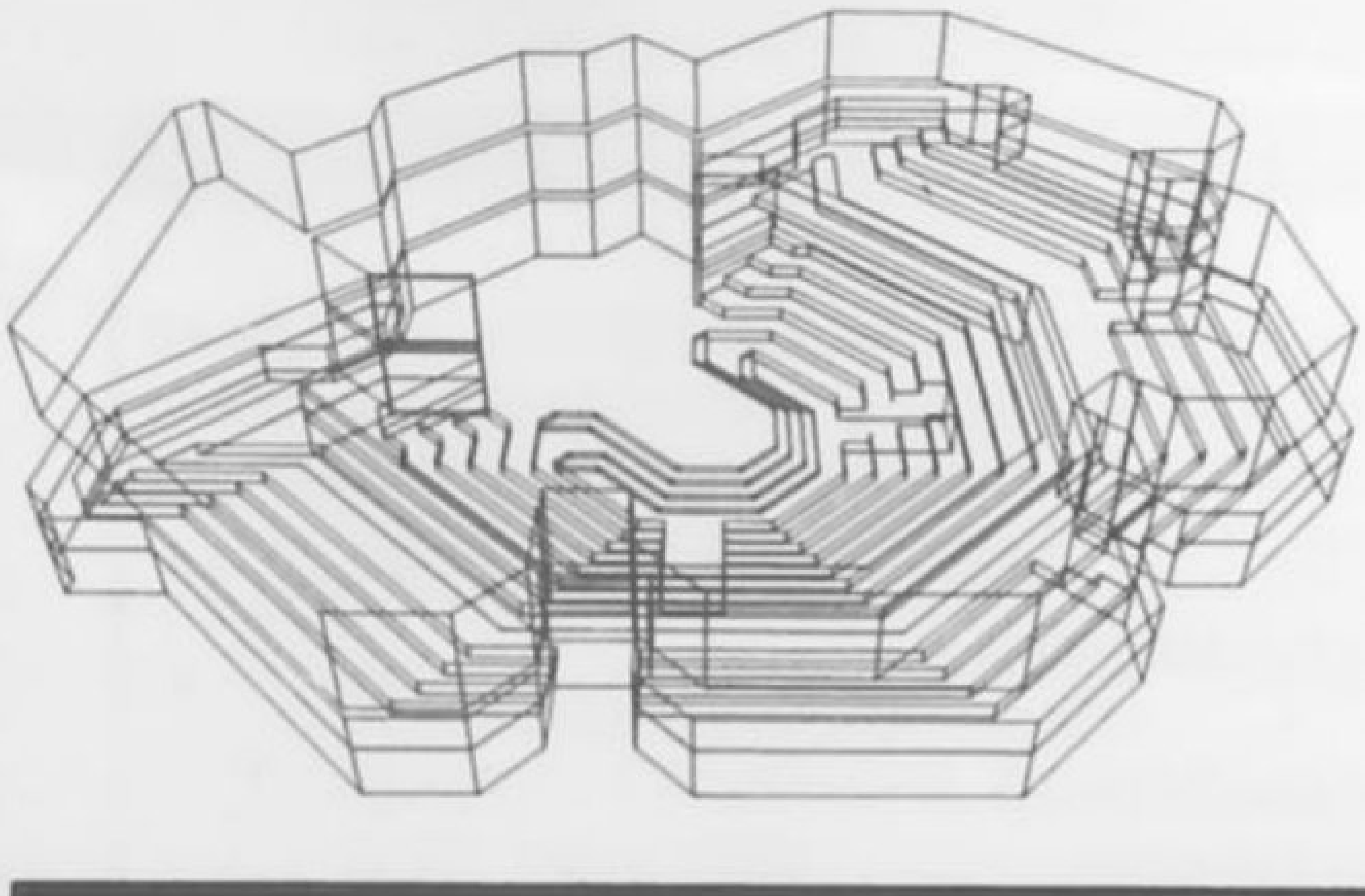
COMPUTER ARTS SOCIETY QUARTERLY WINTER 1981



STRUCTURES OF ORDERED GEOMETRICAL BASE-PATTERNS
Henk Deylius



INTERNATIONAL FESTIVAL OF ELECTRONIC MUSIC, VIDEO AND COMPUTER ART, BRUSSELS



ARCHITECT AND COMPUTER CONFERENCE, LEICESTER

PAGE

Number 50 Editor: Dominic Boreham

COMPUTER ARTS SOCIETY QUARTERLY

CONTENTS

PAGE provides a democratic international forum for artists, composers, writers and all those concerned with the creative use of computers in the Arts to publish their work and ideas, and to further the exchange of information. Publication of articles does not imply that the views expressed by contributors are necessarily shared by the Editor or the Computer Arts Society.

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EDITORIAL

With sadness and reluctance I have to announce that this will be the last issue of PAGE that I shall edit, at least for the foreseeable future. The situation which has precipitated this decision is somewhat complex, but the main features are threefold.

Firstly the Arts Council of GB has decided not to renew the subsidy to PAGE for this financial year. Secondly, the income from subscriptions represents a mere fraction of the cost of publishing the journal. Whilst I viewed the Arts Council's subsidy as a temporary measure which would allow the journal to establish a more substantial subscription, this has not been achieved. Consequently it is simply not possible financially to continue publishing PAGE in the form I would wish, i.e. as a journal. Thirdly, as PAGE has grown, the amount of work involved has become too great to cope with as a 'spare time' activity, witness the extreme lateness of this issue.

Over the last three years I have been much encouraged to continue the battle, not least by the growing response from members. In particular I would like to note the receipt of a number of papers which I would have liked to publish:

Trevor Batten: FG Space, FG Pen, FG Dot/Dash
Anton Eliëns: Epistemological Limits on the Creativity of an Imaginative Artifact
Howard Ganz: The Production of Organic Form
Peter Zinovieff: Don't Make Mozart Learn Fortran

Another member of the CAS is considering taking over the editing and publishing of PAGE, so it is just possible that these papers may still appear in future issues.

Otherwise, the signs are that the future may be somewhat bleak for serious work with computers in visual Fine Art. With the death of Frank Malina (PAGE49) it is uncertain whether Leonardo will continue. Following Malcolm Hughes' departure from the Slade, Lawrence Gowing, Slade Professor, is obviously determined to close down (or 'amalgamate') the Department of Electronic/ Computing/ Experimental Art, built with such dedication and effort by Malcolm and Chris Briscoe. Gowing has cut the number of post-graduate bursaries to 3 and placed a ban on work with video and film. His narrow-minded view of art has provoked a storm of protest from staff, students, artists, etc. Information can be obtained from:

R.J. Cornwall, 1 Collisseum Terrace, Albany street, London NW1

Letters of protest should be sent to:

Professor Gowing, Slade School of Fine Art, University College London, WC1E 6BT

Finally, whilst I cannot, of course, undertake to publish anything in the immediate future, I would still be very glad to receive papers and to be kept informed about the activities of my many friends and fellow members.

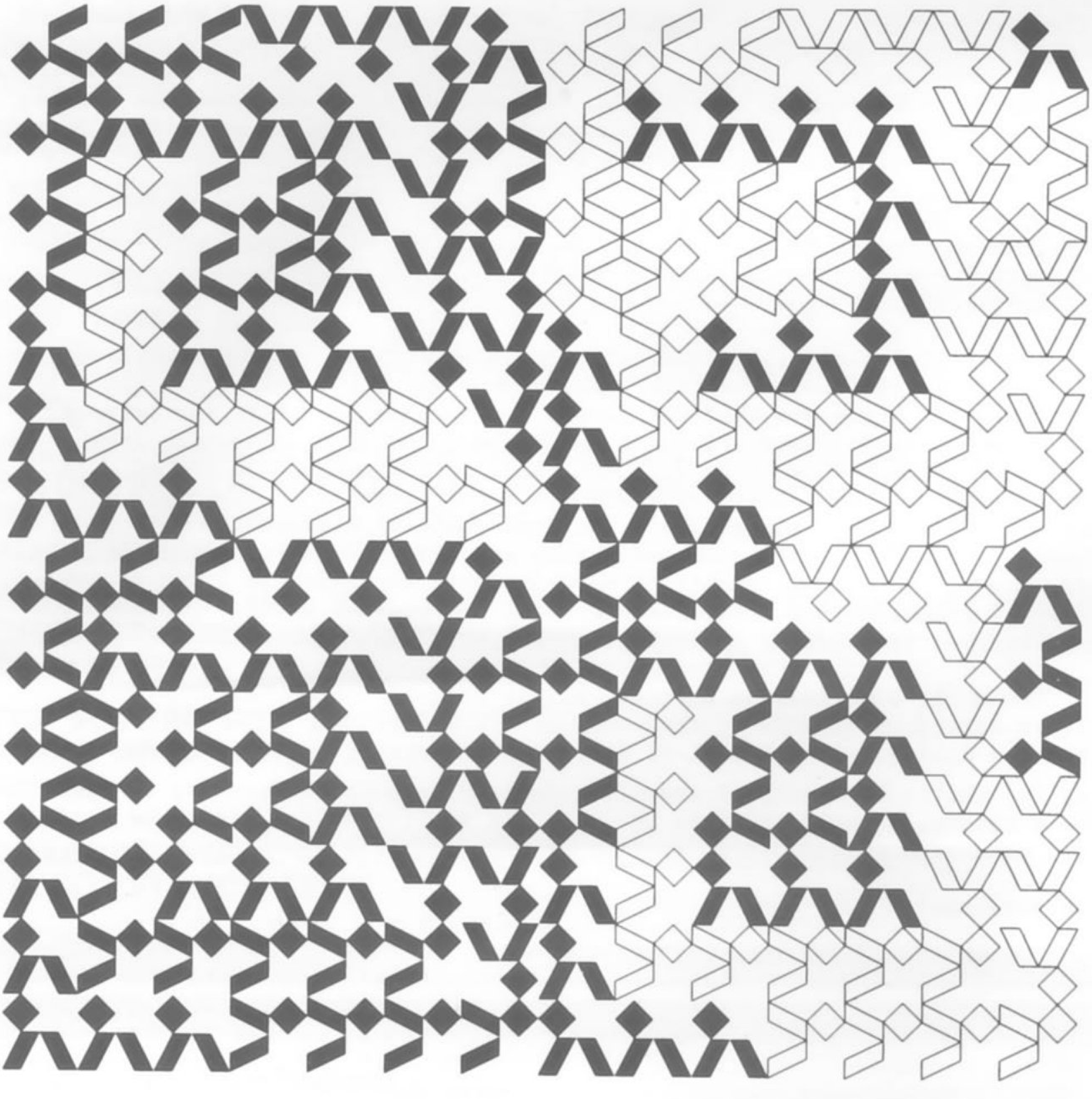
Dominic Boreham

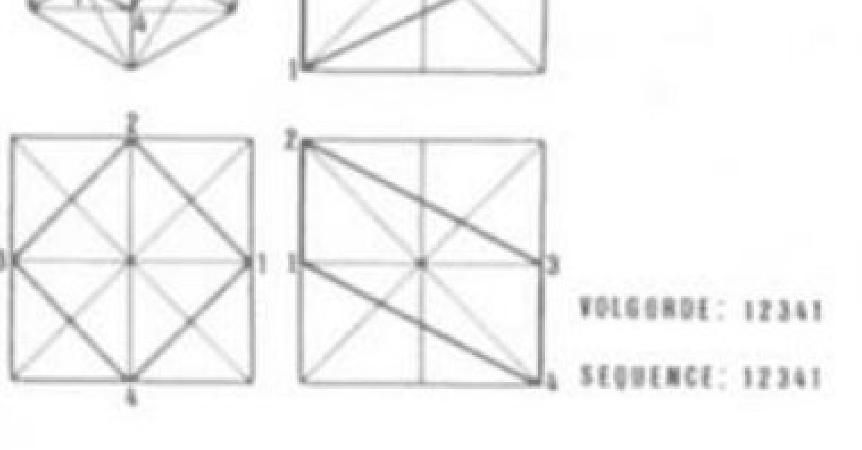
STRUCTURES OF ORDERED GEOMETRICAL BASE-PATTERNS

Henk Deylius

Anemonelaan 5, 5582 GC Waalre, Netherlands

Recognizable structures play an important part in our daily life. Even when we meet more or less insignificant forms we want, supported by human imagination, to discover resemblances. Structures out of another world, for example mathematical figures, seem at first to restrict the possibilities of human perception. A right angle is a right angle, a rectangle a rectangle and nobody thinks otherwise. Apparently there is not much resemblance between mathematical structure and structure in nature. On the contrary, exact mathematical figures are more likely to appear to be the opposite of natural forms.





Henk Deylius: Screenprint 43, 1978, 50 × 65 cm

However, I should like to suggest that what at first sight seem to be opposites, are often found to be complementary; for example:

material-spiritual
concrete-abstract
rational-emotional

According to the character and abilities of each individual, resemblances with these complementary relationships will sooner or later (or never) be found.

Constructivism, outwardly a rational form of art, certainly contains emotional qualities. When precise geometrical structures are put together in relationships, with a mixture of rationality and emotion, new elementary forms come into being. To synthesize these forms, we may use a system for ordering the structures. A particular system says where, how and in what form the geometrical base-pattern is to be structured into the total pattern. This ordering is an affair of the emotion.

The interactions induced in this way between the ordered base-patterns involve bigger, super- and hyper-patterns. A definite relationship now develops between the objective mathematical form of the base-pattern and subjective perception.

Construction of Base-Patterns

As a starting-point for my work the 3-dimensional cube has been deliberately chosen in order to exhibit the coherence between space and plane. A 3-D open cube, represented in 2 dimensions, forms a flat figure, which has the potential to integrate other figures onto itself. In principle this subset of figures is spatial, but by means of projection onto a plane, they can be drawn as a flat figure.

For this purpose the internal diagonal of the cube is chosen as its rotational axis and the projection is mapped onto a plane, normal to this diagonal. Rotated in this way, the projected figure becomes a mathematically exact hexagon.

We find that the hexagon (fig. 1) has this property:
The centres of the cube's edges and the centres of its faces coincide.

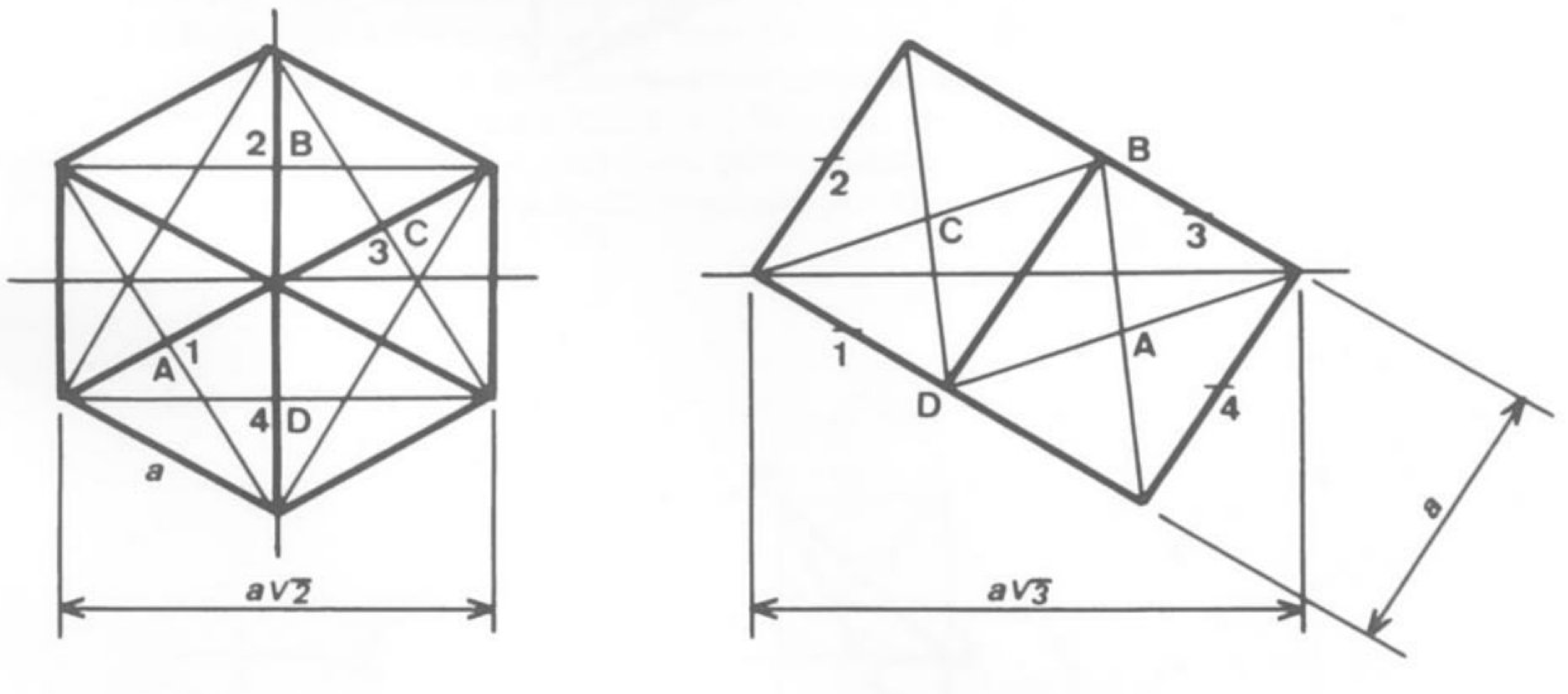


Fig. 1.

This property enables figures to be drawn in the hexagon by means of lines, connecting these centres, which I call "TRANSIT-POINTS". In the illustrations the TRANSIT-POINTS corresponding to edge-centres are indicated by digits, whilst those corresponding to the centres of faces are marked by letters.

By means of a simple example it can be proved that the resulting figures show similarity to line-patterns built in an open cube. Thus if a spatial figure is viewed at a great distance it loses its third dimension and looks similar to the projected one. Hence we can conclude that any other figure, drawn in the hexagon, (that is the projection of the 3-D cube), by passing through the TRANSIT-POINTS, also can be realised as a 3-dimensional shape.

The designed figure appears when the spatial cube is viewed in the direction of projection. When seen from another angle, the figure changes into a totally different line-pattern. This effect may be seen in fig. 2, which shows the projected cube as a hexagon containing an integrated figure. The hexagon may be seen as a flat figure or as a spatial cube. The squares around the hexagon show the different aspects afforded by the directions of view indicated by the arrows E, F and G.

The derived figure in this example is formed by lines, passing through the TRANSIT-POINTS in the sequence 1-2-3-4-1. For the sake of clarity the lines in this example are straight and regular. However, it is

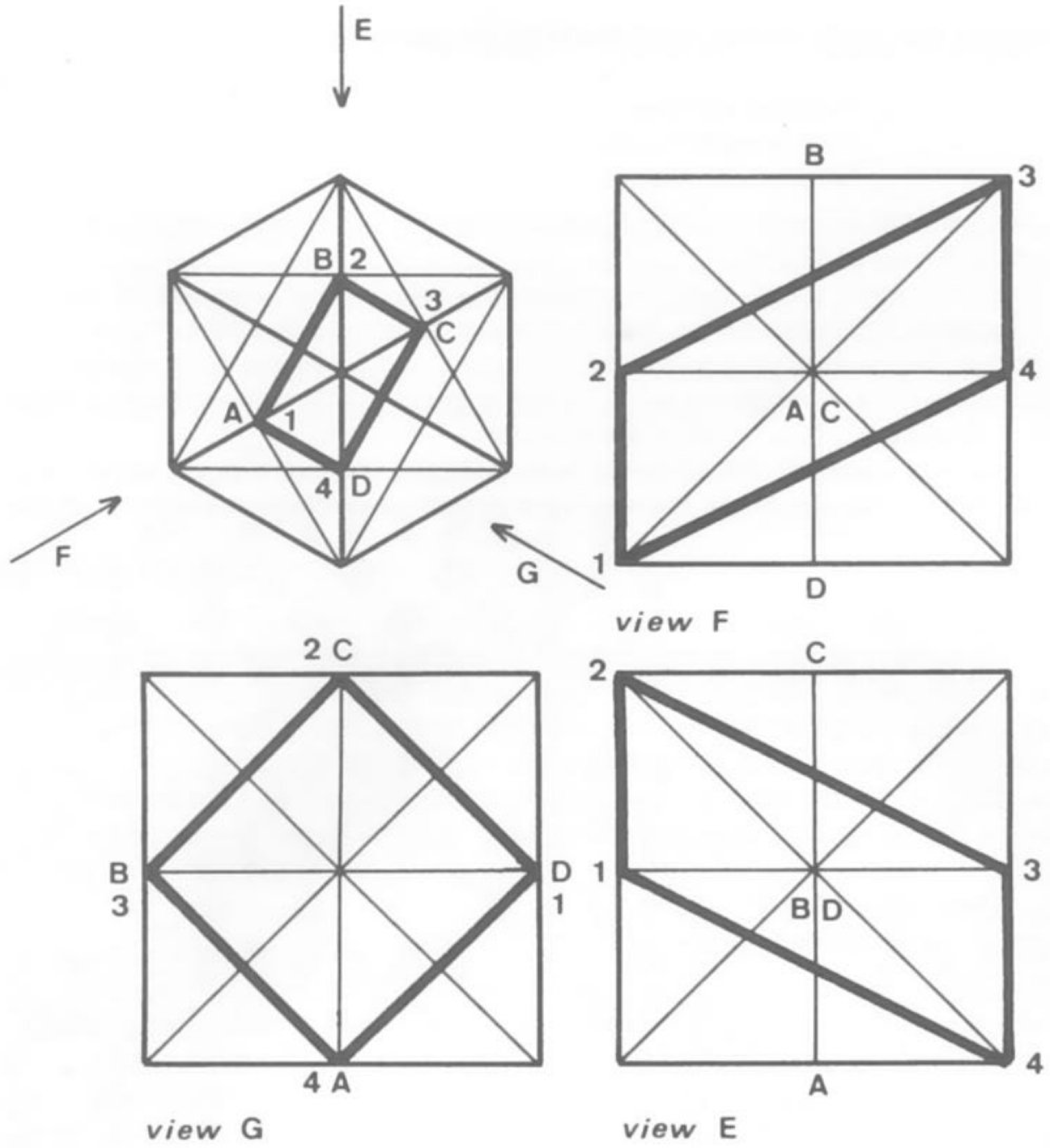


Fig. 2
1 – 4 centres of edges
A – D centres of faces

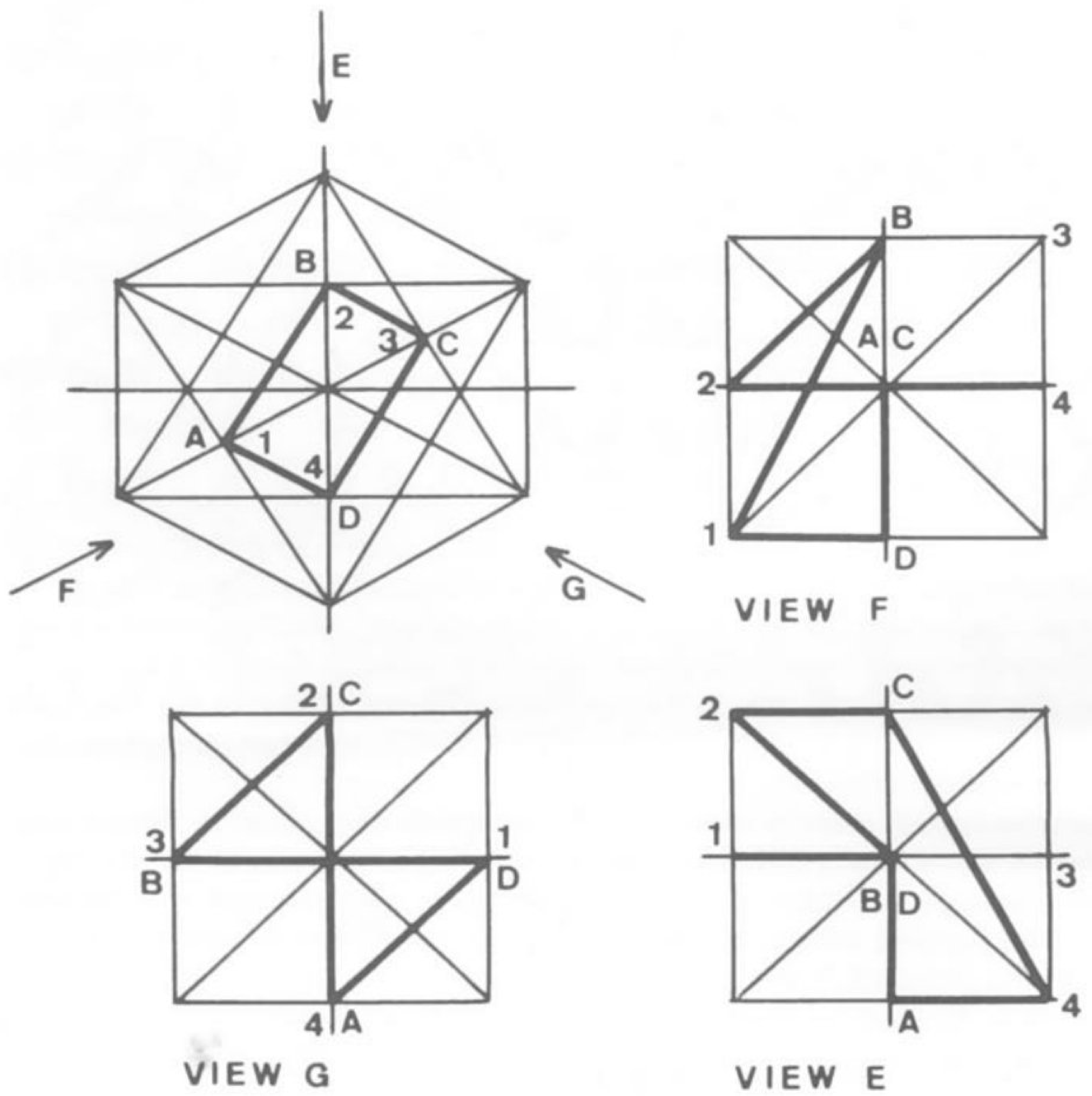


Fig. 3.

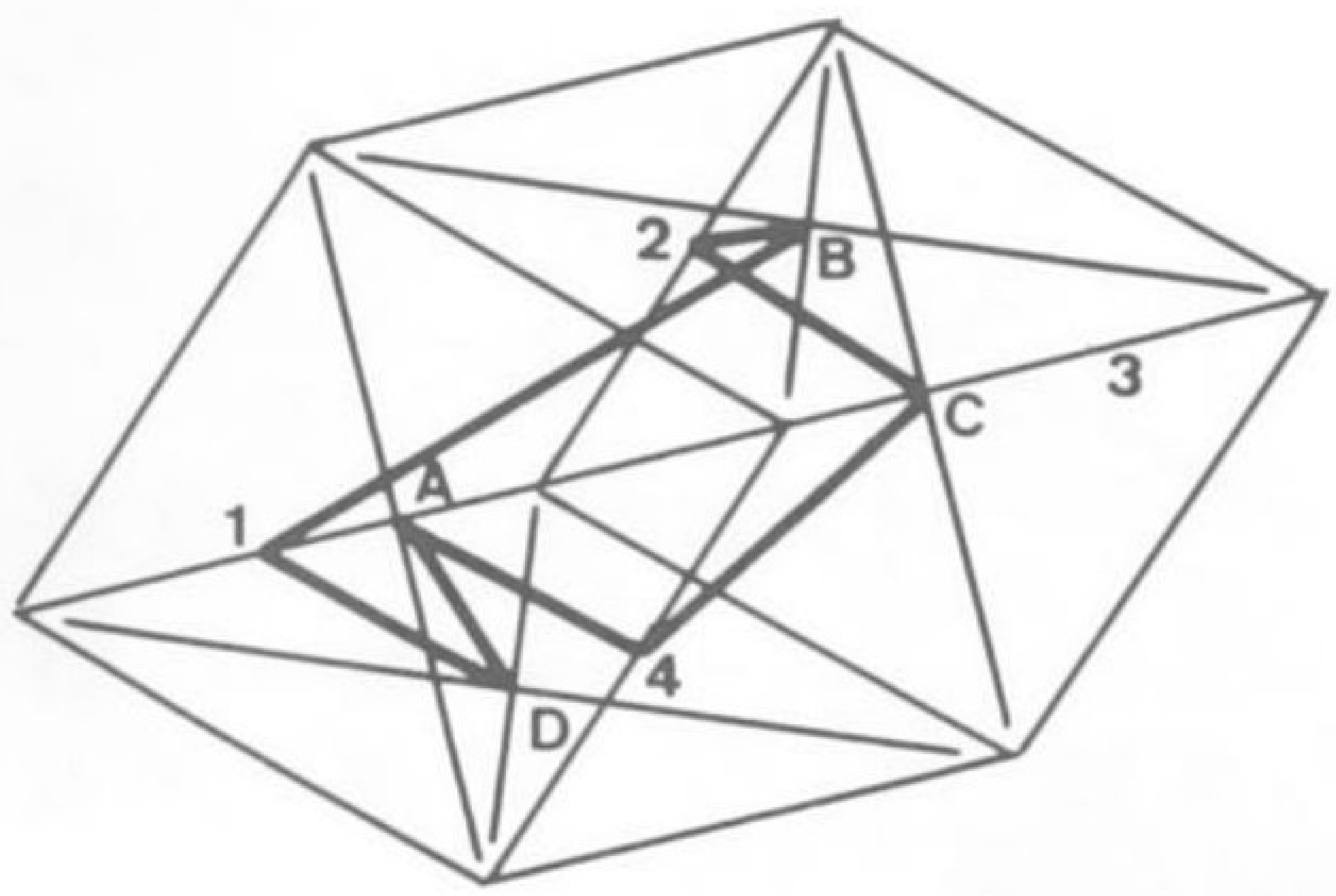


Fig. 4.

not absolutely necessary for the lines to be straight, as will be proved later in the example of the integrated circle.

The figure formed in the hexagon in fig. 2 seems to be an inclined flat rectangle, conforming to our spatial-perception faculty. But the lines forming the rectangle may also pass through other TRANSIT-POINTS, for example: 1-B-2-C-4-A-D-1 (fig. 3). In this sequence the figure appears in the hexagon as the same flat, inclined rectangle, but is built up by a totally different line pattern.

Viewed spatially, the figure is not a flat one, but a 3-D line pattern (fig. 4). Thus a great variety of line-patterns may be obtained by changing the sequence of TRANSIT-POINTS.

As another example, in the hexagon the line 1-2 can also be drawn as 1-B or 1-B-2 or A-B etc. In all these cases the line appears in the hexagon as the same line. For the case of the inclined rectangle there are, on this principle, about 4000 different line-patterns available.

As stated above, the lines need not be straight. Curved lines may also be interpolated, for example in such a way that, seen from the right direction, a circle appears. This circle passes through the TRANSIT-POINTS A-B-C-D-E-F-A in the hexagon. These TRANSIT–POINTS are the centres of the cube-faces (fig. 5).

The circle may seem to be a projection of the inscribed sphere, for this sphere also touches the centres of the faces. But, as fig. 5 shows, this is not the case. The dotted circle is the projection of the inscribed sphere, but this circle does not pass through the TRANSIT-POINTS. It can be concluded that the chosen circle through the characters A-B-C-etc. is in reality neither a projected sphere nor a circle.

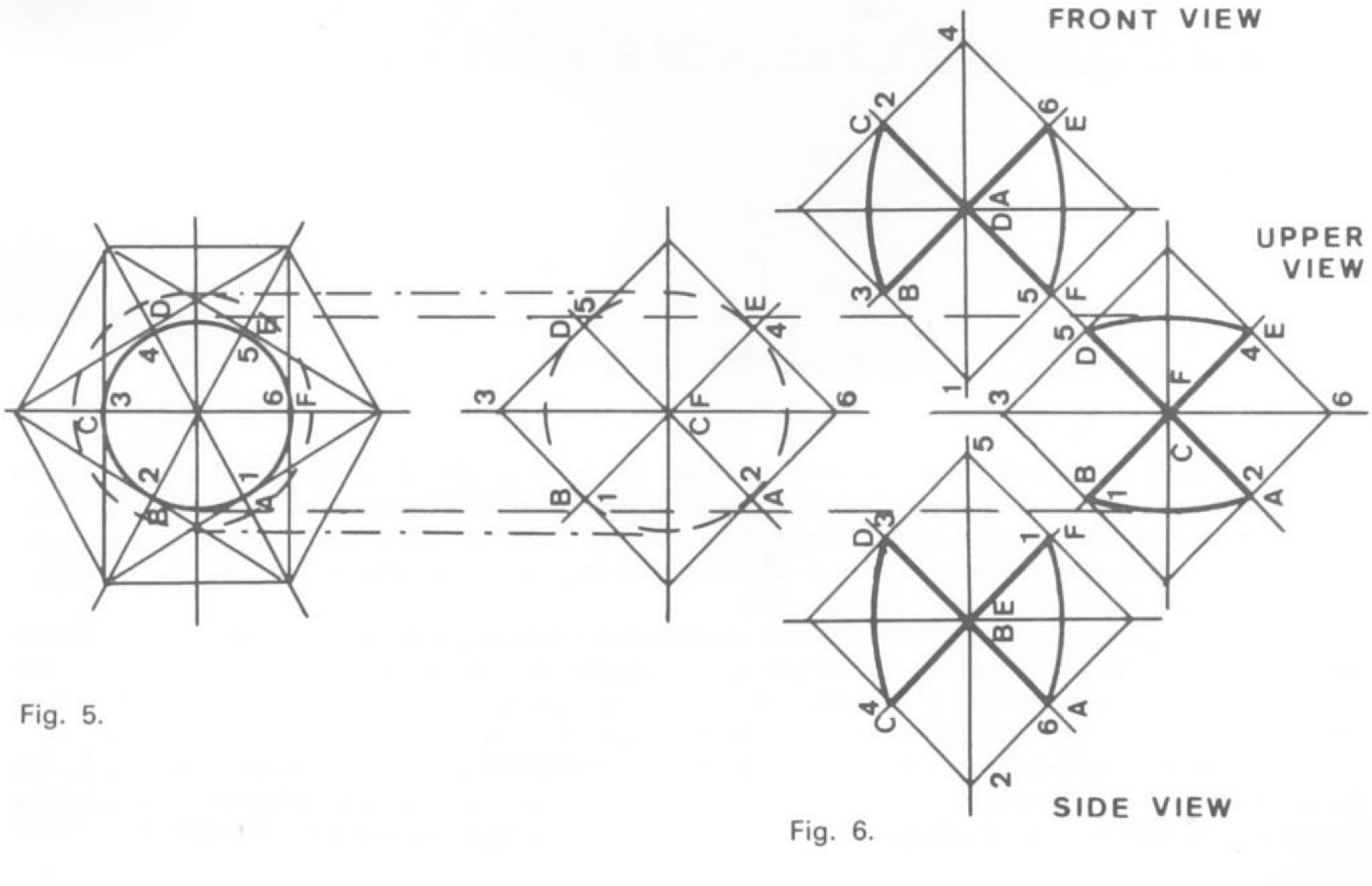
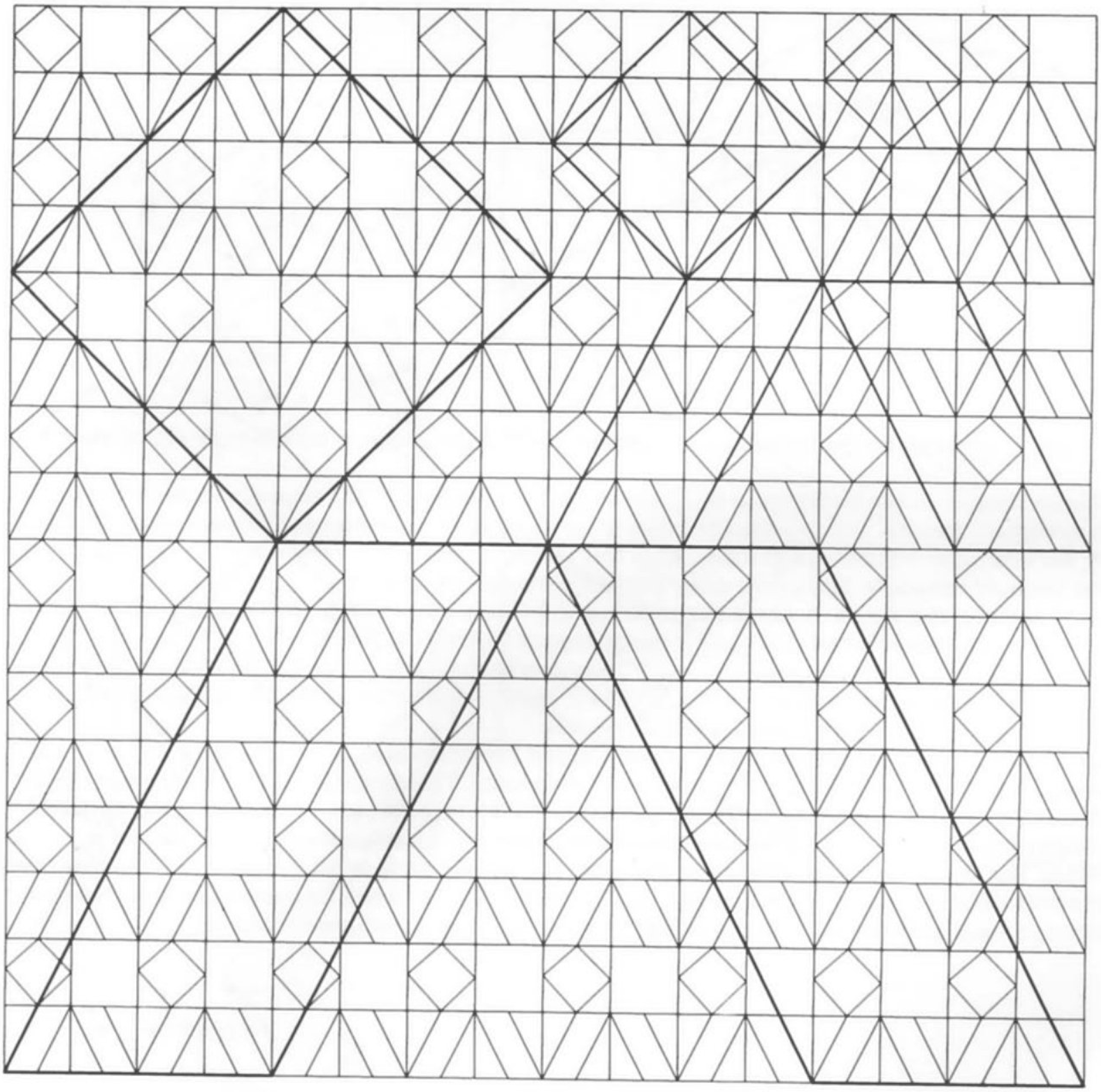
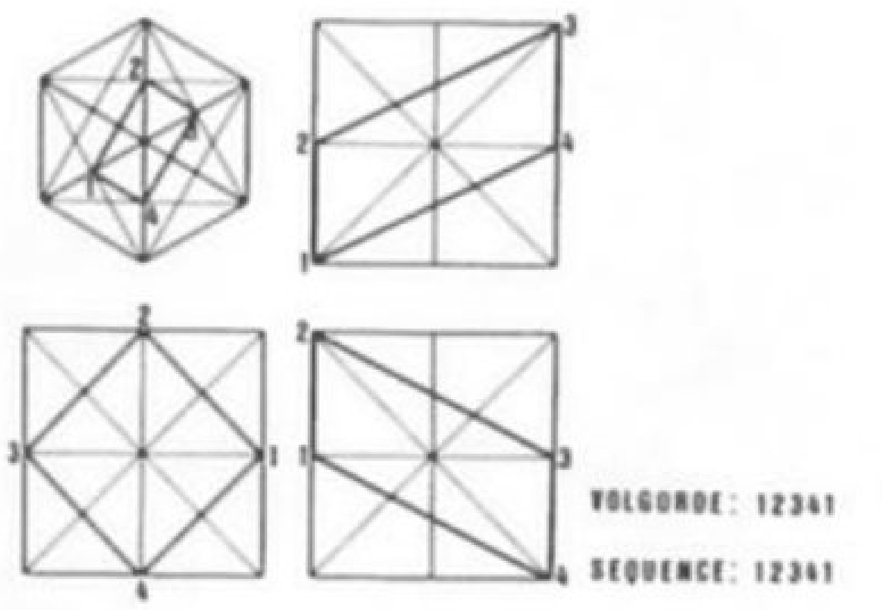


Fig. 5.

Fig. 6.



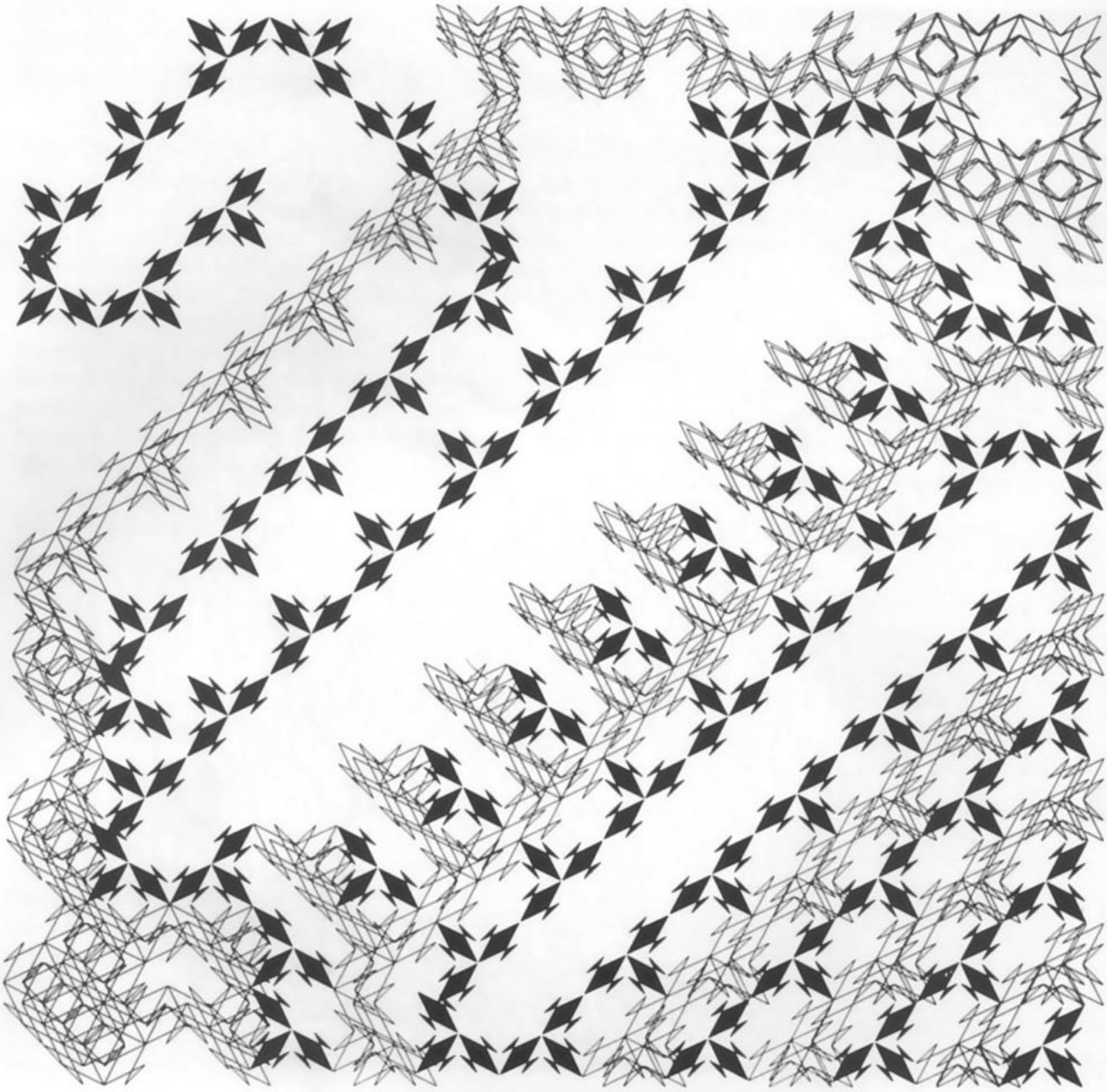


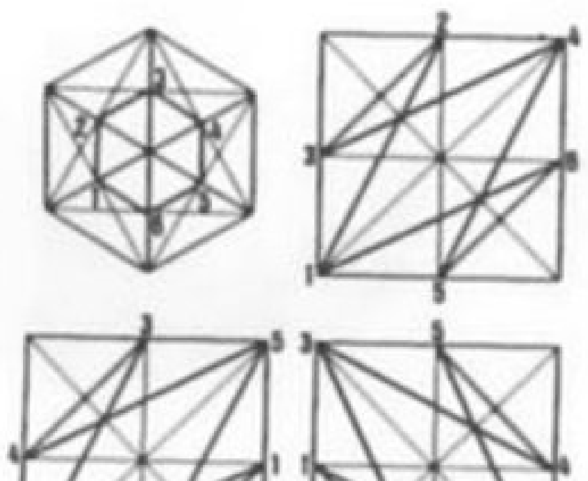
Henk Deylius: Screenprint 39, 1978, 50 × 65 cm

After studying this figure it may be seen that there are more solutions for designing a figure which becomes a circle passing through the designated TRANSIT-POINTS when viewed in the right way (perpendicular to the longest diagonal of the cube). One of these solutions is given in fig. 6, where the line-patterns are drawn in the upper, front, and side view from an open cube. In this case the TRANSIT-POINTS sequence is chosen to be A-B-C-D-E-F-A.

Following this principle it is possible to obtain a very great variety of patterns. Each of these patterns can serve as a basis for the generation of further constructions of ordered patterns. The results obtained depend on the chosen system of ordering. Most models consist of repetition of the base-pattern and manipulation of it, such as translation, rotation, reflection, enlargement etc.

These repetitive activities are eminently suitable for programming into a computer. A design can be hand-drawn and then quantified in a program which functions as input for the computer. The resulting print-out may take the form of a drawing on paper, a cut-film for serigraphy, or a lithographic film.





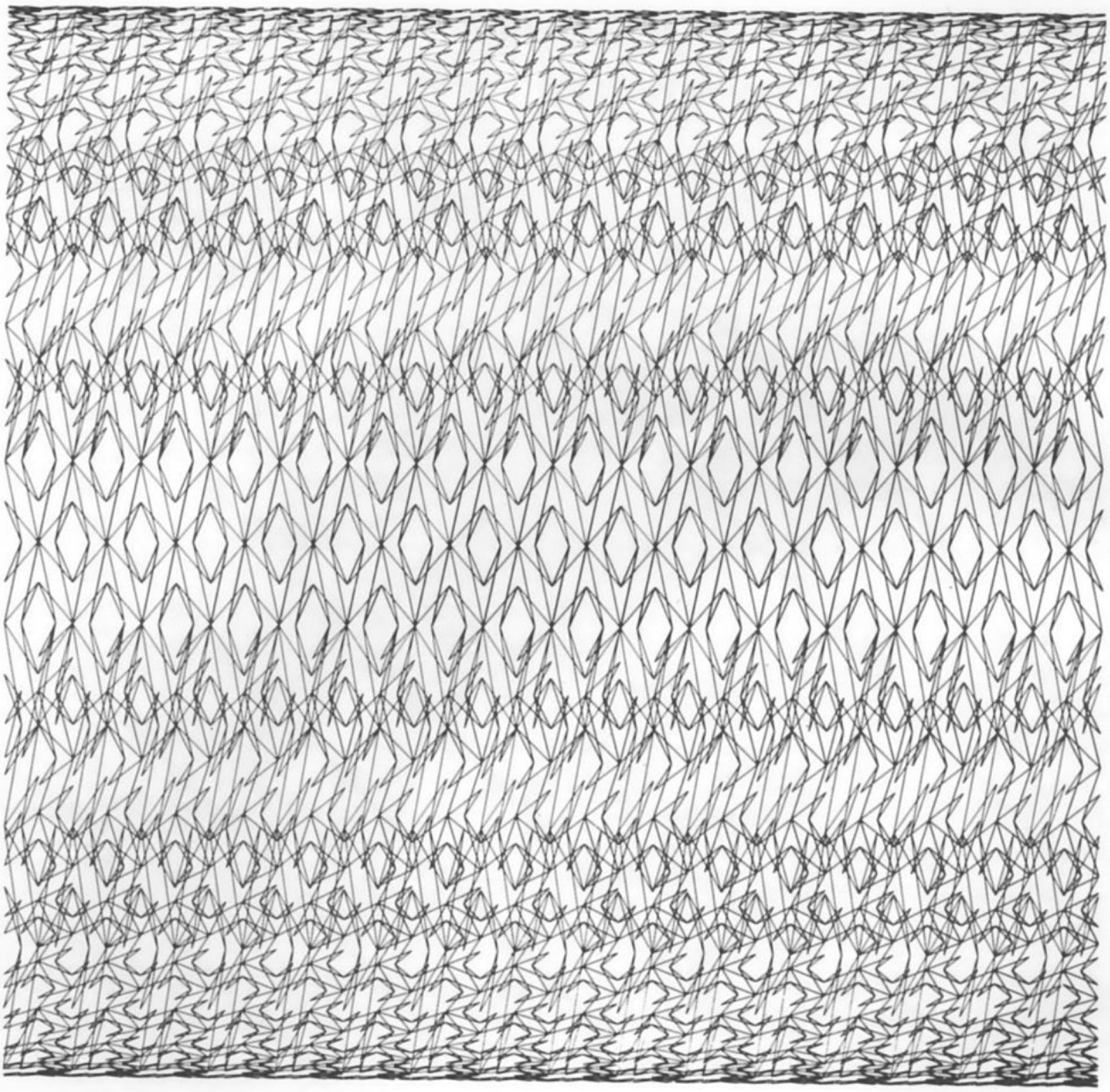
Henk Deylius: Screenprint 51, 1979, 50 × 65 cm

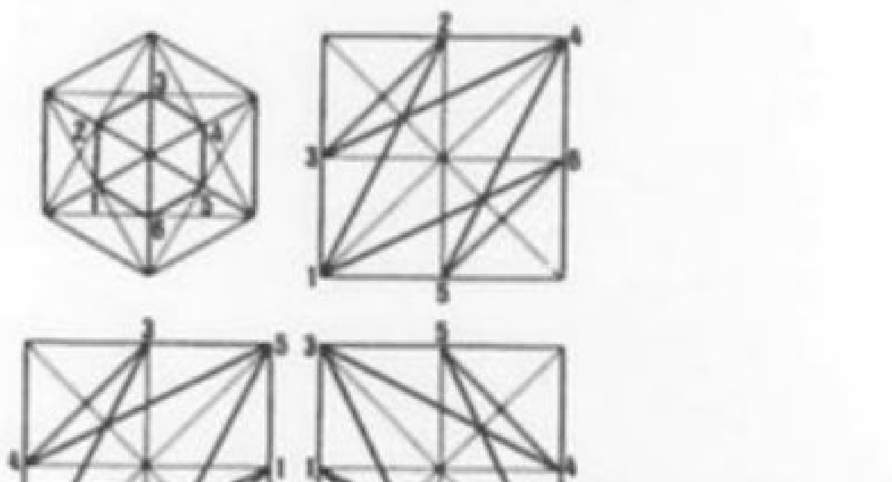
Biography

1920 Born in Amsterdam
Eindhoven School of Art, St. Lucas
Free Academy of Arts, Eindhoven

Collections

Community of Eindhoven
Netherlands State Collection (Ministry of CRM)
Belgian State Collection
Private collections





Henk Deylius: Screenprint 58, 1979, 50 × 65 cm

Exhibitions

1974–78	Eindhoven
	Brugge
	Kasterlee
	Ostende
1979	Brabantse Kunst, Galery Vendomus, Eindhoven
	Rijkscentrum Frans Masereel, Kasterlee (one-man)
1980	Galery de Krabbedans, Eindhoven
	Computer Graphics '80, Metropole, Brighton
	Cultureel Centrum de Coehoorn, Arnhem
1981	Gemeentehuis, Haarlem
	Kunstgalerij Lochem, Lochem
	International Festival of Electronic Music, Video and Computer Art, Brussels
1982	Europese Computerkunst, Rijkscentrum Frans Masereel, Kasterlee

INTERNATIONAL FESTIVAL OF ELECTRONIC MUSIC, VIDEO AND COMPUTER ART
Brussels 28 October – 10 November 1981

This 14 day Festival organised by Omegalfa provided a forum for an eclectic choice of electronic, technology based art, with the emphasis on music. Each day consisted of afternoon lectures at the Shell Auditorium, an evening tape concert and a late evening live concert at Plan K, a disused warehouse. Throughout the Festival an exhibition of computer art and video was held at the Palais des Beaux Arts. The exhibition had an air of indecision about it which was not helped by the mixture of well-known 'classics' of the genre lent from private collections, and recent works lent by the artists.

Omegalfa produced a substantial catalogue which contains notes by the artists and composers, together with their biographic details and some illustrations. The catalogue is in French and Flemish with English translations of most of the texts. With the kind permission of Omegalfa we reproduce here a small selection of the English texts taken directly from the catalogue. Most of the accompanying illustrations, however, are not taken from the catalogue; the credits for these are as follows:

● Photograph supplied by the artist to the Festival organisers and reproduced by permission of Omegalfa
■ Photograph by Dominic Boreham
◣ Photograph by Harbajan Chadha

The catalogue is still available (April '82) from:
Omegalfa Arts Ensemble
Borgwal 16
B 1000 Brussel
Belgium
Pre-paid orders only; account number:
210-0080859-13 at the Sociètè Générale Bank, Brussel
Price: 400BF plus 50 BF postage

Exhibition at the Palais des Beaux-Arts

Inlichtingen : TIB. Grasmarkt ; tel. : 02/513 89 40 en 513 90 90
Renseignements : TIB. rue Marché aux herbes ; tél. : 02/513 89 40 ou 513 90 90

	P.B.A. P.S.K. (gratuit) (gratis)	CONFERENCES CONFERENTIES (gratuit / gratis)	ANIMATIONS ANIMATIES	CONCERTS PLAN K CONCERTEN PLAN K Rue de Manchesterstaat	ATELIERS
28 OCT OKT	PALAIS DES BEAUX ARTS, ouvert tous les jours de 10 à 18 heures, sauf le lundi, exposition de Video & Computer Art + de 60 exposants Entrée Rue Royale, 10 PALEIS VOOR SCHONE KUNSTEN, elke dag van 10 tot 18 uur behalve op maandag, tentoonstelling Video & Computerkunst + dan 60 kunstenaars Ingang Koningstraat, 10	SHELL AUDITORIUM Rue Ravensteinstraat 60 15u/h : Harold COHEN (U.K.)	Galerie Ravenstein Galerij (gratis) « SOUNDSTAIR » Christopher JANNEY (USA) 12 - 18 u/h	20 : Tapes 20.30u/h : Kevin JONES (U.K.) 21.30 : Ulrike & Dieter TRUSTEDT (R.F.A.)	P.B.A. - P.S.K. (gratis) A.R.T.A. 10 - 18u/h (F) Théâtre de l'Atelier : Joan LA BARBARA (USA)
29 OCT OKT		SHELL AUDITORIUM 15u/h : John LIFTON (UK) 15.30 : Jon APPLETON (USA)	Ravenstein (gratuit) « SOUNDSTAIR » Christopher JANNEY 12 - 18 u/h	20 : Tapes 20.30 : Rudi BLONDIA (B) 21.30 : David ROSENBOOM & Jacqueline HUMBERT (USA)	A.R.T.A. (gratuit) - Joan LA BARBARA (USA) Plan K : Morton SUBOTNICK (USA)
30 OCT OKT		15 : David ROSENBOOM (USA)	« SOUNDSTAIR » Christopher JANNEY 12 - 18u/h	20 : Jon Appleton (USA) 21.30 : Groupe d'ART & d'Informatique de Vincennes (F)	Joan LA BARBARA Morton SUBOTNICK A.R.T.A. (F)
31 OCT OKT		SHELL AUDITORIUM 15 : Louis AUDOIRE & Michel BRET (F)	Ravenstein (gratuit) « SOUNDSTAIR » Christopher JANNEY 12 - 18u/h	20 : Tapes 21.30 : Hugh DAVIES (UK)	A.R.T.A. Joan LA BARBARA Morton SUBOTNICK
1 NOV			PLAN K & M.I.T. (Boston) « SLOW SCAN LINK » Don FORESTA & A.TAMBELINI (USA) (gratuit) 16 - 18u/h	20 : Tapes 20.30 : David KEANE (Canada) 21.30 : HET NIEUWE LEVEN (Nl)	A.R.T.A. Morton SUBOTNICK
2 NOV		SHELL AUDITORIUM 15 : David KEANE (Can.) 15.30 : Christopher JANNEY (USA)	PLAN K David KEANE « Installation »	20 : Tapes 21.30 : Morton SUBOTNICK (USA), Joan LA BARBARA, Steph. MONTAGUE, J. FULKERSON	Morton SUBOTNICK
3 NOV		SHELL AUDITORIUM 15 : David WESSEL (USA) (IRCAM) 15.30 : Tod MACHOVER (USA) (IRCAM)	PLAN K David KEANE « Installation »	20 : Tapes 21.30 : MUSICA ELETTRONICA VIVA (USA)	
4 NOV		Palais des Beaux-Arts Paleis voor Schone-Kunsten 20 : Ed. EMSHWILLER (USA)	PLAN K David KEANE « Installation »	20 : Tapes 20.30 : Stephen MONTAGUE (USA) 21.30 : Donald BUCHLA & RADUNSKAYA (USA)	
5 NOV		SHELL AUDITORIUM 15 : Dominic BOREHAM (UK) 15.30 : Donald BUCHLA (USA)	PLAN K David KEANE « Installation »	20 : Satoshi & Midori SUMITANI (Japan) 21.30 : Sten HANSON (SWE)	PLAN K : Don BUCHLA (USA)
6 NOV		SHELL AUDITORIUM 15 : Satoshi SUMITANI (Japan) 15.30 : Sten HANSON (SWE)	PLAN K David KEANE « Installation »	20 : Tapes 20.30 : Jonty HARRISON (UK) 21.30 : Salvatore MARTIRANO (USA)	Don BUCHLA
7 NOV		SHELL AUDITORIUM 15 : SAL MARTIRANO (USA) 15.30 : SULLIVAN (UK)	PLAN K David KEANE « Installation »	20 : Leo KUPPER (B) 21.30 : Alvin CURRAN (USA)	Don BUCHLA
8 NOV		SHELL AUDITORIUM 15 : Computerfilms : VAN DAMME (B) SMYTH (UK) PISZCZALSKI, WEIDENAAR (USA) SULLIVAN (UK)	PLAN K David KEANE « Installation »	20 : Gil KEEV (B) 21.30 : Groupe de Musique Expérimentale de Bourges (F)	
9 NOV		SHELL AUDITORIUM 15 : Maurice MACOT (Canada)	PLAN K David KEANE « Installation » (USA)	20 : Tapes 21.30 : David BEHRMAN & Georges LEWIS & Richard TEITELBAUM	G.M.E.B. (F) Ottignies (complet)
10 NOV			PLAN K David KEANE « Installation »	20 : Tapes 21.30 : Anthony BRAXTON & Richard TEITELBAUM (USA)	G.M.E.B. (F) Ottignies (complet)

ED EMSWHILLER, USA

November 4th, 1981, 8 p.m.
Palais des Beaux-Arts de Bruxelles

Video tapes : 1. *Scape Mates*
2. *Crossings*
3. *Dubs*
4. *Sunstone*

Title of talk : *Reflections on time in electronic image making*

Biography
Dean, Seminars, Independent Projects, studied art at the University of Michigan, the Ecole des Beaux Arts and the Art Students League. He was an abstract expressionist painter and an illustrator (EMSH) before becoming a film maker and video artist. His experimental films (Relativity, Totem, Three Dancers, Thanatopsis, etc) have received awards and numerous screenings at film festivals including New York, London, Berlin, Edinbourg, Cannes, Ann Arbor, Bergamo, Manheim and Knokke-le-Zoute. He has been a producer or collaborator on intermedia productions at the Lincoln Center, the Museum of Modern Art, the Center for Music Experiment, UCSD, the Denver Symphony, SUNY, Buffalo, Tufts and Hampshire College. His videotapes (Scapemates, Pilobolus and Joan, Crossings and Meetings, Dubs, etc) while an artist-in-residence at the Television Laboratory (WNET/13) have been broadcast over PBS as well as shown at Documenta 9 Kassel, Experimental X Knokke-Heist, São Paulo, and given as a retrospective at MOMA. He has received grants for his work in film, video, and computer graphics from the NEA, NYSCA, CAPS, CPB and the Rockefeller and Guggenheim foundations. He has been active in the independant film and video communities, serving on the board of directors of the Film-Makers Cooperative, board of trustees of AFI, media panels of NYSCA, and NEA plus nemerous conferences. Before coming to Cal Arts, he had taught courses in film, video and intermedia at Cornell, SUNY, Buffalo; U.C. Berkeley, Yale, Hampshire and Tufts universities.

JOHN CHOWNING, USA

Phone (1981)

Computer-generated quadraphonic sound In John Chowning's new work *Phone* the sounds were produced using a synthesis technique which allows the simulation of a wide range of sung vocal tones as well as a variety of instrumental tones. The synthesis programs are designed to permit exploration of and control over the ambiguities which arise in the perception and identification of the sound sources. Chowning developed the synthesis technique at IRCAM, Paris in 1979 and realized the piece at Stanford in 1980-81. The work was premiered in Paris in February of this year.

CHRISTOPHER JANNEY, USA

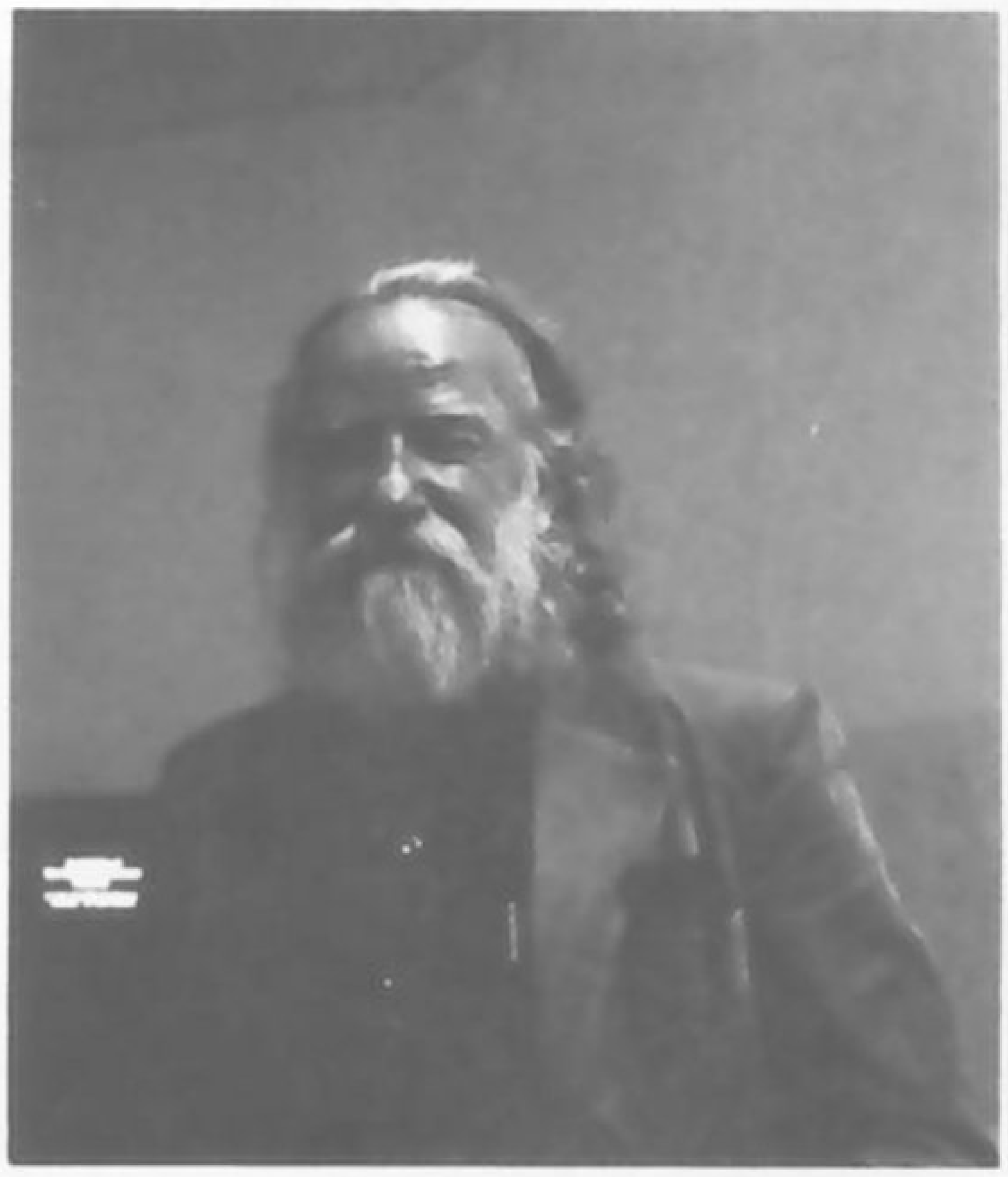
Soundstair

Soundstair is an experiment in translating people's movement patterns into sound. Iw was conceived in April, 1977 at MIT and, in its present form, *Soundstair on Tour,* is a completely portable unit capable of being set up on any stair in less than one hour.

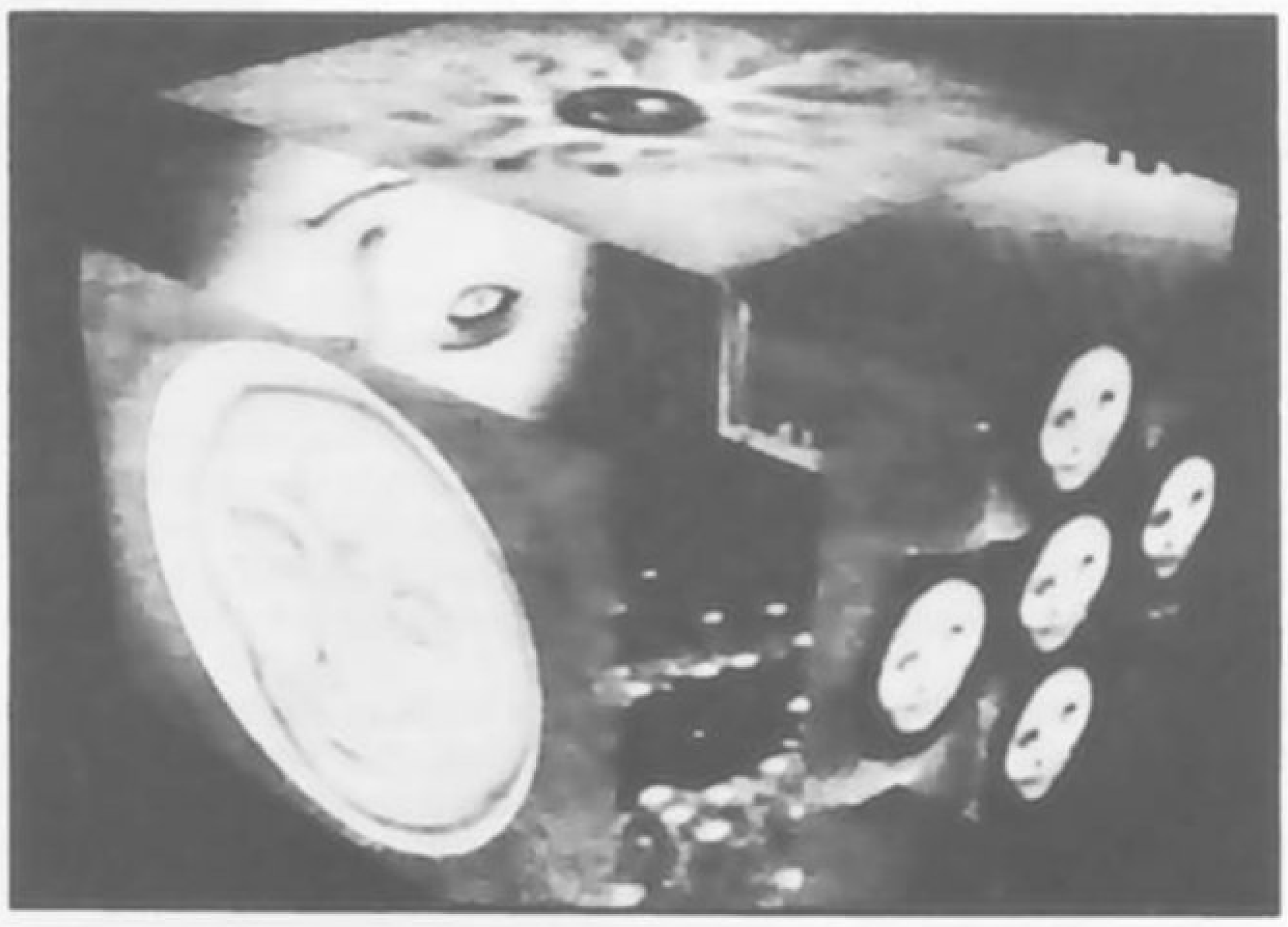
Soundstair is composed of a series of infra-red photo-cell units, sophisticated " electronic eyes ", placed along the edge of an existing stairway, one unit per step. These are wired to a computer which is coupled to a sound synthesizer. The computer is programmed to generate an ascending progession of notes in coordination with the ascending movement pattern of the stairs. As a result, when an individual walks up the stairs, triggering the photo-cells, it sounds as if he or she is walking up the keys of a musical instrument. Moreover, when tow or more people move on the stairs, they " play " them together, interacting with oneanother through sound.

In may, 1979, Martha Armstrong Gray, choreographer, and Christopher Janney, inventor of *Soundstair,* collaborate to create *Dance for Soundstair,* a twenty-five minute work of dance and music. Because the sound is generated by moving on the stairs, the dancers make the rhythmic patterns as well as the sequence of notes while the musician chapes these patterns and notes through the synthesizer. The result is simultaneously an interaction and collaboration between dance and music creating a single sight/sound phenomenon.

Soundstair is an Environmental/Participatory Installation by Christopher Janney. All *Soundstair* electronics designed by Robert Dezmelyk. *Dance for Soundstair* choreographed by Martha Armstrong Gray performed by *Dance Collective.*
Ch. J.
Artistic Director

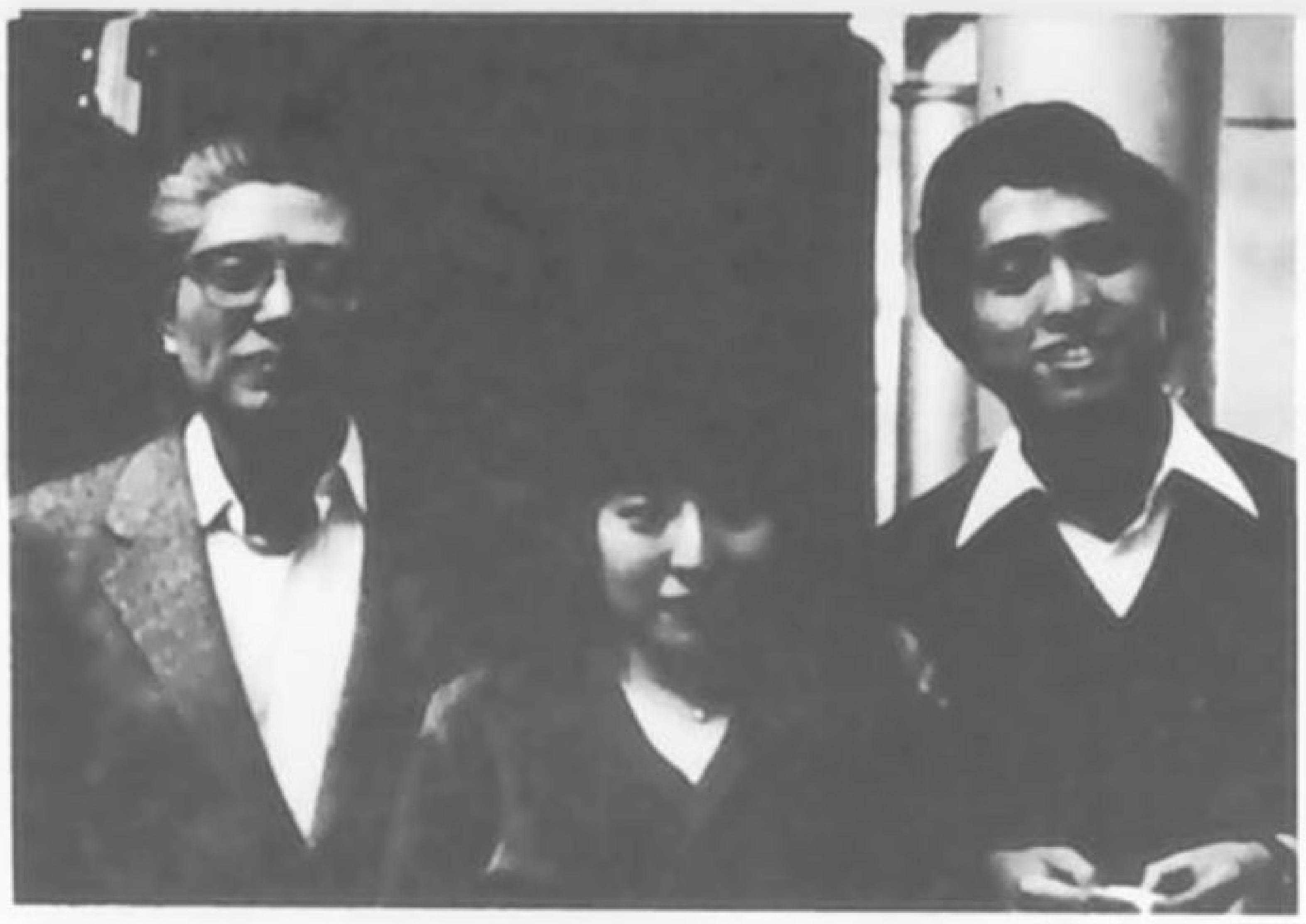


Ed Emswhiller



Ed Emswhiller: Sun Stone, 1979

Christopher Janney: Soundstair



Satoshi Sumitani, Midori Sumitani and Masahiko Hayashi

MIDORI SUMITANI, J
SATOSHI SUMITANI, J

Quark R

Realised at ETSM studio, in 1981
Quark is the most updated ultimate elementary particle revealed today. However, the shape of Quark indicating a point very near the limitation of all substances and existences in the Microscopic world invisible still remains. Quark is proven its existence and can be observed indirectly, by striking High Speed accelerators, but Quark fads away and can not be identified alone. In the microscopic world, Microscopes with high analysis abilities are required.
The shortest possible wave length should be used to eliminate the distortion caused by waves. This short wave length corresponds to the particle with large amounts of energy. Reactions in Microscopic fields causes vibrations of extremely short waves which is similar to the distance of its own domain. In other words, it generates very highly energized particles.
As the substance is devided into smaller parameter from molecules, atoms to elementary particles, the energy linking each parameter together becomes larger. To study the ultimate conditions of a substance, particles need to be accelerated by huge energy. High energy accelerators are considered as eyes or microscopes to investigate the property and construction of atoms and elementary particles. Today 10^{14} electron volt of energy can be achieved by Cyclotron Accelerator/crackup type. Thus ultimate studies of existing substances and even human-beings became possible. However, the shape of a Quark still remains invisible.
A main goal of the compositional work was to endow each object with a clear sense of musical functionality within its context. In *Nscor* this was implemented by using such devices as : the introduction of phrase structure (groups separated by silences), the adjustment of amplitude envelopes (stressing and unstressing sounds in sequence), the application of spatial envelopes (static and dynamic movement, present, distant, and delayed slightly), attention to harmony (in an extended sense), the tuning of durations and other rhythmic elements, and the use of directional timbre melodies.
As to the specific digital sound synthesis techniques employed, they include FM, VOSIM, waveshaping, additive and subtractive synthesis, instruction synthesis (SSP), granular synthesis, and digitized (and then modified) concrete sound (a cymbal). One undigitized concrete sound (modified by means of tape techniques) was also included, as were several analog electronic sounds.
The four-channel master tape was remixed to two channels at the recording studio "Suntreader" in Sharon, Vermont.
The idea represented by the world "Elementary particles" changes by the era. The elementary particles defined in 19th century were atoms. Soon, however, atom was analyzed as a combination of atomic nucleus and electron, and therefore "Elementary particles" then meet these 2-elements. Furthermore, since atomic nucleus is proven to consist proton and neutron, the idea of "Elementary particle" was changed again. Today, atomic nucleus is classified as Lepton and Hadron, and elements forming these nucleus are called Quark. According to the variation of patterns of Quark, an ultimated element, Varion (Proton, neutron) and Meson/Mesotron are found te be organized.
The fact that drew my interest is how Quarks exist. Quarks are classified into 3 color patterns, i.e. Red, Green, Blue. Quark also has 4-different categories so called flavor: u/up, d/down, s/strange, c/charm.
These varieties may reportedly be increased. I was surprised that this consequentially matched the series of my works. The subject of my "*Perfume Isotopy*" in 1978 was flavor, and "*Nought*" in 1980, "*Transparent Space*" in 1975 were transparent, nothing/nil/zero/nought, respectively. In this Quark series, I am going to persuit "emptiness, void" again through invisible unidentified particle, Quark. This work is to be a combined expression of sound, light and dance. We intend to persuit the subject of Quark from each of these categories.

Nought

Satoshi Sumitani : Sound
Midori Sumitani : Photo

Realized at ETSM studio in 1980.
Nought : Electroacoustics work for 16-channels sound space. I think existence and substance of sound to be sophistic. Soundings and soundmoving indicate situation of sounding and moving, and means "the existent". Sounding of tone is "What to be" and "existence" against nothing to be heard.

Nought – Photo Art : There are moments when images pop into my eyes through my camera lens. A brand new space beyond all dimension is layed out in front of me. The image showing itself in the light, is a frozen piece of "time".
Time, in which the great flew of music that had traveled through everything is frozen and put to a deep sleep. And now, again, the image meet a different piece of music born from the same origin, and starts to flow once more, slowly, and speaks out of a universe, brand new ears. *Midori Sumitani*

Biographies

SATOSHI SUMITANI, born April, 1932, in Tokyo.
Graduated from the composition department of Tokyo Arts University in 1955. He has won first prize in the 1954 concours of NHK and the Mainichi press. And in 1973, the winner of ISCM Reykjavik Music Days.
He is a Professor of composition at Tokyo Gakugei University and Head of TATA/Group of Topological Arts and ETSM studio/Electronic Topological Space Music studio. He belong to ISCM Japan's member, and Society of Japanese Musicology. He has written books and numerous articles on Electroacoustic Psychology, aesthetics.

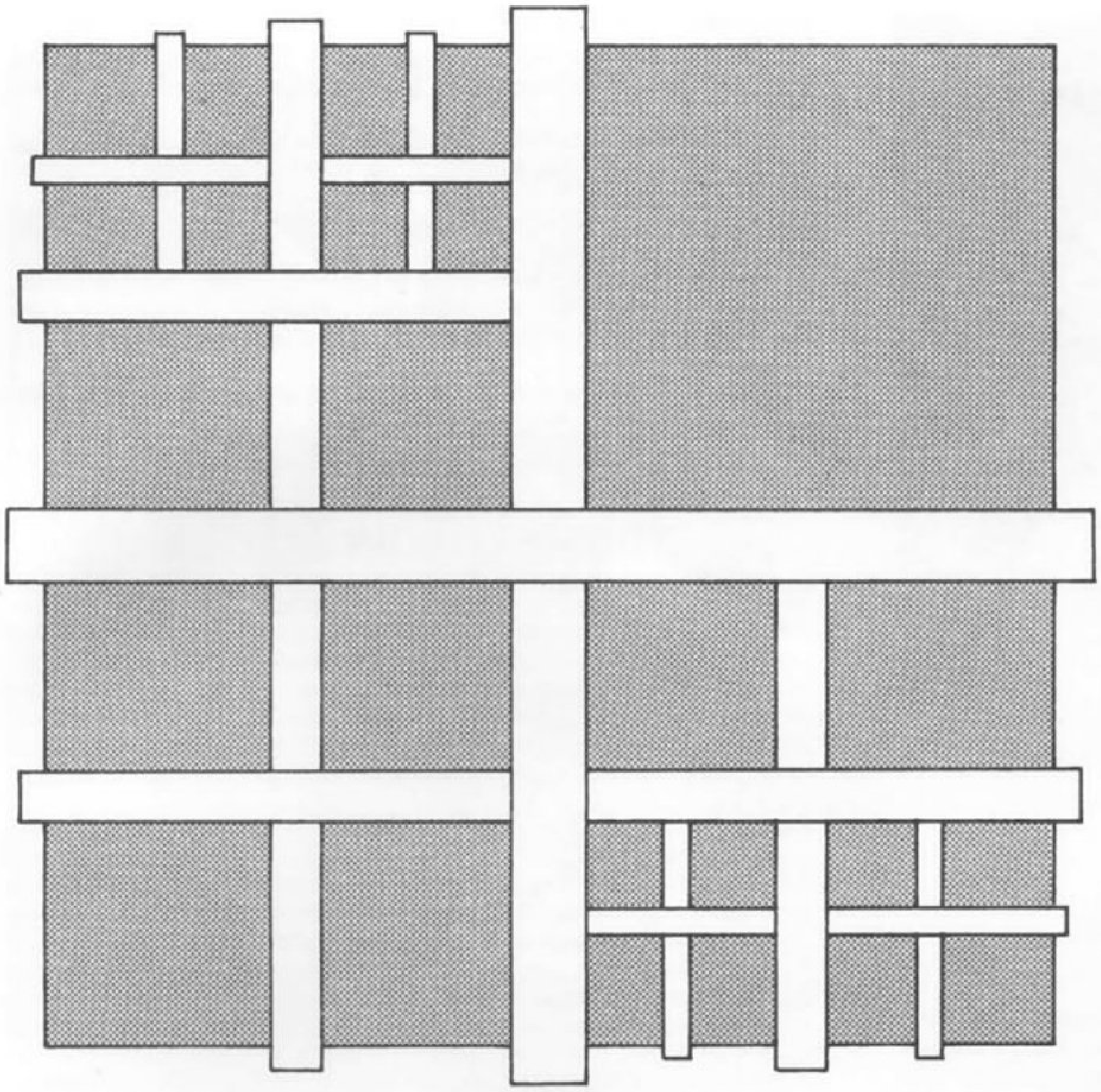
MIDORI SUMITANI

Née le 7 février 1953, MIDORI SUMITANI a été sélectionnée en 1978, 1979 et 1981 au concours "Kokuten" (Tokyo) de photo. Une exposition de ses œuvres sera présentée au Contax salon de Tokyo du 24 au 28 novembre 81.
Elle est membre des groupes *Tata* et Si-Kenkyû.

JEAN CLAUDE RISSET

Songes

for 4 track tape
Songes, an electroacoustic work, has been worked out at IRCAM thanks to the latest "Music V" program which on the one hand allows to synthesize the sounds and on the other hand allows to treat the recorded sounds numerically.
The title suggests the dreaming character of adventures situated on an other scene – adventures of sound figures issued from an absent and imaginary world.
In the beginning of the work, the computer was used to assemble, to superpose and to unite 5 patterns. These patterns, each lasting 2 to 5 seconds, have been recorded separately by 10 instrumentalists of the "Ensemble Intercontemporain". Besides the superpositions, the instrumental sounds have undergone modifications, creating space effects. The harmonic structures of these patterns, repeated in a more or less obsessional way, are found back in a sharp harmonic texture and then in non-harmonic synthetic sounds, the components of these sounds can, following their temporal profiles, fusion in clock simulacrums or can dissociate themselves in fluid textures. The non-harmonic sounds melt one into another and then accumulate themselves in chords entering one in the other which reproduce the frequence relations existing between their components : this accumulation forms a crescendo of tension overloading the sound of frequences from low to sharp. Everything cames calm again through a number of low sounds which are created by temporal changing (like echos reflected back against a wall which moves) : above the low sounds, one can hear the sharp sounds widely modulated in frequence.
The author thanks the instrumentalists and especially David Wersel, Conrad Cunnings and Jean Luis Richer for their help in the first experiment about the treatment of real sounds by the Music V program.



Steve Scrivener: Constant Image, Variable Threshold (Threshold = 7), 1981

STEPHEN SCRIVENER, GB

My recent work is concerned with processes of abstraction. As a working definition "abstraction" is taken to be a process of discarding irrelevant features of a source image leaving only essential ones. The meaning of "irrelevant" and "essential" in this context are not absolute and depend on the purpose of the abstraction process. For example, if the function of the abstraction process is to extract all the animate objects in a scene then these are the essential features whilst the inanimate objects are irrelevant.
It is perhaps already clear that image processing and pattern recognition are subjects that interest me. Typically, in these areas the problem is to devise computational techniques for the automatic detection or recognition of features of particular interest in a visual scene. In order to make this task computationally feasible, or reasonable, what usually happens is that the image undergoes processes that can be viewed as abstractions. For example, a process might abstract the boundaries of objects in a scene. Having gone through this initial phase the image represented as boundaries might provide the input to a higher level recognition process.
I see an interesting relationship between this work and the traditional concerns of the artist; that is to say the problem of representation. This can be charácterised crudely as the business of choosing certain features in a scene to represent whilst ignoring or supressing others. For me, a study of image processing and pattern recognition techniques provides a refreshing approach to an old problem.
In fact the image as such is of very little importance in the work displayed in this exhibition. Instead it is the process of abstraction itself that is being explored. The "image" is a 32 by 32 element matrix, each of which can take a value between 1 and 16. This "image" is generated randomly and can be regarded as a substitute for the greyscale digitisation of a scene. The process that operates on this image attempts to group together "similar" elements into regions. The lines in the drawings represent the boundaries of these regions. What is meant by "similar elements" is determined by a threshold value that is used to decide whether elements should be merged or not. The organisation of the image into regions is done in the following way: the image is divided into 2 by 2 by element regions and the average of each four element region is computed and thus results in a 16 by 16 matrix of averaged values; this matrix then undergoes the same process which is repeated on subsequent matrices until a 1 element matrix results; at this stage 6 matrices exist which can be viewed as being stacked on top of each other to form a pyramid (i.e. with the 32 by 32 matrix at the bottom, the 16 by 16 matrix at the level above it, the the 8 by 8 progressing upwards to the 1 element matrix at the top); each level in the pyramid consists of elements that contain the average of four elements in the next lower level; the regional representation of the image can now be derived by traversing the pyramid top down or bottom up; for example, from the bottom up each of the four elements used to generate the element in the next level up is compared to it and if each is within a given tolerance value then the four are marked as being merge into the one; when one level has been treated in this way those elements marked as merged from that level in the next level up are then considered for merging and so on until the apex of the pyramid is reached; from top down the process is one of splitting. Whether elements are merged depends on the tolerance value used. The piece "Constant image, variagle threshold" illustrates this. Here the threshold starts at Ø and increases by increments of 1. Each drawing in the sequence is independant of every other but there order reveals something of the effect of the tolerance value, or threshold. "Split and Merge" represents the stages in the generation of the regional representation by showing at each level of the pyramid those elements that can be merged or split depending on the direction of travel. Reading from the left the process of splitting is illustrated and from the right the process of merging. This work is based loosely on the work of Horowitz and Pavlidis (1).
The algorithm was implemented on a PET Commodore micro computer. This was simply for convenience as almost any machine would have been suitable. The output on hard copy shows each level of the pyramid appropriately marked. This was then used to produce by hand the drawings. On a different machine the drawings could have been produced automatically. The fact that a computer was used in the production is not important although it would have been rather difficult to generate the drawings without its aid. However the relationship between the work and computing is obvious and important.
S.S.

(1) S.L. Horowitz and T. Pavlidis, "*Picture segmentation by a directed split-and-merge procedure*", Proc. Second Int. Joint Conf. Pattern Recognition, 1974, pp. 424-433.

Dominic Boreham, Alejandro Vinao and Trevor Wishart

TREVOR WISHART, GB

Red Bird

Red Bird is both a piece of music and an aural drama. It uses the sounds of birds, animals, voices and mechanisms, which are "orchestrated" and transformed into one another. Thus words change into birds, animals into mechanisms and so on, resulting in a complex allegory concerned with the oppressive use of reason. Made in the York Electronic Studio, between 1973 & 1977, the piece has many parallel interpretations, but is most easily heard as the dream of a political prisoner.

T.W.

Biography

Trevor Wishart (born 1946) is a freelance experimental composer living and working in York, England. He has produced a number of internationally successful works in new media. These include the extended tape compositions "Journey-into-space" (1972) and "Red Bird... a political prisoner's dream" (1977); the live vocal piece "Anticredos" which explores extended vocal techniques; various environmental music projects (designed specifically for the beach, woodland, a small town, etc.); and the music theatre works "Fidelio" for flute and 8 suitcases, "Tuba Mirum" for prepared tuba, 3 electrically operated audio-visual mutes, tape and actors; and "Pastorale" for flute, tuba, tape, slides; 4 stuffed birds and a stuffed fox, magicians vanishing cabinet, thunder and lightling, rain, Deus ex Machina, etc... Although most of his pieces are concerned in some way with philosophical and socio-political issues, they are also frequently humorous and direct and aim to appeal to a broad audience. Trevor Wishart publishes his own scores and discs and has been involved in the Musicians Collective Movement in England for several years.

ALEJANDRO VINAO, RA

Go" (from "Other Fictions")

Text by Ian Cross.

"Go" is based on a ten chord choral. The text consists of ten phonemes of which "go" is one of them. Ian Cross wrote the text to the music which had largely been composed before being produced in the studio. While working in the production of the piece I found myself more and more interested in the phoneme-word "go" and gradually departed from the original score and text so that I could center the composition on the action suggested by the word "go". The piece intends to convey the feeling of going, of moving, of being active without stating a particular direction for this action. The subject and object of the action is left for the listener to fill in according to his mood and imagination.

"Go" was produced in the Electroacoustic Music Studio at the City University (London).

"Go" was commissioned by Elms Concerts with founds provided by the Arts Council of Great Britain.

A.V.

Biography

Alejandro Vinao was born in Argentina in 1951. He studied guitar, composition and conducting in Buenos Aires where he lived until 1975.

In 1976 he won a British Council award to study Composition and Electronic Music at the Royal College of Music and the City University in London.

In 1978 he was awarded the Cobbett Prize for chamber music for the composition of a string quarter.

At the City University he worked in Electronic and computer music, graduating in June 1979 with First class Honours. He is currently continuing his research programme at the City University, toward a Ph.D. in music.

Alejandro Vinao has written chamber and orchestral works in addition to his work in electroacoustic music.

DOMINIC BOREHAM, GB

Biography

Dominic Boreham trained at Cambridge and Wimbledon Schools of Art, and the Slade School of Fine Art, University College London. He is currently researching in Computer Graphics at the Royal College of Art and at Leicester Polytechnic where he also lectures in Human and Machine Perception. Since 1979 he has been Editor of *Page*, the quarterly journal of the Computer Arts Society.

Originally, Boreham had worked with the traditional media of drawing and painting. In 1971, he began to use photography and film, and by 1974 he was making kinetic constructions utilising electronically modulated light. Since then his creative output has been realised exclusively through electronic media, employing synthesized sound for his electro-acoustic compositions and computer technology for his graphic work. Although he is enthusiastic about the potential merits of digital technology, such as the ability to deal with complex ideas and procedures, precision, control, repeatability, etc ... he generally regards the medium as simply the most natural one for a contemporary artist to be using. He is somewhat suspicious of preoccupation with any medium, prefering to draw one's attention to the work itself and the ideas which lie behind it:

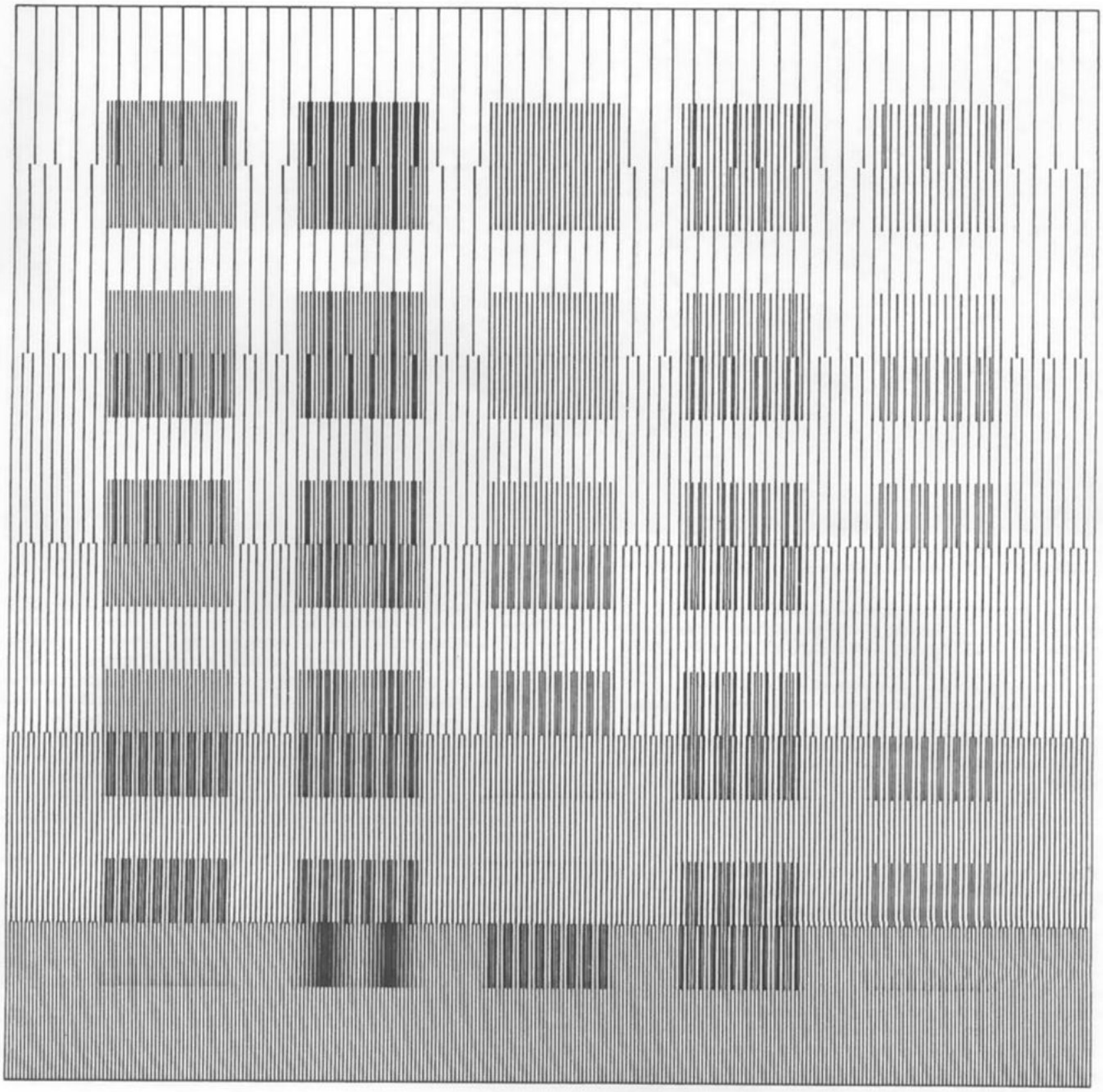
"The integrity of a work of art lies firstly in the quality of the ideas that inform the work, and secondly in the artist's capacity to reify the idea, that is, to find the most perfect form and structure that render the idea sensible. High technology may sometimes offer the best means or the only means to do this. But it is only means, not content" (1).

This statement also alludes to Boreham's conviction that the function of the artist is to "reify ideas", and for him the "ideas that inform the work" must in themselves come from new developments in contemporary thinking if the work is to be truly modern, rather than merely "modernist".

"If art is to have any value in a scientific culture, it must have connections not with the resultant technologies, but with the underlying assumptions around which scientific paradigms are stuctured ... I would like (the viewer's awareness of the artwork's internal logic) to be extended to an appreciation of the ideas which have inspired the form and the procedure, so that the artwork is no longer perceived as an isolated phenomenon, but as a focus or meeting point of ideas coming from a broader, shared world-view" (2).

In the above two papers, Boreham argues that our world-wiew is neither direct nor constant, but rather a dynamic collection of assumptions mediated by current scientific paradigms. The artist must therefore be aware of both the constituents of the contemporary paradigm (philosophy) and the way in which it influences his perceptual experience (psychology), if his work is to make any significant and relevant contribution.

Having defined his position and direction, Boreham has produced artefacts which, on a number of different levels, embody recent conceptual developments in the philosophy of science and perceptual psychology. In the STOS series of drawings (STOS = Solid/Transparent Overlay Study) two independent but related structures are superimposed. The lines themselves function as texture-density gradients, which play on the viewer's tendency to organise figure/ground relationships, although it is not the lines but the spaces between them which carry the significant mathematical relationships. The viewer's perceptual mechanism interprets the smaller groups of lines as "squares", arranged on a 5 x 5 matrix. What is not immediately apparent is that in any one drawing there are only 5 different types of "square", all those in one column being identical. In being "filtered" through the "background" series of lines, the data (i.e., the 5 x 5 squares) become richer, indeterminate, and problematic. Identical



Dominic Boreham: Indeterminacy Grid 74, 1979, 52 × 52 cm

"squares" appear as opaque and advancing, transparent and receding, some break up into individual lines or form interference patterns, whilst others lose half their height, or in some cases merge so completely with the "background" that they disappear.

In the IM series (IM = Interference Matrix), Boreham sets up two matrices of 6 x 6 "squares" which are superimposed. The mathematical series is identical in both matrices, except that they operate at 90° to each other. In addition, one matric retains the square format, decreasing the number of lines as the intervals increase, whilst the second matrix retains the same number of lines which results in the square format "spreading". From a single linear progression and a single structuring principle, 2nd, 3rd, and 4th order structures are generated.

(1) Boreham, D.P. (1979) *Art Relevant to a Scientific Culture*, unpublished paper given at the International Symposium Artiste et Ordinateur, Centre Culturel Suédois, Paris.

(2) Boreham, D.P. (1979) *The Perceptual Interpretation of Structure*, Page Bulletin of the Computer Arts Society, London, 42, June.

HAROLD COHEN, USA

On technology

It is a fact of life in a "high-technology" society that one is afforded little opportunity for consideringn what technology means. The technologist – that is, one who has access to a theory of operation about how the technological devices in his domain work in relation to their environment – necessarily has some idea about that domain, but the truth is that few of us are technologists in more than a couple of domains. There is a difference between being a technologist and being impacted by technology, but it becomes increasingly difficult, for technologist and techno-peasant alike, to grasp how the culture *as a whole* is being impacted, and reshaped, by it's technologies.

What has technology meant to me *as an artist?* The very wording of the question implies the seperateness of technologies which is so characteristic of the society. What technology has meant to *as an artist* has been the opportunity to view the broader scene as a technologist rather than as a peasant. On the whole, I don't think the artist's response to the impact of technology has been noticeably different from the response of any other specialist – deeper retrenchment into the "mysteries" of the speciality, and growing astuteness about marke-

Harold Cohen: Painting, 1979

ting, which is the linguà franca, the universal interface between domains – and but for one thing I wouldn't think the artist was worth considering as a special case. What is being impacted is a set of social roles. Validation of the artist's roles have rested traditionally upon what we might call the " speculative imperative ", applied to the broad landscape of human experience, but which experience is now filtered, increasingly, through technological concepts. It is not clear under what conditions that speculative imperative can be answered adequately from within an *isolated* technological domain, and the position of the techno-peasant may be literally that of a " naive ". It is not clear, in short, what art will *be*, what social roles will be available and validatable for those who now call themselves artists.

The interface between technology and the individual is formed of technological devices, the things which we hold and use and ride in. It would be overstating the case to maintain that devices are *themselves* the hammers which beat the culture into shape, but their power over the individual should not be underestimated. Devices have a strong predisposition to do the things they were designed to do, and their possession – the possession of a technology, in a more extended sense – acts to *constrain* the individual's conceptualising power, not to expand it. In theory the owner of a handgun might use it to hold a rose, but in practise he will view it as a device for shooting people.

But our relationship to our tools has changed in a very special way, and the age-old symbiotic relationship of tool-maker to user which arose simply from the fact that man uses tools has ceased to exist. These changes have not come about only because of the increased complexity of the tools, but also because of the social structure within which we acquire them. Can you imagine how many Xerox machines Xerox would sell if all potential users needed to know how xerography works ? Obviously, it is not in the interests of the marketplace to require technological sophistication of the user, and as technology becomes more and more abstruse, more and more effort goes into the design of the " man-machine interface ", into establishing a work environment in which the user is persuaded that there is *absolutely* no advantage to considering what goes on inside the black box. To take a single example of a black box : modern micro-based word-processing systems have been an instant success on the market, because they put instant power into many hands. In fact, the word-processor is actually a general-purpose computer upon which this paper is being written. My computer will also perform any task I am capable of conceiving in computational terms. The buyer of a word-processor is caught in a tradeoff between general power and instant special-purpose power, and if his advantage is to be measured in terms of productivity and profit, the cost has to be measured in terms of conceptualising ability. The artist involved in " high-tech " gear is likely to be caught in exactly the same tradeoff.

You don't use black boxes, they use you. A black box is not a physical device, it is a physical device plus a state of mind. It is not a closed system, it is a system which persuades the user to *believe* it to be closed, to believe his/her back of understanding to be, not merely normal, but desirable. In an environment where goals are common and well understood, so that devices may be designed to reach them, the advantages offered by the black box are by no means illusory, whatever the cost : a word-processor is well worth having, if you write more than six letters a day and can't afford a general-purpose computer. The artist's goals are not well understood, however, for the single good reason that speculation is open-ended. What functions would you build into a block box designed to support speculation ? The question is no less important for being rhetorical : in the absence of a theory of operation those functions will fully define what the individual will produce, and the societal value of the individuals's work will be exactly equivalent to that of the functions themselves. For the last decade artists have been educated to the persuasion that art-making technologies are to be acquired the way one acquires any commodity in the department store, by reading the advertising on the labels, and the resultant value hasn't been high.

The value may have been lowest of all in computing, which is my own domain of expertese. It is my belief that the computer has all the innate generality required to constitue it as a tool for highly individualised conceptualising processes – that is, as a tool for art-making. So far, it probably qualifies as the biggest and blackest black box in the history of technolgy.

H.C.

(Journal of the Center for Music Experiment, U.C., San Diego, February 1981)

INTRODUCTORY NOTES TO THE GROUPE DE MUSIQUE EXPERIMENTALE DE BOURGES
(The Bourges Experimental Music Group)

The G.M.E.B. was initiated in 1970 by Françoise Barriere and Christian Clozier. Since then, it has been devoted basically to electro-acoustic music, that is the form of making works of musical art through the tremendously powerful electronic and computer tools.

The variety of activities of the G.M.E.B. is supporterd by a team of musicians/searchers, all willingly involved in today's music and its link to society, which commands on their part a high level of artistic and scientific training ans skills to communicate with their public as well.

The basic fields of activity of the G.M.E.B. are :

Research

aimed at designing system capable of enriching the musical " speech ", this research is conducted within the a.R.T.A.M. (Atelier de recherches Technologiques Appliquées au Musical), where musicians, technicians and engineers collaborate very tightly. The " gmebaphone ", the " antonymes ", designed for sound distribution; computerized sound synthesis hybrid system, design for studio work and the " gmebogosse " for pedagogy, constitute the principal and most characteristic devices invented and built in G.M.E.B. laboratories.

Françoise Barrière

Performance and Information

The G.M.E.B. is highly concerned with the necessity of performing as much electro-acoustic music as possible. Hence, its numerous initiatives in this field; concerts, shows, lectures, exhibitions, magazine *Faire* and annual international contest, festival and convention on experimental music at large. The G,M.E.B. is the french representant of the C.I.M.E. (Circuit International des Musiques electro-acoustiques).

Teaching and Pedagogy

Each member of the group participates actively to the pedagogic activities. Training sessions are annually proposed to composers-in-training from France or abroad. In September high-level international courses in electro-acoustic music are attended by composer, performers and teachers wishful of increasing their knowledge of compositional methods and techniques. Finally, thanks to the " gmebogosse ", a pedagogic device invented by C. Clozier, a great deal of children and teen-agers have geen given the opportunity of a live contact with electro-acoustic expression.

Musical Creation

Driven by international concerns, the G.M.E.B. has commissioned many foreign composers to work in its studios. Within the group itself, each composer is asked to develop his own musical ideas in any of the existing electro-acoustic applications.

ROGER COQART, B

Grid structures are constructed from simple linear elements, derived from the square and its division, and assembled with the aid of probabilities laws in a pre-determined order. A spectator interested by such a configuration will discover optical knots at the global lecture of the composition, while nervously scanning it in a search for a more reassuring subject. He, who persists and studies the painting more profoundly, will discover forms and signs who awaken memories of sentiments and emotions, of solid points of reference. He discovers the underlying symbolic work.

The perception of the symbol excludes the attitude of the simple spectator and demands an effective participation as an actor. Words may be indispensable to suggest the sens or senses of a symbol; they are nevertheless incapable to express the real value. The perception of the symbol is eminently personal. A symbol escapes every definition. In its nature lies its aptitude to break established limits and to unite extremes in a single vision. Quoting Wirt, we can say that the property of the symbol is to stay indefinitely suggestive : everyone sees what his own personal visual power permits him to perceive. Without penetration, nothing profoundly is perceived.

R.Q.

JULIAN SULLIVAN

I have used computers in my work for the past 8 years because they offer hitherto unavailable opportunities for certain kinds of representation and expression.

As was the case shortly after the invention of photography there is a natural tendency to use a new technique in a manner stylistically related to models produced by more traditional means. I think this tendency should be resisted.

With certains exceptions, such as in conceptual schemes, I support the view that the artist should be entirely familiar with and in command of the technique, otherwise there cannot be a properly productive interaction. The cost, complexity and rapid development of computer techniques entails that few artists working in this area, including myself, are in this position. Until this problem is solved, significant advances will be slow to appear.

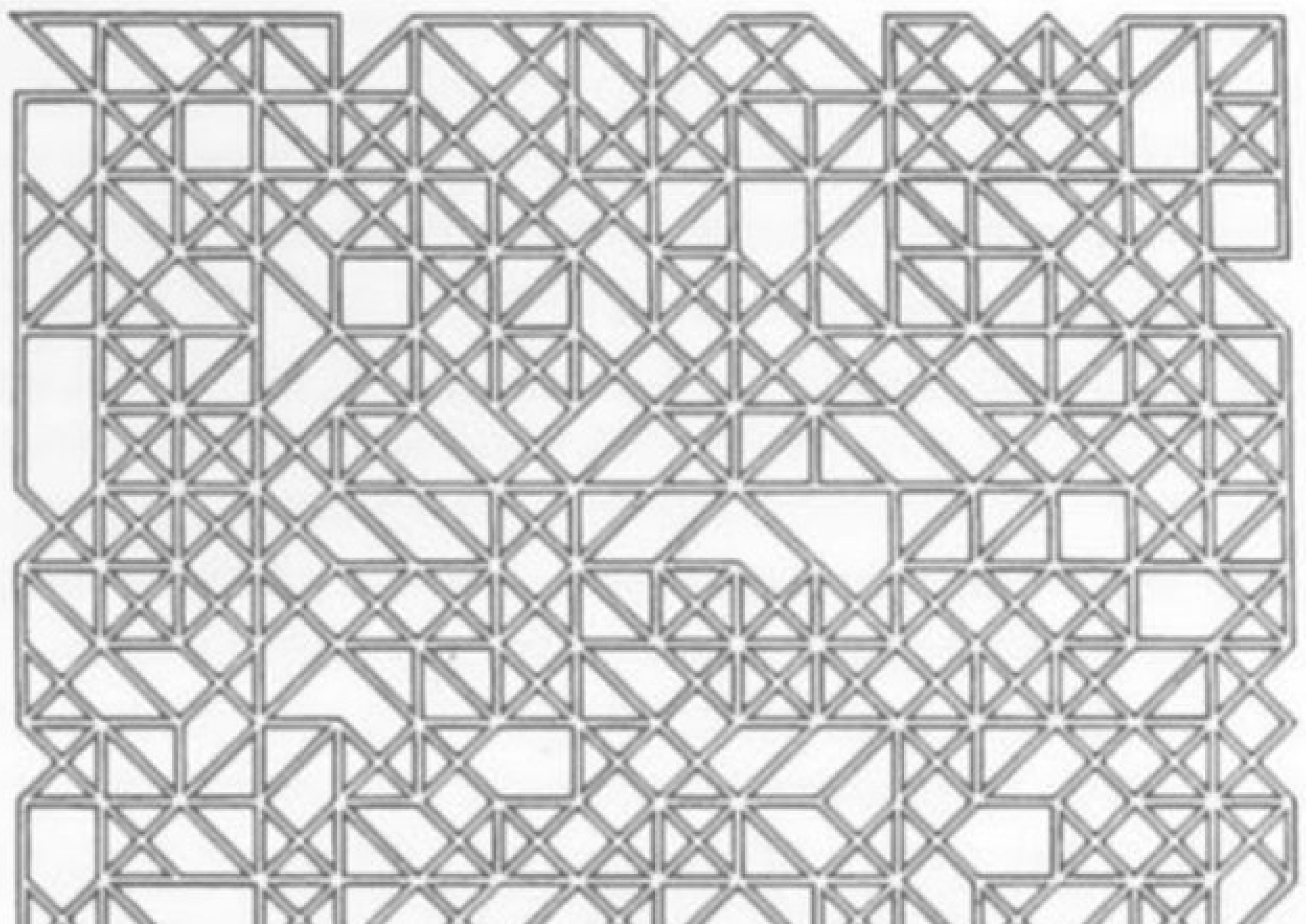
At the moment I am occupied in an attempt to portray adaptive behaviour. Four qualities are examined in relation : shape, structure, space and behaviour. A set of programs has been developed to represent structure as groups of points, at present in two dimensions, but later in three. Clusters of points are analysed into shape.

These points also denote a code of information on the current status of any given point in terms of general parameters with natural connotations such as territorial behaviour strategy, membership of a group, age and other such individual variations. A point when magnified appears as a polygon with a geometry unique to the current code of the individual.

Each individual is a transformable set of generating procedures existing in an environment of other similar individuals. The information content of a point is that combination of parameters that constitute its pattern of behaviour. These parameters are drawn from a repertory of combinations that constitue the range of transformation. The code of any point is not given "a priori" but results from trials and experiments carried out by the point on its environment. Transformation results from comparing the efficiency of procedures in relation to some problem or goal, which is not itself of much importance.

It is of great importance to me that while the work may involve considerable analysis, the intention is to produce objects that convey an understanding of the principles without formal analysis. The drawings do not at present do this as they only show fragments of the development; they are mainly intended to illustrate the principle. Films is the major way I am using to show the whole sequence, although I also intend making drawings of complete sequences.

J.S.



Roger Coqart: Grid Structure, enamel on plexiglas, 120 × 120 cm

ARCHITECT AND COMPUTER
A Conference at Leicester Polytechnic, 8 March 1982

In March 1982 the Kimberlin Exhibition Hall hosted an exhibiton entitled *Architect and Computer*, a touring show organised by the Goethe Institute. To coincide with this exhibition, CAS(Midlands) in conjunction with Leicester Polytechnic arranged a one-day conference on Computer-Aided Architectural Design (CAAD). The invited speakers, all acknowledged authorities in CAAD, presented papers which are published here. In addition to the speakers, the following credits are due:

Welcome Address: David Bethel, Director, Leicester Polytechnic
Morning Session Chairman: Dr Neil Bowman, School of Architecture, Leicester Polytechnic
Afternoon Session Chairman: John Lansdown, Turner, Lansdown, Holt and Paterson, London
Closing Session Chairman: St J. P. Stimson, Douglas Smith Stimson Partnership, Leicester
Conference Organiser: Diane Fox-Kirk, Industrial Liaison Centre, Leicester Polytechnic
Committee Members of CAS (Midlands)

Introduction by the Director, David Bethel

My task this morning is a very pleasant one, to welcome those of you who are visitors to the Polytechnic and to wish all of you here a very informative and rewarding day at this conference examining the latest state in the development and application of Computer Aided Architectural Design tools.

In welcoming you, I wish to take the opportunity of stressing three points. The first is that one of the missions of this Polytechnic is to develop the design process. By "design" is meant "contrive for a purpose"; by "process" is meant "a proceeding or moving forward – a progressive course". Most of the work of the Faculty of Art and Design and the work of the School of Architecture is devoted, obviously, to the development of the design process. Less obvious to many people is that the work of the Engineering Schools, the School of Economics and Accounting and our work in Management Studies, Mathematics and Computing and some aspects of the Faculty of Science is also devoted to the furtherance of the design process. Systems design and the applications of system design pervades most of the work of this Polytechnic. This, I think, means that we are changing the concept of design as a mainly intuitive process to that of identifying and assembling relevant knowledge, and analysing it in ways which allow decisions to be taken on the range of alternatives available for action. Design decisions, then, embrace a number of disciplines all of which are inter-linked. This has important implications for educational curricula.

My second point is to emphasise that, at this Polytechnic, we seek to provide a distinctiveness in higher education which has been described as "education for capability", that is, educating our students to apply knowledge to the solution of real-life problems. This embraces a number of concepts which time does not allow me to develop this morning, but includes the belief that no-one can claim to be educated who is either illiterate or innumerate. As with design, the traditional concept of numeracy is changing rapidly and this change has come about through the development of that modern electronic tool, the computer, the applications of which have moved well beyond its original number-crunching function, to perform tasks which previously were thought to be confined to the province of human intelligence. This development has made redundant certain manual and intellectual skills and invented a need for new skills. This too has important implications for the educational process.

My third point is that one outcome of the marrying of the changing concept of the design process with the changing concept of numeracy, when applied to both product design and architectural design, is to develop a new aesthetic, that is, to produce a new doctrine or science of taste and beauty. Of course, this has always happened; aesthetic perceptions have changed when new ideas have infused thinking. The great battles of the styles in the 19th century were infused by ideas about moral and social philosophy. Now we have the infusion of ideas about the way knowledge can be assembled and processed and tested in a rational, orderly way unknown to previous generations, by a powerful tool which assists the mind rather than the hand.

Johann Wolfgang Goethe would have been delighted to have had the power of a computer to assist him to pursue his many interests, which included the natural sciences and the arts. He might even have recognised that this, the last quarter of the twentieth century, is a period of particular *Sturm und Drang*, and felt at home at this exhibition organised by the Goethe Institute and at this conference organised by Leicester Polytechnic in collaboration with the Computer Arts Society.

A SURVEY OF COMPUTING IN THE CONSTRUCTION INDUSTRY

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1. Computer applications and those relevant to architects

In the past ten years the areas of building design and construction in which computers can be used have not changed greatly. Better programs have been developed on cheaper computers and have become more reliable and user-friendly as a result of greater use, published evaluations and advances in computer science.

The computer, whether micro-, mini- or mainframe, still remains a device, quite simple in concept, for storing, manipulating and presenting information as characters or in graphic form. There are various types of program used by architects: some general data processing aids common to all business management and information retrieval, some borrowed from other members of the design team such as thermal analysis or costing, and some which are central to design development and presentation.

Figure 1 presents a simplified classification of construction industry programs with their users. The architect can use programs developed by other specialists if he has the necessary data available and if he is prepared to take on the responsibility.

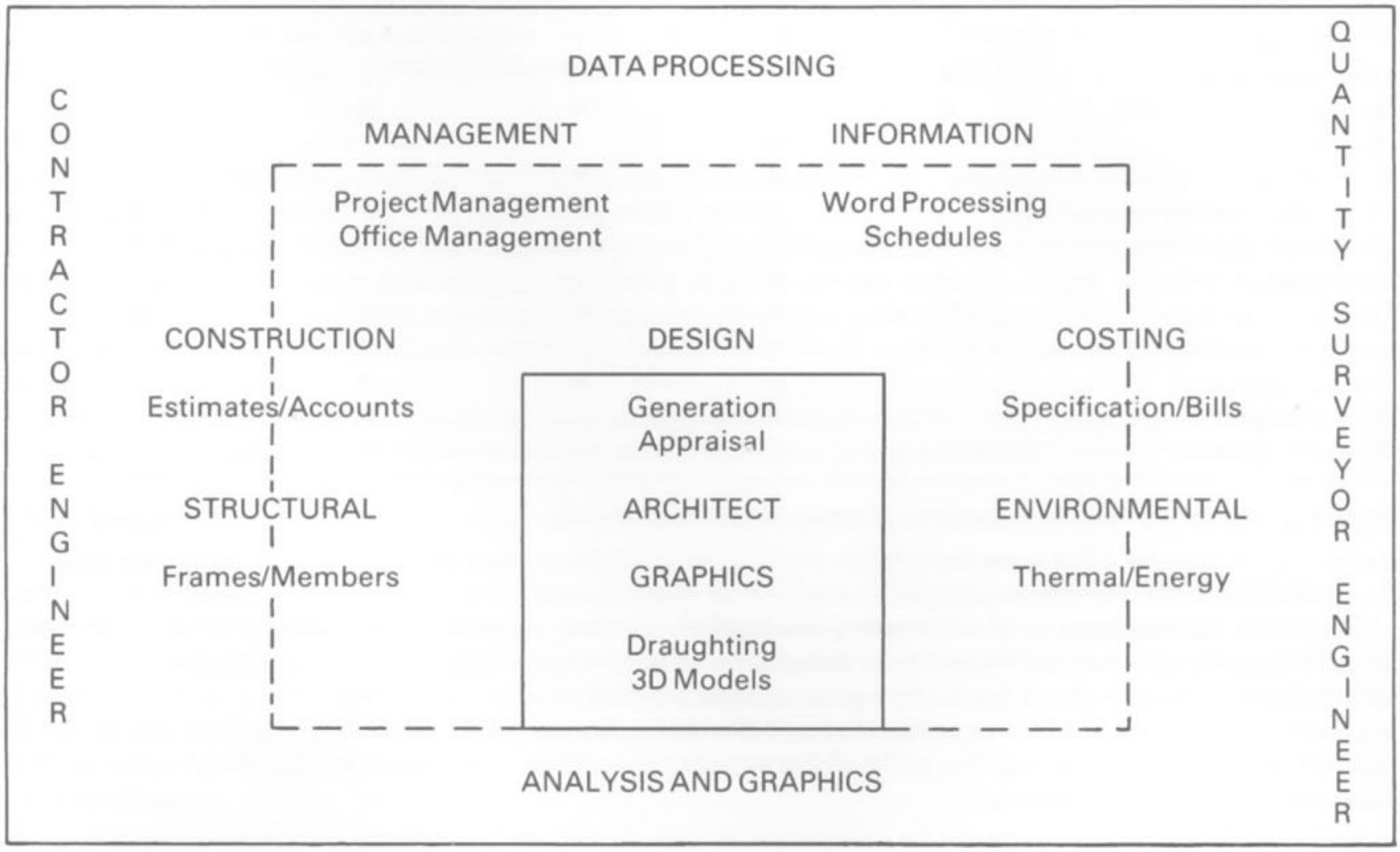

Figure 1 Computer applications related to the architects interests
Solid line – central applications
Dotted line – possible applications

2. The professions and the skills needed to use programs

General data processing applications can be used in parallel by the different professions and, with better communications, this should help project coordination. Communication of project documents including drawings could also increase efficiency at the design and construction stages, but standards do not yet cover the exchange of drawings between different types of computer.

Technical programs package the skills of specialists for wider use. Unfortunately programmers cannot anticipate all the ways in which their programs may be used. It is therefore dangerous for someone lacking the skills of the writer to use his program. The use of a computer does not absolve the user from his professional responsibilities. The architect, if he chooses to use programs from outside his traditional expertise, must take responsibility for their effects on his design.

Applications which have the greatest complexity and which should be left to specialists include: project management, bills of quantities, frame analysis and full energy simulation. Other applications used by the architect at an early stage to check his design could help consultants at a later stage, but they will probably carry out more detailed studies of their own.

3. The suitability of applications for use by architects

In deciding whether a program is suitable for use in architectural practice, apart from an assessment of its cost effectiveness, the following items should be taken into account:

a) The size of computer to which there is convenient access. Since it is increasingly difficult to classify computers, an arbitrary division at £20,000 is adopted in Figure 2.
b) Whether specialist data normally produced by separate consultants is required.
c) Whether the application and operation of the program is too complex for occasional use.
d) Whether an architect would be taking a major risk in accepting responsibility for the results of the program.

Application	Computer Small	/ Large	Specialised data	Complex Operation	Major Responsibility
Word processing	■				
Schedules	■	■			
Specifications	■	■			
Bills of quantities		■	■	■	■
Office management	■	■			
Project management	■	■	■	■	
Accounts		■			
Estimating	■	■	■		
Structural frames		■	■	■	■
Structural members	■	■			
Thermal analysis	■	■			
Energy		■	■	■	■
Design generation		■		■	
Design appraisal		■	■	■	
Draughting		■		■	
3D modelling		■		■	

Figure 2 Factors affecting suitability of programs for architects

4. Changing relationships

The areas for application of computers are unlikely to change greatly but professional relationships may. Before the architect thinks of taking over the work of other specialists with the aid of the computer, he should think carefully about the factors given above. His fellow professionals are likely to be speculating on taking over some of his responsibilities at the same time. It is by greater use of the computer to coordinate and communicate the work of the existing specialists that the efficiency of the construction industry is likely to be improved.

COMPUTER SYSTEMS IN ARCHITECTURAL PRACTICE

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Introduction

The D'Arcy Race Partnership is an architectural practice formed over 3 years ago. The practice offers two main services: conventional design services and specialist services based on the promotion, development and use of computer aids in the Building Industry. The partners of this practice have between them over 20 years experience of using computer systems in production. Both partners specialised in computer applications during their formal architectural training. They subsequently met at the Oxford Regional Health Authority where they assisted in the design, development and use of the three dimensional modelling system now known and marketed as B.D.S. (Building Design System). Four years ago, they decided to form their own practice specialising in computer based contract draughting. Many contracts both very large and small have been undertaken successfully. The practice has now expanded and diversified and is applying its specialist expertise to its own design workload. In addition, the practice is an active member of the Construction Industry Computing Association and Richard D'Arcy is a member of the R.I.B.A. Computer Committee.

This paper concentrates on the use of currently available computer systems in a production environment. Particular attention is given to the benefits, performance and economy of using a system. Finally, comments are made concerning the effects a system may have on the character of a practice and its workload. It should be stressed that this paper is based on experience of using a two dimensional draughting system purchased 2 years ago. The technology of the system is, therefore, at least 3 and probably 4 years old.

Computer system benefits

Speed

Computers are well known for their ability to perform complex calculations and produce large volumes of documentation extremely quickly. It is frequently forgotten (especially by salesmen) that information must be supplied to a computer so that it can demonstrate its prowess. Practices considering the purchase of a system are often amazed to learn that using the system to produce only one drawing would take very nearly as long as using a drawing board. However, having created the drawing on the computer system, it can then be manipulated, copied, rescaled, inverted, mirrored and enhanced with consumate ease. As architects and other design professions produce coordinated sets of drawings (and very seldom single drawings), C.A.D. systems generally allow a substantial increase in productivity.

Accuracy

Computer systems reduce project information to a mathematical form, irrespective of whether the system is modelling two dimensional or three dimensional information. Generally, computer systems also model project information at full size. Inaccuracies caused by working at small scale on unstable media such as tracing paper by draughtsmen of varying ability are no longer relevant using a computer system. Controlling gridlines, elements and components can be located with absolute precision and the designer can, as a consequence, determine whether his details really do fit together before problems are identified on site.

As a rider to this benefit, computer accuracy may be a difficult and frustrating master at sketch design stage where conceptual information is being presented and accuracy is not an important factor.

Consistency

Whilst computer systems can be used to simulate the traditional manual drawing process where a set of "master negatives" are produced, it is more usual to find whole floor plans (and even whole buildings in 3D systems) held as a single set of information or "data base". General arrangement drawings, details, reflected ceiling plans, sections, elevations and elemental schedules can all be generated from a single data base. As a result, information generated from the computer can only be consistent. Indeed those errors undetected by the system will be reproduced faithfully.

Coordination

Many manual drawing "systems" have been developed and are in use to reduce draughting workload and coordinate design information. One such technique in common usage is a system of overlays where elements are grouped onto separate transparent sheets to be read or printed in conjunction with a base drawing. Computer systems allow the designer to place all elements in their correct location in the model of the project. Were a drawing to be generated showing every element it would be extremely dense and confusing. The computer system allows the designer to generate drawings showing only a selected subset of elements, the remainder being suppressed only during the drawing process. Particularly in multi-disciplinary practices coordination can be ensured through this modelling technique.

Automation

It must be stated that computers cannot design and probably never will. They can perform limited tasks with some degree of automation however. As computer models are accurate, dimensions can be applied reliably by the system. In addition, sets of standard symbols can be predefined and applied to any number of projects. In concept this facility is similar to *Letraset* but it is not limited by scale and the designer may develop his own symbols at any time for subsequent re-use. This practice has developed a very large range of symbols, construction details and "standard" hospital rooms which are in constant use both for contract draughting and for our own design projects.

Previously in this paper, I have expressed the need, when using computer systems, to develop and complete the "model" or data base which represents the project. Having done so the process of generating drawings is largely automatic. Staff in this practice often generate 20–25 drawings a day, performing other tasks while the computer plots them.

Performance

Since forming the D'Arcy Race Partnership, a productivity between 3 and 10 times greater than manual draughting has been achieved. The variation is caused by the different character and size of projects completed. The first 1500 drawings completed by this practice required an average of less than 4 hours staff time each. The major proportion of these drawings were dense 1:50 scale general arrangements of A1 and B1 sizes but site survey drawings at 1:1000 and 1:500, general arrangements at 1:200 and 1:100 and construction details at 1:5 and full size have also been produced in volume. In addition, bar charts, diagrams and printed schedules have been prepared.

On a project basis, using only 2 members of staff, over 250 finished drawings were produced for a hospital project of £65 million capital value in a period of 8 weeks. This accelerated draughting programme, as one would imagine, demands more emphasis on management in particular to ensure that design information from the client and other members of the design team is available when it is required.

This performance is by no means an isolated example. Experience of our own design workload is that generally, we await decisions and information from client, design team and statutory authorities. Very rarely do they await information from this practice.

Economics

I have divided this section into two parts.

The first part, costs, identifies the purchase and running costs of a system. From this it is a simple matter to determine what workload is required to ensure profitability. The second part, profits, identifies from our experience the potential "earning" capacity of a system and thus how much profit could be made under favourable conditions.

The following assumptions have been made for the purposes of these calculations:–

1. The C.A.D. system consists of: software, processing unit, disk storage, 2 graphic workstations, high quality drum plotter.
2. Total purchase price of C.A.D. system = £122,000.
3. Leasing costs £33.25 per £1000 per month over a 3 year period, or £21.75/£1000/month over 5 years.
4. Annual maintenance charges are at the rate of 9% of purchase price.
5. A constant flow of suitable design work is available. (This is most unlikely as we all know!)
6. R.I.B.A. work stages and apportionment of fees is used as follows:–

Work stage	Proportion of fee	Time reduction by using C.A.D. system
C	15%	—
D	20%	25%
E F G	40%	50%

7. Costs of training staff to use the system are ignored.

Costs

Leasing over 3 years

Annual costs of system described in assumption 1

	£
Leasing charges	48,678
Maintenance charges	10,980
Total	£59,658

Thus the system has to "earn" £59,658 per year for the first three years.

From assumption 6 the system saves (or "earns") 25% of stage D resources and 50% of stage E F G. The system, therefore, "earns" 25% of the total fee.

Thus the system earns 1½% of the total 6% fee.

Thus a capital building workload of £3,977,200 must be sustained over the first 3 years.

Leasing over 5 years

Annual costs of the system in assumption 1

	£
leasing charges	31,842
Maintenance charges	10,980
Total	£42,822

Thus the system must "earn" £42,822 per year for the first 5 years.

Thus a capital building workload of £2,854,800 must be sustained over the first 5 years.

For overseas work, the total fee earned may be only 2%. In this case, an overseas workload of £11,931,600 must be sustained on a 3 year leasing basis and £8,564,400 on a 5 year leasing basis.

Profits

For our experience a 2 workstation C.A.D. system with users of average competence is capable of processing £60,000,000 of capital building work per year. Figures for the D'Arcy Race Partnership are considerably higher than this by virtue of the greater expertise of our staff.

	£
Total fees earned on £60 million @ 6%	3,600,000
Proportion of fees "earned" by system based on 25% of the total 6% fee (1½%)	900,000
Annual cost on 3 years lease	59,658
Annual cost on 5 year lease	42,822
Profit on 3 year lease basis	840,342
Profit on 5 year lease basis	857,178

Again for overseas work where the total fee earned may be only 2%, profit will be £240,342 on a 3 year leasing basis and £257,178 on a 5 year leasing basis.

Effects

Installing and using a C.A.D. system will have a number of effects on a practice, some of which will be disadvantageous. The following list of effects is by no means complete but are either pertinent to this practice or have been observed in other practices.

A practice with a C.A.D. system may:–

- Seek and accept commissions of a much larger size than they would have been able to handle in the past.
- Discontinue the employment of contract draughtsmen.
- "expand" by taking on a greater workload without employing more staff, aquiring more office space or reducing its design or documentation standards.
- allocate a greater proportion of its staff resources to "design" activities with the assurance that a major proportion of production documentation can be automated.
- propose or accept a shorter timescale to complete a commission with the ability to meet deadlines more easily even if problems do occur.

It should be noted that some of the effects or policies above are mutually exclusive.

Also there are a number of inevitable consequences of using a C.A.D. system.

- training staff will be an expensive process and will take much longer than system vendors suggest. My practice allows three months for new staff to build up expertise to a production standard. We suggest the system will not be profitable until the second or third project.
- existing staff cannot be expected to universally accept this new technology, nor will some members of staff ever reach an acceptable standard of competance on the system.
- management will be under great pressure to allocate resources to maximise the benefits the system can allow. This will be a particular problem initially where no experience exists to guide management decisions.
- day to day maintenance of the system and security procedures for data are a vital, but not necessarily onerous, new function to be performed by a responsible member of staff.
- the true limitations and performance of the system will be discovered some months after it has been in use. These characteristics may be surprising and almost certainly will not be found in, or will be at variance with, the sales literature.

Conclusions

There are over 50 different C.A.D. "systems" on sale in the U.K. Of these, only 20, or thereabouts, are suitable for architectural or building applications and of these there are only 4 or 5 systems which are of a sufficiently high standard of design and development to be used effectively in a production environment.

I estimate there are in excess of 250 C.A.D. systems in use in the U.K. The majority are to be found in Engineering design offices; British Leyland and Rolls Royce, for example. Over the last 12 months, the architectural profession has developed a consuming interest in C.A.D. and the number of systems in architectural offices is increasing rapidly. My advice to potential C.A.D. system purchasers is to tread very carefully and seek unbiased expert advice or they may be "blinded by science".

THE APPLICATION OF COMPUTER-BASED MODELS TO THE PREDICTION OF FUNCTIONAL PERFORMANCE AND VISUAL IMPACT OF BUILDING DESIGNS

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Introduction

The concept behind computer modelling is quite simple. Using a computer, we develop models of the operational behaviour and aesthetic character of design proposals which will allow prediction of how a real building would perform in the real world. This paper presents three complementary examples. The first shows the use of a general appraisal model to refine a design for a hotel. The second shows the detailed examination of a particular building subsystem to obtain specific data on energy utilisation. The third shows that computers can also model alternative realities that are not based entirely upon models relying on the mathematical laws of physics and economics, by producing very accurate photomontages for visual impact analysis studies.

The Design of a Small Hotel

From the input of basic sketch design data the computer will calculate areas, environmental conditions and costs, in the same way that the environmental engineer and quantity surveyor would do initial heat loss calculations and building regulation checks, and cost plans. The computer program used (Sussock, 1978) has the slight advantages of speed and tolerance. It produces its answers immediately and does not mind the designer trying out different ideas. The benefit of this is that several design alternatives may be quickly investigated before working up the most promising in the sure knowledge that it is economically and environmentally feasible. Figure 1 shows a summary of design alternatives investigated in one particular example.

Energy Conscious Hospital Design

A joint study by DHSS, BDP, ABK and Grifford and Partners, of energy utilisation in a standard 300 bed Nucleus hospital has revealed opportunities for energy savings of up to 50% on current hospital design practice. The detailed thermal analysis carried out in this study made extensive use of a sophisticated dynamic energy model known as the Environmental Systems Performance (ESP) program (Clarke, 1979). The design options investigated and resultant design decisions are summarised in figure 2. Figure 3 shows some of the detailed investigation of glazing and shutter options, and figure 4 the identification of the summer overheating problem (Corcoran, 1980).

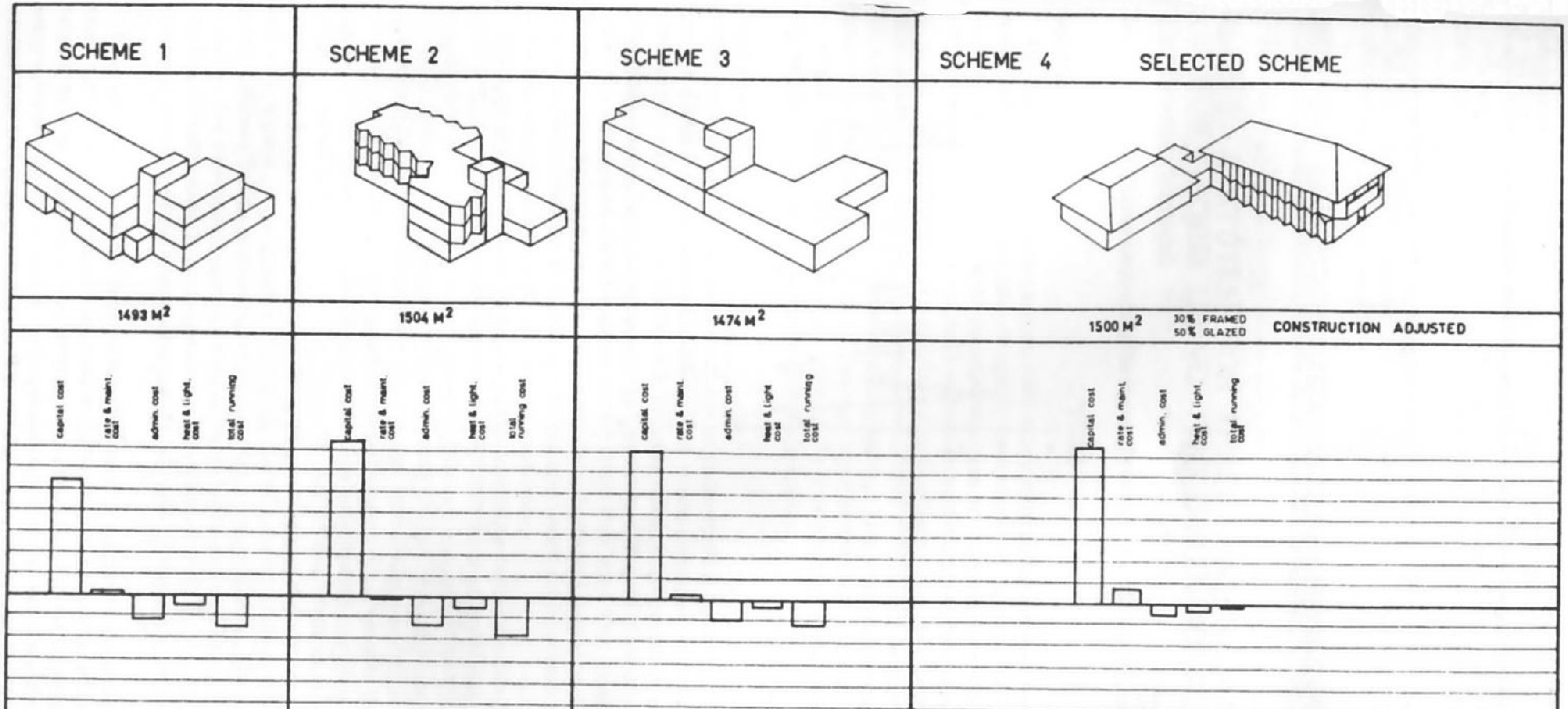
Visual Impact Analysis

Using a mixture of advanced techniques from cartographic geography, TV video technology and computer graphics it is possible to generate accurate line drawings or coloured photomontages of design proposals (Bridges, 1981). Figure 5 shows a typical line drawing output of a building in its surrounding urban context. It shows the proposed Edinburgh Hilton Hotel as it would appear from the Castle Esplanade. The hotel was digitised from the architects drawings whilst all the rest of the data was photogrammetrically digitised from aerial photographs.

Conclusions

The first example illustrated an iterative search for a design solution in which an appropriate balance is struck within a range of cost and performance criteria. The appraisal techniques allow a broad range of alternatives to be considered and help direct the search to eventually 'fine-tune' the chosen design. Appraisal models may also be used in a 'research' context to provide insights on the detailed effects of specific design changes. The second example showed how the energy consequences of various design options were rapidly and accurately assessed. Accuracy of representation is also of importance in the siting of buildings in urban environments or minimising their impact in the rural environment. Computer models enable the visualisation of large numbers of alternative views quickly, easily, and objectively without any 'artistic licence'.

This type of computer-based model is now starting to make a considerable impact on architectural practice and education. This impact stems from a fundamental difference between these new models and the traditional physical models. The new models are predictive rather than descriptive, dynamic rather than static and explicit rather than implicit. The implications for designers are far ranging, but, far from threatening the architect, indicate the way he may regain control of the overall design and, hopefully, enable him to produce better buildings.



COMMENTS

1. LARGE CIRCULATION AREA
2. RESTRICTED VIEW FROM BEDROOMS

COMMENTS

1. CONSTRUCTION RESTRICTED
2. HIGH RUNNING COST

COMMENTS

1. LONG CORRIDOR

COMPONENT	AREA (M²) NET	AREA (M²) ANCILLARY
BEDROOM	720	144
FUNCTION SUITE	73	29
RESTAURANT	60	30
GRILL ROOM	69	27
LOUNGE BAR	52	16
ADMIN	79	
FOYER	165	
PLANT ROOM	36	
TOTAL	1254	246
GRAND TOTAL	1500	

COST OUTPUT	POUNDS
CAPITAL COST	271764
RATE AND MAINT. COST	25256
ADMINISTRATION COST	32855
HEAT AND LIGHT. COST	7505
TOTAL RUNNING COST	65616

Fig. 1. The use of a general appraisal model

study sequence	assumptions carried forward
Neutral Nucleus datum	
control temperature	18°c control temp. retained
window size	35% window adopted
multiple glazing	triple glazing adopted
orientation	orientation not significant
insulated shutters	insulated shutters not warranted
lighting	installation with reduced lighting load adopted
rooflight (model)	rooflit design adopted
construction mass	heavyweight upper floor lightweight lower floor
insulation thickness	100mm of insulation in roof and floor constructions
ventilation rate	controlled ventilation at 1 air change per hour adopted
summertime temperature	need for solar control indicated
revised Nucleus load	

Fig. 2. Design options investigated with ESP

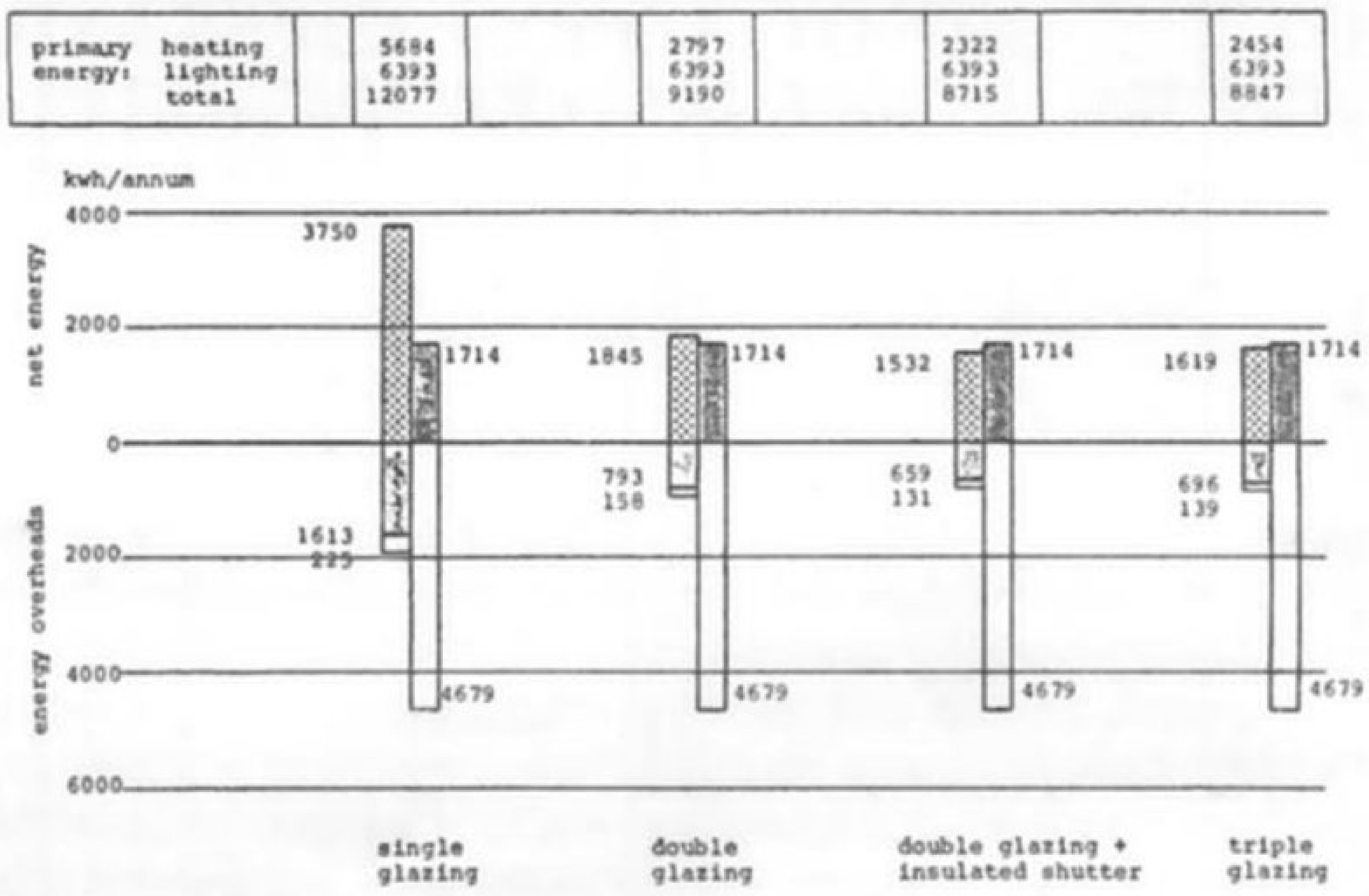


Fig. 3. Comparison of window options

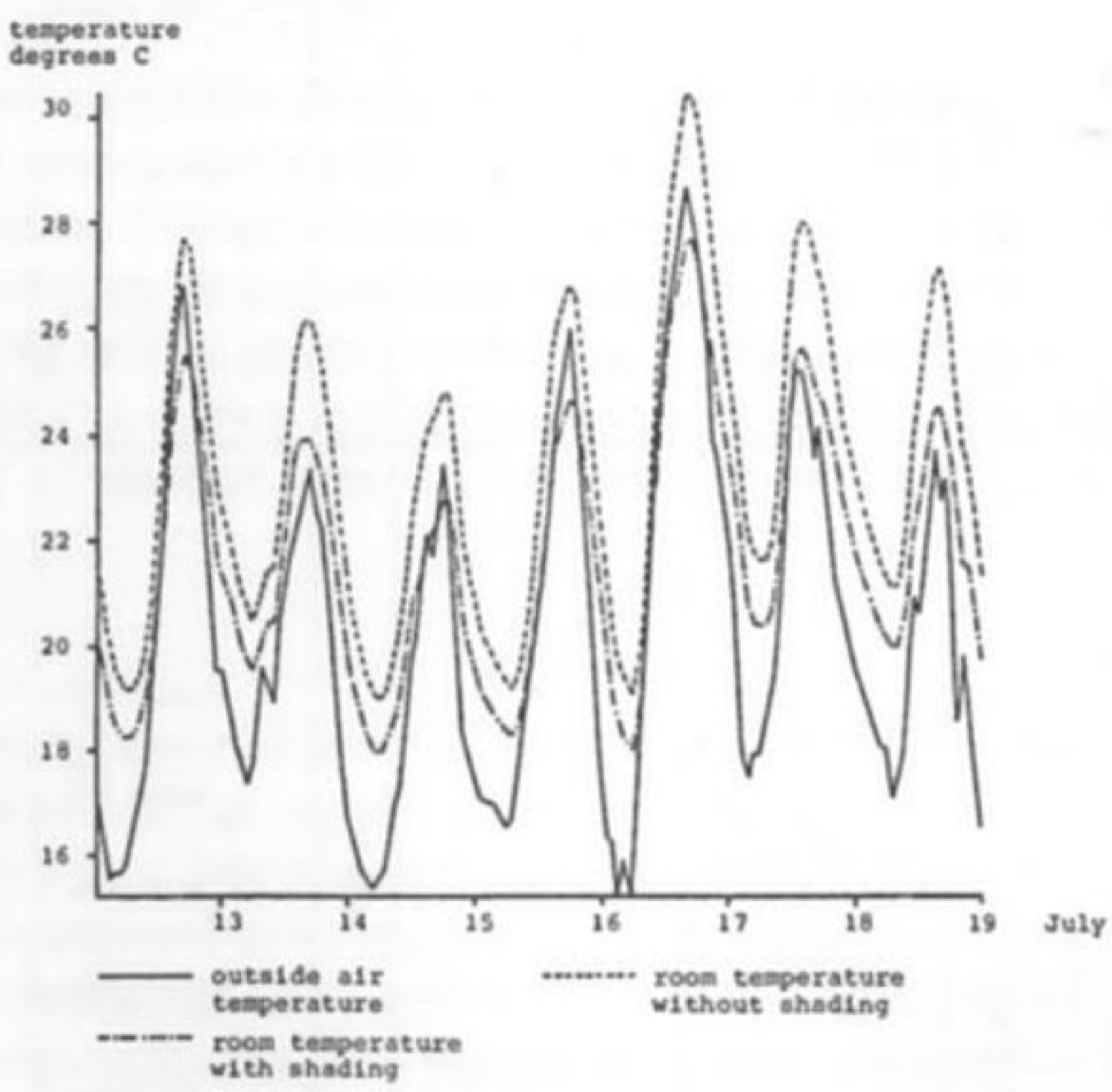


Fig. 4. Summertime temperatures in an upper floor six-bed ward

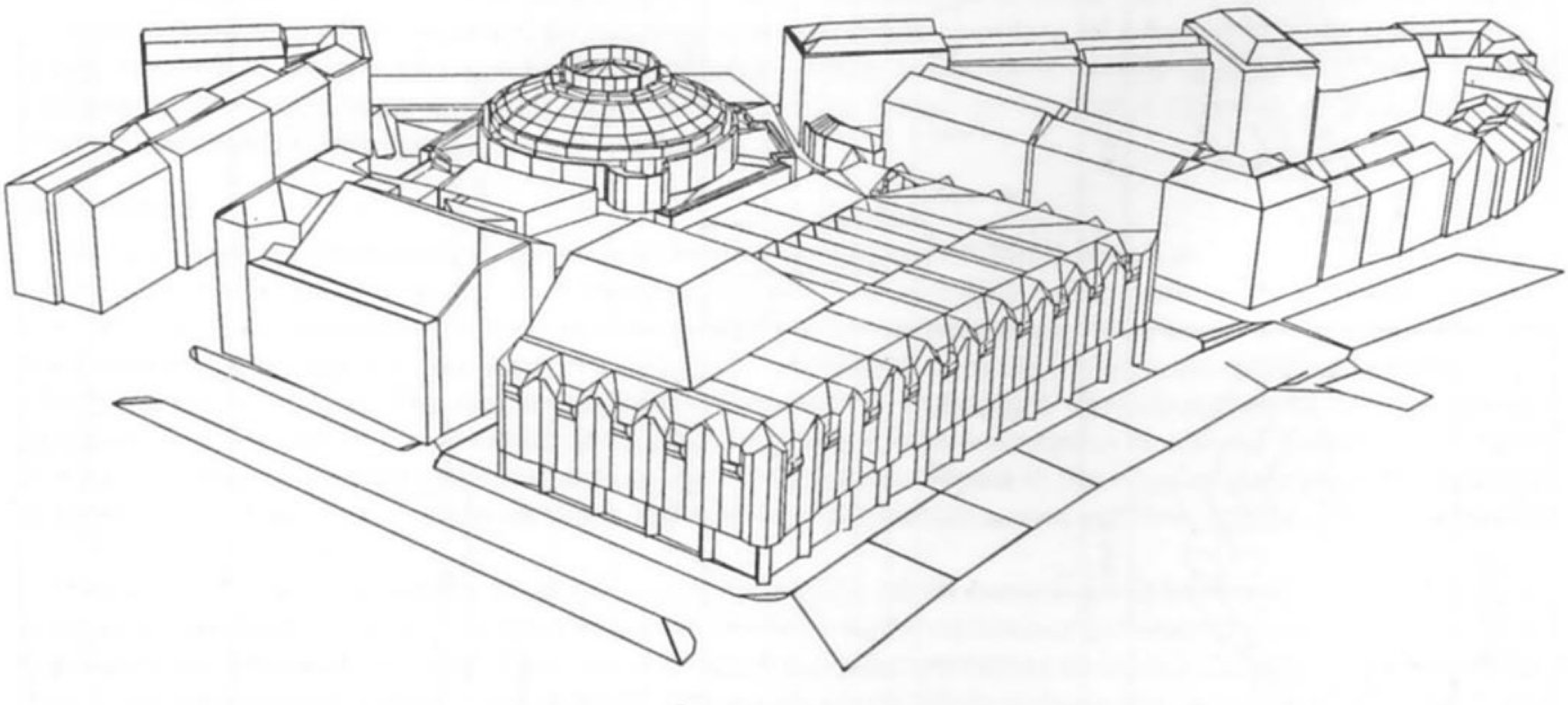


Fig. 5. The proposed Edinburgh Hilton hotel as viewed from the Castle Esplanade

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GABLE: A SYSTEM FOR THREE-DIMENSIONAL VISUALISATION OF BUILT FORM USING TWO DIMENSIONAL INPUT

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Introduction

The computer can now usefully fulfil many roles in the architectural design office of which perhaps the most well recognised are two-dimensional drafting, three-dimensional visualisation and building performance calculations. We shall concentrate here on the three dimensional visualisation role but it must be remembered that any good CAAD system should integrate these roles to avoid unnecessary duplication of input. The GABLE system developed at Sheffield University provides simple two-dimensional input techniques with facilities for three-dimensional output and building evaluation studies as well as the conventional two-dimensional drafting facility. This paper concentrates on how GABLE automatically interprets the two-dimensional drawings input by the user and establishes a three dimensional building model suitable for both perspective drawing routines and, if desired, building evaluation studies such as daylighting which rely on spatial organisation data.

Information Input

The problem of getting the computer to understand a building three dimensionally as a building, not just as a collection of abstract drawings, is made considerably more difficult if architecture is seen, as realistically it must be, as an organic process rather than purely one of component assembly. The latter view is of course quite acceptable when working with grid planned, dimensionally co-ordinated system building, but not all buildings are constructed that way. The existing building stock, which we must maintain, re-use and extend, is often irregular in form and reliant on traditional constructional techniques. A satisfactory computer system cannot rely upon such artificial restrictions as planning grids or assumptions of rectangular form and component assembly.

Solution evaluation studies by definition take place before the design is finished and often before many characteristics of the final solution are known. We are thus faced with the problem of designing computer systems which can understand not just finished solutions but emergent, ill formed and incomplete building designs. The designer must be able to describe his solution to the computer gradually as it develops. Since no two designers work in quite the same way and no two design problems are precisely the same it is reasonable to assume that our system must be able to accept information in virtually any sequence and allow the designer to change any aspect of his design at any stage (Lawson 1980).

This requirement has profound implications for the kinds of data structures which such computer programs must establish. When a designer is sketching during design, components of the solution may not only appear or disappear but may be moved around or change in size, shape and construction. As a result of these changes such components may change their topological relation to other elements in the solution. For example a window may not only be changed in size and shape but may be moved so that it lies in a different wall. Such a movement may cause the window to be in a different elevation even though opening into the same room, or alternatively the window may change rooms but remain in the same elevation.

Thus an analysis of the data required to describe a particular building element shows it to consist of three quite distinct forms of information (Lawson 1981). We shall call these locational, specificational and relational, and explain them by reference to a simple window. The locational data quite simply describes where the window is in space. The specificational data describes the performance characteristics of the element. In the case of a window this would normally include the width and height, glazing pattern and frame material. The third, and by far the most problematic and interesting kind of data, relational, describes how the element fits into the building as a whole. In the case of our window this would include the wall in which it is found, the space into which it looks and perhaps the elevation to which it belongs.

A further analysis of the nature of building elements shows that they can be specified in one, two or three dimensions. The GABLE system allows for all three kinds of elements which are called "edges", "surfaces" and "units" respectively. Our window is an example of a "unit". The window's bounds are determined in all dimensions and it simply needs locating in the building. However the wall into which it goes is an example of a "surface". Here the element is specified in terms of its cross section only, and when it is located the extent of the wall plane may be drawn differently for each instance of the same type or wall in the building. Between the wall and the roof surfaces there may be a series of eaves or verges. These are examples of "edges" which are specified effectively as junctions between surfaces and only have their length defined at the time of location.

This then brings us to how the computer is to be instructed by the designer about the locations, specifications and relations of all the building elements. To achieve a high level input technique GABLE seeks to use a method of describing the building to the computer which resembles, as closely as possible, the method which would be used by the architect without a CAAD system to describe his building to other members of the design team (Lawson 1981). Normally he would describe locational data by means of drawings, frequently two-dimensional and usually a plan view. Specificational data is usually described separately in text or annotated drawn form in schedules with cross references to the drawings. Interestingly, relational data is largely not described explicitly at all, but rather is derived by those looking at all the drawings. Members of the design team can tell simply by looking at a plan, in which room or elevation a window belongs and can find the same window on plans, sections, elevations or perspective views.

MIDAS

In GABLE, MIDAS represents the perceptual ability to look at two-dimensional drawings, relate them to specifications and to other drawings and deduce the three-dimensional interelatedness of all the elements. The objective in designing MIDAS was that it should not ask questions of the user which would seem unreasonable if they were asked by another architect looking at the plans. In fact MIDAS takes the single line diagrammatic plans input by the user and combines these with the various building elements specifications to generate three-dimensional models of the outside skin and inside of interior spaces. The rest of this paper will be devoted to an outline of how this joint designer computer synthesis of a building model actually works.

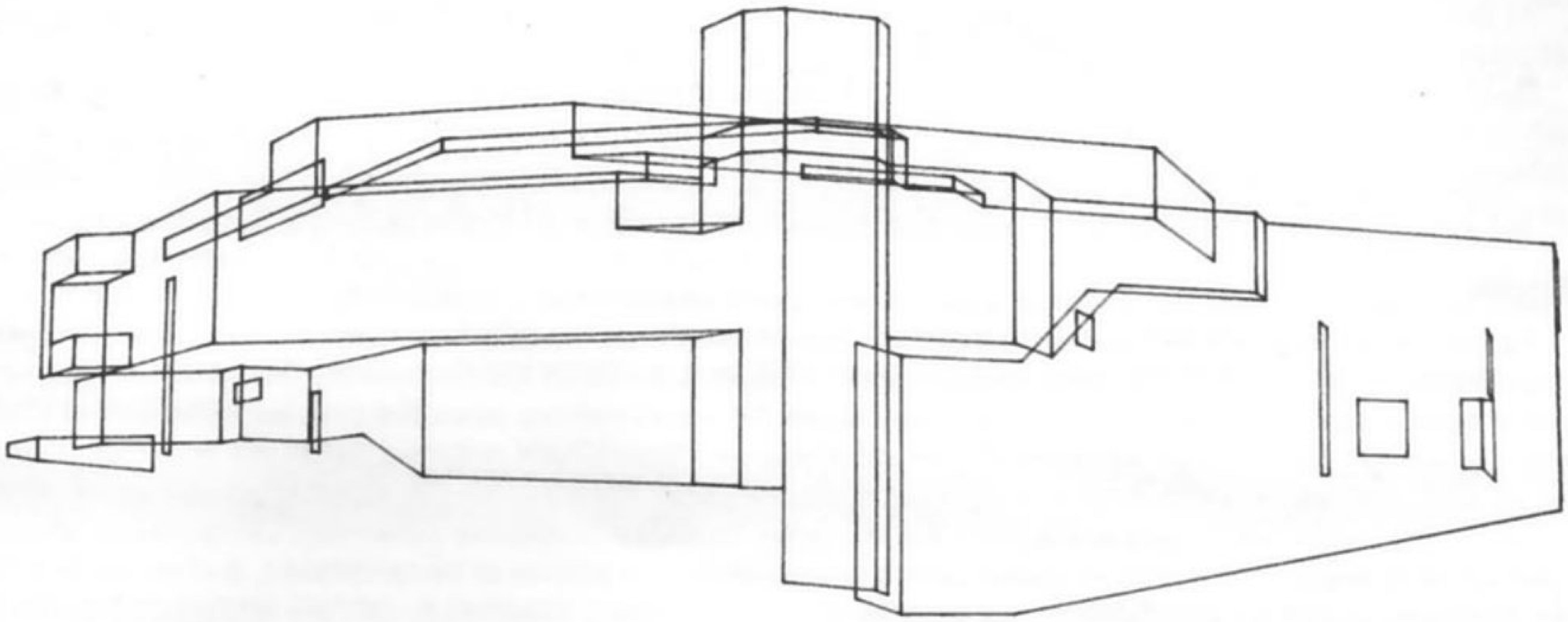
The designer generates all the locational data needed about the building by inputting three kinds of drawings; floor plans, a roof plan and elevations. These drawings parallel the conventional architectural design drawings and are usually created in the order listed here, but need not be. Not all of the drawings are needed before MIDAS can begin work, and for sketch design stage the elevations may not be needed at all as will be shown later.

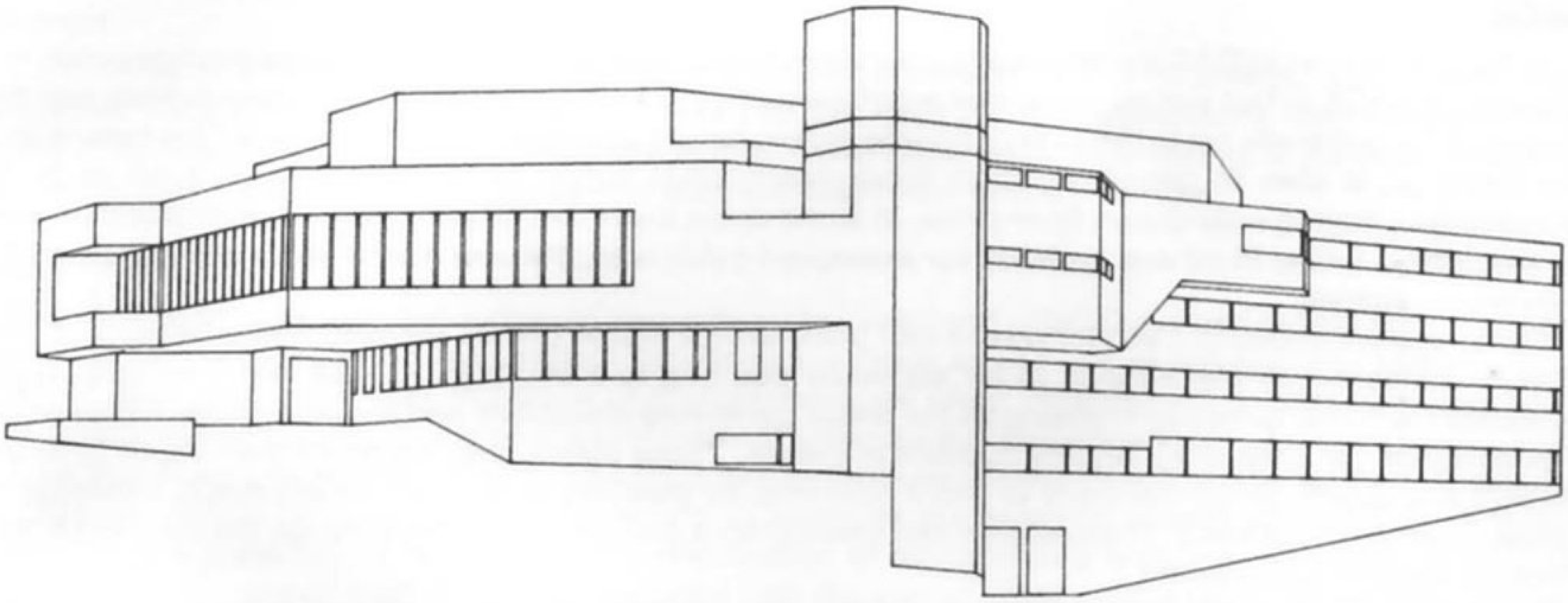
The floor plans may include external walls, interior partitions, windows, doors and floors and later will also include staircases. The command structure allows for these elements to be added, deleted, moved, respecified, redimensioned and, in most cases repeated. In general, elements are located by pointing either with the screen cursor or digitising plotter pen and then pressing an alphabetic key. The key pressed is deemed to represent the specification to be attached to that element.

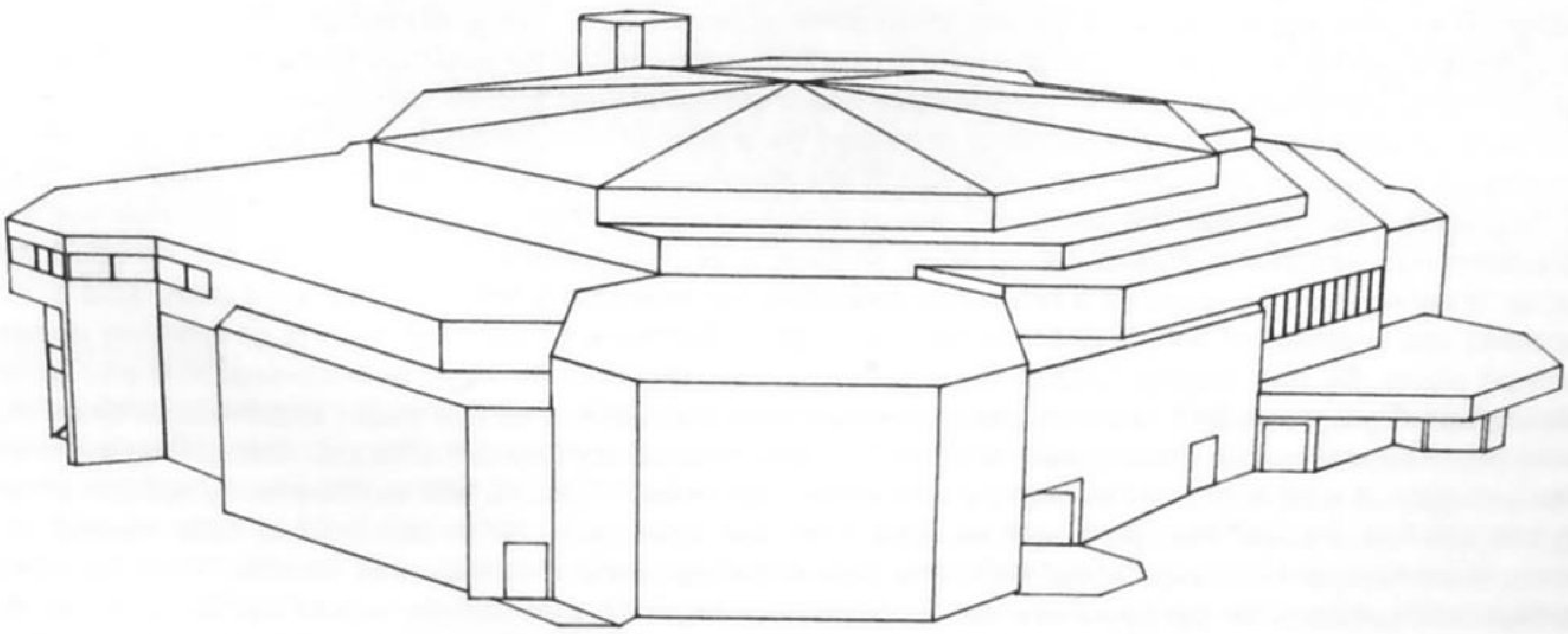
Walls are drawn simply by indicating either end of the centre line. Windows and doors are located in walls by pointing to their centre. The floor is assumed by the system to occupy all of the area inside the external wall and to be of the same specification and height throughout. However the user can add any irregular polygonal shape of floor panel and associate with this different heights or specifications. Alternatively, any room can in its entirety be so altered with the additional facility of raising or lowering the ceiling. When drawing around a floor panel the specification keys pressed for each line are taken to that particular "edge" or balcony thus associating details such as upstand or downstand walls and handrails with each line. Complete rooms or floor panels can similarly be removed altogether thus allowing for any combination of stepped platforms, mezzanines and multistorey spaces.

ISAAC

Once floor plans have been so created and stored MIDAS is able to operate the space modelling routine ISAAC (Lawson and Riley 1982). ISAAC examines the relationships of all the external and internal walls and from these develops an outline in plan of each space, taking account of the thicknesses of the walls. ISAAC also allows for the possibility that spaces may have more than one boundary in plan as with courtyards or internal partitions which are entirely freestanding within the space. It is of course also possible for spaces actually to contain other spaces in the manner of Russian dolls. At this point ISAAC has allocated all the internal faces of external walls and both faces of partitions to their appropriate spaces. It is therefore possible next to identify to which spaces wall openings such as windows and doors belong. Finally ISSAC associates any floor panels with their spaces and also considers openings in the ceiling







resulting from holes in the floor above.

At this point the interior space model for the floor level is complete and the user can run programs such as interior perspectives or daylighting studies which rely on that data.

Roof plans are created in a similar manner to floor plans except that the element added is the roof plane which is shown bounded by eaves, verge, ridge, hip or valley lines. Of course the user must also give some information about the section of the roof and this is done either by adding heights to points of intersection or giving pitches to planes or a combination of the two as the designer finds most convenient.

RODIN

As with floor plans MIDAS is able to build a three-dimensional model of the roof, this time using the roof interpretation routine RODIN (Riley and Lawson 1982). In fact RODIN also allows the designer the luxury of not accurately positioning fold lines such as ridges, hips and valleys since the precise locations of these are calculated from the intersections of the roof planes. All that RODIN requires is that the equation of each roof plane is soluable either because at least three points have been given both plan locations and heights or because at least two points and a pitch are supplied. RODIN will operate iteratively using planes already calculated to supply information about points to enable further planes to be calculated, and so on. RODIN, for example, assumes all points on eaves lines to be fixed in plan location and eaves and ridge lines to be horizontal, so that heights of points calculated on one end of such lines can be transferred to any other points on the line. If RODIN finds either insufficient or conflicting information, error messages indicating the nature of the problem related graphically to locations on the roof plan are made available to the designer.

SAGE

A third routine in MIDAS automatically operates as each floor plan is stored, to create crude projected elevations. SAGE in fact simply generates a vertical rectangle for each external wall drawn in plan with the height of the rectangle set to the overall floor to ceiling height assigned to that floor level. This means that the designer is able to generate rough three-dimensional output about the exterior, such as block perspectives having only drawn floor plans. In some cases these SAGE generated elevations will be very nearly correct whilst in others, typically for example a gable wall, the user may wish to draw on accurate elevational shapes.

Elevations are added in a similar way to roof plans except that all planes are assumed to be vertical. The user indicates which elevation is to be added by pointing to a key plan. GABLE will then display an elevation from that direction showing all the SAGE generated elevations and the roof planes if they exist. The designer can then draw on any number of planes. These planes may be given their depth (into the screen) and specification manually or more normally, by pointing to the appropriate SAGE elevation or fascia displayed by GABLE. The designer can also call for a section to be taken through the building at any depth to assist in this process.

Those parts of the GABLE system which allow for the inputting of floor plans, roof plans and elevations also enable the user to reposition, redimension and respecify elements. MIDAS continually monitors the alterations made by the designer to the building and will re-run only the necessary routines on the relevant areas of the building to re-establish the complete three dimensional model required for the evaluative software. In addition MIDAS will, if requested create neat and dimensionally faithfull two-dimensional drawings such as floor plans or roof plans and, later, elevations, sections and room elevations, all entirely automatically from the three dimensional model. These drawings unlike the single line diagrams input by the user obey architectural graphics conventions for example showing the thicknesses of elements, using different pens to emphasise major sectional lines and include hatching.

The final optional link in the chain is provided by a purely two-dimensional graphics system which enables the designer to create drawings which are abstract to the system and not interpreted by MIDAS. This graphics facility uses the same command structure except that instead of placing external walls or windows the designer is manipulating lines, shapes, arcs, text, dimension lines and so on. As usual any other drawing may be used as a reference including for example a MIDAS generated plan. This easily enables the creation of overlays for such drawings as furniture or lighting layouts or working dimensioned plans. By this means GABLE provides high level facilities for both two-dimensional and three-dimensional graphics, and enables designers to create and update all the major architectural drawings very much more simply, quickly and reliably than by using purely two-dimensional draughting systems. For example, a wall is moved in plan by one simple command. MIDAS will automatically rebuild all the space models around that wall and recreate the neat floor plan. Since the wall is now moved in a three-dimensional building model then any new drawings involving that wall whether they be plans, elevations, sections or perspectives will show the change. This of course would not be so were the designer using a purely two dimensional draughting system, where many lines on several drawings would all need changing manually to bring the computer model up to date. Also by adopting this three-dimensional approach the GABLE system makes possible the other powerful role of the computer as a building performance evaluator without the need for additional effort on behalf of the user.

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THE FUTURE FOR ARCHITECTS WITH SMALL MEANS AND LARGE AMBITIONS

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Abstract

Computing as a new mode of working, integrated with architects' design practices, is discussed. The individual nature of design procedures is linked to the need for new computing technology. Future computing, based on fundamental advances in the field of knowledge engineering, is outlined. Advice is offered on current options for architects who wish to benefit from future advances.

About Architects

We don't need to be told that architecture is subject to varied and often ill-defined design procedures in response to changing and often unpredicted demands (such as the use of the building industry as a national economic regulator). We know that procedures are often idiosyncratic to particular architects and we call these intuitive, calling on the professional experience of individuals.

True that some procedures used by architects can be formulated overtly and can be applied repeatedly to different design tasks, such as calculations to measure the areas of spaces allocated to different functions in a building, or to evaluate the distribution of daylight in a building. However, even such procedures will vary in how they are integrated into the rest of what architects do when they design, how data is collected on which calculations are to be performed, and how results are judged in the context of all other considerations which bear on the design of a building.

More critically, we do not know how and to what extent overt procedures embrace issues that other people recognise when they pass judgments on the buildings of architects. This point is typified in the question; do quantifiable aspects of a design correspond to people's perception of building quality?

The intuitive resources of architects are the best assurance we have got that architects will respond sensitively and constructively to the evolving needs of people. Intuition is not the only necessary resource, but intuition must be allowed to moderate the explicit and shared knowledge that architects and others apply to design decisions. If we accept this role for intuition then we must also accept that design procedures are necessarily idiosyncratic to individual architects' offices.

Where architects are required to give physical form to the needs and aspirations of other people, the idiosyncratic nature of architects' design procedures needs to be recognised as inherent to their role as designers.

Computers Now

What happens when we have computers? Computing technology is still at that stage of development when it is difficult to harness computers to the tasks that people expect them to perform. Computers require highly specialised people to instruct them precisely how to execute machine procedures, so that they can be seen to be doing what other people expect them to do. These specialised people need a thorough knowledge of the inner workings of computers, and their instructions form computer programs. Programmers thus serve as intermediaries between computers and their end-users, interpreting the needs of users into sets of procedures that computers can execute (Bijl, 1980).

Programs encapsulate a programmer's view of the users' work-practices. Programming is a highly

skilled and labour intensive activity, and is therefore expensive. Once a program becomes operational it should meet the requirements identified in the programmer's initial view of the users' practices; but work-practices change. The high cost of programs, plus the practical problems of unpicking program code to accommodate change, presents an inherent conflict between a program's need for a stable world and the user's experience of an evolving world.
The limited ability of any program to accommodate change, without incurring expensive program redevelopment, explains why computing has been applied first in subject fields that employ stable procedures, such as administration and accounting, and the physical sciences. This also explains why computing is only now being introduced to the field of architecture. The demands of architects, together with all other ordinary people whose work-practices are not bound by some stable procedural discipline, call for new advances in the field of computing.

The Future

In the long term, we need fundamental advances in computing technology which make it very much easier for end-users to harness computing resources to their own work-practices, and to modify computing operations as their practices change.

To illustrate this point, if we can consider computing as a means for undertaking journeys through fields of information, then current computing technology is analogous to physical journeys undertaken by train; you can only go where the track has been laid and it costs a lot to move the track. New technology must enable us to drive computers like we drive motor cars, without a mechanic and chauffeur in attendance; users should be able to decide their own goals and their own routes. The technology must then provide the system environment of vehicles and routes, including the means of opening up new routes, to enable ordinary people to arrive at their own chosen goals.

But we are not actually concerned with physical journeys. The essential function of computers is to store information and enable people to view and manipulate that information. In this sense, computers are tools that extend people's intellectual powers; as tools they need to connect with people's use of knowledge. Recognition of the link between computers and knowledge has led to the recent emergence of knowledge engineering as a field that heralds new computing technology of the 80s and 90s (Fig. 1).

INTERACTION BETWEEN USER-WORLD & COMPUTING ENVIRONMENTS

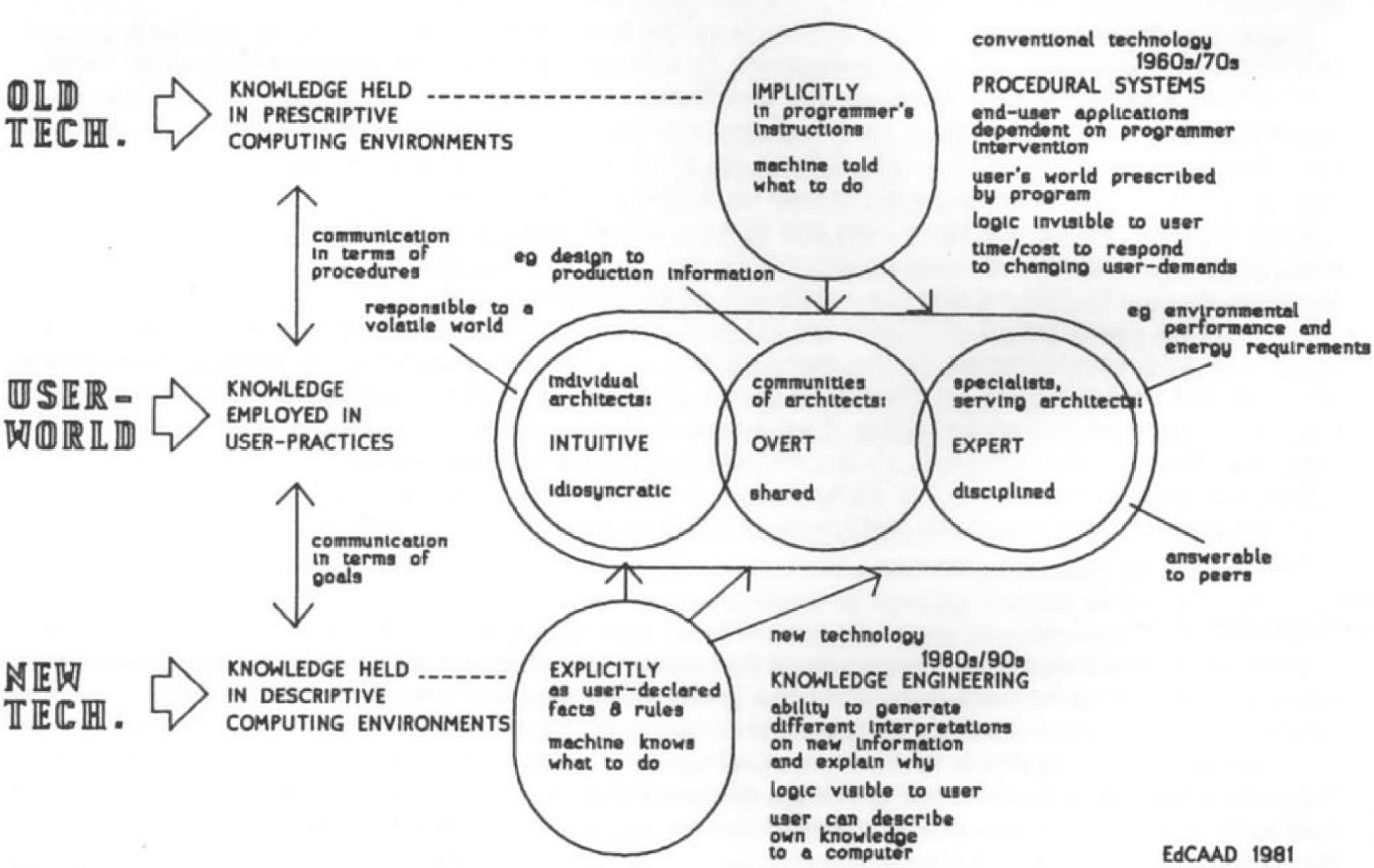

Fig. 1.

Building knowledge into computers presents severe conceptual problems and it will be many years before Zen of Blake Seven becomes a practical reality. Some basic principles have already become evident. New technology needs to differentiate between what information is stored in a computer and how that information is stored, to enable information to be accessed by reference to content rather than the physical organisation of a storage structure within a computer. This distinction is currently encapsulated in relational database systems (Stonebraker, 1980). Similarly, in calling upon computers to perform tasks on stored information, we need to differentiate between the expression of what goals we wish to achieve and how a computer must execute the necessary procedures to achieve a goal. This distinction has been partially implemented in logic programming (Swinson, 1982). Such differentiation is aimed at making it possible for the user (or the applications programmer) to drive the computer without needing to know the internal workings of the machine.

In knowledge engineering, the interpretive role of traditional applications programmers should eventually be replaced by a new ability of computers to interpret information received from users, in terms of facts, rules and goals that relate to the world in which the user operates. In responding to a user, the computer should then also be able to explain why it "thinks" a particular response is appropriate.

By building into computers knowledge that enables them to exercise this interpretive role, we can expect future computing systems to be able to build different interpretations in response to users declaring facts and rules which describe their own world, and invoke appropriate computing operations in response to users describing their own goals. Computers will then have the capability of varying their own operations in step with users' evolving work-practices. This ambition is of paramount importance for designers.

Meanwhile . . . . .

In the meantime how should architects approach computing? That architects should enter this field is important both because of the benefits it offers to individual offices and because architects need to influence the future development of this technology.

Firstly, architects must be aware that by adopting computing they are adopting a new mode of working; their use of computers should not be limited by a precise anticipation of a single task; applications are likely to change and grow. Secondly, most architects work in small offices; they need a low-cost entry into the field, with a good growth path.

Recognition that computing applications in any one office are likely to change influences the choice of software environment. This choice involves two primary considerations:

a) the software environment should be portable across a wide range of different equipment, permitting computing operations to be moved to more powerful computers as the user's demands grow;
b) the software environment should ease the task of building evolutionary computing applications, by offering good software tools for modifying existing programs and assembling new programs from parts of other programs – the envoronment should minimise the need to write new program code.

Two basic choices are presented at the low cost end of the computing market. On the one had, the CP/M● and UCSD/P■ software environments have become well established across a wide range of very low cost micros (up to c.£6,000), albeit with different dialects for different machines; this choice gives access to a large assortment of simple applications programs.

On the other hand the UNIX▲ computing environment (Kernighan et al, 1979) is becoming the de facto standard for larger micros and minis (from c.£6,000 to over £100,000); this choice gives access to a large range of software tools that can be used on sophisticated computing applications. UNIX is relatively new in the commercial market and therefore offers few ready-made applications to get new users started, but this position is likely to change dramatically over the next year or two. UNIX is the only widely available software environment that meets the requirements of portability and evolutionary applications described above; it is very well established in the R&D world and, therefore, the future developments outlined in the previous section will become available first to existing UNIX users.

The CP/M and UCSD/P environments will support single users running simple programs. Problems will arise when users wish to run too many programs, extend the functions of their programs, operate on growing amounts of data and, particularly, when they wish to use full graphics (see Tables 1 and 2). Initially some of these problems can be overcome by doubling machine resources and, later, by networking resources; users will then be investing more in equipment than if they had chosen the UNIX environment.

The problem of upgrading from CP/M or UCSD/P to UNIX is that the investment in know-how to use the initial software environment does not carry across to the new environment, and this investment is likely to be greater than the various costs of equipment. One way in which costs will become evident is the way that applications programs will need to be changed to exploit the facilities of a different environment.

Starting with simple, single programs, users will find that data required for discrete tasks such as heat

Equipment cost/ Software environment	Computer applications/ No. of simultaneous users
Up to £6,000 CP/M or UCSD/P on Apples, Pets, etc.	■ Word processing ■ Simple calculating functions ■ Diagramatic graphics (e.g. graphs) ■ Supports a single user-terminal
£6,000 to £100,000 UNIX on DEC LSI 11s, PDP 11s, VAXs, or Zilog Z8000, Motorola 68000 based machines	■ Better word processing ■ Useful calculating functions ■ Useful drawing systems (inc. production drawings) ■ Integrated information systems (supporting a range of operations on a common database) ■ Supports 4 to 16 or more simultaneous users

Table 1 Computing Environments

Cost	Item
£0 to more than £20,000	Acquisitioning by commissioning or purchase
£4,000 to more than £20,000 per year	Maintenance, development and user support (in-house or bought in staff costs)

Table 2 Applications Programs

loss or materials quantity calculations will contain some information that is also potentially useful for other tasks. As the number of tasks multiply so the user will want to reduce the effort of entering data repeatedly for different tasks and users will then want to run integrated information systems that reflect the particular work-practices of their own offices. At that stage, they will need more powerful computers and they will want to use new software techniques emerging from research. Using UNIX, such upgrading is possible with minimum disruption of invested know-how.

The minimum entry level for UNIX will support four simultaneous users, resulting in a very low entry cost per user. At the lower end, UNIX will support full graphics and, as users' demands grow, the same computing environment can be moved to more powerful computers. The growth path then only involves equipment costs.

Thus the short term decisions of architects who wish to get into computing can take account of future developments. Their entry into computing can involve modest investments in hardware with, inevitably, higher investments in software. To embark on such a course, architects need help. When opting for CP/M or UCSD/P, there are many sources of help in the commercial world and in academic establishments. Placing more emphasis on the future and opting for UNIX means that, in the short term, there are few sources of help and they are mostly in the academic world; this shortage of support is likely to change dramatically as commercial companies offering software support wake up to the needs of architects and others in an expanding computing market.

Conclusions

Computers offer people a new mode of working, giving people ready access to large amounts of information and enabling them to minipulate that information to their own purposes. As such, computing operations need to be integrated into the users' work-practices and must be capable of being changed in step with evolving user-practices.

The work-practices of architects are conditioned by the varied and often unpredicted demands which other people place on them. Consequently, architects need to combine overt (explicit and shared) procedures with individual intuitive experience. The idiosyncratic nature of architects' design procedures is inherent to their role as designers.

The use of computers to aid design depends on new advances in software technology that will accommodate individual design procedures. These advances are required not only for architects but also for all other ordinary people whose work-practices are not bound by some stable procedural discipline, in an expanding market of computer users.

New technology must give users more direct control over their own computing operations, with less dependence on specialist programmers translating users' practices into machine procedures. Knowledge engineering offers the prospect of a future in which users will be able to tell their computers what they want them to do; computers will then be able to interpret user requests to decide how to execute appropriate machine procedures, to do what users ask. In future, this ability to interpret and respond to information from users will make it very much easier to match computing operations to the individual and changing requirements of users.

Meanwhile, architects can choose to enter the field of computing now in a way that will enable them to benefit from advances in technology in the future. Architects should enter this field now, both to gain the benefits it offers to individual offices and to influence development of future technology to meet the needs of the profession.

Notes

● CP/M is a trademark of Digital Research Inc.
■ UCSD/P is a trademark of the Regents of Univ. Cal., San Diego
▲ UNIX is a trademark of Bell Laboratories

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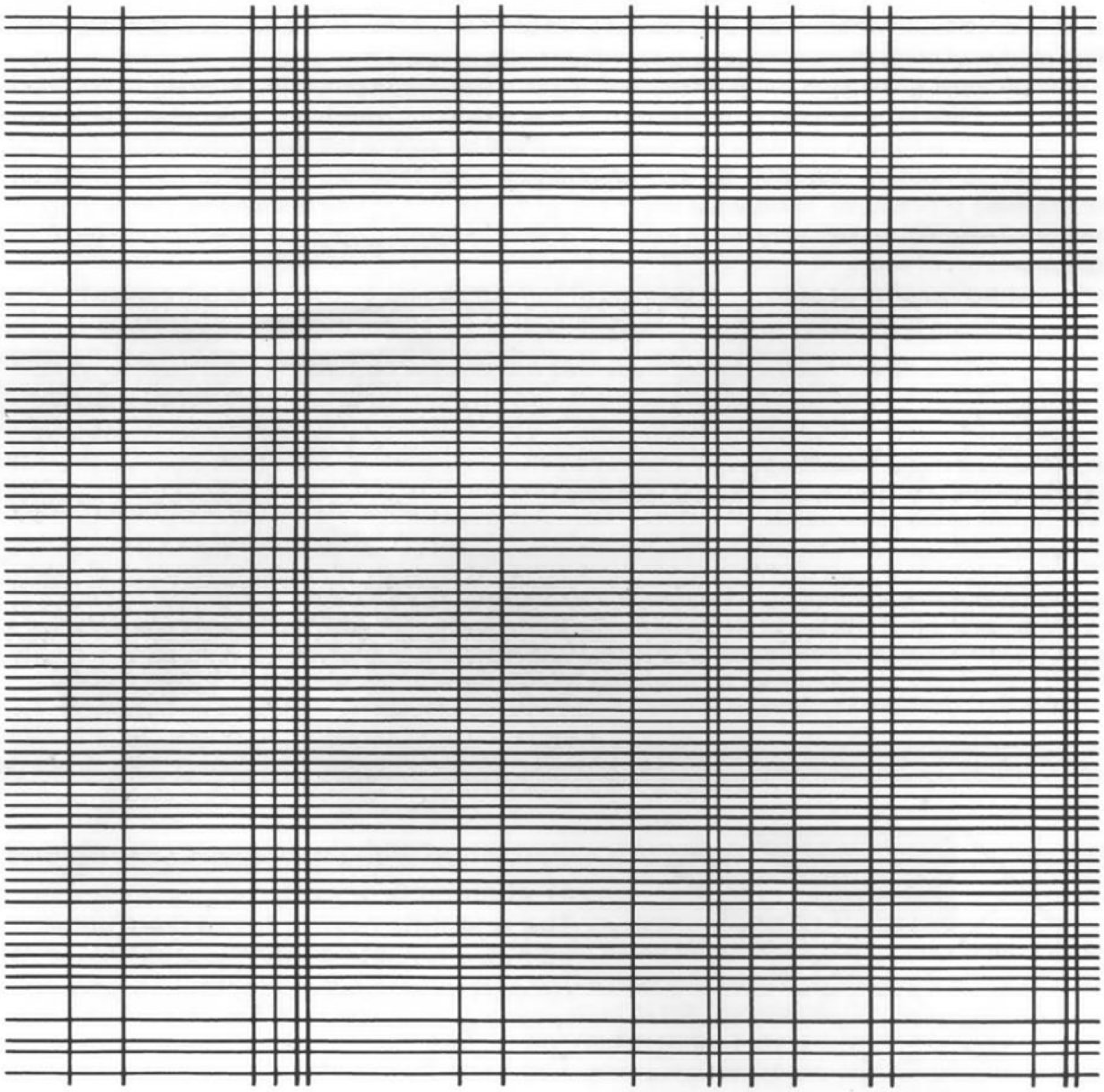

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