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"An investigation of some factors affecting the use of computers for image-making"

Rachel Finkelstein, May 1984.

SUPERVISOR'S DECLARATION

I declare that I have inspected the submission, that it is complete, that it is in the agreed form, and embodies the content, agreed between candidate and Department and that it meets the requirements laid down by College and Department.

R Smith

Nov 9 1984

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DECLARATION

The Picaso software used to generate the computer animation sequence was written by Dr.John Vince. The Jackson software used to generate the images for section one of the video tape was written by Brian R Smith. The Vicar software used to generate section three of the video tape was written by members of the Atmospheric Physics Department at the Imperial College. Apart from the quotes and illustrations credited, the contents of this thesis have not been published before.

SUMMARY

The author undertook 3 tasks in order to investigate some factors which are affecting the use of computers for image-making.

1. A survey of computer art.

2. A Questionnaire and conclusions to the investigation

3. A video of computer image-making techniques, to gain some insight into the problems and possibilities of this technology for artists.

With a background in art this has proved to be a difficult programme of study for the author. However, this has made it possible to approach the study from an artist's perspective and to try to arrive at an understanding of relevant computer software, system and processes from this point of view.

GLOSSARY OF TERMS

-ALGORITHIMS

A sequence of mathematical or logical steps designed to achieve a required result.

-BASIC

Beginner's All-purpose Symbolic Instruction Code. A common high-level computer programming language. It is easily learned. The language was developed at Dartmouth College in the USA.

-BYTE

A term used to indicate a specific number of consecutive bits treated as a single entity. A byte is most often considered to consist of 8 bits which, as a unit, can represent a character or number.

-CAD

Abbreviation for computer-aided design. A CAD system is an automated design and drafting system that speeds

up the design process by eliminating many tedious, time-consuming tasks previously performed by hand.

-CAM

Abbreviation for computer-aided manufacturing.

-DATA

A general term that is used to denote facts, numbers, letters ,symbols,etc.,that can be processed or produced by a computer.

-DIGITIZER

Refers to a specific device which converts an analog measurement into digital form.

-DISK

Refers to various fixed or removable direct-acess storage devices consisting of a magnetic medium on which data is stored.

-INBETWEEN FRAMES

These contain the simple successive changes in movements between the key frames.

-INTERACTIVE COMPUTER GRAPHICS

This refers to systems that allow the user to interact with the computer and therefore have more control over the production of images. Input devices are provided to enable the user to convey his requirements to the computer.

-FORTRAN

FORmula TRANslator. A compiler language developed by the IBM Corporation; originally conceived for use on scientific problems but widely adopted for graphic programs as well.

-FRAME BUFFER

This is a digital memory where the image is stored as a matrix of intensity values. The image is stored as a pattern of binary digits which determines the intensity and/or colour of the corresponding pixel on the screen.

-MENU

This refers to a list of command options available to the user on any one of the input devices.

-PIXELS

These are the rectangular picture elements arranged as a matrix in the display screen.

-PLOTTER

A device which, when given appropriate signals from a computer, produces an image, graphs, etc., on the paper.

-SOFTWARE

The term software was invented to contrast with the physical hardware of a computer system. Software items are programs, data, languages and procedures of a computer system.

-SOFTWARE PACKAGES

Refers to a comprehensive library of utility software available for most computers.

-PROGRAM

The set of instructions written by a programmer to determine the computer's actions.

-RANDOMNESS

A condition of equal chance for the occurrence of any of the possible outcomes.

-REAL TIME ANIMATION

This form of animation generates a sequence of frames at a rate of more than 25 frames per second.

-SUBROUTINE INSTRUCTIONS

In most systems, subroutines may be used as if they were single commands by employing one of the programmed instructions of the repertoire. This capability allows the programmer to define his/her own special command, through the use of subroutines, which may be changed if desired.

-SUBROUTINE LIBRARY

Refers to a set of standard and proven subroutines that is kept on file for use any time.

CHAPTER 1: Introduction

1.1 The aim & plan of the project

The aim of this work was to investigate some factors affecting the use of computer technology for image making. It was hoped to gain an understanding of some of the ways in which people used such systems. The experiments and approaches are not just research tools leading to conclusions in the report, but also constitute a body of work making up the project, exemplifying attempts to use computers in visual work, and forming a basis for discussion in the report. It was felt that there was a need to contribute evidence and basic data to the continuing and growing discussion on the use of computers to process and manipulate visual representations.

The work was not meant to be innovatory in its use of

computer graphic techniques, but rather to throw light upon some of the ways in which people find computers easy or difficult to use for a variety of visual tasks. Thus the design and image-making work presented in the accompanying video-tape portrays a number of attempts to produce different forms of computer graphics, so that the author could gain an understanding of what was involved, could relate this work to others' experiences , and could then draw various conclusions from the work as a whole.

It is hoped that the work may form the basis for future design research studies, being a first step towards an understanding of some aspects of an increasingly important area.

The work may be of future use to artists and designers who are imterested in the use of information processing systems. More importantly, it leads to some suggestions that will be available to those designing such systems, and ways of explaining and improving them. From an enquiry into the present advantages and disadvantages of computer use, it is thus possible to provide information for those engaged in course design, in setting up and running visual computer facilities,

and in conducting future research in those areas.

To accomplish these aims the project was divided into two parts:

Part 1. A report comprising of the following parts: 1a. A background to the project 1b. The description of the experimental programme 1c. The questionnaires and conclusion to the investigation.

Part 2. A video- The author's own computer based experiments in four parts which consist of: 2a. Free hand drawings made at the RCA using Jackson. 2b. Animation sequence made at the Middlesex Polytechnic using Picaso 2c. Video manipulation sequence made at the Imperial College 2d. Simple graphic programs made at the RCA using Basic language.

One can not separate the project from the report as they feed and complement one another. The author needed to do the visual experiments in order to enable her to understand the problems involved in the use of computer for image-making. This experience was needed

also when the author was engaged with the formation of the questionnaires, and during the interviews.

1.2 Research methods

The research methods used can be divided into three categories:

1. Background reading-

The references for the background reading are to journals, proceedings, conference reports and text books. Background reading was done with the intention of raising ideas and questions about the factors which affect the use of the computers for image-making, as well as familiarising the author with the context and with relevant background information. A bibliography and filing system was maintained.

2. Interviews/questionnaire-

An open ended type of questionnaire was used for the data gathering. The results were used to provide a basic outline for follow-up interviews.The author recognises that there are disadvantages to the use of this type of questionnaire. For example, the

circumstances varied from interview to interview, and the authors' own input to the conversation/questions inevitably changed over a period. Further, respondents were perhaps less likely to be as objective in a face-to-face situation than if they were providing written questions in their own time.

However, it was felt that since the purpose was to raise issues and ideas, problems and solutions, the advantages of the probing, relatively subjective approach outweighed the lack of rigorous comparability between answers and the more formal approach that a statistically-based method would have required. To keep the results consistent, the author conducted all the interviews, which were recorded on tape to avoid faulty reporting of the answers. The people that were chosen to be interviewed were members of the Computer Arts Society, and other workers in the field. A pilot survey was used first to test the questionnaire and adjustments were made. The findings of the interviews are to be found in chapter 4. Formal procedures to analyse or classify the questionnaires have not been used, because the point was not to make a detailed, statistical survey, but rather to throw light upon the respondents' experiences and views. The author feels

that the experiences and thoughts of each individual person in this case are valid, and need to be recorded in order to widen our understanding of this new area of creativity, and give us clues to the factors that affect the use of the computer as a medium for the production and manipulation of images. The transcripts of the interviews may be found in the appendix of this report.

3. Experimental programme-

A number of computer assisted film/videos and drawings were produced by the author to consolidate knowledge in the use of the computer as a creative medium and to gain an insight into the problems other artists face in the process of production of an art work with the use of a computer. A variety of techniques was adopted, ranging from image-processing to the direct programming of a computer to produce graphics.

The above three methods were used togther to allow a wider and better understanding of the subject, and as a way of gaining more information concerning the use of the computers for image-making.

It is also hoped that the video-tape will be of some value to illustrate points made in the rest of the work, so that future workers can actually see the kind of thing being referred to, rather than having to imagine it, or to infer a whole process from a series of still images.

1.3 Summary of findings

All art uses technology of a kind: the computer is not the first innovation that was adopted for artistic use. One of the main reasons why computer art has been looked at as 'nonsense' is that in the sixties it was mainly computer programmers and scientists who have produced computer images, trying to call them art. The most significant change in the seventies was the involvement of artists with the use of computer images. The author points out two new developments in the late nineteen seventies and beginning of the eighties which were the introduction of the 'painting system' and telematic system to art practice. The author found that computers are mainly used as a tool although there are other examples that transcend this, like the work of H.Cohen, J.Lansdown and E.Ihnatowicz. The author feels that the use of artificial intelligence in art to simulate creative behaviour, is still an open question as long as questions like "What is creativity?" are not answered first.

The author's findings from the interviews are listed in section 4.2. Views emerged about the applicability and nature of the computer in art, and background information was developed leading to conclusions and suggestions for enhancing the role and ease of use of computers in image-making.

The main factors affecting the use of computers for image-making hinge around the needs and views of the users, and the nature of the systems available. When different people perceive computers as different kinds of things, and when they see their own and the computer's role from different points of view, they are bound to have differing criteria to apply to the hardware and software.

Nonetheless, certain views tended to be held in common, such as the idea that artists should be enabled to program, and that the computer did not in general hinder the users' artistic processes.

CHAPTER 2: The artists and the computer

2.1 Introduction

This chapter provides a context from which to make sense of the use of computers for image-making. The use of the technology by artists, rather than, for instance, illustrators or television graphic designers, is discussed: most computer graphic techniques have been used at one time or another by artists, and it is asserted that the computer/art perspective provides a coherent and useful way to look at what is, and has been, going on when creative people use computers for image-making.

First, we may ask: how and when does an area of technical innovation get established as Art?

It may be of use to note that Susan Sontag has tried to answer this question in relation to photography and in her book "On Photography"(Sontag,1977) she wrote:"The age when taking photographs required a cumbersome and expensive contraption - the toy of the clever, the wealthy, and the obsessed - seems remote indeed from the era of sleek pocket cameras that invite anyone to take pictures. The first cameras, made in France and England in the early 1840s, had only inventors and "buffs" to operate them. Since there were then no professional photographers, there could not be amateurs either, and taking photographs had no clear social use; it was gratuitous, that is, an artistic activity, though with few pretensions to being an art. It was only with its industrialization that photography came into its own as art. As industrialization provided social uses for the operations of the photographer, so the reaction against these uses reinforced the self-consciousness of photography-as-art".

One can't use it as a direct parallel to the history of computer art, as computers were first used for military and industrial uses rather then creative use, but one needs to recognize that historically innovations had to

go through various processes on their way to being accepted as an art form, and 'computer-art' may be seen to have 'grown up' as an art-form, as did photography.

The use of technology in art did not, of course, start with the use of computers. As Jonathan Benthall (1972) & Barbara Rose (1972) have stated in their writing, virtually all art uses some aspect of technology.

Jonathan Benthall,Art and Technology crrespondent for Studio International, in "Science and Technology in Art today"(op cit) wrote: "Virtually all art uses technology of a kind. Artists who remain aloof from modern tecnology are, in effect, simply preferring to use the technologies which have been absorbed into traditional art, such as painting, carving and the like".

Barbara Rose, a contributing editor on 'Artforum' and New York magazine, wrote in "Art as Experience, Environment, Process"(op cit) about the historical relationship between engineers and artists: "During the late medieval period little or no distinction was made between artists and craftsmen. Similarly , during the

Renaissance, both artists and engineers were often trained at court, not in a university. Thus, the division between the arts and the crafts and between art and engineering is exclusively a problem of modern specialization."

Thus artists have either adopted, or taken for granted, technologies of their day. Leonardo da Vinci insisted that science was essential to all practice:

" How to study.
First study Science, and then follow with practice based on Science.

" Those who are in love with practice without science are like a sailor who gets into a ship without a rudder or compass and who can never be certain where he is going".

Leonardo da Vinci 1452-1519 (extract from his notebook in'Artists on Art',John Murray 1976)

Science and art today tend to be thought of as separated doctrines: one, an analytical tool; the other the result of an elusive creative process.

Lynette I Rhodes in the catalogue for the show "Science

within Art", Cleveland Museum of Art, 1980 Ohio, wrote a brief historical account of the relationship between art and science in various civilizations.

"In earlier civilizations scientist and artist were often one person. The artisan who fashioned an object from fire-hardened clay was also a scientist learning to understand the properties of his materials, and a technologist using these properties to achieve a definite end. Art itself often led the way to insights and discoveries that science later acted upon. Such practice in ancient times as the polishing of mirrors or cutting of accurate facets on germs to produce a more decorative glitter, contained the germ of later optical devices. The use of metal oxides to make stained glass windows and coloured enamels ultimately resulted in the chemist's borax bead test. The list of technical discoveries that have evolved from artistic activity is enormous. Excavation at many Middle Eastern archaeological sites shows that artistic purposes have indeed often preceded practical ones. Fire-hardened clay figurines, for example, predate the fired pots found at these sites. The copper dress ornaments and beads made in the seventh millennium BC in Iran considerably preceded the use of copper in

weapons.

"During the Renaissance, and in fact until the seventeenth century, science and art were closely allied - looked upon as twin aspects of learning.....By the end of the seventeenth century, as a result of the writing of scientists such as Galileo, Kepler, and Newton, who had rejected the medieval doctrines, new foundations for physical science were laid based on mathematics and rigorous empirical experimented"

It is easy to find examples of ways in which technical innovations have been incorporated into, and have thus changed, art. For example:

A new mode of painting emerged, when artists like Morris Louis and Kenneth Noland used acrylic paint developed after 1943 - quick drying and water soluble - which could be applied directly to untreated canvas and deeply saturate its fibres.

Styrofoam, a soft, synthetic material was developed by Dow Chemicals, capable of being shaped or carved into the most complicated forms. In the mid-1960s' several artists began to use this new material substitute for

wax in the casting of metal sculpture; this process of 'foam casting' was later adopted by industry.

With neon tubing, laser images, plexiglass, inflated polythene tubes, television cameras and monitors, etc., - artists have employed a wide range of technologies to push beyond the boundaries of art, and at times, it seems, almost to redefine it.

But it might argued that the computer, with its general capabilities, is not just one more item of technology - perhaps not even just a tool.

Inevitably when looking at the future of the artist-computer relationship one finds that it is necessary to examine and attempt to answer questions like: "What is 'computer art'?" " Does the term 'computer art' refer to computers making art or to art made with the help of computers?" What kind of contribution has the computer to offer to art or artists ?. The author will try to cover these and other areas during the course of this report.

2.2 History of computer Art

This sub section is not presented as an attempt to write a comprehensive historical account of the subject, but rather as a brief outline of the history of the making of computer art.

David .R. Clark (1982) in his article titled :"The technical foundations of computer image making" wrote:

"The recent history of computer image making is, to a large extent, the history of the development of new technologies. The constraints which these technologies impose have determined both the style and process of computer imagemaking. A clear understanding of these factors, and an appreciation of the mechanisms of perception, are prerequisites for the study of picture making by computer.

"The rate of appearance of new ideas in the various fields in which computers are used for image-making may just be beginnig to decrease. The subject is beginning to stabilize. The preceding 20 years have witnessed an explosive growth in both the range and number of

devices on which images can be created by computation.....As is always the case with a 'new' field of enquiry, it is the coming together of people with different backgrounds but a common interest that generates an explosion of creativity. No one person can claim the credit for starting the subject up; when the time is ripe, the process of nucleation seems to happen in several places almost simultaneously."

J. Reichardt (1971) sees the beginning of the computer art movement in relation to concrete poetry movement taking place since the early 1950's. In her book "The computer in art" she wrote:

"Computer art, of which the first tentative steps date back to 1956, has much in common with concrete poetry. Its exponents are composers, artists, engineers, doctors, mathematicans, philosophers and poets- all those in fact, who have access, know-how, and the desire to exploit the computer and its various printers and graphics peripherals, for making pictures.....Computer art has been, practised in Britain, Germany, Italy, Austria, USA, Japan, Canada, and South America. For obvious practical reasons the

centres of this activity are industries with research departments, universities with computer centres, and the computer firms themselves. No art department or art college by the end of the 1960s had its own computer, although several art departments of large universities, such as that in Columbus, Ohio, have access not only to the university's computer but also the help of the technical staff."

What David R. Clark and J. Reichardt agree on is that in the making of the history of computer art, no one discipline or group can get the credit for it.

Common sense tells us that the start of the history of computers in art could not have been before the time the technology was invented. But in reading the material that was written on the subject one finds increasingly that the question of when the practice started is connected with the definition and the acceptence of the activity as 'art form' . For example Brian Smith (1982) in the introduction to the catalogue for the show "Artist/Computers/Art" says:
"Much so-called 'computer art'is nonsense: had it been produced by a pencil and ruler, or by some plastic drawing toy from the supermarket, no one would look at

it twice"

Alan Sutcliffe,(1968) ex-chairman of the Computer Arts Society, took the opposite view. In the original policy document of the society he wrote:
"This is why we chose the commonplace name of the society, even while agreeing that the term Computer Art was to be deprecated. It is still a convenient shorthand word for "creative work in which a computer has been used". I felt that any such work deserved a showing and its author a hearing. No matter how trivial, I thought it was significant that someone had used a computer to make something".

There appear to be two main periods into which one can divide the history of computer art: one is the nineteen sixties when mainly non-artists have used the computer to produce images, people like W. Fetter, Michael Noll and Gustav Metzger. And the second period is the seventies and eighties where more artists got involved in the poduction of works of art using computers, including workers such as M.Mohr,V. Molnar, H. Franke, H. Cohen, R. Ascott etc.

The author will try to illustrate what seem to be the most influential work of both of these period. What most of these artists have in common is the use of random elements in their programming. The random element was sometimes seen as a possible equivalent to the intuitive elements in the artist's work.

Influential work from the Sixties period:

Leon D. Harmon and Kenneth C. Knowlton (computer programer) produced their first computer graphics at Bell Labs in 1967, after Harmon was asked to make a 'modern art' mural to decorate an office. The complete idea, according to Harmon, emerged within minutes, and two months later the office was emblazoned with a 12-foot long, and by now famous, nude made of alphanumeric characters and produced with the aid of computer. The nude, and various other images generated in the same way, Knowlton and Harmon referred to as 'computer processed pictures'. (Figure 1)

William Fetter of the Boeing company was the first to devise a simulation technique for aircraft design. One of the Boeing projects was the animation of the human

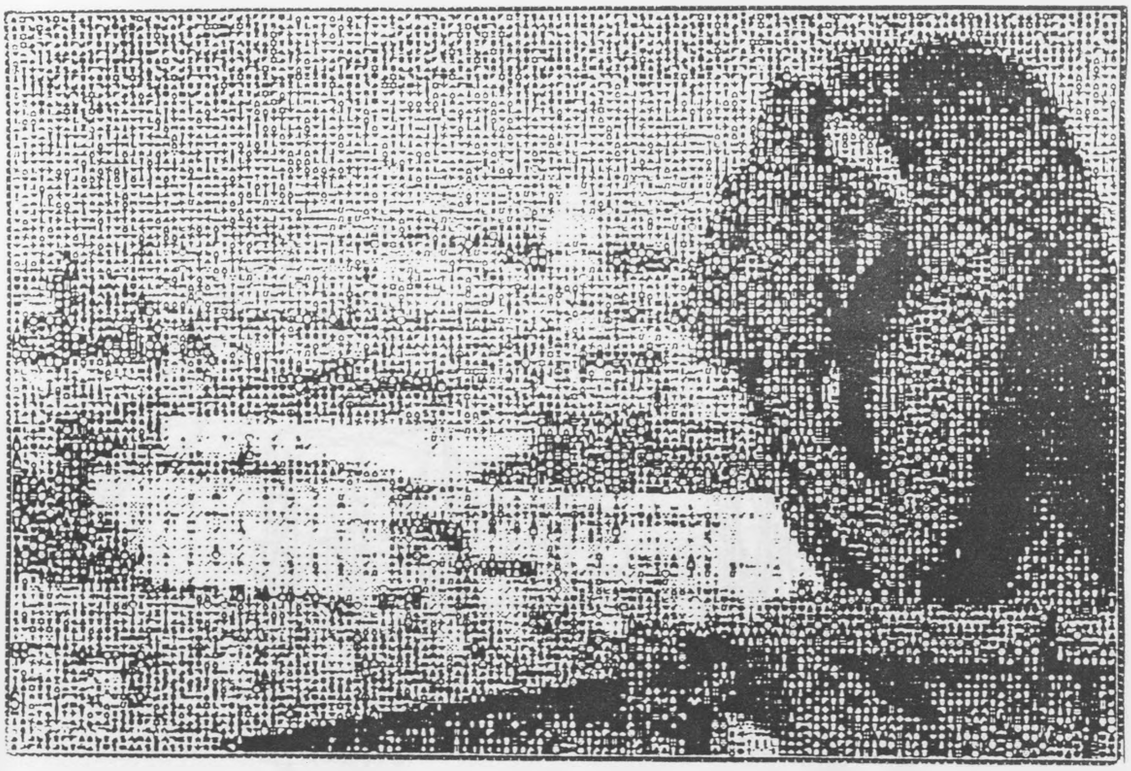


Figure no. 1: Leon D. Harmon and Kenneth GARGOYLE, studies in perception III.

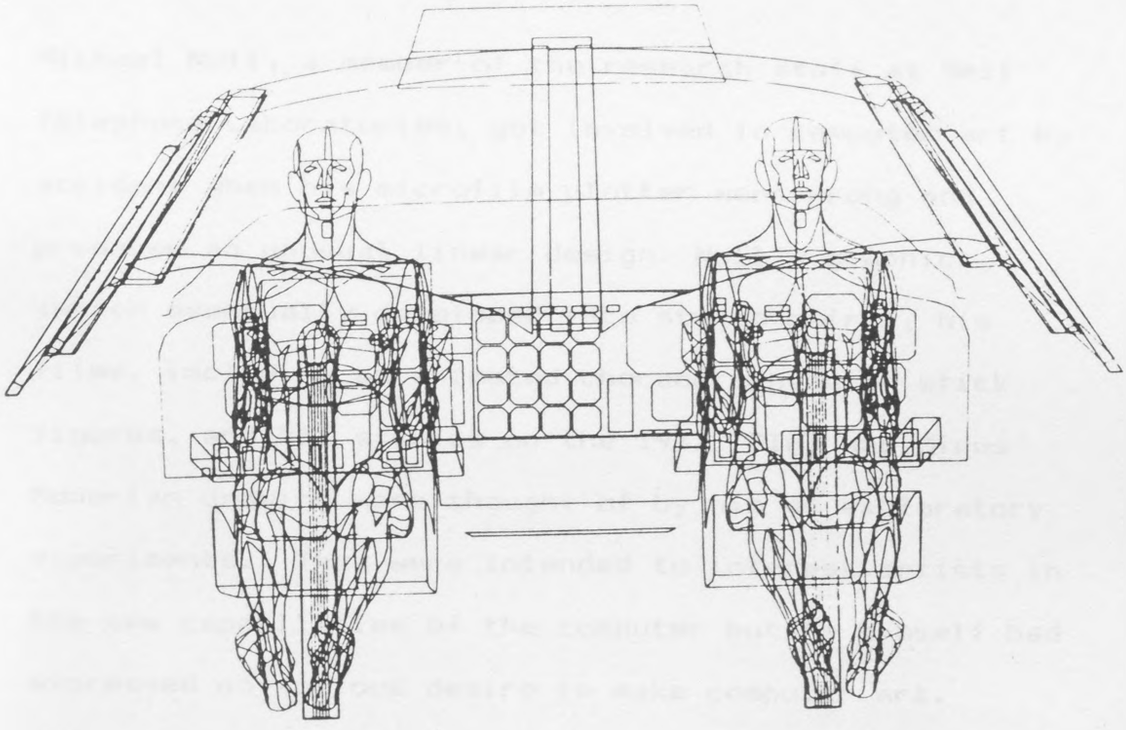


Figure no. 2: Boeing computer graphic, two 50-percentile pilots in a cockpit.

figure by the computer, including film sequences which showed the movement of various limbs. Each of the figures was based by the Boeing designer on Air Force data, representing the "50-percentile" pilot of the US Air Force. The manipulation of the figure was used to determine a man's possible movements in the cockpit and the arrangement of instruments for easier reach. (Figure 2)

Michael Noll, a member of the research staff at Bell Telephone Laboratories, got involved in computer art by accident when his microfilm plotter went wrong and produced an unusual linear design. Noll's graphics (which eventually developed into stereo pairs), his films, including an animated choreography with stick figures, and his studies on the 1917 'Plus and Minus' Mondrian drawing were thought of by him as exploratory experiments. They were intended to interest artists in the new capabilities of the computer but he himself had expressed no serious desire to make computer art. (Figure 3)

Bela Julesz from Bell Telephone Laboratories experimented with texture and visual perception, in which he used the techniques employed in random

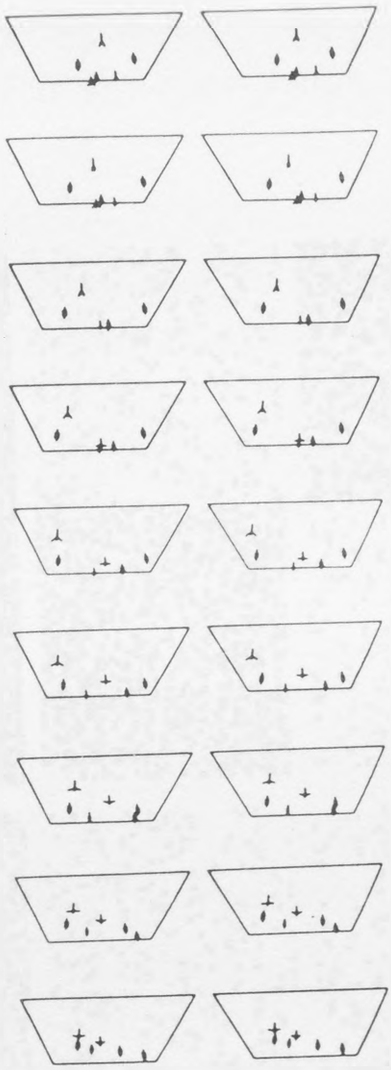


Figure no. 3: Michael Noll, example of stick figure representation of human motion.

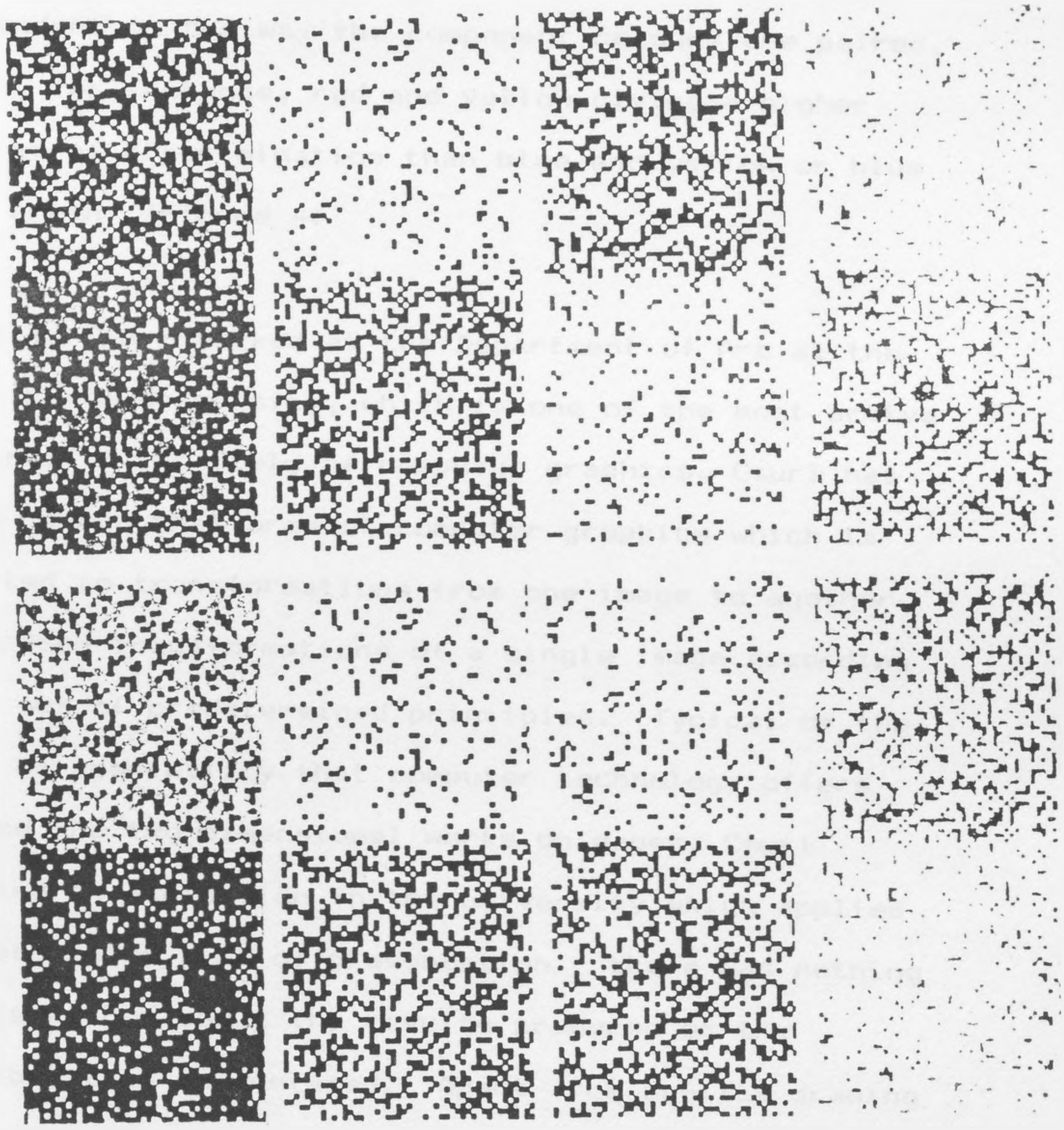


Figure no. 4: Bela Julesz, experiment with texture and visual perception.

generation patterns. Random-dot paterns generated by computers have shown that the recognition of familiar shapes is not needed for discrimination of textures, or even for the binocular perception of depth. He discovered that texture discrimination is highly dependent on the way the component colours are paired, with, for instance, red and yellow giving a higher degree of discrimination than blue and yellow or blue and green. (Figure 4)

Charles Csuri worked at the Department of Art at the Ohio State University, which is one of the most active centres in the field of computer graphics. Csuri has gone beyond that area of computer graphics which is limited to transformations from one image to another, or indeed transformations of a single image according to a set of predetermined principles. Typical of the sort of possibility that computer technology offers beyond the two-dimensional works on paper, Csuri mounted an exhibition in the university which applied an open-ended type of presentation - there was nothing finite either about the results produced or the possibilities encountered. Apart from on-line drawing controls, there were television sets on which one could alter the colour, movement and shape; screen projection

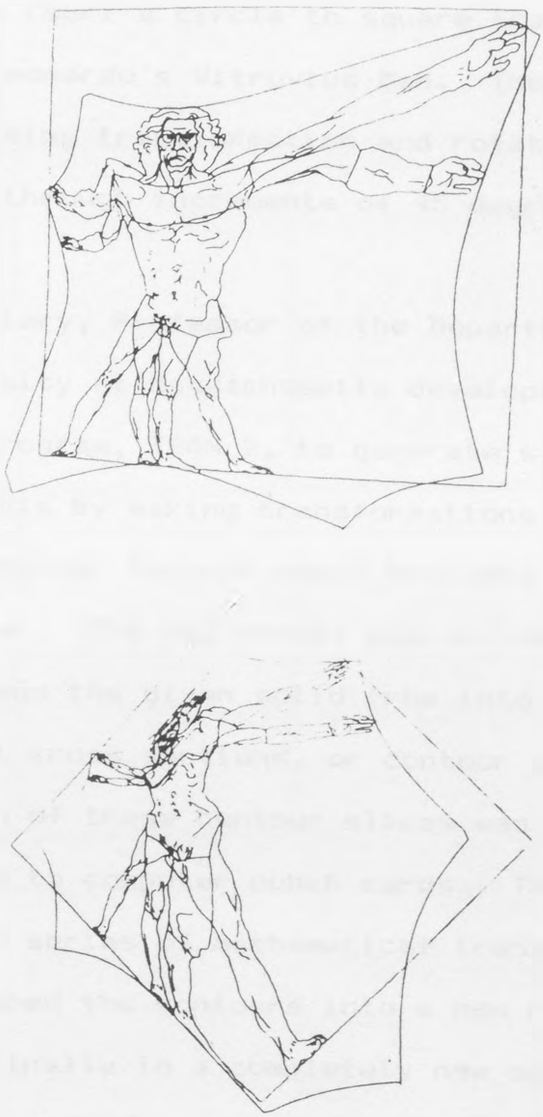


Figure no. 5: Charles Csuri, circle to square transformation. Based on Leonardo's Vitruvius Man.

of pictures controlled by signals from a spectator's body, as well as an electronic sound laboratory where visitors could make their own sound sequences. Figure 5 is Charles Csuri's circle to square transformations, based on Leonardo's Vitruvius Man. These images were produced using transformation and rotating the pre-image through increments of 45 degrees.

Robert Mallary, Professor of the Department of Art at the University of Massachusetts developed a computer graphics program, TRAN 2, to generate sculpture. He achieved this by making transformations on a given three-dimensinal form of which the data was fed into the computer. The end result was arrived at by breaking down the given solid from into regular series of parallel cross sections, or contour slices. The information of these contour slices was eventually transferred to computer punch cards. The slices underwent a series of mathematical transformations which reshaped the contours into a new range of forms resulting finally in a completely new overall outline. The plotter reproduced a series of perspective views of the overall form, as well as a complete set of transformed contour sections which Mallary called 'computer transformation templates'. These were used

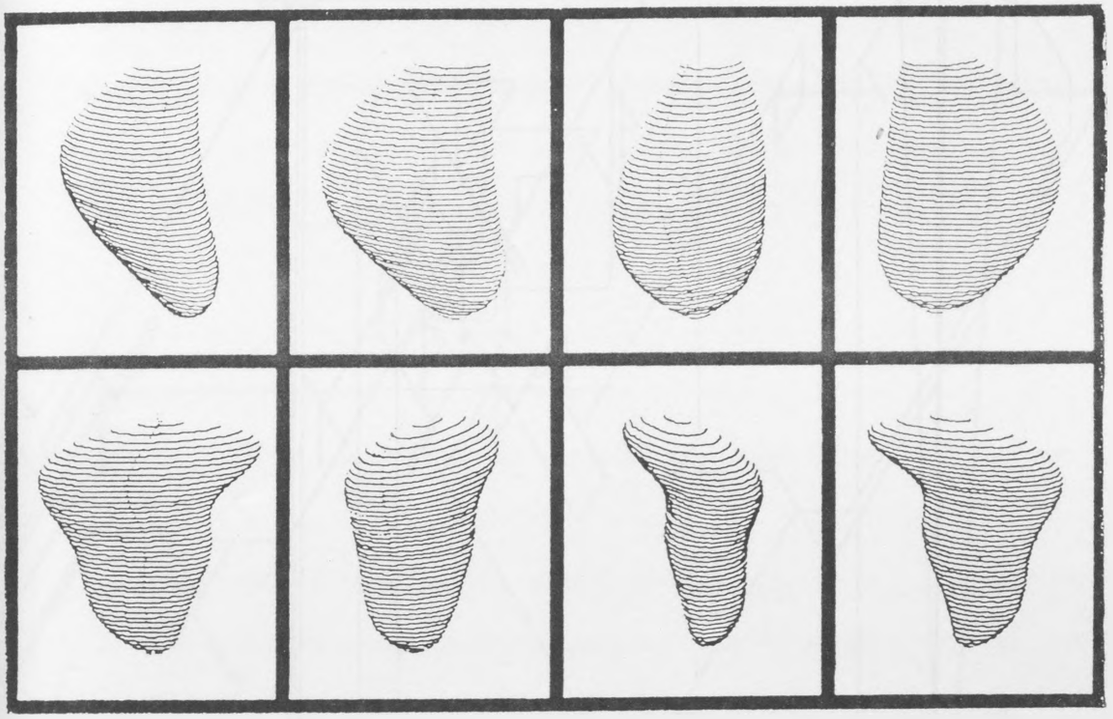


Figure no. 6: Robert Mallary TRAN 2 computer drawing for sculpture.

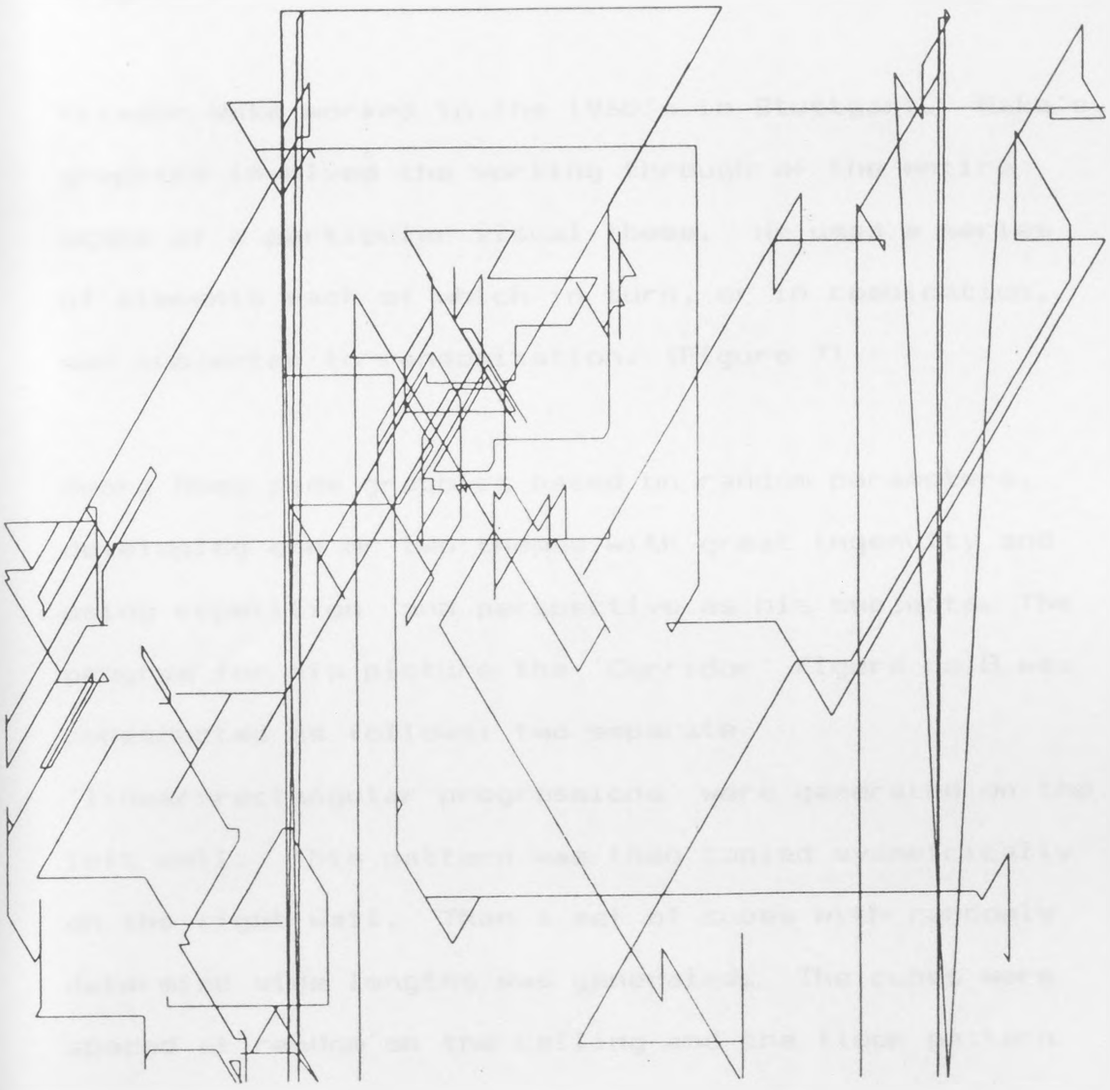


Figure no. 7: Frieder Nake POLYGONAL COURSE NO.7 1965

Random elements include: number of polygonal angles, direction of each polygonal side and length of each polygonal side.

as patterns for making the sculpture in some appropriate material such as laminated wood or plastic. (Figure 6)

Frieder Nake worked in the 1960's in Stuttgart. Nake's graphics involved the working through of the entire scope of a particular visual theme. He used a series of elements each of which in turn, or in combination, was subjected to randomization. (Figure 7)

Georg Nees made graphics based on random parameters, developing one or two themes with great ingenuity and using repetition and perspective as his subjects. The program for his picture the 'Corridor' Figure no.8 was constructed as follows: two separate 'linear-rectangular progressions' were generated on the left wall. This pattern was then copied symmetrically on the right wall. Then a set of cubes with randomly determind side lengths was generated. The cubes were spaced at random on the ceiling and the floor pattern was then drawn.

Gustav Metzger worked out a particularly simple method of putting a light source on a graphic plotter, in which an optical fibre is used as a light conductor.

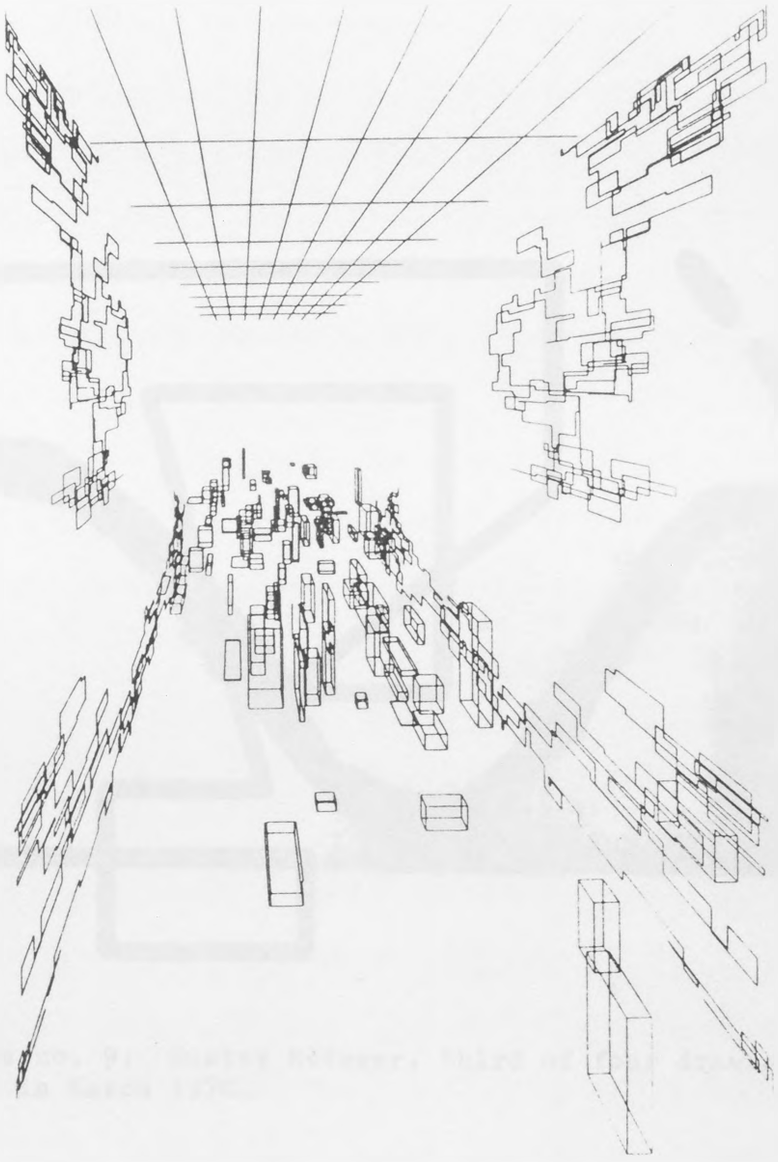


Figure no. 8: Georg Nees, Corridor.

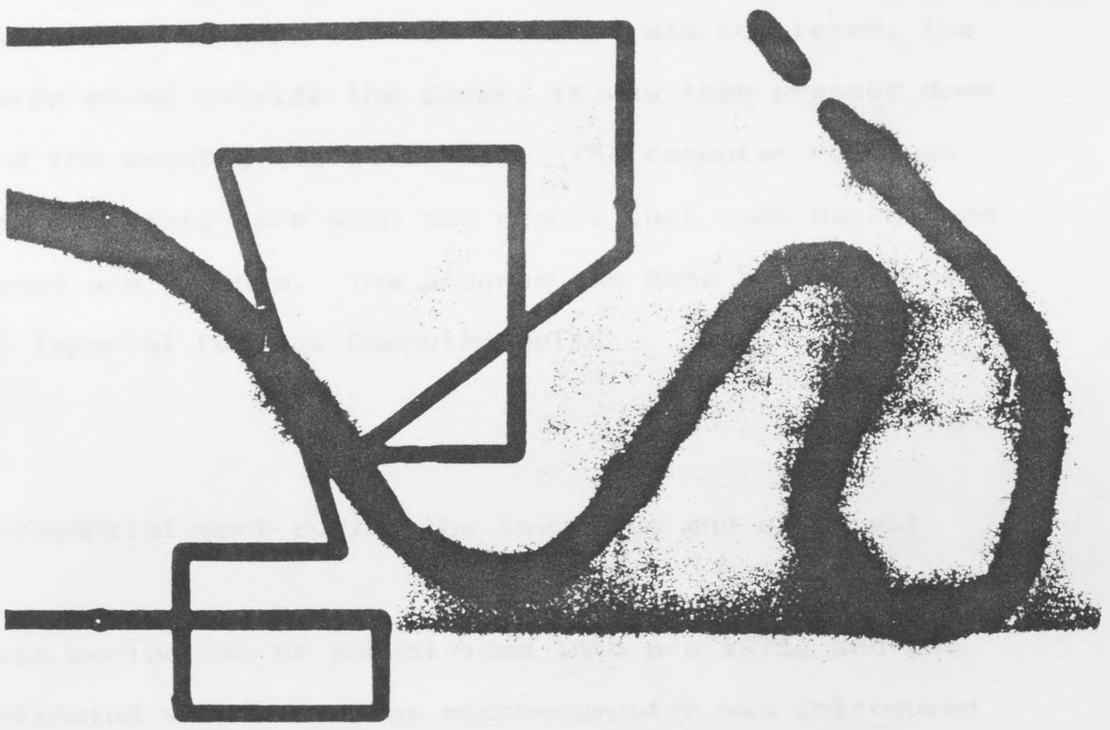


Figure no. 9: Gustav Metzger, third of four drawings produced with light in March 1970.

One can thus conveniently achieve the effects of light and shade, giving a rather painterly result. Figure no.9 is the third of four drawings produced with light in March 1970. It was made on a Calcomp 563 plotter. The movement of the plotter was continuous. The drawing was started at the bottom left hand corner with the end of the light guide about a quarter of an inch away from the paper. When the line was completed, the guide moved outside the paper; it was then pressed down and the drawing was continued. The computer room was not comletely dark with the result that some background tones are visible. The program was done by D.E.Evans of Imperial College Computer Unit.

Influential work during the seventies and eighties:

This period can be sub-divided into pre 1975, and the following years when the micro-computer was introduced to the market, a device which was much cheaper than, but sometime as powerful as, some of the old main frame computers.

The author will not cover the pre - 1975 period in full in this section as some of those artists' works are

covered in the section on Is the Computer Merely a Tool? of this chapter. The artists referred to there include: R. Coqart, B.Demio, V.Molnar and H. Cohen (whose work is also mentioned in the section on artificial intelligence and the arts). To complete the picture for the above period one needs to add artists like M.Mohr, Tony Longson and H.Franke to the list. (Some of their works do not use computer output directly but are transfers of drawings or visual forms on to 'conventional' media: paper or canvas on which the drawings are enlarged, re-drawn by hand or painted).

Manfred Mohr, a German artist, works mainly in two dimensional graphics. Figure no.10 (P-197/A) is a matrix of randomly rotated cube couplets having thick lines within the window imposed by the frontal view of a cube.

Tony Longson makes three-dimensional constructions which he describes as "drawings in space". Marks are densely printed on to layers of clear perspex, and make up geometries which form and re-form as the viewer moves around the object. (Figure 11)

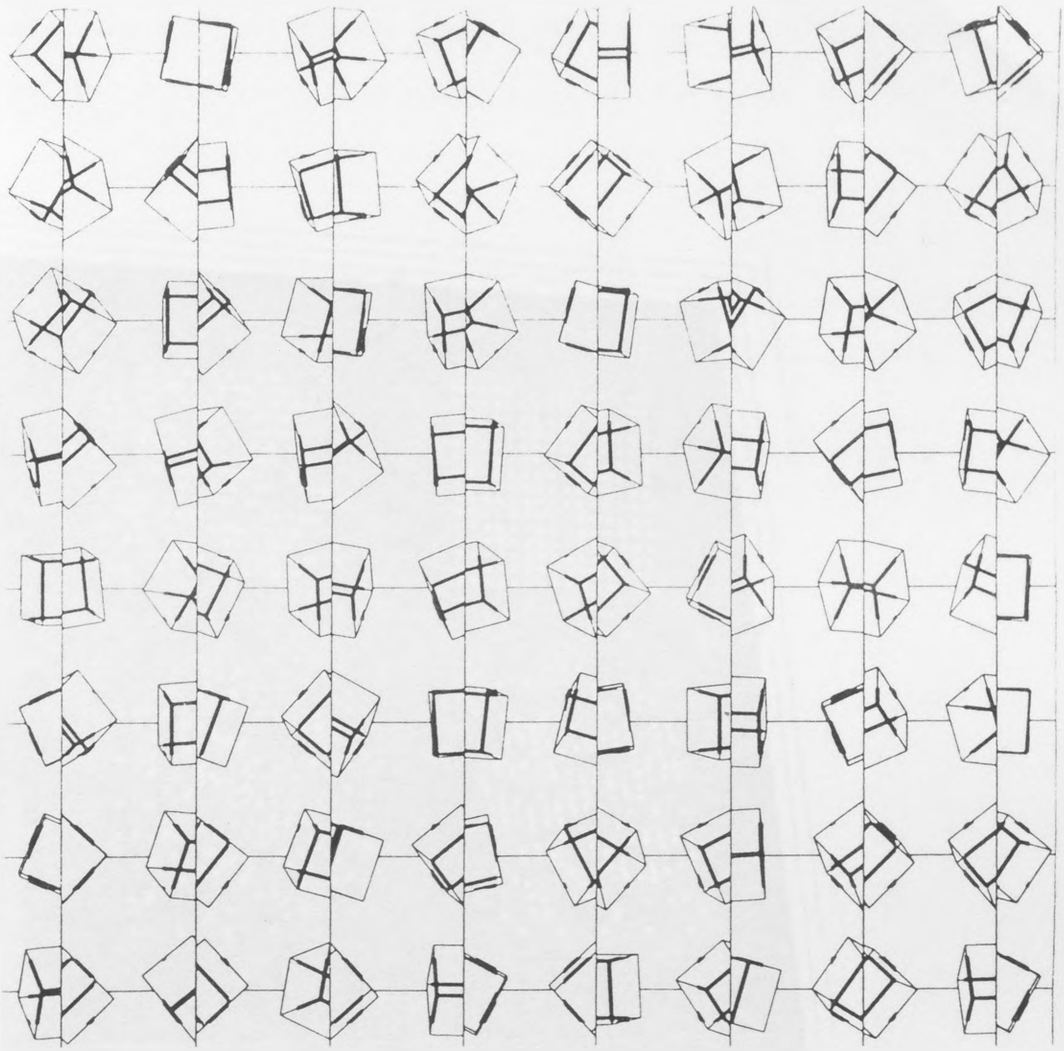


Figure no. 10: **Manfred Mohr** P-197/a Drawing 1977

A matrix of randomly rotated cube couplets having thick lines within the window imposed by the frontal view of a cube.

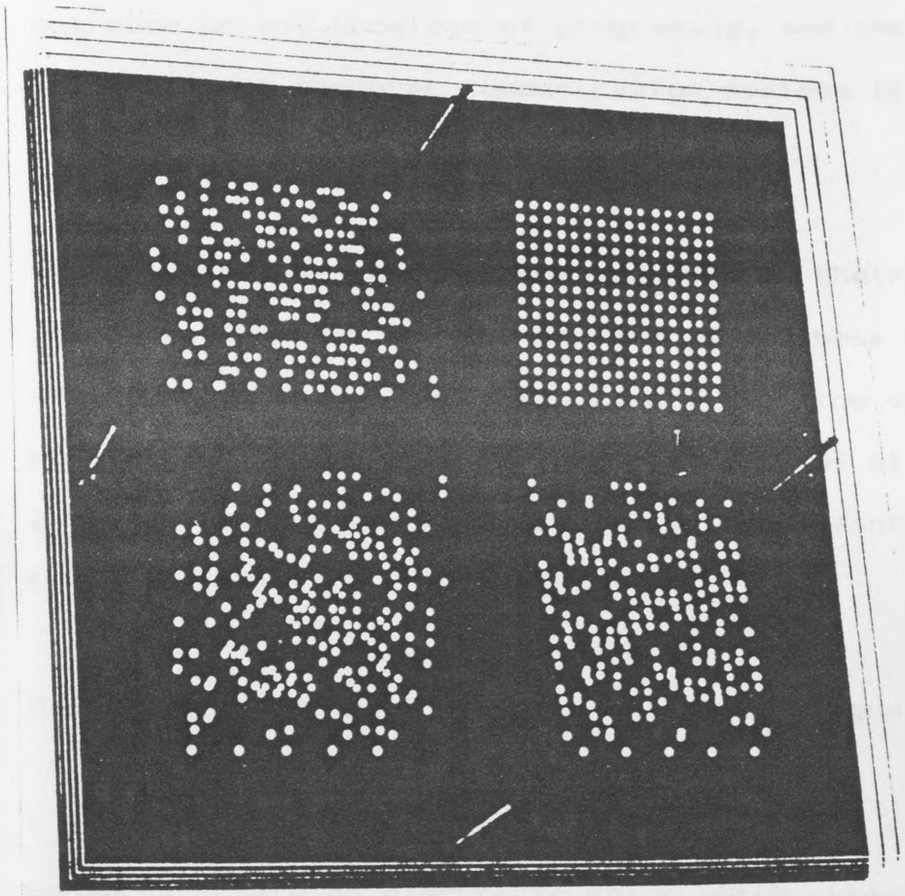


Figure no. 11: Tony Longson, Quarter 7 1976.

Two new developments of the late 1970's and the beginning of the 1980's in computer image-making were the introduction of 'painting system' software which allows artists and designer to use the computer with out much or any knowlege of programing, and the adaptation of computer communication systems to art practice.

Two artists that use the above methods in their work are Sonia Sheridan and Roy Ascott. What these two artists have in common is the identity of the viewer as participant, the belief in the break down of elitist art practice and the removal of time constraints from their systems.

Roy Ascot wrote about his work in the catalogue for 'Electra 83':

" Telecommunication and computer systems when they converge create an electronic space which presents radically new possibilities for the artist. It is an interactive space in which the locations of the participants are irrelevent. The message is generated out of the negotiations between participants in the system who, because of computer mediation, can access this new information space asynchronically - that is

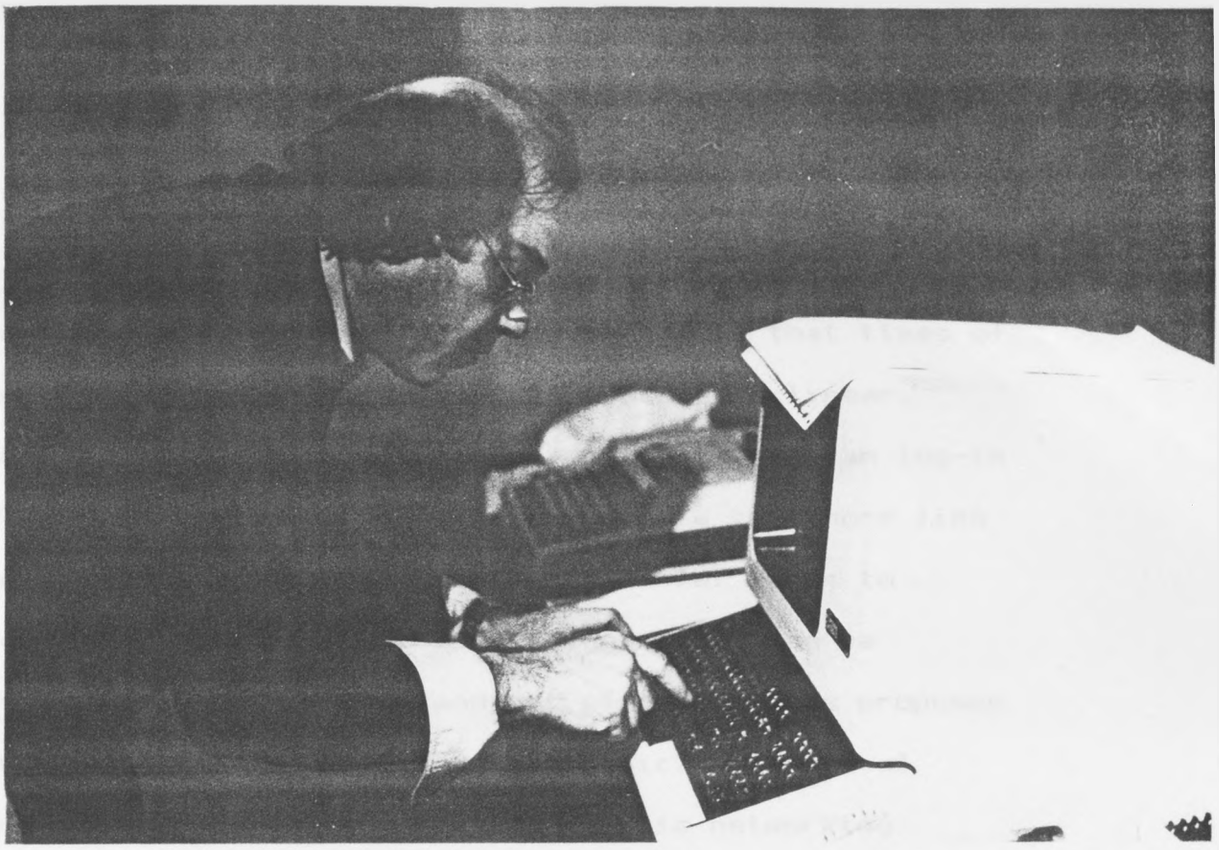


Figure no. 12: Roy Ascott at 'Electra 83', Paris.

Figure no. 13: Sonia Sheriden & Rachel Finkelstein at 'Electra 83', Paris.

without constraints of time or space such that times of access, of input and retrieval need not be linear. With a portable data terminal, participants can log-in from any location on the planet where a telephone line and electric power source are available. Thus to utilize this electronic space, the artist can be effectively out of body and out of time. This proposes a metaphysic (as well as an aesthetic) which is of evolutionary significance. Electronic networking provides the first medium for the artist which can truly breach the boundaries of time and space and which will ultimately breach the boundaries of individual mind, of territories and of cultures. The true consequences of the combination of art and electronic information technology will not properly be seen until there is universal availability at very low cost of the means of transmission of digital information within a planetary interactive network embracing the audio,visual and text/data modes. Even at this stage of development we can sense the emergence of a planetary consciousness which I call 'network consciousness'."

Sonia Sheridan (1983) wrote in the catalogue for 'Electra 83':

" Electronic tools:

The environment which houses electronic tools should be free of dust. It is sometimes dark and usually cool. There is little smell, noise or feeling of heavy physical action. Only an incessant hum indicates the presence of activity. Electronic systems have the capacity for storing, collecting, transmitting and multiplying information in a relatively silent environment. Once tedious physical labor was taken over by mechanical tools, now tedious mental labor is assigned to electronic tools. But unlike mechanical systems the act of creating returns, as with manual work, to real-time. Think it - have it. 'You push the button and we do the rest!' is more appropriate to the computer era than to the photographic era. The user starts out with a tool, which has a hidden point of view, far more complex than that which is programmed into a brush, a printing press or a camera. In the 70's when John Dunn asked me what I wanted in a computer I responded that I wanted a system that would enable me to paint, draw, print and photograph and eventually - in time - I would wish it to make Persian carpets. By the late 1970's John had created a couple of systems. EASEL is the system that most appealed to me. It permits all of the older systems - and their

capacities for letting us move in Time and Space in unique ways - to be added to new possibilities for transmission, stretching and compressing, via tools appropriate for communicating and interacting in our times. It is no longer necessary to divide production among various trades. Not only can the viewer have an original but the viewer can return to the role of participant in an original experience."

Thus we can see there have been a variety of approaches to the use of computers in art. There has been a change in perception of the activity - it is a long way from 'accidental graphics' to the work of Sonia Sheridan or Roy Ascott. Although linked by the fact that they all use computers, many of the artists mentioned here have little else in common with one another, so that one might expect them to have a wide range of needs and problems when using computers for image-making. Later sections of this report try to throw some light upon this question.

2.3 "Is a computer merely a tool?"

The objective of this chapter is to provide a context within which to establish how, and why, an artist chooses computer-based tools to help in the process of creation. But is a computer merely a tool, or does it co-operate more equally with the person in the creation of the final art work?

Michael Thompson (1975) in his article "Not Flocking to the Computer?"in PAGE, the journal of the Computer Art Society, believed that artists prefer to use simple tools as they allow them more flexibility and mobility.

"Artists characteristically make things for the sole purpose of looking at them. Most of them use only their eyes and hand, together with simple media such as pencil, gouache, acrylics etc. The advantage of such manual work is the continual visual monitoring of how the job is going, and immense freedom to change to more-or-less any colour or form at any stage". Thompson feels that this type of closeness of artist and medium is not always the case when artists are

using computers, and he goes on, in relation to the use of computers as artists' tools, to say that "Most artists will find that the design of a program and its writing, which may involve considerable study of manufacturers' reference manuals, are both very time consuming. Then there is the debugging of the program. Even more important than time is the nature of the work itself which is remote from the visual medium an artist needs for the continual exercising of his skill".

A different view on this matter is given by Jasia Reichardt (1971) in her introduction to her book "The Computer in Art". Reichardt felt that the move towards creation by amateurs is one of the positive aspects of computer art and she continues:"Creative activity need not necessarily belong to the conventionally prescribed areas of painting, sculpture, poetry and music. They also demonstrate that creative activity is not the prerogative of those with diplomas from art college, creative writing courses, or an academy of music, or those profesionaly engaged in these fields. This is particularly true of computer art where anyone able to write a computer program, can convey visual information

to paper without being able to draw, even the simplest design, by hand".

Harold Cohen, a practising artist who has been working with computers since the end of the nineteen sixties, and who recently had a show at the Tate Gallery, writes as follows on the question of the role of the computer (Cohen,1983): "I've always maintained that if you can't make images without a computer, you probably can't make images with one, either".
His exhibition at the Tate consisted of a full-scale computer installation utilizing a unique drawing device of Cohen's own design, to produce an endless series of gigantic "freehand" drawings, no two of which are alike.

There seem to be two main lines of developments in the use of computers in Art. The first one certainly is the use of computers as a tool. Here a computer is used explicitly as a mechanism for generating, efficiently and quickly, the effects which the artist wishes to achieve. It forms a definite ,well-specified stage in the creation of the work and the artist knows

exactly where, when and how he or she is going to use the computer. The point in the development of a work at which it is used varies from artist to artist. We shall now consider some different examples by looking at artists writing about their work.

Vera Molnar (1980)

"I use a computer to combine the forms because I hope that the assistance of this tool will permit me to go beyond the bounds of learning, cultural heritage, environment;in short: of the social thing, which we must consider to be our second nature. Because of its huge capacity for combination, the computer permits systematic investigation of the field of possibilities in the visual world, helping the painter to clear his or her brain of mental/cultural"ready-made",and enabling him or her to produce combinations of forms never seen before, either in nature, or in museums, to create unimaginable images". She continues: "My work is built up with the most simple geometric forms. This fact is not due to the conviction that they are "better" or more "beautiful" than other forms; or that they are privileged forms having qualities necessary for building up valid visual artwork. This choice is

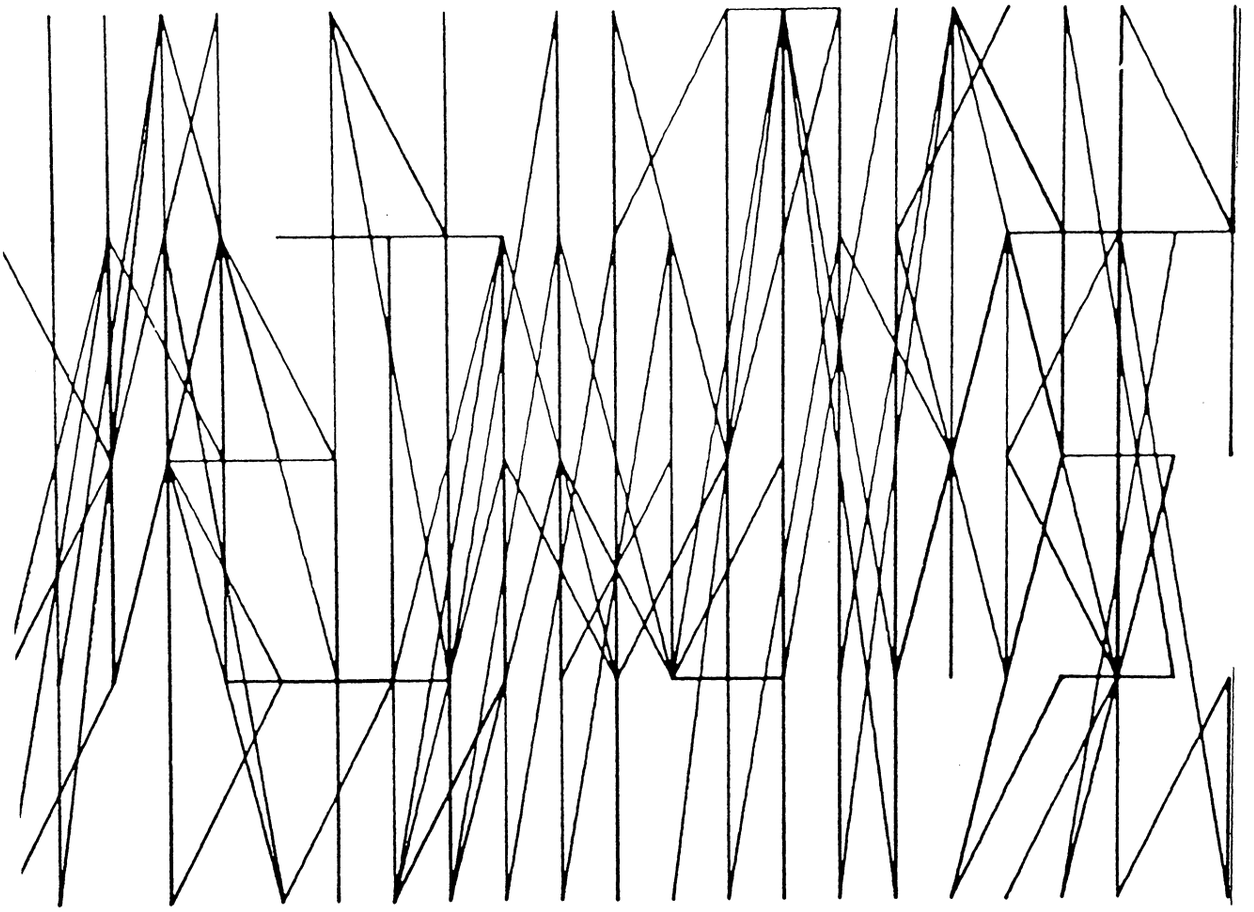


Figure no. 14: Vera Molnar: "10 Points",1979.

to be considered first as a result of my subjective taste: I like the plastic strength of geometry, I like the rational purity of mathematics. But there is also another less emotional reason for my basic choice: these elementary forms are easier to describe, to manipulate, and to maintain control over. One can more easily proceed with their construction, following the rules the painter has given to herself. The third reason for my choice is that it seems to me that elementary geometric forms are less likely to be interpreted by the onlooker who often tends to project all kinds of semantic content which are irrelevant to the purpose of the painter". (Figure 14)

Bernard Demio (1980)

"In his creative approach the artist uses a mini-computer in the following manner:(Figure 16 pg.53)

"First Stage:

Starting from the basic idea, the artist does some preparatory conceptual work in the form of drawings, rough sketches, and various other attempts. He/she defines the constraints of his/her creative work and

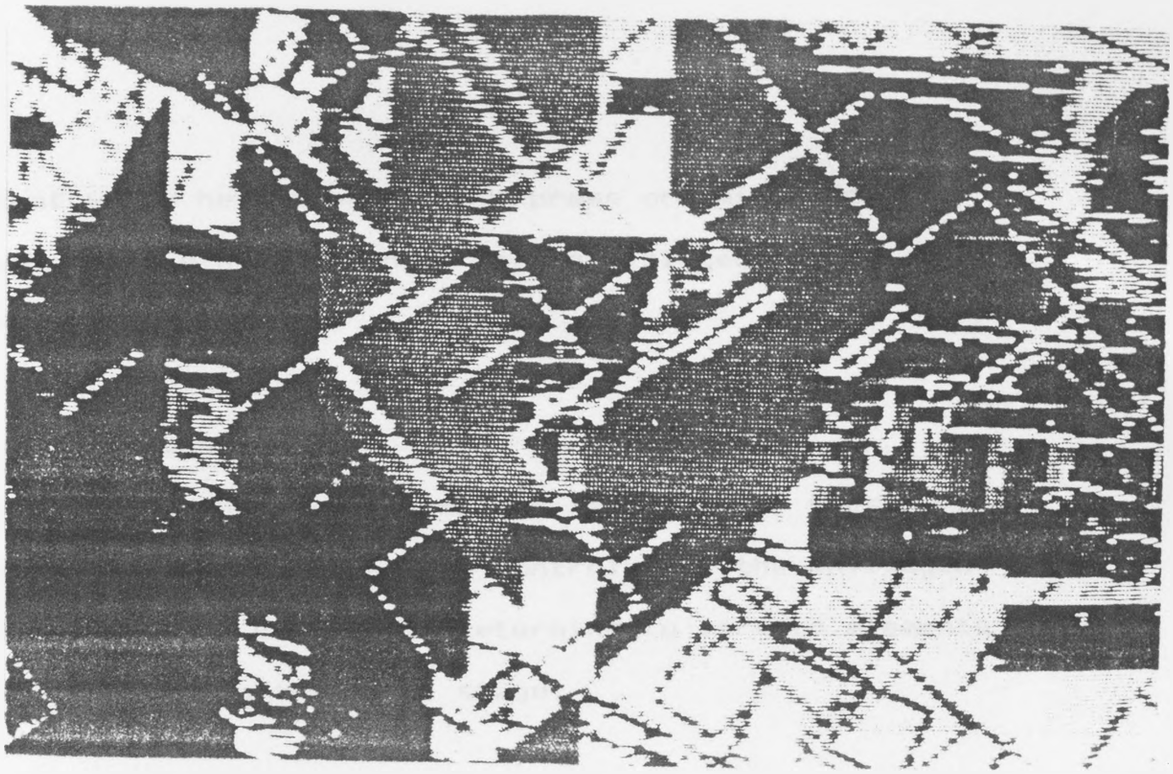
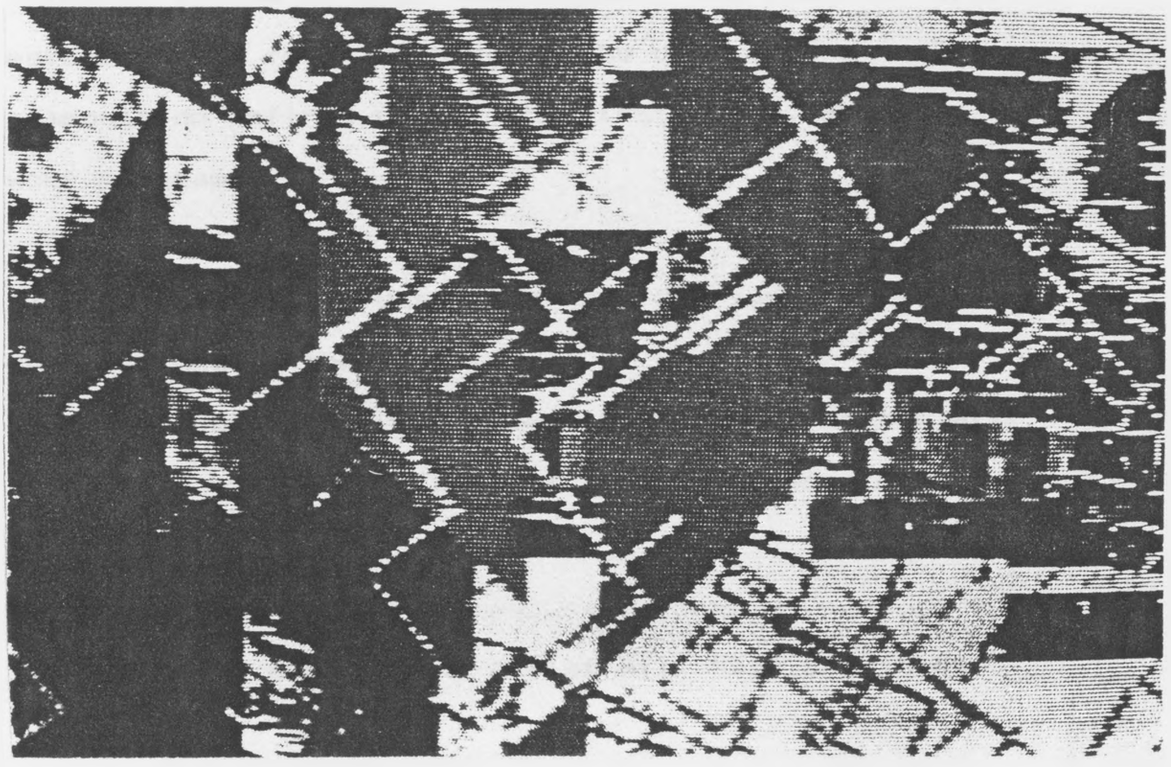


Figure no. 15: Bernard Demio : Drawings.



that which he/she wants to express or omit. (For example the definition of the initial generating forms).

"Second Stage:
Setting up the formal computer language for these forms, the colours and the controls for the envisaged composition. Eventually returning to certain elements defined during the first stage.

"Third Stage:
Artist/mini-computer dialogue. Given a work program adapted or chosen by the artist (program of forms or colours, in low or high resolution), the computer will establish the relation between the data of the composition defined during the first stage, and this work program.

"The program will process the data and suggest combinations to the artist.
As a function of his/her investigations the artist will be able to explore one path of testing rather than another.

"In exploring a path, the artist will have new ideas

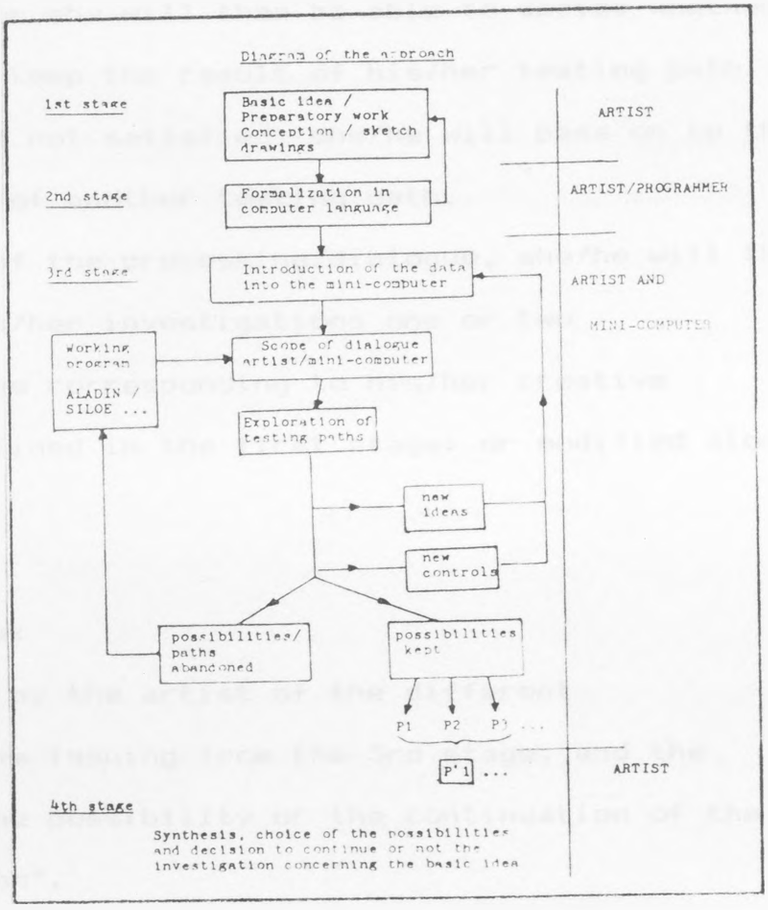


Figure no. 16: Bernard Demio ,diagram of the approach.

which may or may not be reintroduced as data. He/she will think of new composition controls which will enable him/her to quickly put into effect his or her ideas. He or she will then be able to decide whether she/he will keep the result of his/her testing path. If she/he is not satisfied, she/he will pass on to the exploration of another testing path.
At the end of the processing/dialogue, she/he will thus have for his/her investigations one or two possibilities corresponding to his/her creative controls defined in the first stage: or modified along the way.

"Forth Stage:
A synthesis by the artist of the different possibilities issuing from the 3rd stage, and the choice of one possibility or the continuation of the investigation".

Bernard Demio seems to be arguing that the artist can adopt different roles during the process - is it possible ? Can these areas be so rigidly defined ?

Roger Coqart(1980) writes: "Throughout the history of art, new technological resources and devices have been absorbed into various art media of their time. One of the most significant instruments of our time is the computer, which has been used in diverse ways for the creation of works of art during the past dozen years. In my case the computer is used as a means to create geometric constructions in which a few elements are arranged in a statistically valid manner, in order to obtain a great variety of objective examples of growth structures". (Figure 17)

Sozo Hashimoto(1980), in writing about the process of producing a "UNIVERSAL MANDALA", a "visual means for assisting self-integration and transcendence", states that "The computer was extremely useful, as a great deal of calculation was necessary to compose points, lines, and geometric forms regularly".

In these cases the artists are using the computer as a tool - a very complex tool, but nevertheless its relation to the artist is very much that of the paint brush or hammer and chisel and may be seen as a logical or natural development of that relationship.

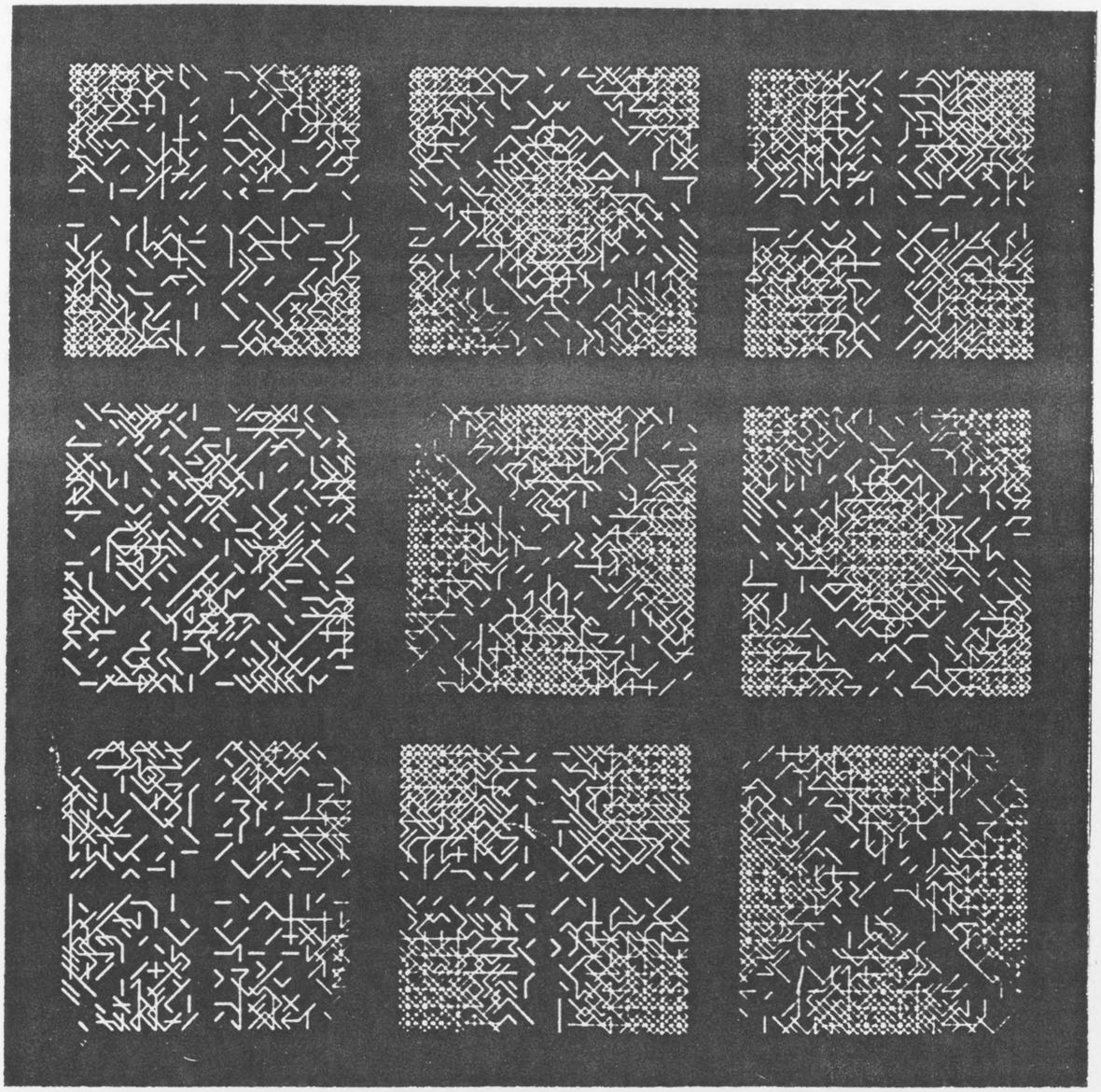


Figure no. 17: Roger Coqart, Logic Constructions, reversed computer drawings, 1979.

The other line of development seems to be where the use of computers by artists diverges from this tool-like use into a less well-defined relationship where the artist and the computer co-operate more equally in the creation of the final art work.

An example of this method is John Lansdown's work on ballet, where the computer generates a score for a dance which can be taken by the choreographer and moulded or developed as he wishes.
Kilgannon(1979), a poet, uses the computer as a means of generating a set of ideas. He then selects an idea from this set to use as the basis for a poem which he then writes himself. In Kilgannon's case the computer produces verses generated by specified rules of format, word and phrase content. The following is an example of the sort of output generated by the computer, and it is clear that only ideas, not finished poetry , are the product. The poet himself must then work on the computer's output.

lyric 7302 written by Elliot 4130 computer and Algol program. Easter 1969.

"suddenly gonna be happy to sonia we love then.

someone dont lemme remain under mick someone be with.
sadly be happy after sonia we gotta never.
remain regularly want upon one someone wanna
sadly under the miserably in someone,sylvie.
gonna regularly want very much the old wine they.
swinging solution perform quickley on someone wanna
remain as well as wanna sadly of the old, old wine when
go out the movie star someone along him will tell or
gotta miserably. not be happy to pat we when.
create anyone never remain of someone wanna
remain the movie star.sadly approach to pat we when
gotta miserably in the beautiful opinion.
tony dont liketa never remain when the old wine them.
swinging solution perform quickly on someone wanna".

To return to visual art, with Harold Cohen's drawing machine (Catalogue of the show in the Stedelijk Museum Amsterdam 1978), in a very similar way to Kilgannon's poetry, the artist can't predict, before he runs the program, the exact form of the final art work. What is most interesting in Cohen's project is that he was one of the first artists that proposed to simulate human behavior in his art work. (The author elaborates

further on this matter in the section devoted to Artificial Intelligence and Art.)

Harold Cohen(1978) (explaining the working of his computer drawing instalation)

"All the important activity takes place inside the computer, and that isn't actually visible. To manifest what it's doing, the computer needs to have some sort of display device, or output device, under its control. In this installation I have both a Tektronix graphic display and the cart, which I designed and built especially for exhibition use.....The computer steers the cart around by sending it commands to drive its wheels at different speeds, so that it moves in short curves. But the wheels slip on the paper too much for the computer to be very sure where the cart is after a while, so it is designed to operate under a sonar navigation system. Twenty times a second the cart sends out a burst of ultrasonic noise. Specially -built microphones in the four corners of the drawing help figure out where the cart is. Instead of using the normal cartesian convention and telling the cart, 'go to point x,y' the main computer says, in effect, 'move the left wheel L mm, and the right wheel R mm, and then say where you are.' With this feedback system

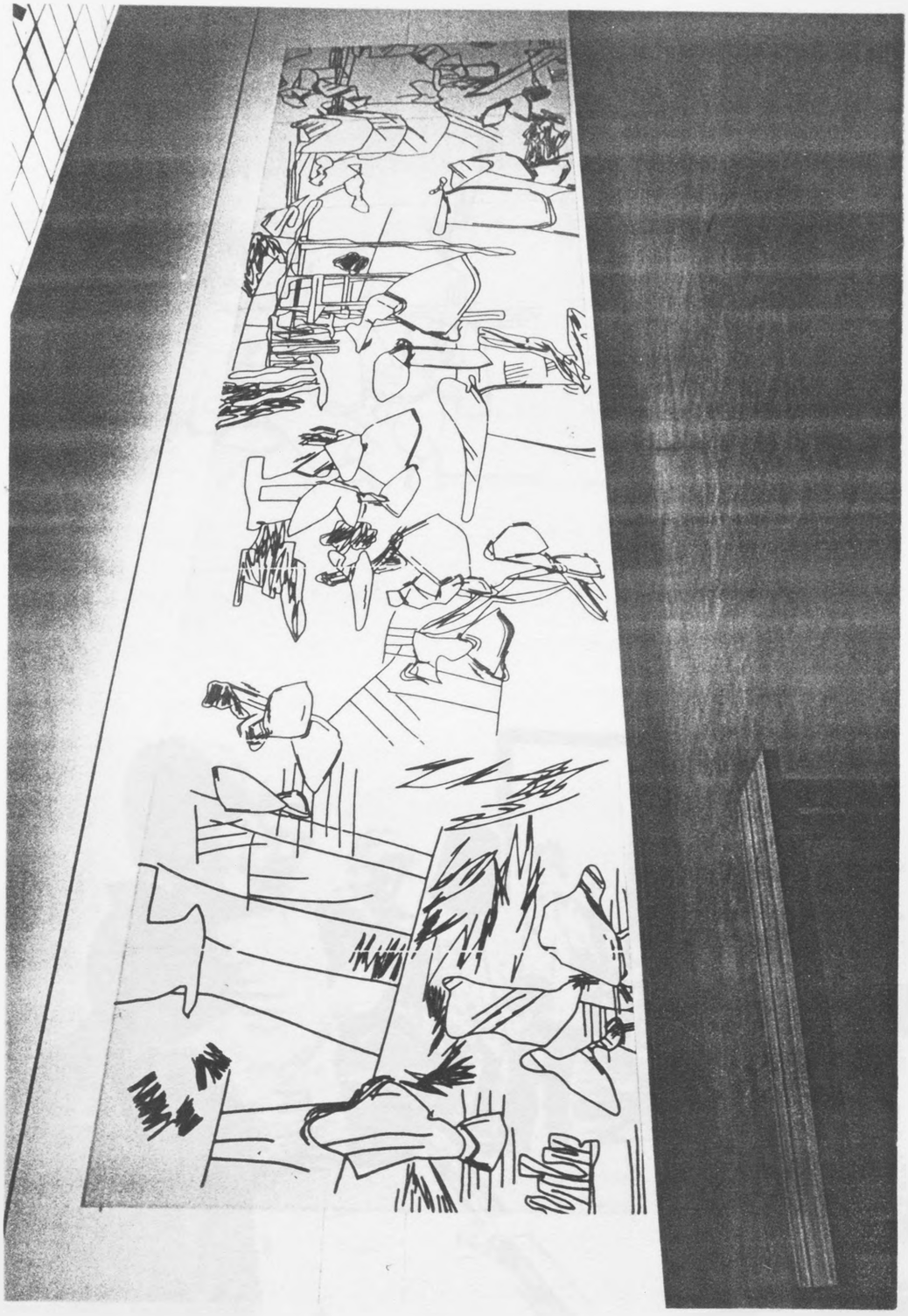


Figure no. 18: H. Cohen: largescale work based on computer plot - Tate Gallery 1983.

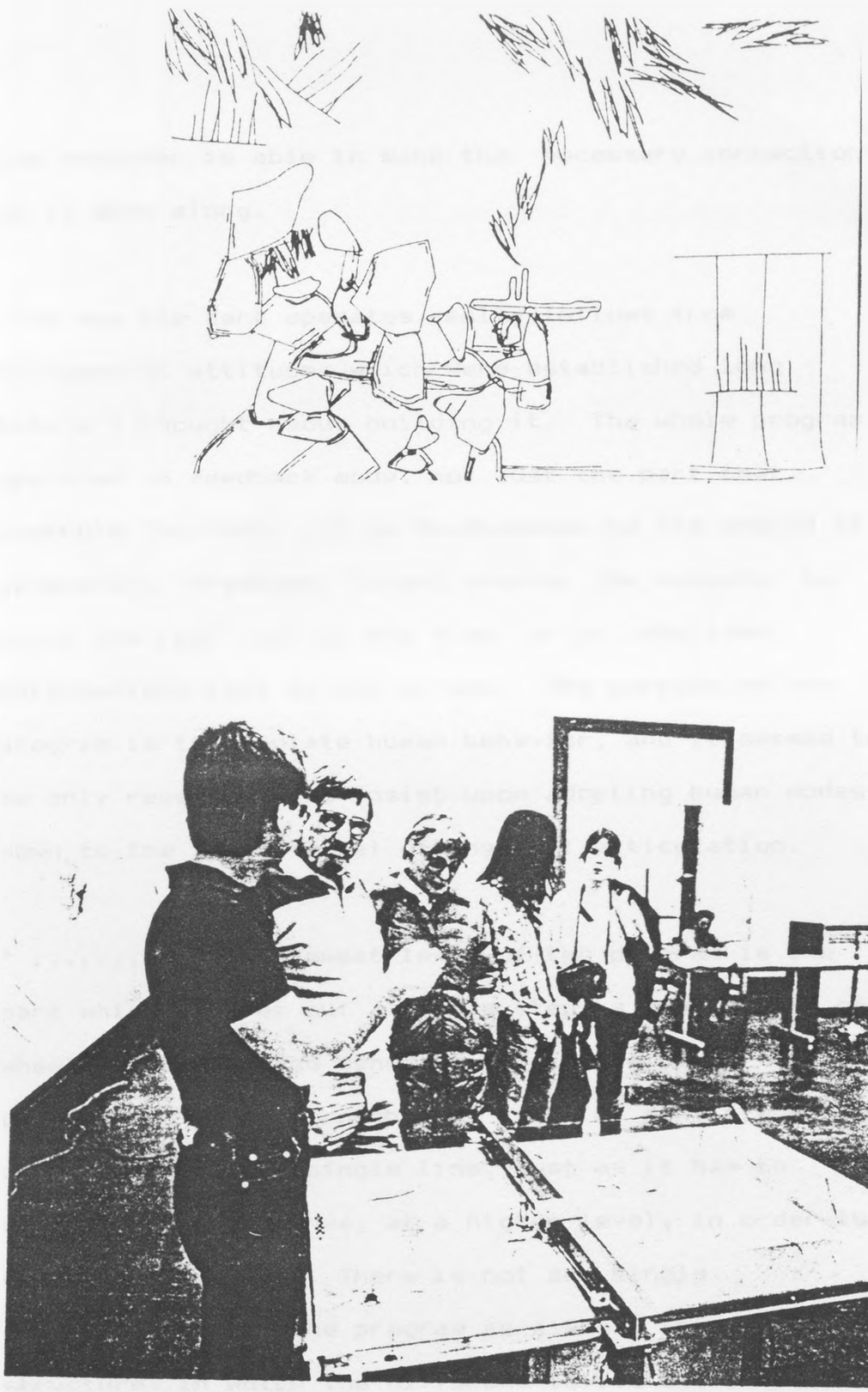


Figure no. 19: Harold Cohen.
Brooklyn Museum installation, 1983.

the computer is able to make the necessary corrections as it goes along.

"The way the cart operates really follows from fundamental attitudes which were established long before I thought about building it. The whole program operates in feedback mode, not just the part that controls the cart. It is fundamental to the method of generating 'freehand' lines, whether the computer is using the real cart on the floor or an idealised, make-believe cart on the screen. The purpose of the program is to simulate human behavior, and it seemed to me only reasonable to insist upon adopting human modes down to the lowest level of physical articulation.

" .....The very lowest level of the program is the part which figures out a single step, a single pair of wheel movements, and sends it off to the cart. The program has to go through that level of many times in order to produce a single line, just as it has to contruct several lines, at a higher level, in order to complete a drawing. There is not any single controlling part: the program as a whole is a control structure, in which the different levels exercise specific kind of control. The lowest level will go on

generating steps until the level above it recognises that the current line has been completed: then control is passed up to the next level, which will go on generating lines until it sees that the next level, which will go on generating lines until it sees that the correct figure has been completed .....and so on. These lower levels don't decide whether the drawing as a whole is complete, just as the topmost level of the program does not control the cart.

"I am not sure that I would want to say that the program, or any part of it, knows what a drawing ought to be like. The whole program describes the entire drawing process, but it wouldn't be possible to predict from the program what any of its drawing would be. I have to run the program to find out."

Not only is the computer not always seen merely as a tool - it can be argued that computing is not something that exists "for" painting, music etc, but instead as a separate art form altogether.

Brian Smith, (1983) in a interview with Eyepiece Magazine, has said: "....computing is a medium in its own right and I think it is a mistake to try to map it

on to film or photography or painting or architectural drawing or whatever. In the same way it would be rather silly to talk about film as being 'kind of theatre' or 'only moving photographs', it is clearly more than those things".

To sum up what was said in this section we can return to the main question of this section "Is a computer merely a tool?" It seems clear that a computer can be used "only as a tool" if one chooses to use it that way. But in the hands of artists like Cohen and indeed of Edward Ihnatowicz (reference to section 2.4 of this chapter) it has been used as a more equal partner in the decision-making process. Different artists have different needs, as well as different characteristic qualities that made them choose to use computers in different ways.

Dominic Boreham (1982) has argued that in the past, certain artists were able to come to terms with the limitation imposed by programming vector graphics, to the extent that they were able to make successful works of art, because their approach had the following qualities:

1. Clear objectives.
2. Logical and closely defined procedures.
3. Pre-defined visual structure.
4. Absence of a need to manipulate the image during or subsequent to its generation.

Boreham expanded on it in his thesis (Boreham,1983) by saying that : "Very few artists have come to terms with this technology to the extent that they have been able to produce work of artistic merit. However, these artists constitute an exceptional minority who find many of the characteristics of computing reconcilable with their conceptual, stylistic or aesthetic premises. Where they encountered difficulties they resorted to traditional methods and media, finding effective personal solutions, whilst leaving the basic limitations of the technology unchanged."

As we shall see in section 4.2, not everyone agrees with this view. Different people perceive the computer differently. It <u>can</u> be just a tool, but need not be so limited. One factor affecting the way artists view the computer is the type of system that they have access

to. The most powerful computers, ones having the ability to use "Artificial Intelligence", for example, in ways which presumably go beyond a simple tool, are not generally available for experimental use by artists. In the following section the role of artifical intelligence is discussed.

2.4 Artificial intelligence and the Arts

"Assumptions about computer art are varied. They range from the naive belief that computers will take the place of human artists to the more sophisticated belief that soon the Leonardo of computer art will come. This person would be a scientist, programmer, humanist, and artist - the true universal person" (Ruth Leavitt, 1976)

What is Artificial Intelligence (AI)?

Stephen Wilson (1983) in his article: "Computer art: Artificial Intelligence and the Arts", wrote on the subject:

"Artificial Intelligence is a domain of computer science devoted to the exploration of the limits and the methods of using digital computers to perform functions carried out by human brains, such as understanding natural languages and information

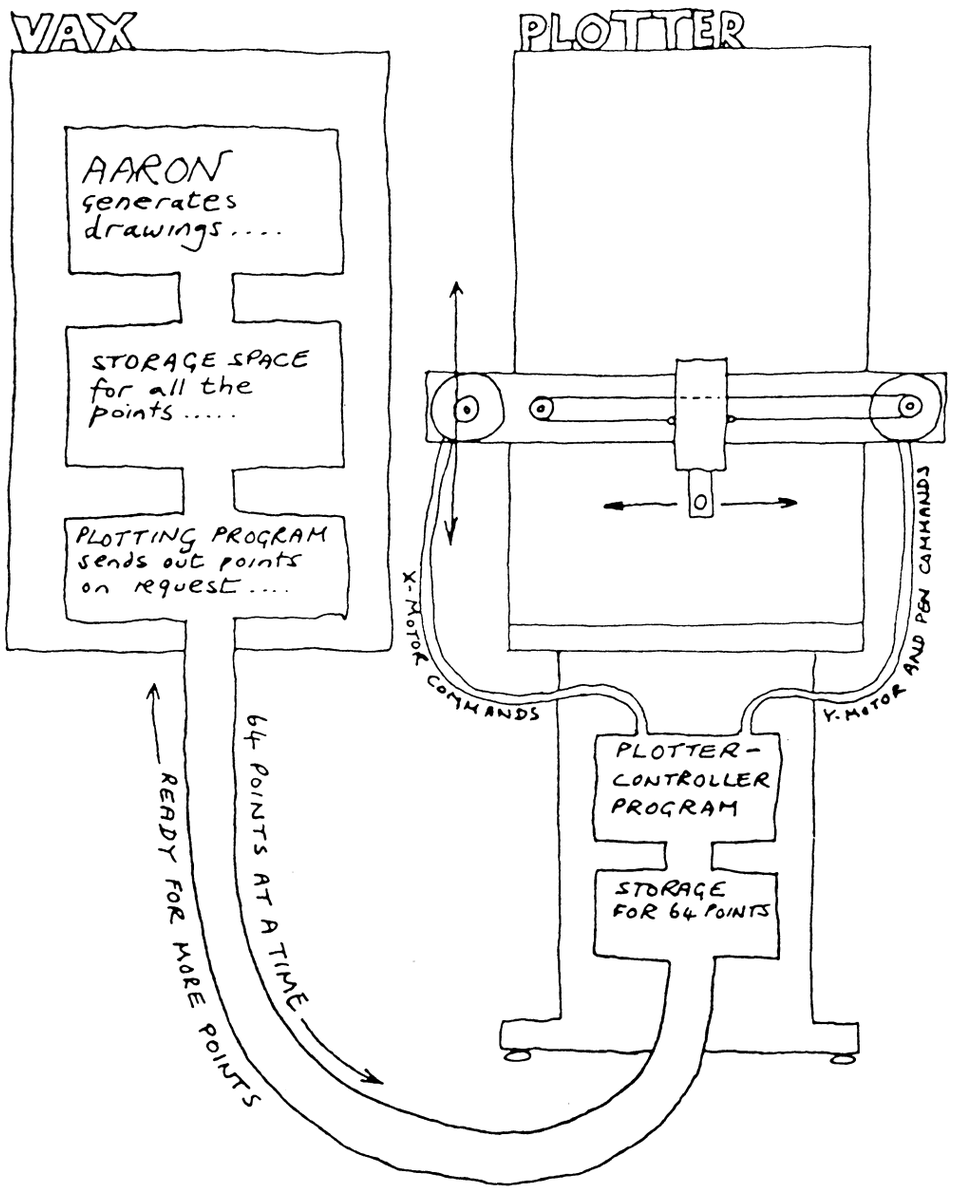


Figure no.20: H.Cohen: AARON.
Illustrates the relationship of software-programs-to the hardware.

obtained through the senses and solving complex problems. Work in this domain is essential if computers are to be applicable to a wider range of matters than possible at present in science, technology and daily life."

Harold Cohen is one of the few graphic artists to attempt to uses AI techniques in a serious way. His program AARON uses what is called in the AI community an 'expert system': the idea being that if one can wrest a significant body of knowledge from some expert and find some way of representing that knowledge so that a program can make use of it, then the program should be able to perform the way the expert performs.

Figure 20 illustrates the relationship of software - programs - to the hardware. There is often a huge speed discrepancy between a computer and any physical device. Thus AARON, running in the VAX computer, stores its output and releases it, on request, to the plotter. Each plotter is equipped with its own micro computer which handles these transactions, and also works out how to drive the motors to produce the

F= figure
S= system
L= line
P= point

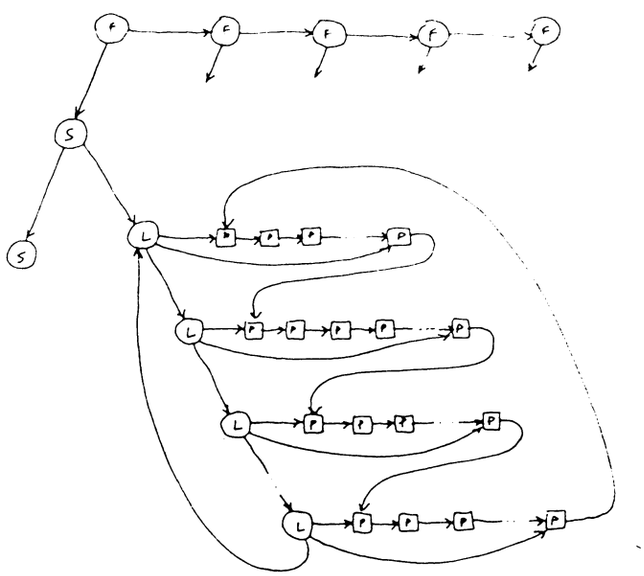


Figure no. 21: Illustrates the way the program AARON is structured.

specified movements. In practice, four copies of AARON are running simultaneously- more correctly, time-sharing- in the VAX, and each communicates with its own plotter.

Figure 21 is a diagram which illustrates the way the program AARON is structured:

Each picture may have an arbitrary number of figures. Each figure may have an arbitrary number of systems. Each system may have an arbitrary number of lines and each line may have an arbitrary number of points.

A data-structure, which represents the whole picture 'internally', is built up as drawing proceeds. Each figure is linked to each successive figure, and also to its own first system. Each system is linked to each successive system, and also to its own first line. Each line is linked to the successive line, and also to its first and last point. Each point is linked to each successive point.

The figure illustrates the tree-like form of this data-structure. It also shows, particularly, how closed forms are represented: the last point of each

line is linked to the first point in the next line, and the last point in the final line is linked to the first point in the first line. Also, the line entries are themselves linked to form a closed loop.

More AI-related work has been done in the context of interactive sculpture. Here are a number of examples of artists who have used computer systems cybernetically, sometimes employing sensors to respond to environmental changes. (Cybernetics is concerned with organisation, control and communication in systems).

Edward Ihnatowicz (U.K)constructed the object 'Senster' that moved its head towards the source of a soft sound or movement and away from the source of sound exceeding a threshold of sound intensity, or violent movement, under the control of a computer system. (Figure 22)

Nicholas Negroponte (U.S.A) produced an installation called 'SEEK', consisting of a group of cubical blocks with small rodents (gerbils) living among them. A computer-controlled, motorized arm moved and

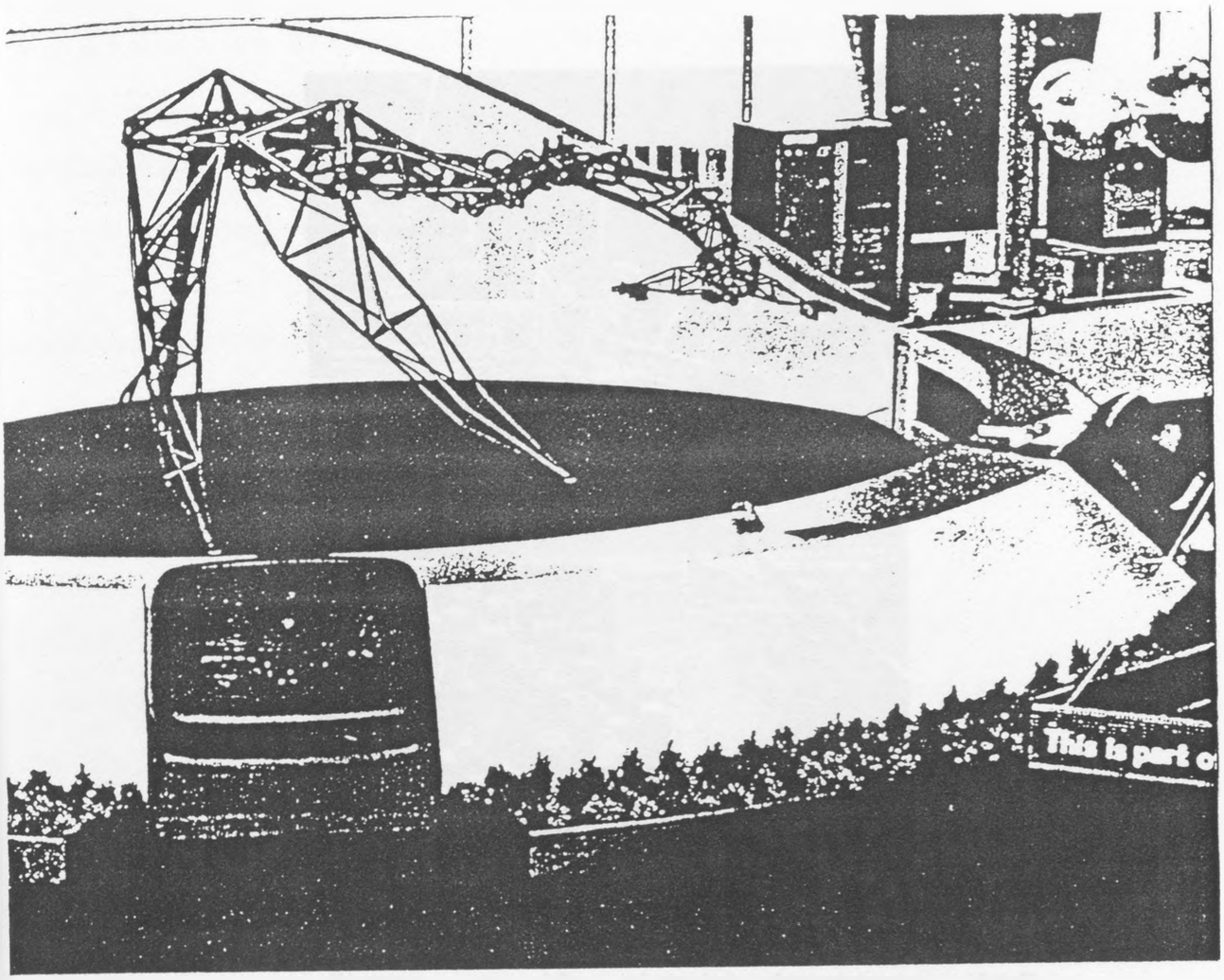


Figure no. 22: Edward Ihnatowicz, The Senster, 1971.

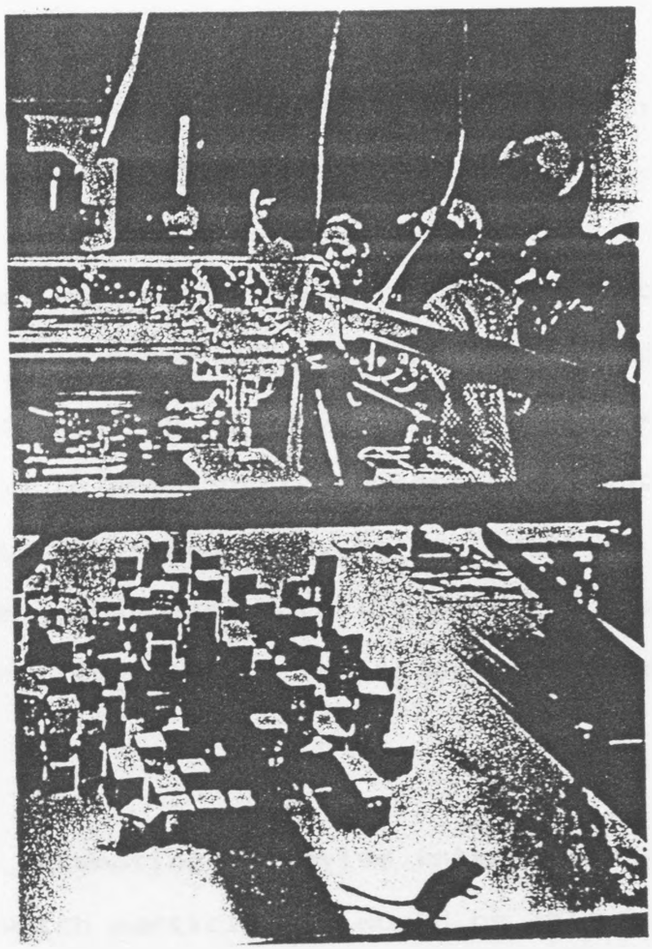


Figure no. 23: Nicholas Negroponte 'SEEK', responsive environment for small animals, gerbils, 1970.

re-arranged the blocks. The computer system was equipped with a pressure sensor to determine changes in block positions caused by the movement of the gerbils. The system then attempted to place the blocks in positions responsive to the gerbils' 'desires' as indicated by their previous movements. The gerbils, however, kept dying. (Figure 23)

Several years ago Nicholas Schoeffer (France) proposed the construction of a tower whose movable parts and lights would be controlled by a cybernetic system with sensors responding to atmospheric temperature, wind speed,sound level, etc. Recently, he has built a mobile light tower whose base actually contains a small computer to control the piece's responses to changes in its environment.

Artists are also attempting to devise interactive video performances in which participants would be able to modify each other's images with the help of computers by means of a satellite television communication system.

There is another type of work that is worth mentioning: the machine that can itself create a "work

of art". Michael J. Apter (1969) in his article "Cybernetics and art" wrote:

"Some artists have thought in terms of not only creating works of art in the form of machines but creating machines to create works of art. Many examples of this were included in the exhibition of 'Cybernetic Serendipity' which took place in London in 1968.....Examples include pendulum drawing machines and Tinguely's painting machines....Another notable example of machine-artist is the robot painter of Hoenich." These, of course, can not be said to exhibit artificial intelligence.

The author tends to share, as regards AI, the view of some theorists who have serious reservations about claims made for its future. For example, Hubert Dreyfus in "What computers can't do" (Dreyfus, 1972) is of the view that there are aspects of human mental functioning that can not be matched by computer AI, because it is doubtful that a computer program can be devised to take account of the human's background awareness, such as what it is to have a body , to have feelings and other intangible mental aspects that humans possess.

As long as questions like:What do artists do when they make images? What is ceativity? Or what are the characteristics of aesthetic qualities of artworks? are still open to debate, the potential application of AI in the visual arts will stay as a theoretical debate about the relationship between artists and viewers and between artistic processes and artworks.

Cohen has noted some of the problems that arise when one tries to write an expert system for image making using existing models (from chess-playing or mathematics). In the introduction to the catalogue for his show at the Tate Gallery in 1983 he wrote: "How well the chess-playing program performs is largely a function of how much knowledge the same program had. Would the same be true in image-making? Suppose I said that I wanted AARON, not merely to generate images, but to do so creatively... We might still think of the program as an expert system, perhaps, but in this case the expertise would have to do with the behaviour of the individual, wouldn't it, rather than with the behaviour of ink on paper or whatever? And that being

the case, expertise would have to be expressed, not simply by the inclusion of items of knowledge, but by the form of the program itself. It would no longer be enough to have the program make images as well as a human artist".

We have seen in this chapter that, both in the way the computer is perceived and used by the artist, and in the kind of process used, there are a wide range of relations between artist and computer, and between the computer and the visual product.

The next chapter portrays the author's own attempts to produce examples of images using computers in a variety of ways.

CHAPTER 3: Experimental programme devoted to techniques

3.1 Description of procedure & equipment used

The author needed to carry out a number of experiments in computer image-making in order to enable her to understand the problems involved in the use of the computer as a creative medium. This experience was needed also when the author was engaged in the formation of the questionnaires, and during the interviews, allowing some shared experience of the problems involved.

The video, which is a record of the author's own computer experiments in four parts, consists of:

A- Free hand drawings made at the RCA using the' Jackson' painting and drawing system

B- Animation sequence made at the Middlesex

Polytechnic using 'Picaso'

C- Video manipulation sequence made at Imperial College using 'Vicar 2'

D- Simple graphic programs made at the RCA using the Basic language for programming.

Each section was divided into sub-sections, references to which can be found in the Video.

There follows a short description of each section.

A- Free hand drawings made at the RCA/DDR

Software used: 'Jackson' paint system

Language used: BASICSG2

Computer used: Research Machines 380Z microcomputer.

Paint systems use a set of instructions written by a programmer to allow artists to use a computer without having a knowlege of programming. 'Jackson' is an interactive, general purpose electronic painting and drawing system which is used for a wide range of tasks, such as graphics, fine-art, design, animation etc. 'Jackson' is run by a microcomputer, the Research Machines 380Z, which has two modes of resolution for graphics: high and medium. 'Jackson' uses the high resolution mode which can have 4 colours on the screen at once out of 256 colours which the computer has available. By using a a 'reset colour' box on the digitizing pad one can redefine a colour to one of the 252 colours still available to choose from. The actual 4 colours that one starts with when using 'Jackson' are 0= Blue ,1=Red, 2=Green, & 3=Yellow.

Input in 'Jackson' is by menu using a digitizing tablet and a keyboard. The output is either a colour or monochrome display, and the resolution of the image is 320 points or 'pixels' horizontally * 192 points vertically in high resolution mode. The 380Z computer is connected to a Calcomp 81 flatbed plotter, which uses up to 8 different pens , so hard copies on paper are possible '(samples of the output using the plotter: Rachel1 & Rachel2 Figure no. 29,30). But since one can not copy exactly on paper what one can get on the screen, it is usually preferable to take images of the screen using a still camera (Figure no.24,25). It is also possible to record directly onto video tape as was done by the author (reference can be found video tape section A). Images produced using 'Jackson' can also be saved on magnetic disc, and can be called up or manipulated later.

Some options available with 'Jackson':

Command: tells the computer that the user has temporarily stopped drawing, and is about to input

information such as brush size, colour, etc.

Colour: (in theory only 4, in practice up to 10 on screen at once in "high resolution", from a range of 256.) The extra 'Illegal' colours are obtained by optical mixing of closely cross-hatched areas using 2 or more colours togther.

Brush: (any size, and including 'striped paint' etc.)

Airbrush: (variable size and density, and two colours at once if needed.)

Lines: (of any thickness, including auto horizontal and vertical.)

Area as brush: (define any part of existing image as a 'brush'.)

Reset Colour: (change any or all colours)

Stop/Clear: (halt the program or wipe the screen to the current background colour)

Perspective block: (variable horizon effect.)

Axes: (auto X and Y axes with variable spacing, tick-marks etc., used for graphs, histograms and so on.)

Shading: (cross-hatch any size rectangle, with stripes, 'illegal' new colours etc., then erase to shape using a small brush loaded with background colour.)

Text: (any colour, any size, anywhere; including 'bold'.)

Lo-res Block (uses low-resolusion graphics, characters etc., in blocks, superimposed on the high-resolution colour screen.)

Macro define-Macro use: (create and save library of line shapes, call up, scale, use.)

Twixt: (limited line animation.)

Repeat: (simple or half-drop repeat pattern using any area of screen as module.)

Save: (complete image saved on disc with a name, can be

called up later.)

Pixel: averaging (smooth text, create special effects, clean up visual 'noise' etc.)

Grids (create a regular 'graph-paper'-like screen grid, or any irregular four sided grid, or show part of a large grid on the screen, giving a perspective effect.)

The following are functions and commands used by the author during her experiments with 'Jackson'. The visual output can be seen in the Video tape sections A1,A2,A3. The underlined texts in this section are the interactive parts in the use of 'Jackson'.

A1

COMMAND

SELECT OPTION

COLOUR 3

COMMAND

SELECT OPTION

PAINT BRUSH

<WIDTH> ? 50

HEIGHT ? 50

AUTO PERSPECTIVE (Y/N) N

2 COLOUR (Y/N) N

COMMAND

SELECT OPTION

CHANGE PRESENT COLOUR TO WEIRD (Y/N) Y

OK-DONE

STOP (S) OR CLEAR SCREEN (C) ? C

2A

COMMAND

SELECT OPTION

COLOUR 1

COMMAND

SELECT OPTION

DEFINED SIZE (D) OR WHOLE SCREEN (S)? D

TOUCH LOWER CORNER

TOUCH UPPER CORNER

NUMBER OF LINES TO BE USED ? 20

COMMAND

SELECT OPTION

PAINT BRUSH

<WIDTH> ? 30

HIGH ? 1

AUTO PERSPECTIVE (Y/N) ? N

2 COLOUR N

COMMAND

SELECT OPTION

COLOUR 2

COMMAND

SELECT OPTION

SIMPLE REPEAT (R) OR HALF DROP(H)? R

HIT LOWER LEFT CORNER AREA

```
NOW HIT UPPER CORNER

DONE

COMMAND

SELECT OPTION

CHANGE PRESENT COLOUR TO WEIRD (Y/N) ? N

WHICH COLOUR 0-3 ? 0

RANDOM (Y/N) N

WAVE PEN NEAR PAD

COLOUR FIXED
```

A3

COMMAND

SELECT OPTION

COLOUR 3

COMMAND

SELECT OPTION

ENLARGEMENTS IN HORIZONTAL & VERTICAL

DIRECTION (X,Y) 1,1

TEXT / RACHEL

BOLD (Y/N) Y

HIT START POSITION

MORE (Y/N) Y

ENLARGEMENT IN HORIZONTAL & VERTICAL

DIRECTION (X,Y) ? 3,2

TEXT ? HELLO

BOLD (Y/N) ? Y

HIT START POSITION

MORE (Y/N) N

COMMAND

SELECT OPTION

USE AREA AS BRUSH

HIT LOWER LEFT CORNER OF AREA

NOW HIT UPPER CORNER

DONE

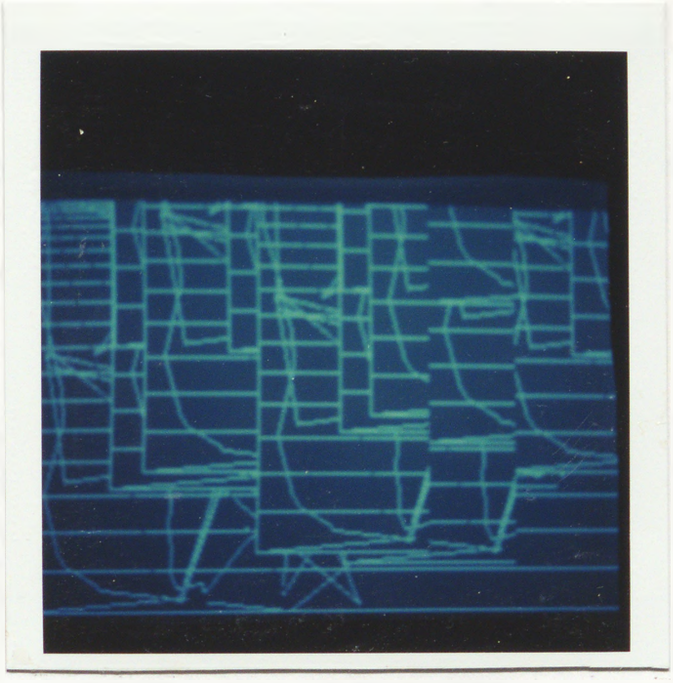


Figure no. 24: "Jackson", area as brush.

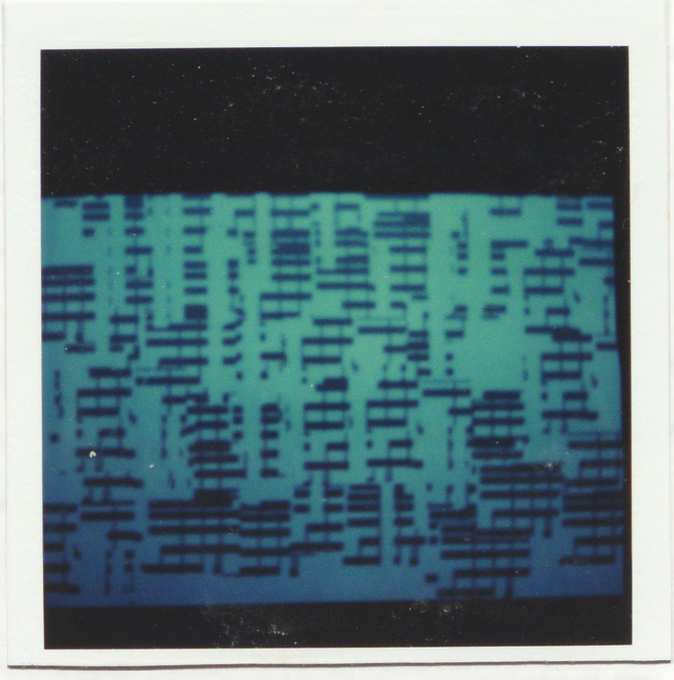


Figure no. 25: "Jackson", reset color .

B-Animation sequence made at the Middlesex Polytechnic

Software used: 'PICASO'

Language used: Fortran

Computer used: Prime 550 computer

Picaso (Picture Algorithms Subroutine Oriented) is a Fortran-based computer graphic system designed to ease the interface between programmer and graphical problem areas. The philosophy behind PICASO is one of reducing the solution of a problem to modules and using available subroutines together with fortran to produce two and three-dimensional graphics.

Middlesex Polytechnic's computer graphics facilities are located in the computing centre at Bounds Green location in north London.

The system is based on a Prime 550 processor, 2.25M Byte disk storage, 800BPI magnetic tape, 300LPM printer. It utilises a Calcomp 960 plotter and a

Calcomp A0 digitizer. There are 12 Insight graphic terminals (512x512 points) with joy-sticks, and an Epson printer.

The author took the one week full time computer graphics course run by the department. Two short animation sequences were made using the computer graphic system at the Middlesex Polytechnic during the course. The aim was to use Picaso subroutines to animate a digitized image. After these were digitized, they were plotted onto paper and later recorded on 16mm film. Illustrations of the movements can be seen in drawing format in Figure 26 of the report, and in section B of the video tape.

The program used to executed the movements:
The only difference between the two movements is the statement which establishes a 3-D observer looking at the origin from a different distance and from another angle.(Ref.PEYE pg.95)

```
A (1000), B(1000)
CALL START
CALL FORMAT(30.0,30.0)
CALL FRAME (-2.0,2.0,-1.5,1.5)
CALL POSITN (0.0,27.0)
CALL IN2D(A,'R    ')
CALL THICK 8A,6.0,B)
DO 1 I=1,24
DISTNC=CUSHN(24.0,10.0,I,24,1,0)
ROTATN=CUSHN(0.0,360.0,I,24,1,1)
ELEVTN=CUSHN(0.0,45.0,I,24,1,1)
CALL PEYE(0.0,0.0,0.0,DISTNC,ROTATN,ELEVTN)
CALL DRAWIT(B)
CALL NCLOSE
CALL FRANUM(0.0,-0.25,I,0.0)
CALL NEXT(0.5,-1.0)
1 CONTINUE
CALL FINISH
STOP
END
```

There follows an explanation of the PICASO System Commands use in the writing of the above program. (The System Commands have a global effect on a PICASO program and generally can be called at any time during

a program's execution.)

CALL START: Initialises any PICASO based program.

CALL FORMAT: Defines the maximum area available to the PICASO system.

CALL FRAME: Establishes a rectangular frame within which drawing is permitted.

CALL POSITION: Changes the physical position of the current FRAME on the display device.

CALL NEXT: Establishes the next position for the current FRAME on the drawing area as defined in FORMAT.

CALL FINISH: Terminates a PICASO based program.

Object Drawing Commands used in the above program: (Object Drawing Commands may be used to draw perspective views of two dimensional shapes and three-dimensional objects)

DRAWIT: Draws a PICASO object with no shift or

scaling.

Input-Output Commands used in the above program: (The Input-Output Commands are used to load and unload external disc-based files storing coordinate data as PICASO shapes and objects.)

IN2D: Load from a disc file 2-D coordinate data (creates a PICASO shape).

Other commands used in the writing of the above program are:

PEYE: (Polar coordinate EYE)
Function: establishes a 3-D observer using polar coordinates.
Category: System Command
XF,YF,ZF: (REAL) are the X,Y,Z coordinates of the point under observation.

DISTNC: (REAL) is the distance of the observer from (XF,YF,ZF)

AZIMTH: (REAL degrees) is the angle in the (X-Z) plane the obserever is rotated from the Z-axis towards the X-axis.

ELEVTN: (REAL degrees) is the observer's angle of elevation relative to the (X-Z) plane.

DRAWIT

Function: Draw a PICASO shape or object without scaling or shifting.

Category: 2&3-D drawing command.

NCLOSE (ENCLOSE).

Function: Draws the boundary of the current frame (as defined by the FRAME)

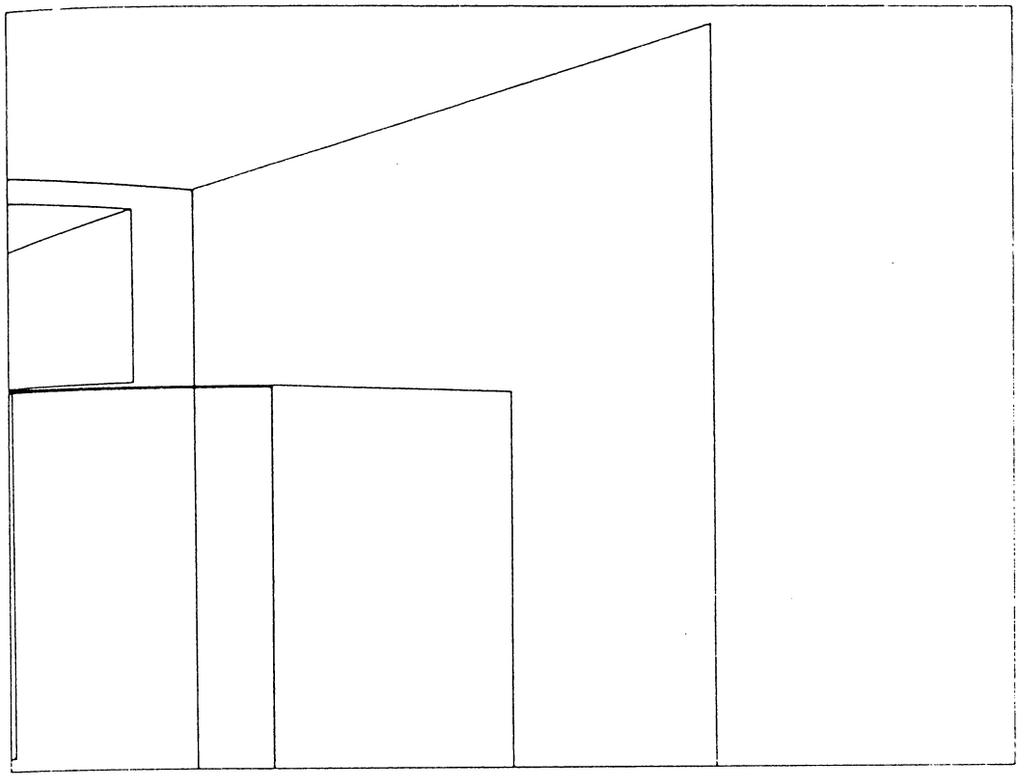
Category: System command.

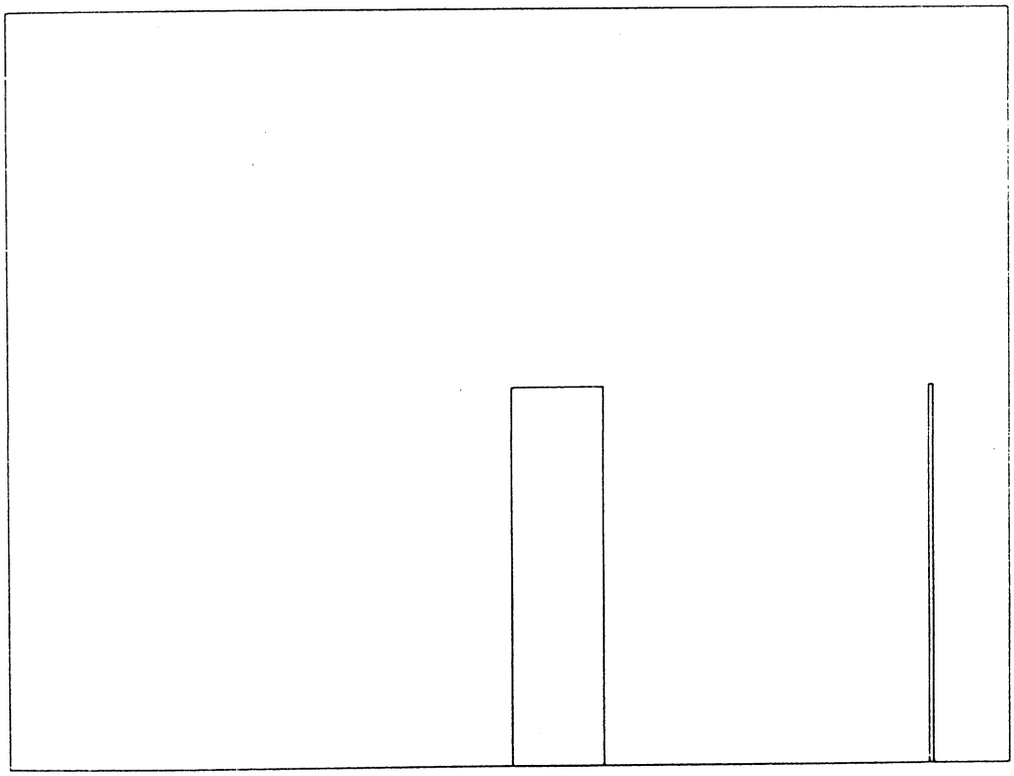
THICK

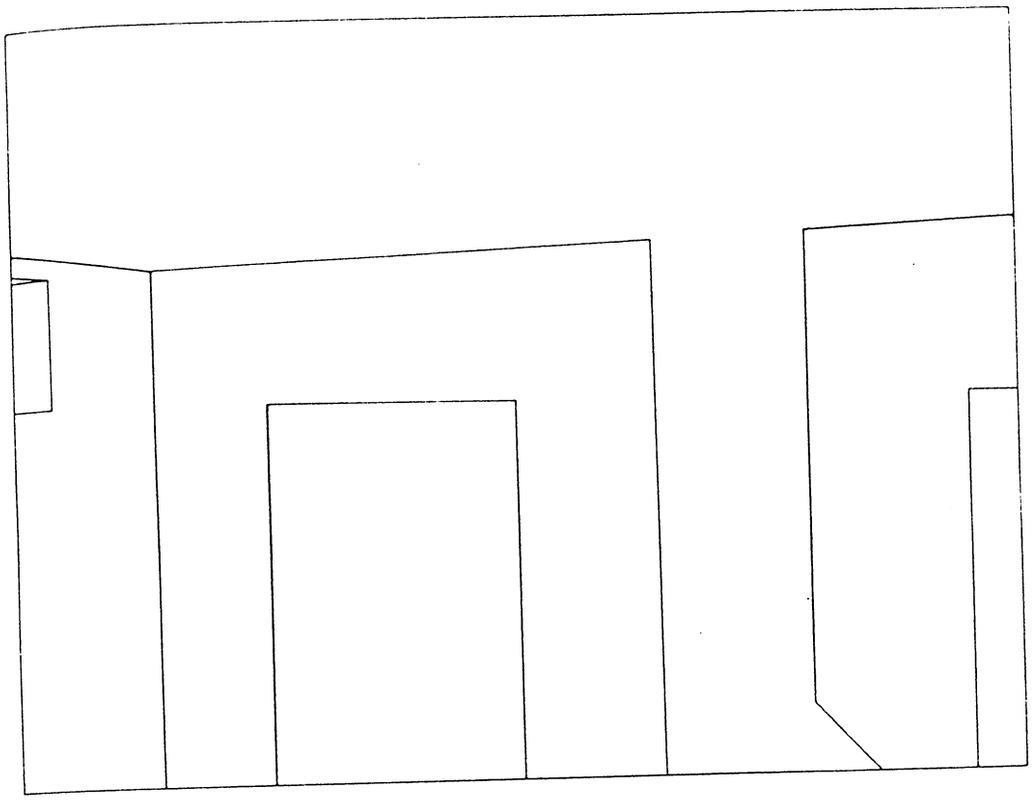
Function: creates a PICASO object from a PICASO shape by including a z-coordinate 'Z' inches thich.

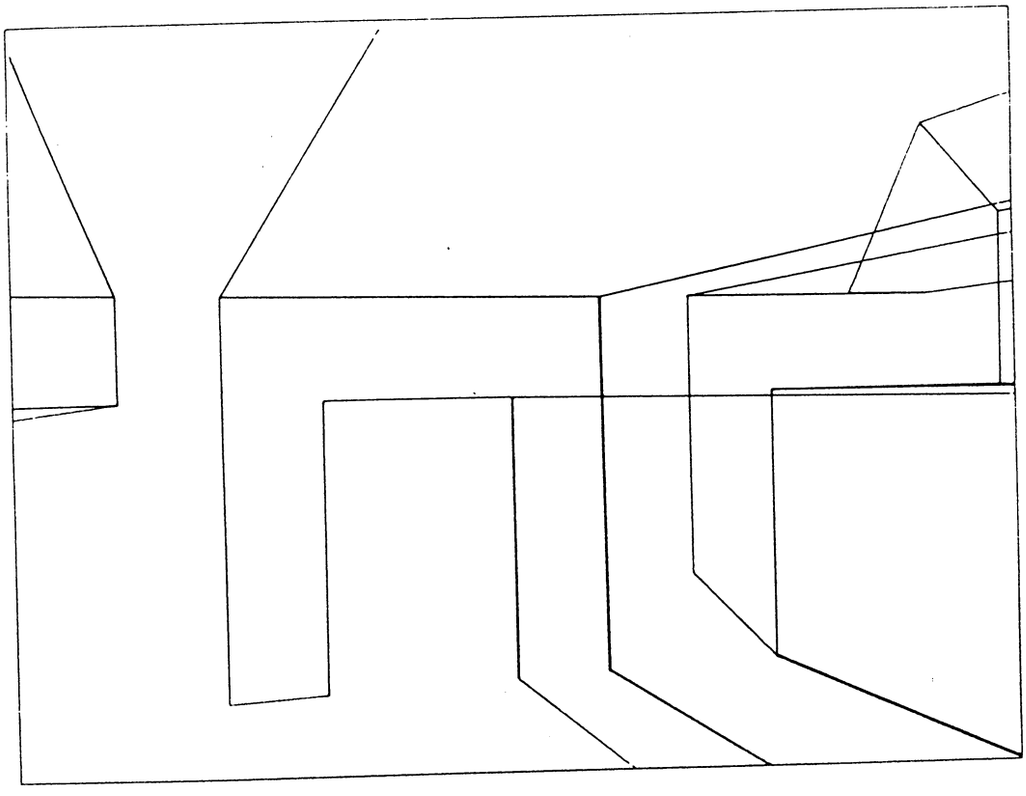
Category: Shape manipulation.

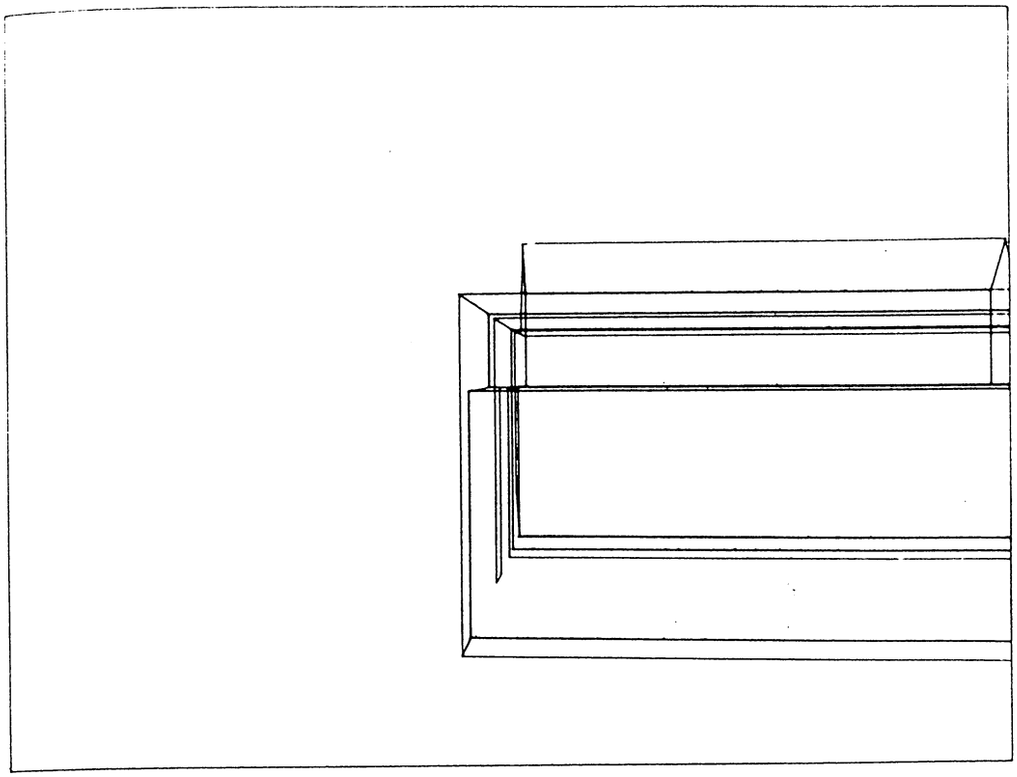
Figure no. 26: Middlesex Polytechic, Animation sequence.

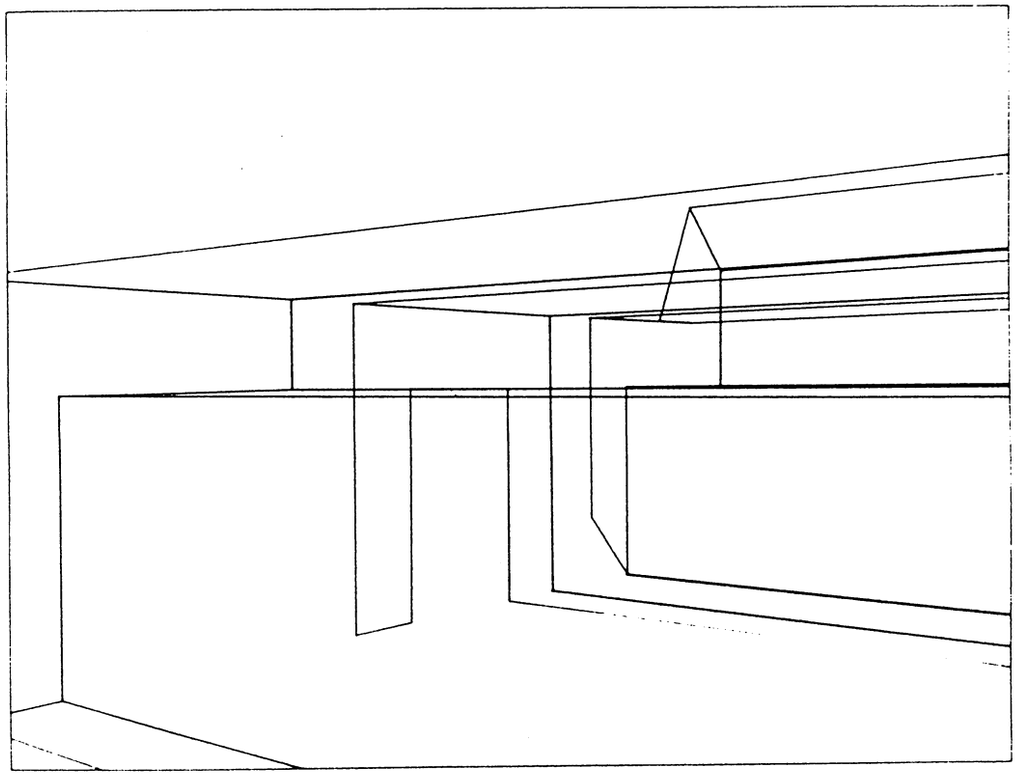


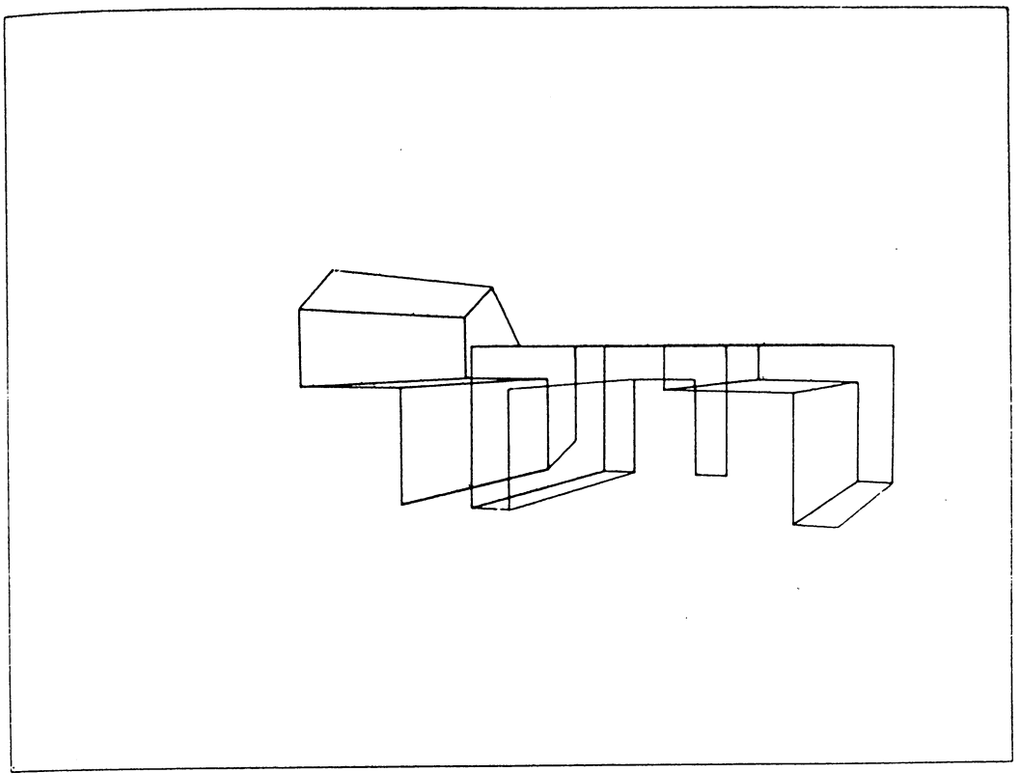


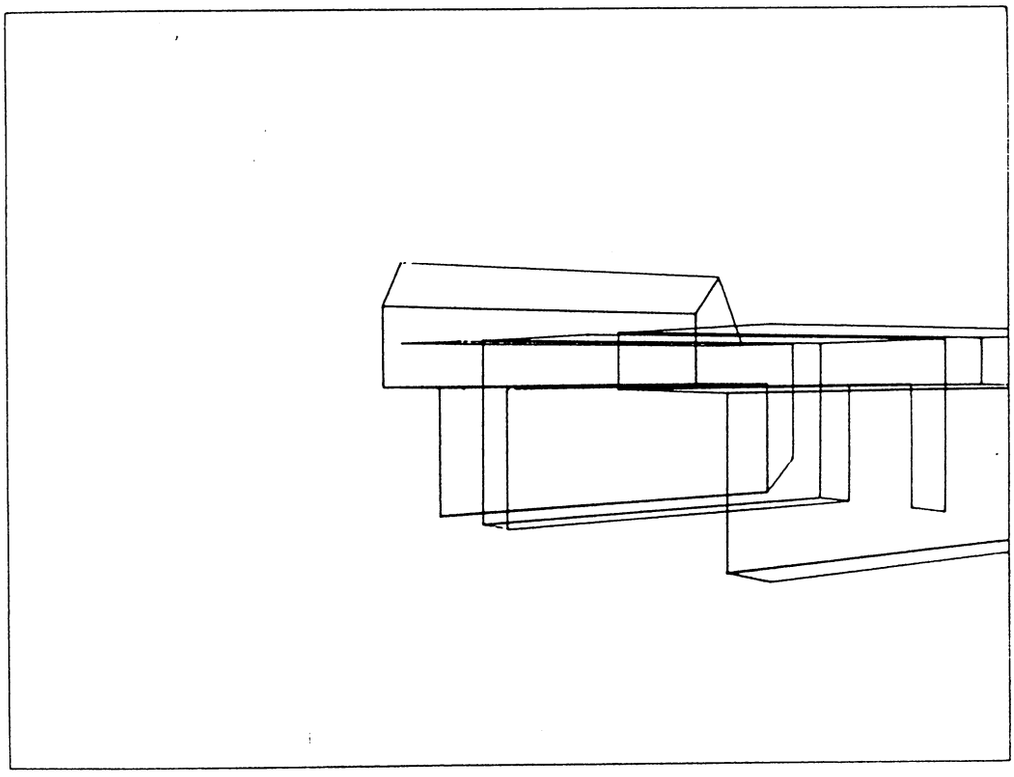


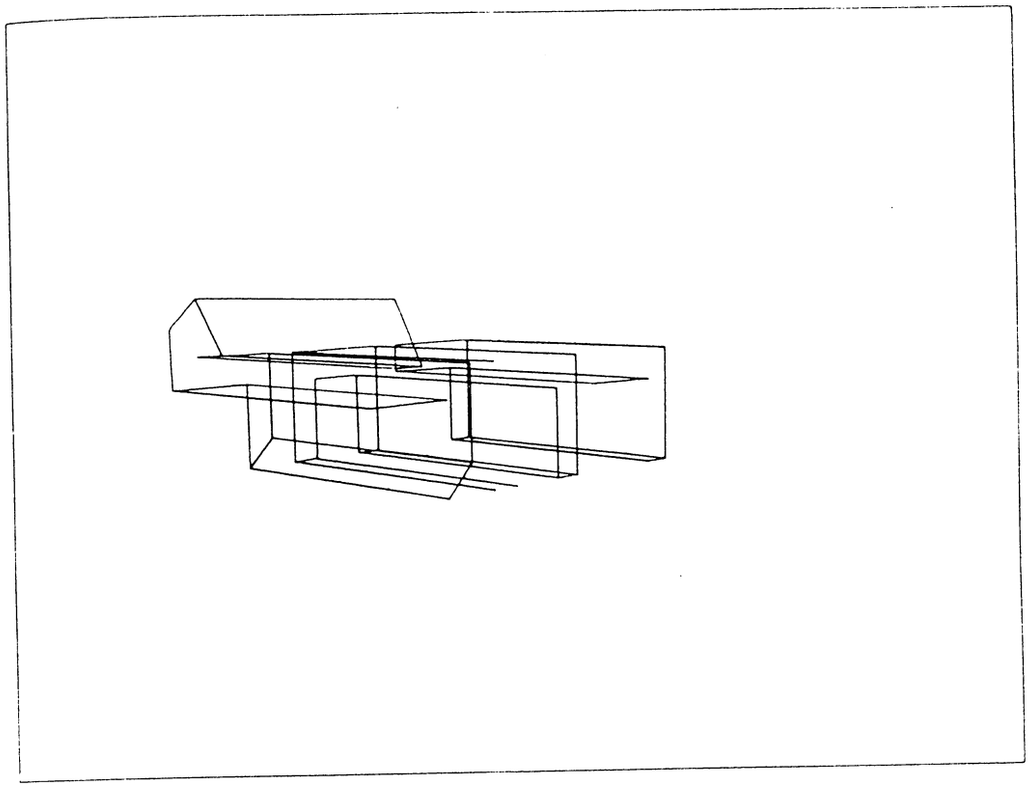


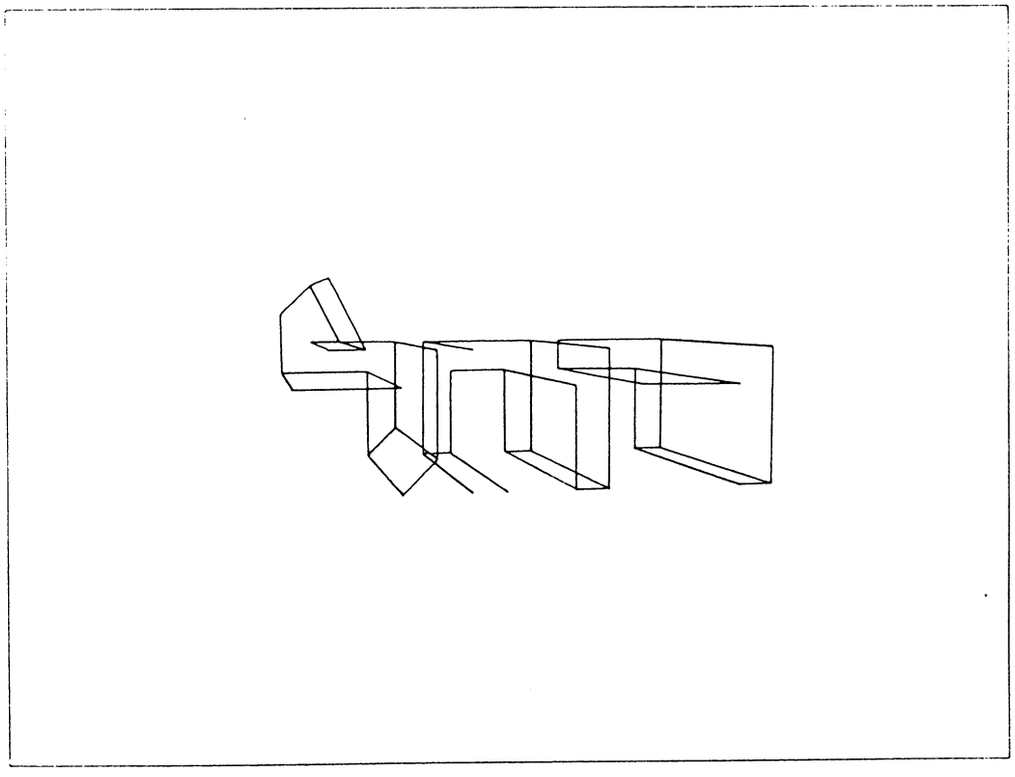


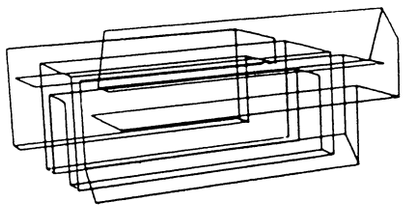


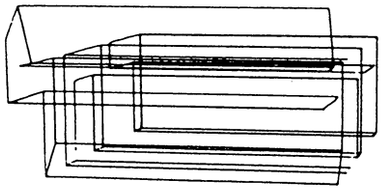


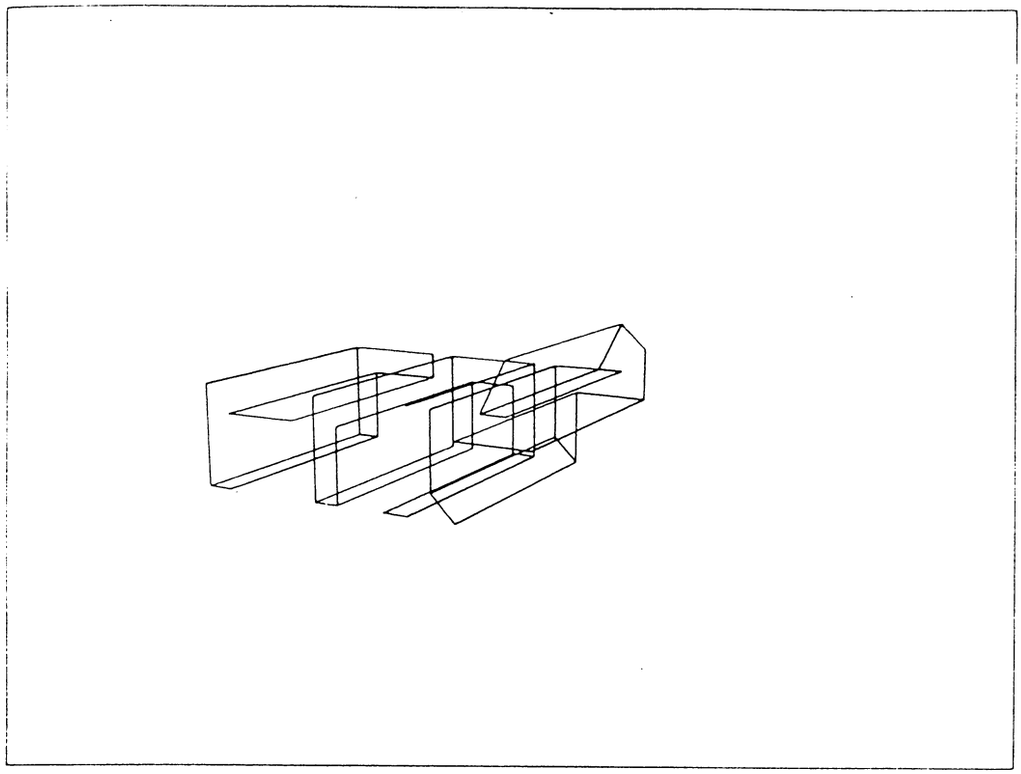


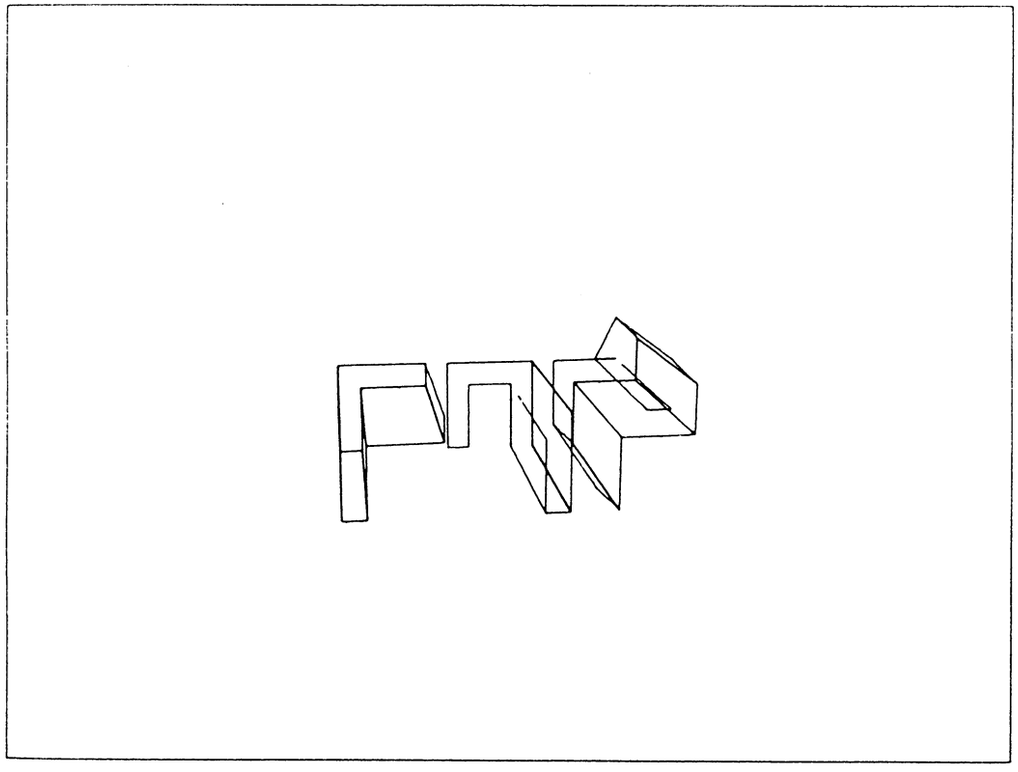


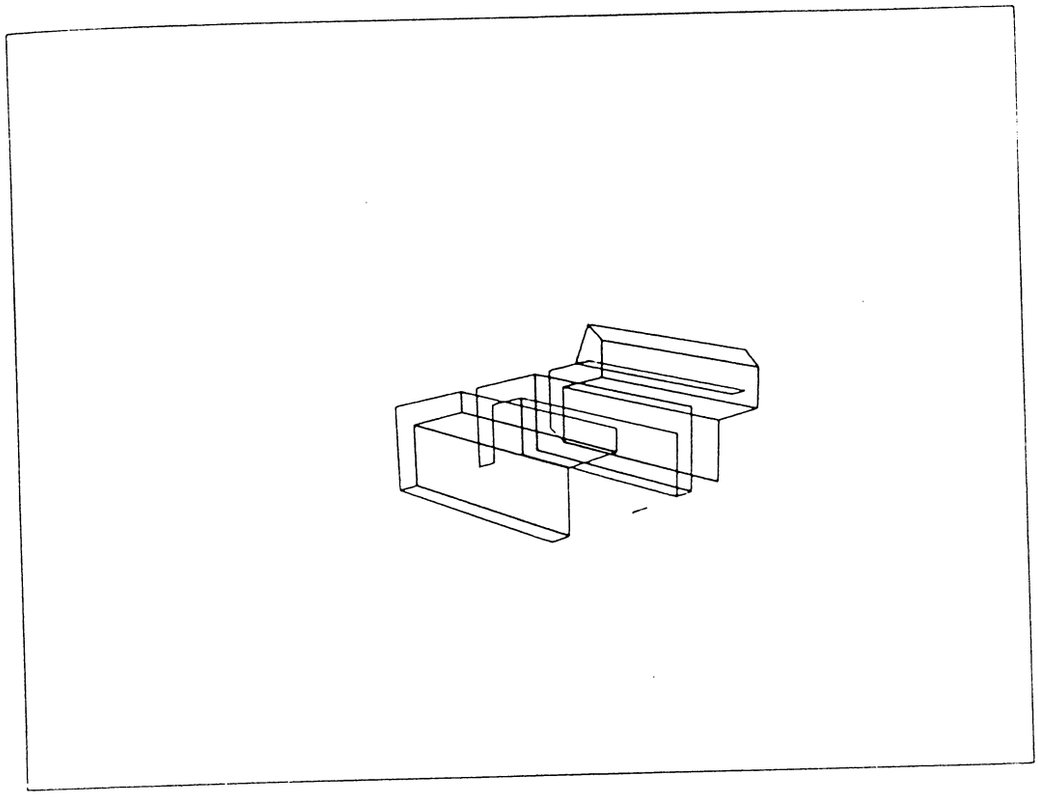


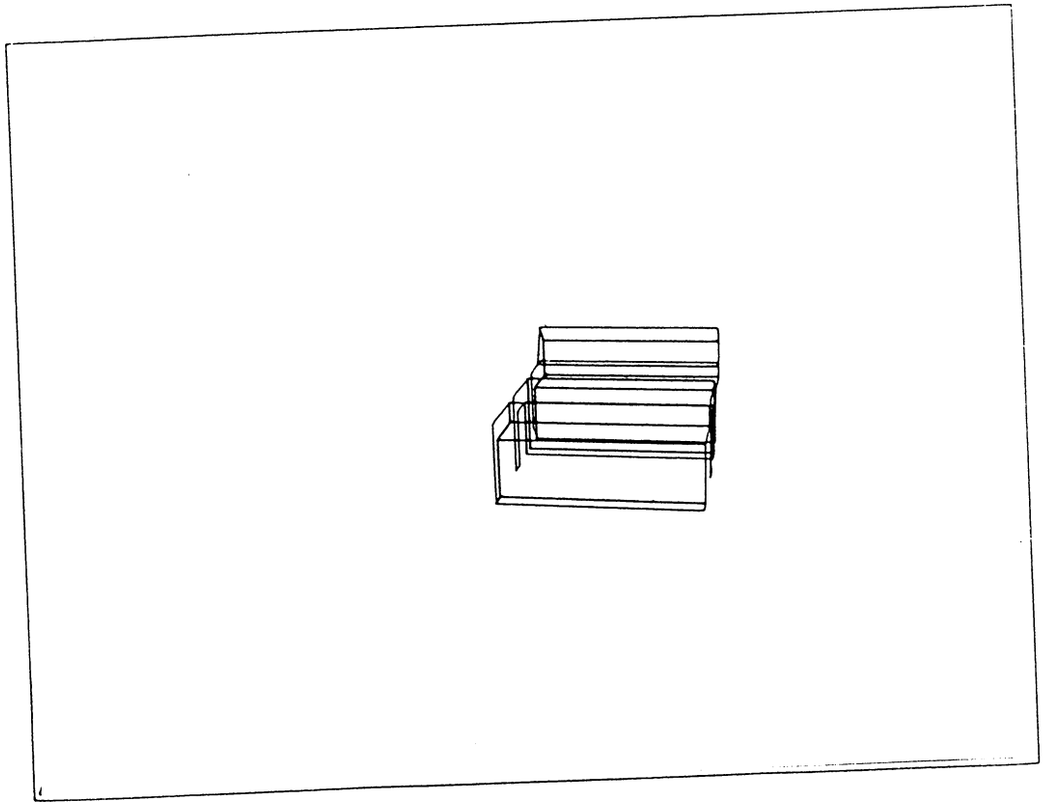


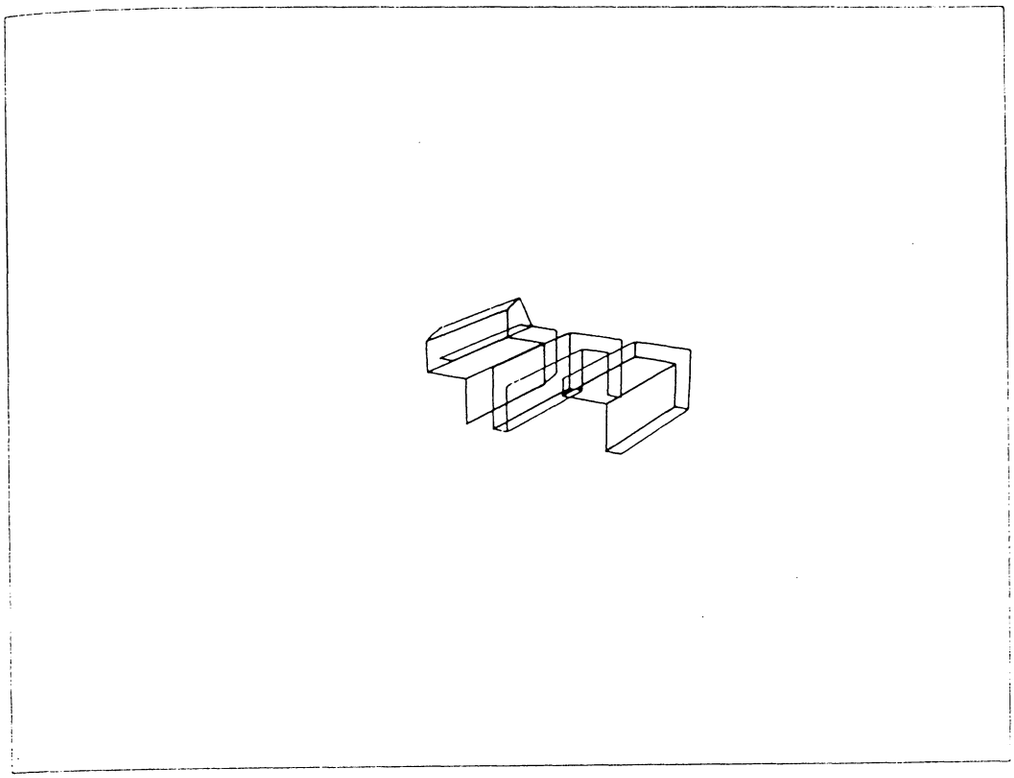


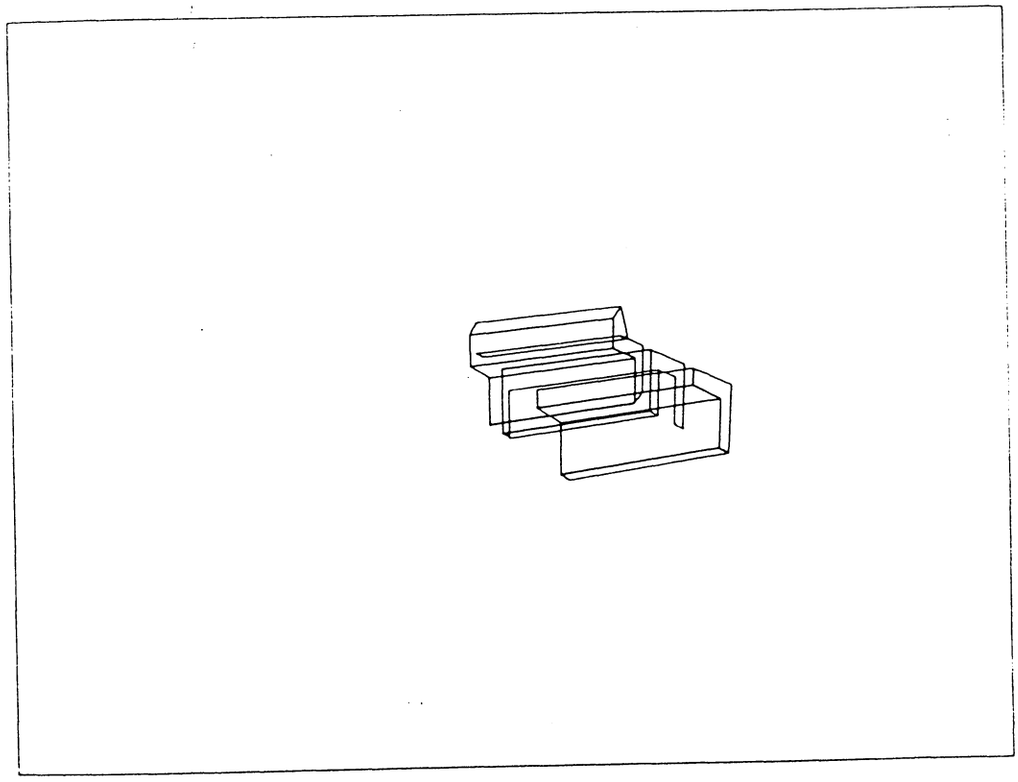


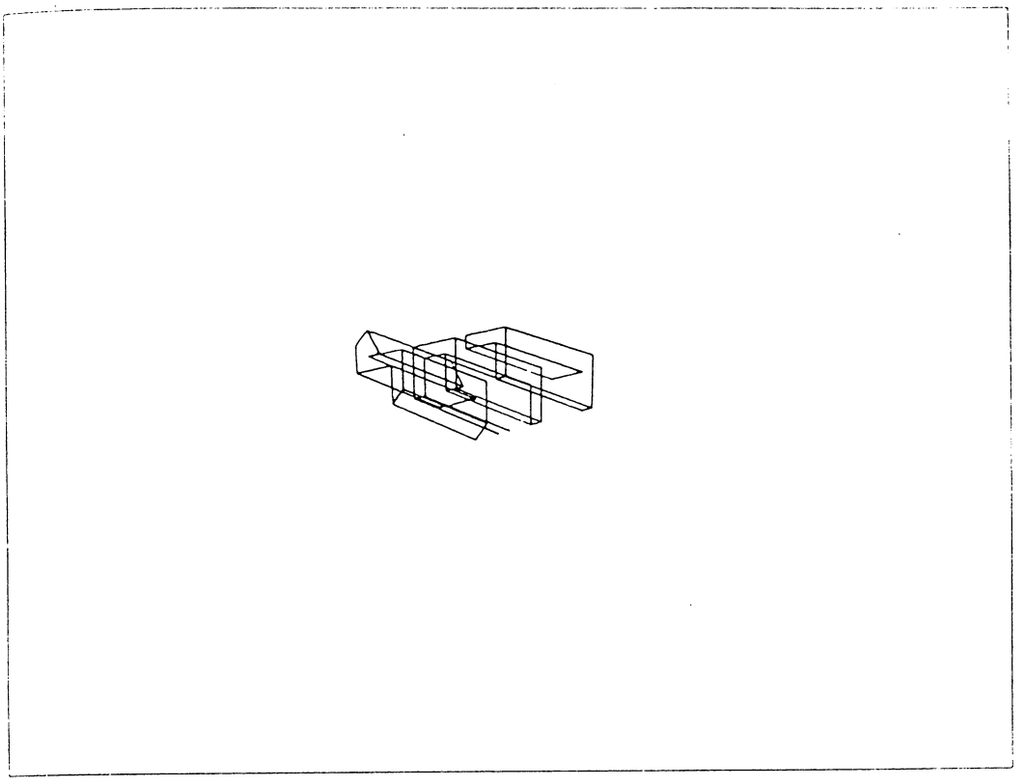


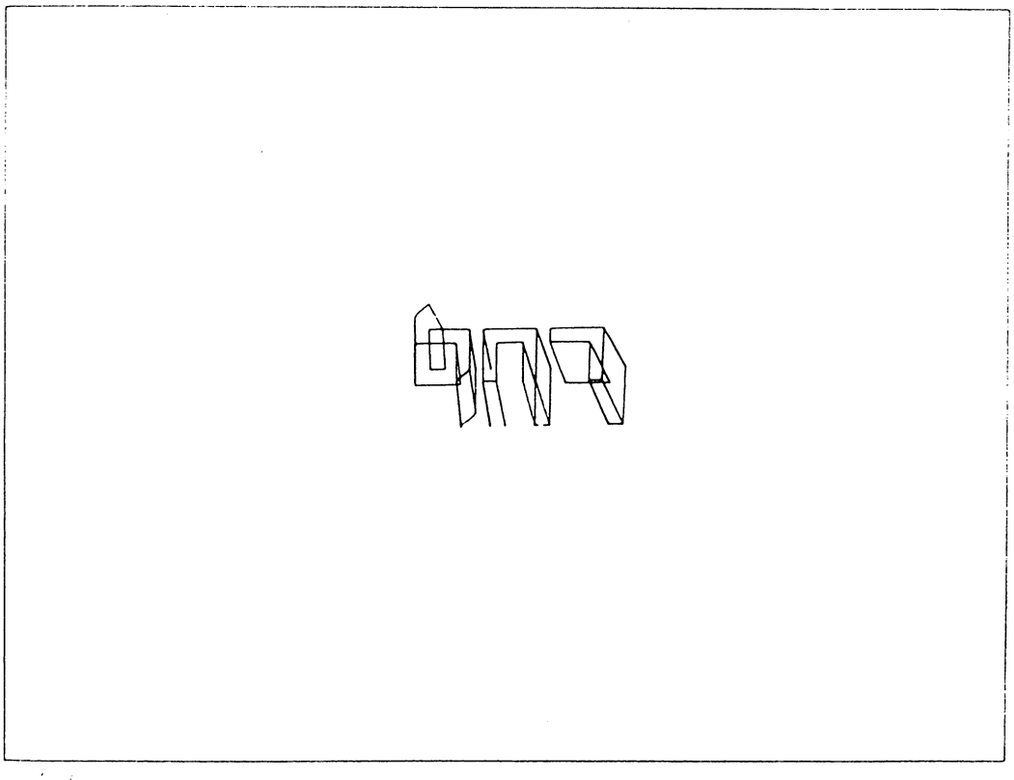


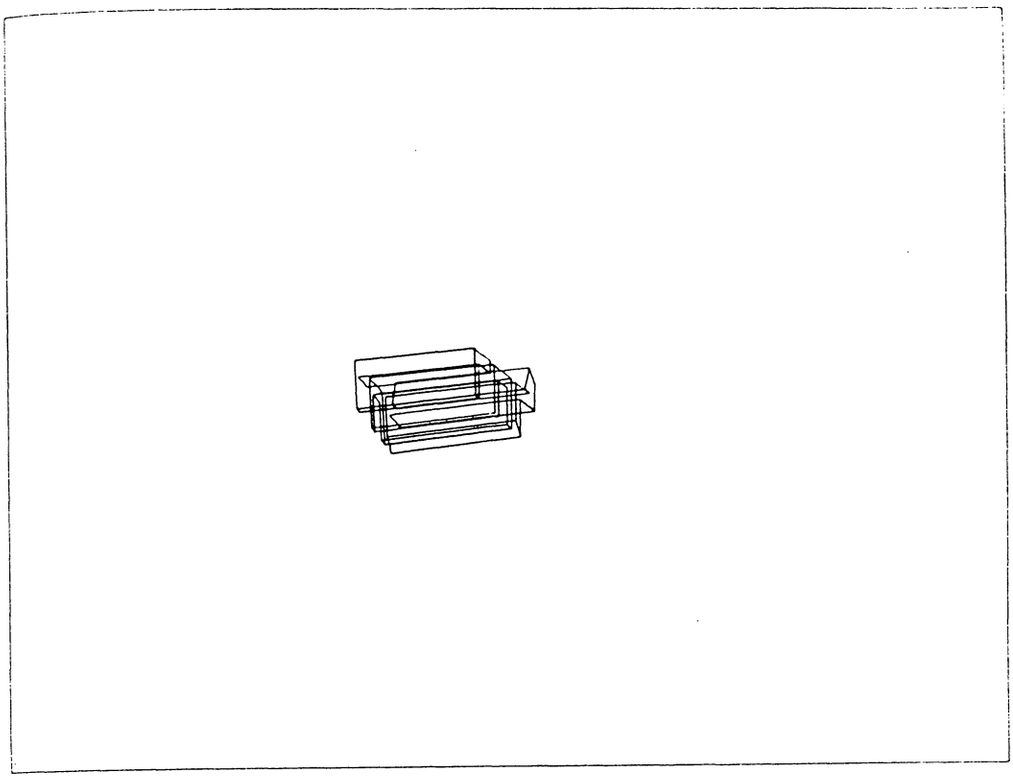


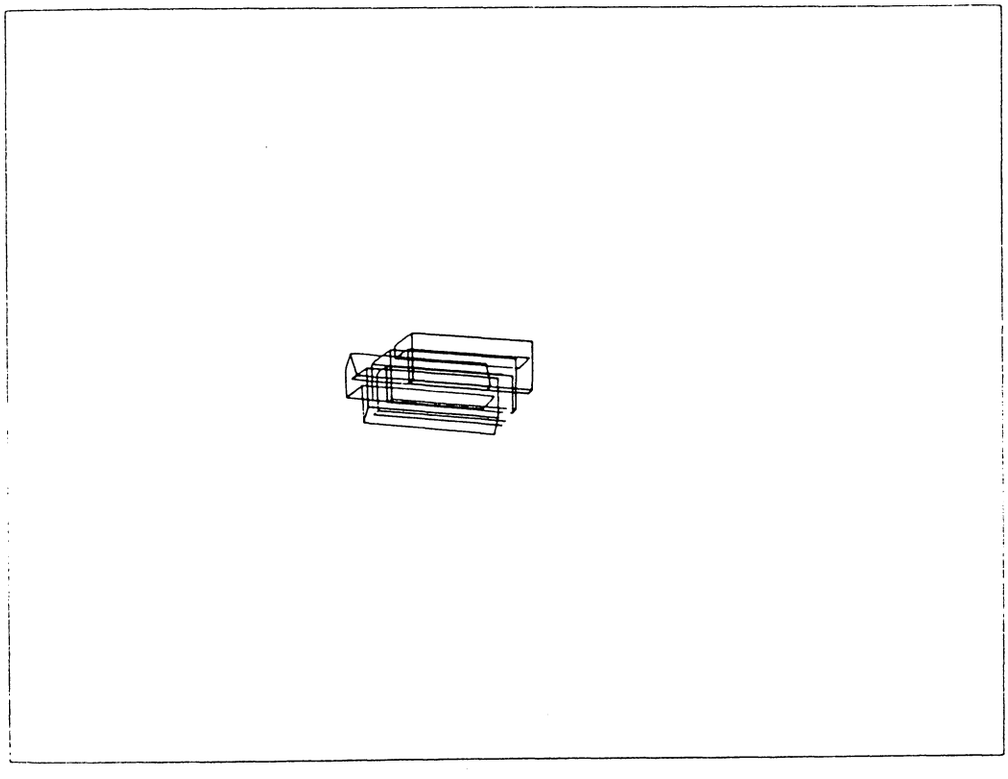












C- Video manipulation sequence made at Imperial College

Software used: 'Vicar 2'

Language used: Fortran

Computer used: Vax 11/780

The Centre for Remote Sensing, at Imperial College, is a national and international facility for the development of Remote Sensing and Image Processing activities in Earth resources, vegetation studies, geology, atmospheric physics, image processing and pattern recognition. The author got to know about the Centre while she attended a course in programing Fortran at Imperial College in June 1983. When the author approached Dr.Garry Hunt, the head of the unit, with a request to allow her to experiment with the use of the centre for image processing, the response was positive and during July 1983 the author with the help of Dave Rumball, a research student at the centre , produced the work which is shown on the Video section C.

The Centre possesses an interactive multi-user processing facility which consists of two central processing units, a VAX 11/780 and a PDP 11/24, with large on-line disc storage, a PPL 121 video disc display unit and three I2S digital display devices. The system software is derived from a portable version of the American Jet Propulsion Laboratory VICAR (Video Image Communication and Retrieval) .

The author took Polaroid images (Figure 27) from an existing film called:"Fare well",then the photographic positive was digitised into the system via the I2S. One frame store can be loaded from the video camera synchronised to the system. This is then available to all parts of the system. The I2S supports a graphic tablet (Sumagraphics) and, as part of its image processing capabilities, a trackball driven cursor that can be used to write to both the image (8-bit) and graphic (1-bit) planes. These images are also available to the whole system. The output for the work was recorded on video tape (BVU 200P). Monochrome images from either the PPL or I2S are recorded directly, and colour images after first encoding them as a PAL/B signal.

Programs used to manipulate images in order of appearance on the video:

C1 -IPSEU

Program does sophisticated pseudo colour, using I2S primitives.

C2- IROAM

Program permits roaming about images occuping multiple channels on the I2S. The parameters relate directly to the image plane configuration as used in IIPUT to display the image.

IMOV

This routine is for making long movie loops on the I2S: it steps and Zooms the four quadrants of the channel to create four separate 128*128 pixel movie frames; the maximum capacity of the I2S is then 4*6=24 frames.

C3- IZOOM

Program for doing interactive integral, replicative zoom on the I2S.

C4-IREG

IREG is a program for interactive registration on the I2S display. It can be used to register images in existing I2S channels, or data sets can be specified. Registration can be done in two ways. With the first method the images are scrolled until they are physically registered on the I2S. The resulting registered images are written to two different channels. Only translation is allowed in this mode. in the second method tie points are selected and a tie point data set is written. This is used by the warp program to distort one of the images so that it is registered with the first.

It offers 4 display modes:

(i) Flick screen mode with variable flick rate. The display flicks between the 2 pictures continuously.

(ii) Subtract mode. One of the images is inverted . Registration is accomplished by creating uniform brightness.

(iii) Colour mode. One picture is coloured red, the other green, and they are added togther.

(iv) Split screen mode.

Most options are menu selectable.

An enhancement option allows the user to stretch the two pictures either together or independently.

The zoom factor can be changed while scrolling.

The user can optionally link to points in either or both images when scrolling.

C5-BOXFLT

Program does low pass filtering. Filtering is done by forming a sliding average within a box of specified dimensions. The type of input data (byte or halfword) is read off the system label. This can be overidden by specifying either of the keywords BYTE or HALF. The output data set is in the same format as the input data set.

C6- IBLOTCH

Program creates a blotched region on the graphics plane. Optionally regions may be filled in.

C7-IBOXCON

Program reads an I2S channel and plots a contour map. This routine makes very heavy use of the VAX and elapsed time increases exponentially with the number of samples in the box.

Button functions:

Cursor control:

'A'...Enable motion of top left corner of box

'B'...Enable bottom right hand corner

'C'...Move box as a whole

'D'...Exit back to calling program & plot contours.

Display of cursor

'A'...Switch display of box cursor off if it is on & on if it is off.

'B'...Exit from program leaving box cursor in Plane 0.

'C' or 'D' ..Exit from program after erasing box cursor in plane 0.

C7-WARP

WARP does a 'rubber sheet' transformation on a VICAR image, based on tie point data provided by IREG. A polynomial distortion model is fitted for the least squares deviation of the tie points. The order of the polynomial can be 1,2 or 3.

C9-FFTPIC

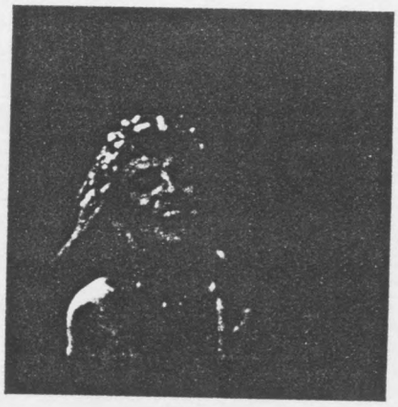
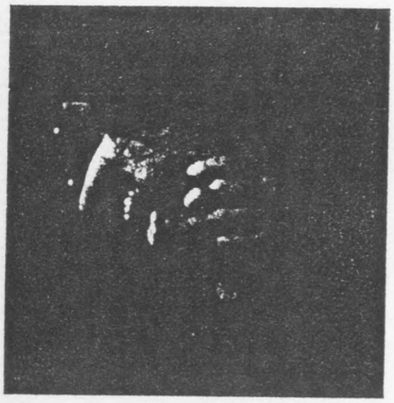
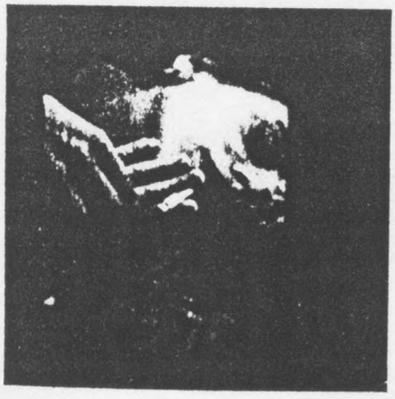
FFTPIC is used to re-format 2-D fourier transforms into a form suitable for display. It includes amplitude and phase options. Lin or log can be selected. This program requires secondary input data to store intermediate results.

Figure no. 27: Still images used for sequence made at Imperial College.







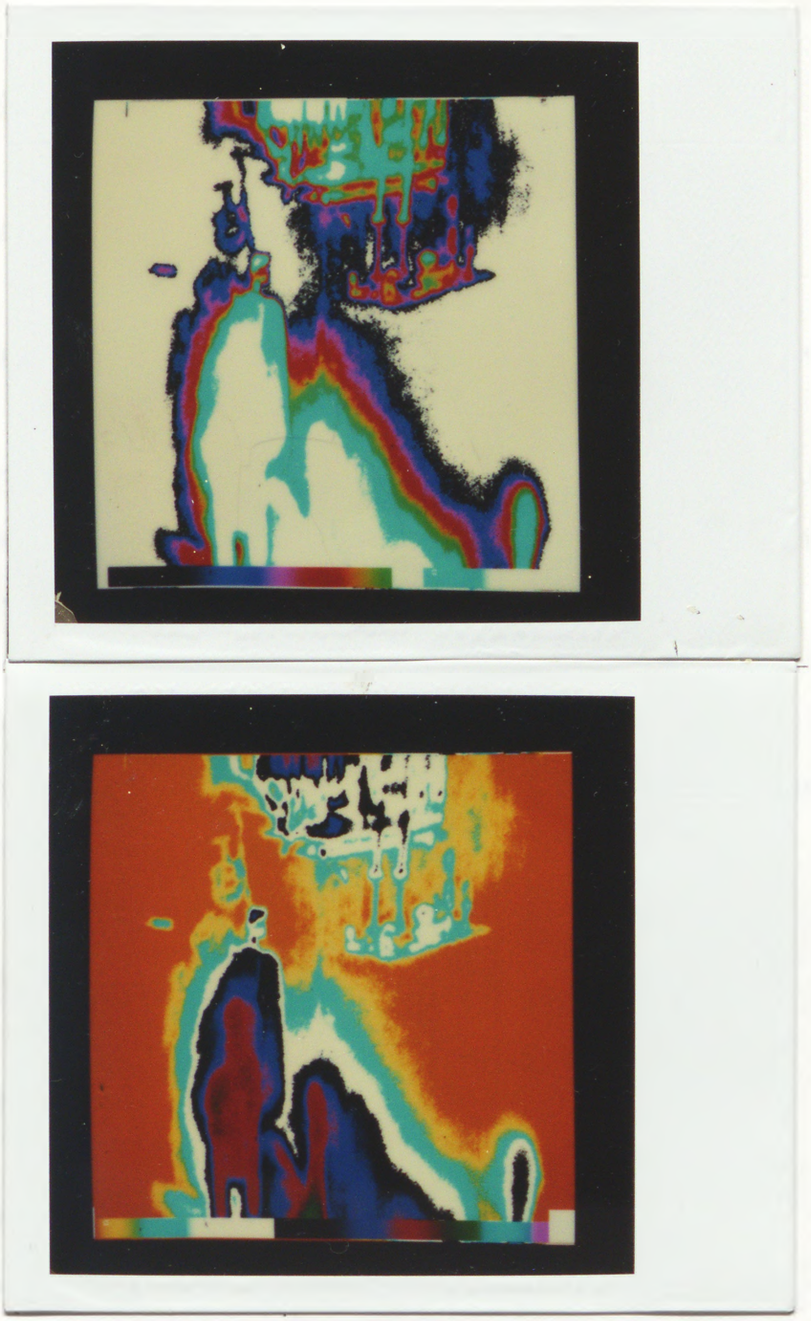


Figure no.28: 'C 1', Imperial College.

D-Simple graphic programs

Language used: Basic

Computer used: Research Machines 380Z microcomputer

The author used BASIC for programing these graphics movements, which is a high level programming language. BASIC stand for Beginners' All purpose Symbolic Instruction Code and it can be used on all computers containing a BASIC interpreter. The equipment set up at the computer studio/ RCA, is the same as in sub-section A of this section.

Program listings

D1-'RACHEL 1'

```
90  PUT 12
100 CALL "RESOLUTION",0,2
105 RANDOMIZE
110 FOR I=1 TO 3
120 READ X(I),Y(I)
```

```
130 NEXT I
140 DATA 150,150,150,60,250,60
150 XF=INT(11*RND(1)-5):YF=INF(11*RND(1)-5)
160 FOR I=1 TO 3
170 X=(I)=X(I)+XF
180 Y=(I)=Y(I)+YF
190 NEXT I
195 C=INT(3*RND(1)+1)
200 CALL "PLOT",X(1),Y(1),C
210 FOR I=2 TO 3
220 CALL "LINE",X(I)<Y(I)
230 NEXT I
235 FOR I=0 TO 3:CALL"COLOUR",I,INT(256*RND(1)):NEXT I
240 GOTO 150
```

Line 90 - clear the screen of any text on it.

Line 100 - set up the screen for high resolution graphics.

Line 105 - when you refer to random numbers you want them to be really random and not always taken in the same order from a pre-determined series of pseudo random numbers.

Lines 110-140 - Inside the loop values for x(I),Y(I) are read in from the statement.

Lines 150-190 - you then take an X factor which is a random number and a Y factor which is also a random number and then for each of the co-ordinates add on random factor X and the Y. A conceptual shape is thus defined, and random numbers added to its co-ordinates.

Line 195 - random colour is added.

Lines 200-230 - the points are plotted out.

Line 235 - randomly change the colour of the shape. Colour 'I' is changed to,INT(256*RND(1)) which means 'pick a random colour between 1 and 256' .

240 - end of loop: back to line 150. The result is that the shape you define in the first part of the program can shift around the screen left and right, up and down in small steps and it will change its colour randomly each time it does it.

D"-'RACHEL 2'

'Rachel 2' is the same as 'Rachel 1' the difference is in the shape.(lines 140-142)

```
90  PUT 12
100 CALL "RESOLUTION,0,2
105 RANDOMIZE
110 FOR I= 1 TO 6
120 READ X(I),Y(I)
130 NEXT I
140 DATA 150,150,150,60,250,60,250,100,200,150,150,150
141 XF= INT(11*RND(1)-5):YF=INT(11*RND(1)-5)
141 XF=INT(11*RND(1)-5):YF=INT(11*RND(1)-5)
142 FOR I=1 TO 6
143 Y(I)=Y(I)+YF
144 NEXT I
145 C=INT(3*RND(1)+1)
150 CALL"PLOT",X(1),Y(1),3
160 FOR I=2 TO 6
170 CALL"LINE",X(I),Y(I)
180 NEXT I
190 GOTO 141
```

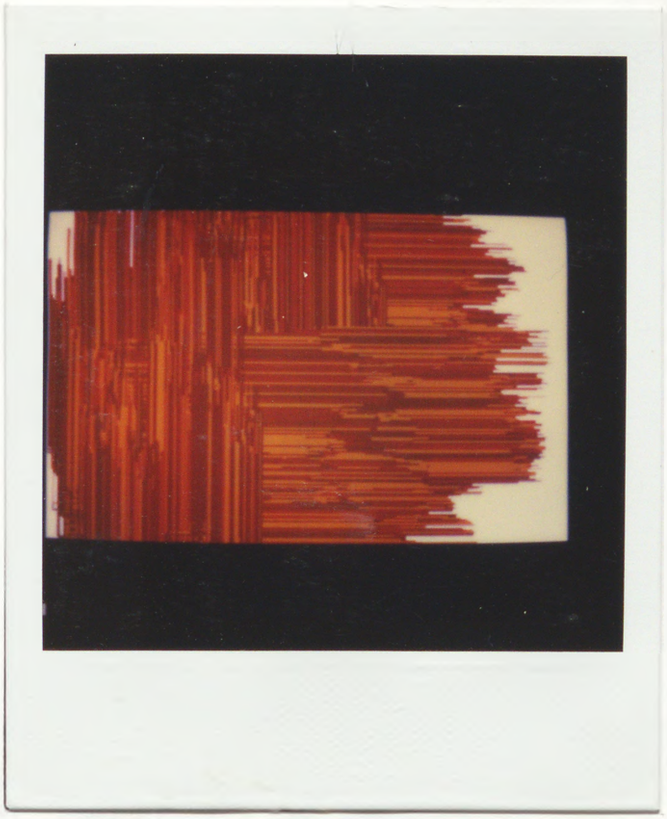


Figure no.29: 'RACHEL 1', 1983.

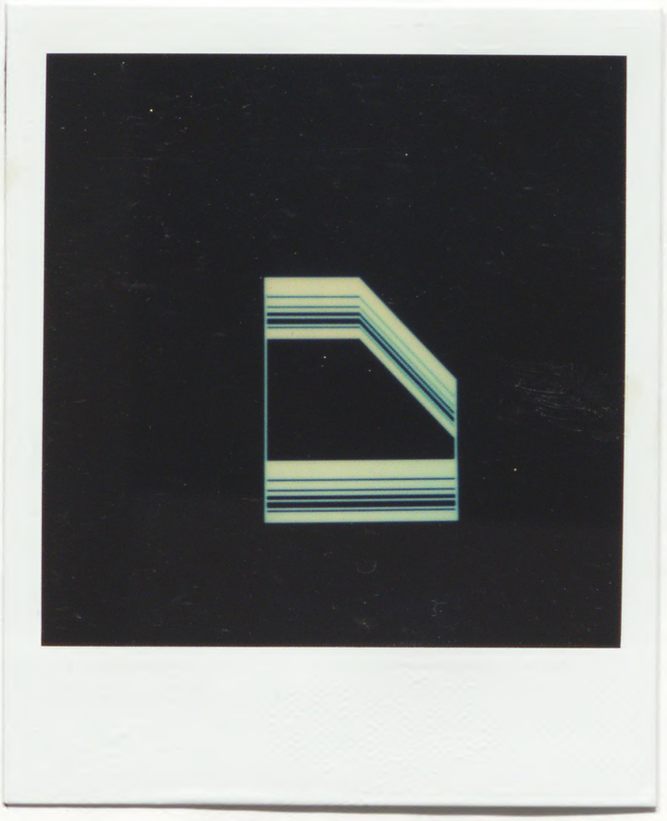


Figure no. 30: 'RACHEL2', 1983.

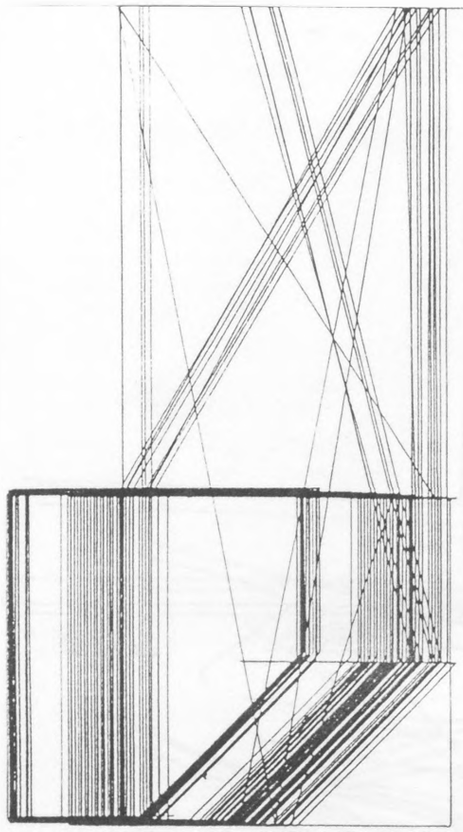
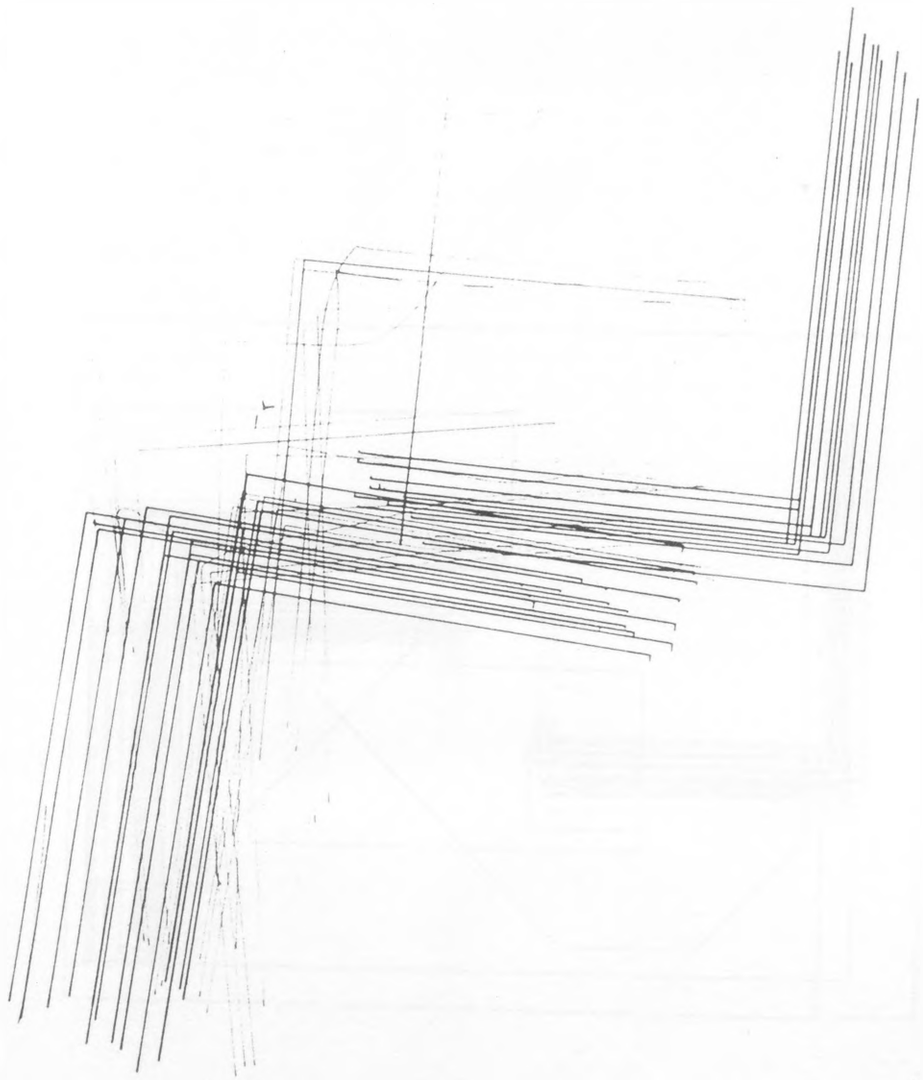
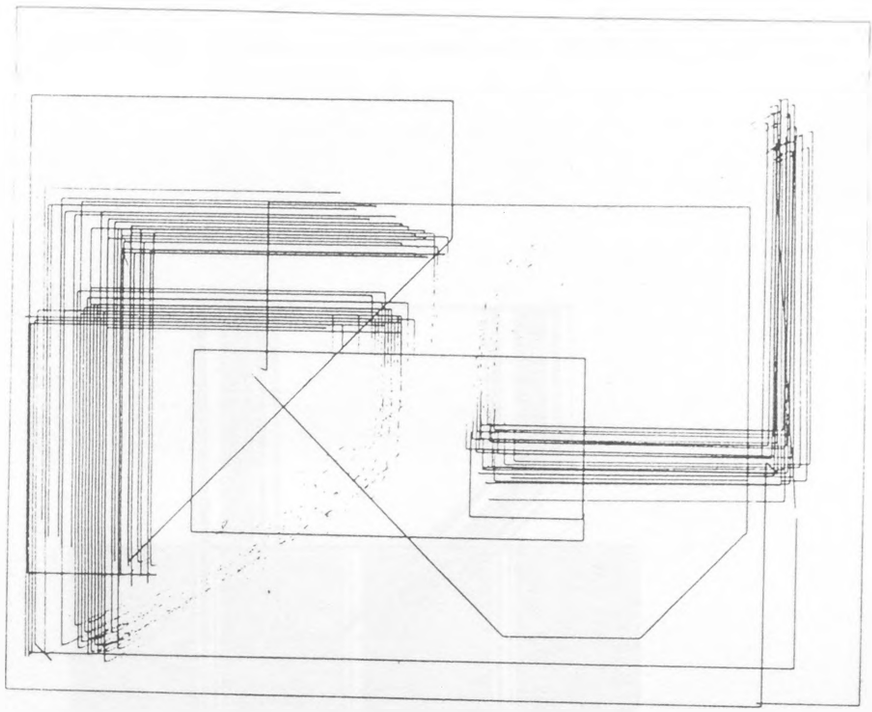
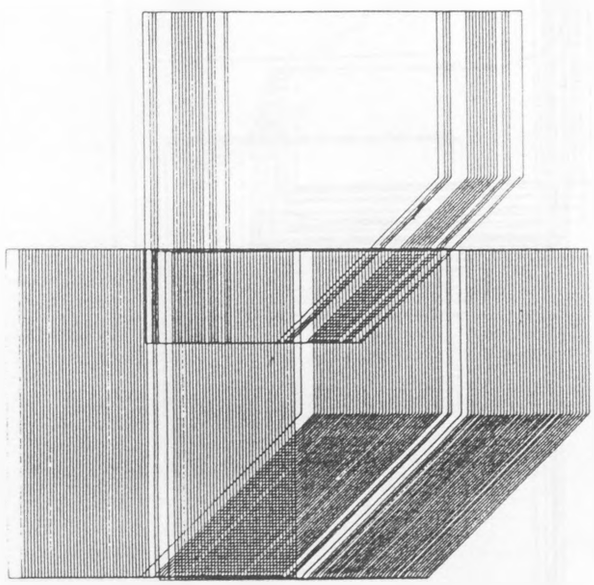
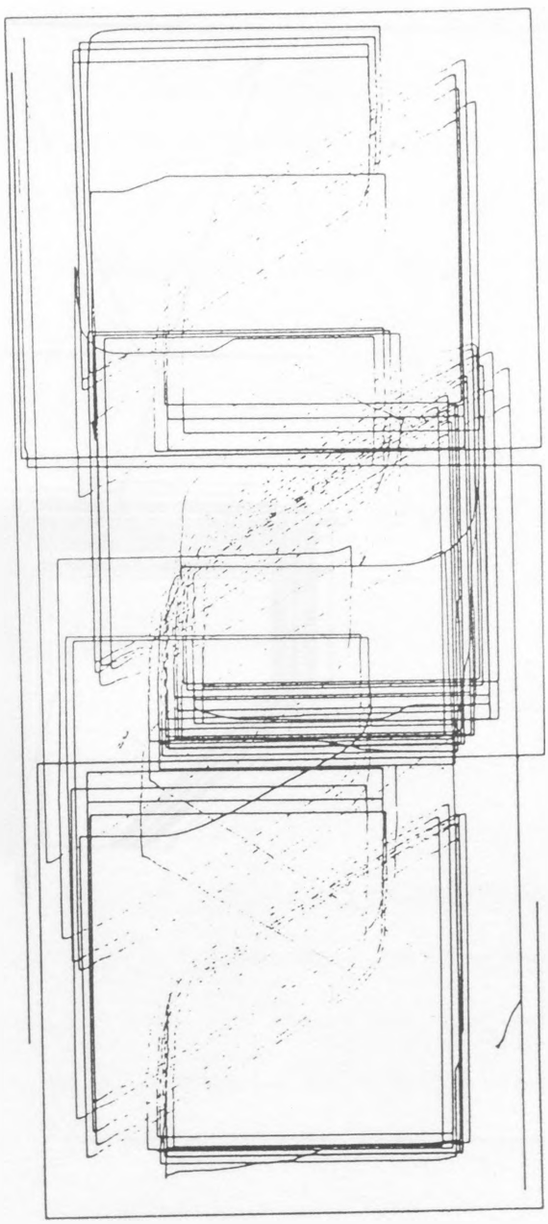


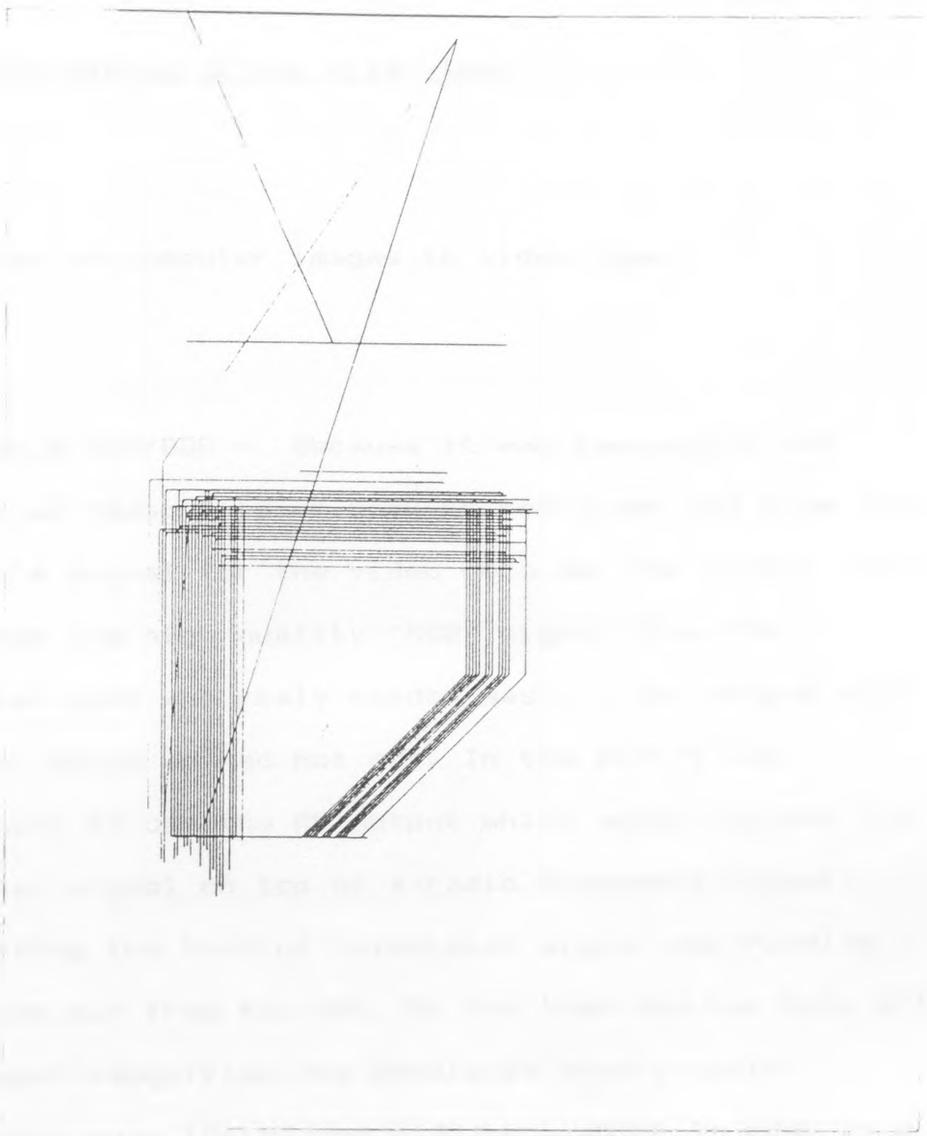
Figure no. 31: 'Rachel1' & 'Rachel2' free-hand plotting.
pp 123-129.











3.2 The making of the film/video

Transfer of computer images to video tape.

Section A RCA/DDR - Because it was impossible for technical reasons to re-combine red green and blue into a single signal for the video recorder the author could not used the high quality 'RGB' signal from the computer.What was realy needed was a video output with colour, which we had not got. In the end it was necessary to use the RF output which super-imposes the computer signal on top of a radio frequency signal, simulating the kind of television signal you receive over the air from the BBC. By the time one has done all the super-imposition and modulated onto a radio frequency wave inside the computer, which is done in a rather cheap way as opposed to how the BBC do it with all their resources, one ends up with the worst of both worlds but that was the only way to record in colour.

Section B Middlesex Polytechnic - The plotted images,

ink on paper, (two 24 frame sequences) were filmed with a 16mm rostrum camera. Each of the movements was filmed twice, once at 2 frames per image and once at 3 frames per image. The positive was sent then to a commercial laboratory in order to have it transfered onto video (via telecine).

Section c Imperial College - The material was recoded onto video tape(BVU 200P). Monochrome images from either the PPL or I2S are recorded directly and colour images after first encoding them as a PAL/B signal. A constant problem is that both PPL and I2S frame store produce pixels whose aspect ratio is 3:2. This is because they both dispose 512 elements along the TV line instead of the 768 required to make each pixel'square'. Thus, pending a digital line converter, all frames for final display are 'pre-squeezed'by horizontal averaging in a software program so that, on display, each pixel is seen as effectively square.

Section D RCA/DDR - As in section A.

Editing:

Those sources A,B,C,&D were first viewed by the author with the intention to select the best possible material for the Video. Logging and timing of the material took place at that stage and the author had by that time a rough cut(editing) in her mind. The title sequences were decided upon and typesetting of the titles was done at the Graphic Department/RCA. Those titles were then filmed onto video in the Department of Design Research. Three days of editing were booked at the Video studio in the Environmental Media Department (it was difficult to get more days as they give priority to their students). The editing technique which was used is called 'insert editing' in which you transfer your source through an Editing Controller to the Editor tape (your master). The equipment used for editing was a Panasonic Editing controller AV-A960. Commentary was put over to illustrate the images and to complement the material available in the report.

Facilities for super-imposition during editing, as well as more time for editing, would have given better results.

3.3 Critical appraisal of the experimental programme

The author did not cover everything, but did choose a range of techniques, that were available, manageable, and all of which were designed to help the author with her understanding of the use of computers for image making. This experience was needed also with the formation of the questionnaires, and during the interviews. It is possible that other processes and techniques could have been used, which might have enhanced the appreciation of other workers' problems, but within the time and facilities available, it was hoped that the following would be sufficient and useful.

The techniques were:

1. Image making using a rather complex, existing software package on a microcomputer.

2. Animation and 3-D work using an existing software library of sub-routines on a large main-frame computer.

3. Image manipulation of video images using computer-based equipment.

4. The direct programming and output of simple images using a commonly available programming language.

The author was concentrating on basic, simple interaction with computer based systems, as she was looking to gain insights into fundamental problems rather then probe the 'fine detail'.

The author did not try to produce sophisticated images (either with existing software or from BASIC) but rather was interested in how easy it was to understand and use the systems, and how to make simple ideas turn into visual imagery.

The author found that each of the experiments had a new set of procedures to learn in terms of equipment and language. It would have been easier and perhaps more productive if the author had to learn to use only one

system which was sophisticated enough to have done all the experiments with. The author found that each of the systems had its own limitation (the experiences of software limitation have been used to write section 4.6). In the process of learning to use a new system the author found that she tended to accept those limitations and carve her own work to fit into those limitations, which could be a disaster visually. The author wishes she had had access to more time on each of the systems she used (Imerial College, Middlesex Polytechnic) as well as access to a more sophisticated paint system such as the Flair or Quantel to be able to compare them with the ones she has used. The author found also that learning a language like Fortran, which is not specifically a graphic language, in a scientific set-up (Imperial College) was not very productive for the purpose of graphics, since much of the knowledge gained was (graphically) redundant. What we have to aim for is a graphic language, or a concentration on graphic implementations of a language, in special design courses for that purpose.(Critical notes of the production of the Video can be found in Section 3.2)

However, despite the limitations described in this section, this was an invaluable exercise from an

artist's perspective, giving the author considerable fundamental insights into the process of computer image-making techniques.

CHAPTER 4: Factors affecting the use of computers for image-making

4.1 Description of enquiry

The interviews(ref.1.2) were transcribed and divided along lines indicated by the questions; in some cases cross references were made when peoples' answers covered more then one topic. The author interviewed 9 people. From the 17 questions the author gathered 8 topics to be covered in this chapter. The questionnaire and the transcripts of the interviews can be found in the appendix of this report.

4.2 Interview findings

From the interviews, the following general points emerged. Some, perhaps, are not at all suprising, but until now, there seems to have been no attempt to outline the basic ground from which any further studies can emerge.

Background

The majority(7 out of 9) of the people the author interviewed had art or design training: the rest, like Robert Dixon who is a graduate of mathematics, or Brian Smith, who took his first degree in material technology, are self-taught in art.

Most peoples' age was mid 20's to mid 30's.

None of the people had any training in computer science.

They all were self taught in computer programming .

They had all come across computer graphics/art in the late 60's to Mid 70's .

Working with computers

Most(6 out of 9) of the people saw the role of the computer as a tool - a labour saving device. Brian Smith, an example of the minority, said that he is more interested in getting the computer to model and simulate things in Art & Design, than he is in using the computer just as a tool to solve small or big problems. John Lansdown felt that there are two levels to the way he uses the computer: one was simply as a tool when he was using it to generate graphics, and the other when he was dealing with dance, when the computer acts as a choreographer devising scripts for the dances. He says " In that sense it is a machine that has a certain amount of knowledge about what a dance is and what a movement is, and how to convey that to dancers".

Most of the artists did not have their own personal

computer(6 Out of 9). They used whatever they could get hold of in an Educational Institution or at their work place. The ones that have their own computers have microcomputers like the BBC and the Commodore 64.

The majority of the people the author interviewed had stoped doing visual work other than their computer image making activity. The exceptions included Jeremy Gardiner who says that at the moment he finds that 75% of the activity of making art, for him, is the actual craft side. Alan Rudge felt that the design problem should dictate if there is a need to use the computer or not. And Brian Smith said "when I use a computer I try to use it qualitatively instead of quantitatively", avoiding the need to get him as a person to do things which machines do.

Most of the people felt that doing one's own programming is important, as using other peoples' software has its limitations. But then on the other hand Jeremy Gardiner who did not find it necessary to learn to program, said in the interview:"I have not done any programming to speak of, since I have not found it necessary. I think when you are using a computer to have a liaison with the programmer it is an

important experience and you have to be prepared to

recommend the use of a computer if the work is suitable for mathematical analysis. He goes on to say:"It is rather like you wanted a perfect realistic picture, the use of the camera in this case will be a reasonable device. By analogy, if the kind of picture you want has a great deal of patterns that can be analysed in mathematical terms, then use a computer to realise it". Andrew Petrou on the other hand says " I will recommend it to anyone who is interested in art, because I think that art is as broad as you wish to make it. Art can encompass practically any area. In a sense it is about time that art and technology coincided again. If they can work togther then it could be a much more human technology for a start. I would not suggest that the computer be used all the time. There are things that the computer can learn from the paint brush. To produce just computer art would mean a very thin environment artistically and would lack a certain kind of emotional vigour."

All the people interviewed felt perhaps surprisingly in view of the constraints, that they could obtain sufficient visual feedback from the screen during their creative work.

Computers and art

The majority of people felt that artists do not need to be restricted to one medium, so that the computer could be exchanged for another medium at appropriate points.

They all felt that good computer art work is more likely to be produced by an artist coming to computing rather than by a computing person who "finds" art.

Most people felt that computers had most influence on design and music, rather than on art. They felt that computers should have had a bigger influence on art, or at least as much as they have had on other areas of society. Jennifer Sadler is a believer in the role computers will play in the arts movement of this century when she says:"I think the computer's impact on art will be of a similar order to that of the discovery of perspective in the early Renaissance. The qualities of computer generated material will be what distinguishes the work of this century from everything that has preceded it."

Most people felt that computers probably can simulate an artist's style, but they can't really be creative. As Alan Rudge put it:" I think computers can simulate human behaviour, but to actually simulate it does not necessarily mean being that thing. You can simulate artistic creativity, but the very fact that it is a simulation makes it non-artistic. The only thing that is artistic about a computer program is the actual element of creativity that went into writing those programs, which is still a human aactivity rather than a computer activity. The computer just follows instructions. Therefore the computer is not doing anything creative. It is always the person that programmed that computer who is doing the creative part of the activity. Whatever comes out of the machine is put in by humans no matter how many levels back down the line you go."

There follow a number of central question that were raised and answered in the interviews:

4.2a What type of computers do artists use and why?

This question is of specific relevance, since from it were likely to emerge pointers towards the central area of interest of this report: factors affecting the use of computer for image-making.

Typical of the responses to this question was that of Jennifer Sadler, who said: "I will use what ever I can get hold of", and a number of people interviewed used what they happened to have available at their place of work.

One view that emerged from a number of artists who were interviewed by the author, was the feeling that one does not need one's own computer, " As having to look for a computer helps you to make contacts with people which you would not normally have made"(Jeremy Gardiner).

Robert Dixon did not think it is very important that

one has one is own computer as long as you have access to one.

Some of the people had the use of mini and main frame computers when they worked for a company or an institution which owned one. Gareth Edwards works at the Middlesex Polytechnic and he has access to the Prime 550 which is a very powerful mini and to the Dec 10 which is a large main-frame computer.

John Lansdown, who works with System Simulation, uses a number of different types of computers for the different types of application he is involved in. He says: " When I am working on dance, then I use my own computer or the computer that is part of my business which is a Tektronix 40/54A. I also use that machine for graphics and for doing computer animation. But I also have access to a lot of other machines- Prince, GEC Machines, Vax and LSI11 Base Machine- quite a large range of different machines for different uses."

The reason most people did not possess their own computer was finance. Computers are still an expensive item to buy for a freelance artist, especially when one counts in the output peripherals like a digitizer,

printer and so on. Most artists also find that the kind of computer they can afford to buy is not powerful enough for the work they need to do, as graphics routines take a lot of memory and processing power, meaning that there is a constant need to upgrade the smaller systems.

4.2b What role does the computer play in the process of creation ?

Some interviewees clearly believed that they were using the computer as a tool, and indeed Jennifer Sadler said that she could not realy see how a computer could be used in any way other than as a tool. Simon Bradley, too said that the computer is just a drawing tool. Jeremy Gardiner said: "For me the computer is a tool.

It is an instrument of improvisation and a labour saving device. My role is that of an artist who uses the computer as just another medium". Robert Dixon sees the computer:"as a mathematical drawing instrument. You can do things with the computer, from a mathematical point of view, that were never possible before. My role is that of conceptualizing an idea, formulating it and translating it into computer language. When I get the result (output), I compare it to the original conception and modify it accordingly."

Gareth Edwards uses it as a tool for asking questions : "I can ask 'what if' ? with the computer, and I can ask 'what if' ? with the pencil. But the kinds of questions I can ask with the computer are the kinds of questions I am involved with as an image making person. For example, what if I change the environment to portray a ninety degree turn, or what if I turn it up side down etc..."

However, the way some people saw the computer was as a means of stimulating ideas and simulating various kinds

of process. Andrew Petrou sees the computer having many roles, one of which is as a toy, but he also stated: "The computer also enables me to record certain thought processes. I get a feedback from the computer which helps me to formulate new ideas to feed back into the computer. Thus there is an interaction- it is like communication."

In a very similar way Brian Smith, quoted previously, describes the role the computer plays for him in term of modelling or simulation.

4.2c Does the computer work relate to artists' and Designers' 'non-computer' activities ?

Some people, like Simon Bradley, concentrated their image-making exclusively on the computer. He said " I am not involved in making any other sort of drawings other then sketches which go in my sketch book to work out an idea. I am not producing art other than with the use of the computer."

On a very similar line John Lansdown said: " I do not do any other form of animation except computer animation, and I do not do any other form of choreography except computer choreography."

Alan Rudge on the other hand said that: "If I find that I have got a design problem that can be best tackled by the use of computer, then I shall, but if the problem can be dealt with easier without the use of a computer then I shall not."

Jeremy Gardiner found that the craft side of his work is very important:" I find that 75% of the activity of making art, for me, is at the moment the actual craft

side. The art effect itself is very important in my creative process."

Jennifer Sadler felt that her non-computer work related to her computer work and could not see any reason to distinguish between the two. She said : "If I discover something in one area that looks as though it might be useful in another I will try to use it. I do not see any reason to make a distiction between 'computer' and 'non-computer' in design work, any more that there is a need to make a distinction between 'cooking vegetables' and 'cooking fish'; one would do slightly different things of course, but the basic principles are those of cooking, not of botany as opposed to zoology, and hopefully the end result is a tasty meal ! The final result is what matters, not the route by which one arrives at it."

Andrew Petrou also finds that his 'non-computer' work relates to his 'computer work' when he says: "While I was at St. Martin's , I investigated perspective, as I saw perspective as an aid to the understanding of certain things about painting and about space. I was also in an area which was not definitely art or definitely technology or science, but more where the

two met. These border line areas have always fascinated me. I began breaking up spaces rather mathematically using geometry, which the computer is very good at handling. I also touched on the idea of reproduction and printing which I always liked because it takes you away from the preciousness of the painting. So you can change some things - if you do not like a certain size or shape you can reproduce it in different sizes and shapes, manipulating an image rather than having the image dominate the process. The process is very important, what you can learn on the way or by doing it slightly differently. The computer allows you to have your cake and eat it, because you can record the image you first attempt to achieve and have it on tape or disc, and then you could also have variations of it. So it was an extension of where I was going anyway."

For Brian Smith the relationship between his computer work and non-computer work is inseparable. He said on the subject: "A lot of metaphors and analogues come out from the use of computers. I started out being interested in a particular type of art which was much more computerish even though I never used a computer for it. I have got much less mechanistic and systems

orientated in my art since I have been using computers, paradoxically. Before, I used to be interested in systems art using systems, numbers and a very mechanistic rigid type of process to get results. But now when I use computers I am much more soft about it. I try to use it qualitatively instead of quantitatively, and to get me, as a person, to do things rather than to try and get the computer to do things which machines do."

4.2d Why do artists choose to use a computer at all ?

Simon Bradley on the question of how and why did he get involved with using computers in art:"I was interested in the way Islam used geometric structuring for their designs and I knew that there was a three dimensional counter-part to the two dimensional structures which they applied to their design. I began to explore them by drawing plans and side elevations, and from them constructing perspective drawings, which was a very laborious process. By chance, I saw a drawing machine at a building exhibition, constructing perspective views from data which made me realize the possible usefulness of the computer to the kind of work I was interested in."

Gareth Edwards had come across an Apple computer in 1978, and on one of the program tapes there was a flight simulation. He says:"While I was playing with it, it occured to me that if I could create my own computerized landscape I should be able to manipulate that environment as I was doing with the flight simulation. It took me two or three years to get my act togther with computers. At that time there was no

software (on small computers) for artists or designers and I realised that I would need to teach myself programming to enable me to realise my dream".

Andrew Petrou first got involved with computers when he was at the Middlesex Polytechnic doing his Post Graduate Certificate in Education. "It was a development of a personal interest and realisation that as a tool in the art & design world, and in art & design education, a computer can do so many things with a lot less fuss and a lot less preparation."

Jeremy Gardiner while a student at RCA in 1980 was trying to use technological subjects and themes for his painting. He says :"I was trying to create a language of painting that encompassed technology in some way, at that time I realized that technology was moving away from muscle power and moving towards an era of brain power, which is what the computer is all about. At that time I went to a lecture in the Department of Design Research that Brian Smith gave on the use of computers in art and found it very interesting and useful. Just after that I started a mural project and for the images I have used an inbetweening program.

When I finished that project, I realised that the computer can be a very useful tool."

Alan Rudge came across computers during an introductory course in his first year at Coventry Polytechnic. "At that course you were presented with all kinds of basic drawing commands already put in for you, and you did not actually have to get involved with the programming at all. The computer we used was a large main frame computer used by the whole college. You had to put the information on punched cards, and a lot of them were already pre-punched with commands like draw and rotate. You just used to have to punch a number. It was not a very powerful package as it could only produce B&W wire frame type drawings. It was all done as part of the programme of the computer centre at the college, so you actually never saw the plotter or the computer."

Brian Smith got involved with computers in art and design as follows: "I stopped using certain aspects of science and technology in my art and started to concentrate on systems and cybernetics. I did not have a computer then, but I was using other people's computers. I got to use computers when I came

here(RCA) as a student. I used the big computer that DDR had in the basement and also the Imperial College link over the telephone."

John Lansdown said:"I am an architect and I had quit a large practice. In about 1960, I began looking at computers as a tool for architectural design. That made me interested in actually using computers to generate design, and for a while I played about with the idea. There was an exhibition in London called "Cybernetic Serendipity" in 1968, which showed that there were a great number of people interested in using computers and cybernetic machines in order to do art, and at the same time the British Computer Society (BCS) organised a competition for computer music that was quite a success. It was held in conjunction with the IFIP Conference in Edinburgh in 1968, and at that conference Stanley Gill suggested that there should be a group set up by the BCS, a group that is devoted to work on the computer aspect of music. Those of us that were present thought that to limit it to music would be a mistake, and decided to have it cover all art. That was the start of the Computer Art Society (CAS), and as the secretary of CAS I have been interested in using computers for all art, but in particular dance and

graphics. I have used computers to generate dances since 1968, and had a dance group that used to perform for me."

Most of the interviewees chose to use a computer because they found it a time-saving device.

For example, Jennifer Sadler said on the subject:"Most, if not all of the things I have done so far would be perfectly possible without the computer but they would have taken a great deal longer to arrive at."

Simon Bradley:"I could do my work without the use of a computer but the computer takes away the donkey work."

Andrew Petrou thinks that there is always another way of doing things:"But the reason I use a computer is it is so expedient."

However two of the people the author interviewed found that they could not have done their creative work with out the computer. Jeremy Gardiner said:"I am relying on the computer to create new stylistic devices and to explore possibilities that perhaps I have not thought

about". John Lansdown in relation to his work with dance said :" I am interested in the area of creativity where you can devise procedures that generate art work."

4.2e To what extent do artists involve themselves in the technical production of their work , for example programming?

Most(7 out of 9) people interviewed were doing their own programming and they can program in more than one language.

Gareth Edwards said:"I have written all my own programs. I can program in Basic, Fortran, Pascal, Forth & Assembler."

Simon Bradley started by using other peoples' programs but he said: "The need to tailor these programs to my ideas made me take up programming."

On the other hand one finds an artist like Jeremy Gardiner who has not done any programing as he has not found it necessary. The software he has used includes: Picaso, Jackson, and some programs written by Gareth Edwards.

Jennifer Sadler, like Jeremy Gardiner, has used only existing software but in contrast to Gardiner she is not happy about it, stating: "So far I have only really used other peoples' software, sometimes with

small modifications of my own. This is not a satisfactory state of affairs from my point of view because I like to have as much control of the whole process as possible."

All the rest of the artists the author interviewed are doing their own programing using a variety of languages from Basic to Assembler to Lisp, Fortran & Pascal.

When she asked "Do you find activities like the study of manufacturers' reference manuals, & debugging of programs, remote from your normal artistic activity?", the author found to her suprise that most artists were prepared to devote the time needed as part of the discipline of using a computer. As Jennifer Sadler put it: "It is no more time consuming than priming canvas, making frames, mixing paint, cleaning out furnaces or any other routine part of technique in any craft". Gareth Edward's answer was:" Not for me, the processes I use to paint 10,000 blades of grass and debugging programs are very similar". Simmon Bradley said:"Yes, they are remote from the normal ways of working, but those activities can be quite enjoyable." Jeremy Gardiner answered:"You have to be prepared, if you are going to use computers, to devote some of your time to

accepting the kind of discipline." Andrew Petrou said:"As an artist, I do not feel I am totally remote from those skills. I think that in every artist there is a scientist. From that point of view I am facinated by how numbers can be translated into images." John Lansdown's answer was:"Yes, the process of programming is quite different from the process which is a creative process. It is just as creative as doing art work. While you are programming there is often very little visual feed back in the art sense of the word. You are doing a technical but creative job when you are programming, which requires a rather different part of your intellect than when you are doing a work of art."

Brian Smith on the same question has said:"If you drive a car from here to Glasgow it is not much use looking at a manual to see how the engine works. The important thing is that you have got to know how to drive and know where you are going to. So if those reference manuals, and if the debugging in car terms is like making sure that the lights are working properly or the engine does run properly - it won't help you to drive the car from A to B, you have still got to know where you are going to. I suppose a lot of artists have problems which are more like 'how do I get from A to

B', than 'how do I add these two numbers togther'. I think that if they are actually programming the computer themselves they might need quite a lot of technical information to help them. Quite often, they will be using programs that will be already existing and then they do not need to know any of that."

4.2f Does Art/Design work created with the use of computer have an impact on the Art world ?

Alan Rudge stated:"I think it has an influence on design. The main impact is that everybody can see that there are some things that they ought to be doing. I think that one of the important things is that people just get to know what kind of machines there are around so that they can ask the right questions to the people that are building them in the first place. I do not think you get enough communication between design people and computing people."

John Lansdown feels that it is having a gradual impact on art. He specified the different impacts on different areas. "On electronic music, it has had a considerable impact. It is now unlikely that anyone would embark on any piece of electronic music with out the help of a computer....In other areas it is having only a mariginal effect...But in general the computer is not having the impact on art that it should have. This is a disappointment to me, because I think that art should normally respond to changes in technology and ideas, and the computer is such a change to the way

we look at things, and artists have not really responded to the challenge the computer makes."

Brian Smith thinks it has an influence, though not very much yet, and it is mostly negative. He went on: "People avoided it like the plague because 'computer-art'was mostly nonsense. It has a much bigger effect on design I think. It would not be that the work itself has much effect on art, but the fact that people are using computers day to day in their life will make art different in so far as art is to do with life. It is a part of life and it will be a bigger and bigger part of life. It will be involved in art so far as that reason stands if not others. But in design terms, since it is so much easier to use computers in various parts, but not all parts by any means of the design process, they are beginning to colour the kind of design that is coming out. Also, it is trendy now to use images that look as if the computer made them."

Jennifer Sadler, as already mentioned, can see a big future to the role of the computer in art : "I think its impact will be of a similar order to that of the discovery of perspective in the early Renaissance. The

qualities of computer generated material will be what distinguishes the work of this century from everything that has preceded it."

Jeremy Gardiner thinks that the reason computer aided art has a bad name in the art world is :" Mention computer aided art techniques to most people, and they immediately think of crude, teleprinter-produced print out of Snoopy and the Mona Lisa which commonly adorn computer room walls. Artists themselves often regard computer aided art techniques with deep suspicion and many have described them as unprofessional."

Alan Rudge fears that some artists who are using computers fall into the trap of thinking that one needs to use different kinds of measurements to judge computer work, different from the criteria one might adopt to judge any other art work. "I see no reason why computer artists should not be just as capable as any other type of artist to produce work of artistic merit."

Andrew Petrou sees the computer as a potentially revolutionary tool and he said: "I think it does blow apart what is of artistic merit and what is not. An

aspect of what is of merit in relation to high art could be blown apart by computer art, if we get enough artists to produce computer art. Again you see the idea of being able to produce it, to create an image that anyone could have on their video screen, or you could print it as many times as you want. I guess to some people, that may seem to cheapen the image, but to me it makes it more accessible."

Gareth Edwards believes that computers will have an impact on art but he is not sure how. "It has made such an impact on our society that it will be ludicrous if it did not have any impact on art at all. I do not believe that there is a conscious decision in art education to exclude computing. But unconsciously they are doing their best to keep the new technology away."

Brian Smith believes that so-called computer art has been produced by people who were not artists and therefore their works are not necessarily likly to stand the test of time. He and John Lansdown both state that the 'good' art produced by computer artists tends to be produced by artists who have come to computing rather than by computer people who have 'found' art and design."

4.2g Do artists that choose to use computers have any common qualities?

Dominic Boreham has argued that in the past certain artists were able to come to terms with the limitations imposed by programming graphics, to the extent that they were able to make successful works of art, because their approach had the following qualities:

a. Clear objectives

b. Logical and closely defined procedures

c. Pre-defined visual structure

d. Absence of a need to manipulate the image during or subsequent to its generation.

The author asked the artists that have been using computer graphics in their work if they agree with Dominic Boreham, and could they themselves fit into these categories ?

Gareth Edwards answer was: "Not really, anything that is pre-defined and absolute is just a waste of time with computers. In response to Boreham's points:

a. You have to be always ready to drop everything and start all over again.

b. I am a pretty messy programmer

c. It depends with what system you are working

d. Quite the opposite."

Robert Dixon on the other hand tends to agree with Dominic Borehams' arguments when he said:"I would agree with clear objectives, but then I do not think it is different to any other art activity. Logical and closely defined procedures seem at the moment to be in the very nature of using computers. With respect to pre-defined visual structure: certainly, if you are a visual artist you ought to have a pre-defined visual structure. It is the next one that is very doubtful(d). I think at the moment I fit into the category of not trying to manipulate the images as they are pre-defined. But the possibilities of interactive graphics are great."

Andrew Petrou does not think that he can fit into any of those categories. The reasons, he said, were:

"a. Sometimes I am very unclear about what I want to do when I start programming.

b. Programming style in itself is very personal.

c. Often I use the computer to explore, and sometimes I get an idea from the computer of what I want to do.

d. The computer allows you to do so much in terms of manipulating an image, and it will be a waste not to use this facility.

Artists that use computers have the following in common: they are not afraid of technology; and they have the ability to use images as an idea."

John Lansdown on the same question said:" I would certainly fall into the category of someone who wants to explore procedures as a way of generating art works, but Dominic does not do that. He is someone who thinks out the output and works towards devising procedures which help him produce the output. I work the opposite way. I do not consider what the output is, but just consider what the procedure is and see what it produces."

Brian Smith thinks that Dominic Boreham's argument says more about Dominics' work than about computer image-making. He goes on to say: " Computers need not require any of those things, and I would be very unhappy if only people with those qualities were attracted to the use of computers. All kinds of

artists use computers- ranging from people like he has described there, very hard edged, systematic artists, to people who want to do very conceptual, soft, poetic things."

4.2h Can a computer simulate human behaviour in the sense of 'being artistic' ?

Jennifer Sadler thinks that " If you accept that art is something that the observer constructs on perceiving an action by someone else ,then yes, it is possible for a machine to be artistic, because it is possible for a machine to produce certain types of event at random which people might perceive as artistic. If however, one thinks of art as primarily a conscious effort to express emotion (I am considering the process from the artist's point of view now), then no, it is not possible (at least not yet) for a computer to be conscious or have feelings and therfore not possible for it to be artistic."

On a very similar line Andrew Petrou thinks that the computer can't ever simulate an artistic creative activity because it has no reason to do so. Jeremy Gardiner also states that a computer has no intuition, imagination or emotion. It will never be able to create any thing that is truly abstract.

Simon Bradley takes a very simple view of the matter by

saying that: "If a piece of work cannot be singled out as being generated by a machine, then the answer to the question is : yes, computers can simulate human behaviour H. Cohen's drawings are an example of that."

John Lansdown does not see the value of making the computer simulate an artist. He says: "You could create a computer program that simulated a particular artist's style. But except then for study purposes it is difficult to see the advantage of it."

Alan Rudge thinks that computers can simulate human behaviour, but to simulate something does not neccessarily mean actually being that thing. He believes that one can simulate artistic creativity, but the very fact that it is a simulation makes it non-artistic. As stated before: "The only thing that is artistic about computer programs is the actual element of creativity that went into writing those programs, which are still human activities rather than the computer activity. The computer just follows instructions. Therefore the computer is not doing anything creative. It is always the person that programmed that computer who is doing the creative part of the activity. What ever comes out of the machine is

put in by humans no matter how many levels back down the line you go."

Brian Smith thinks that a computer can simulate aspects of human behaviour. But he goes on to say: "If you talk about algorithms and the ways of solving problems, then sometimes we put our ways of solving problems into a computer program or what we think of as our ways, and get it to do things; but we might be right and we might be wrong. Sometimes you do not even know how you yourself do things, so how can you get a computer to do that ?"

Robert Dixon believes in 'computer power', and his futuristic view is that: "Who could put a limit on what it is going to be doing? At the same time you could say that human behaviour may be becoming more machine like."

4.3 Some background influences on the use of computers in image-making

Since the end of the 70's computers become cheaper and more powerful. One finds that more and more people bought their own personal computer (1 out of 25 families) which allows more children early access to the machine. Many primary schools use computers and the more affluent schools run educational programmes using computers in their art & design classes. People are getting used to seeing computerized images on television in advertisements and films. People in their work places in factories or in offices learn to accept the computer as a tool which is involved in the process of production or the running some of their every day activities. Designers and architects use CAD systems in the process of creation of their product or their design. One thus can't avoid being aware that the computer is here to stay. The developments are not as advanced in fine-art departments in art colleges. But schools of fashion, textiles and graphics are all trying to keep up to date with the new technology.

There are many new developments of new and sophisticated software in different institutions and on the open market, devoted to art and design work.

Some of the main points affecting the use of computers for image making, which come across as a result of the investigation:

- Most of the artists who are using computers have not got training in computer science and these people are all self taught in computer programing. This meant that they all had to struggle with the technology & the scientific aspects of the use of computers.

- Most artists do not have their own personal computer in their studios (mostly for financial reasons). If they do have their personal computer it tends to be a microcomputer which is not as powerul as most mini and main-frame computers are, which obviously affects the type of art work produced by the artist using them. If an artist wants to buy computer time from some commercial company he or she could not afford to self-support a project like that, as it is extremely expensive.

Hardware systems are not oriented to the artist/users' needs. There is a need to encourage the development of computer graphic systems which fulfill a wide range of media requirements while remaining cost-effective.

- Most artists when they do have a computer can not afford to buy peripheral equipment like a digitizer or a plotter and they tend to lose quality when they end up recording their output, for example with a Polaroid camera pointing at the screen. Although some artists would not mind keeping their output on magnetic discs, there is no way that a gallery will be able to sell an art piece in this format, as unless the buyers have the relevant compatible equipment they would not be able to play it back. Most artists do not even show their work from discs in exhibitions.

- Most software which is available is found to limit the activities of the artists who are using it. And some artists give up the idea of using computers for image-making after a short experience with the use of software which does not suit their purpose. Quite a lot of artists are not ready to re-educate themselves and add to the skills they need for the creative process, and learn to program.

- The artists that end up using computers to create images have spent two to three years trying to get hold of the information and struggling against the difficulties. A lot of them, stop creating for that period of time. What we need is an education system which is aware of the changes which are taking place and which can be flexible enought to adjust to the change.

- There is much prejudice in the art world about computer art. But as more artists are getting involved in producing art with the use of computer that situation is changing. There are more shows at respectable galleries and museums showing computer art. The Arts Council has recently shown an interest in choosing a computer artist for one of their residency projects. Film festivals, for example in Exeter, have been looking for experimental work in computer film production.

4.4 Setting up a course in the use of computers for image-making in Art eduction, taking into account the factors that have emerged so far

Since it clearly emerges that there is a need for more efforts in this area, this sub-section of the report is looking at two approaches to setting up a course in the use of computer in Art and Design Colleges. The approaches are based on the findings of the interviews, the authors' own explorations in the use of computers for image-making, and on her experience of teaching at Gwent College of Art, in the Fine Art Computer studio.

At Gwent, most students viewed the computer as a complete and almost indecent invasion of their world of art. However, though most approached in a nervous and resentful way, others were eager and excited. It seemed not to be the invasion of the computer itself which created the initial barrier, but the fact that, to the students, the computer equalled mathematics which to most of them was a totally alien subject. The visits

to the computer studio were on a one-to-one basis: the students arranged times to meet a tutor, and then introductions to the use of the software, or to programming, were given. This emerged as the best system to work with art students, as it was very difficult to get them to commit themselves for a whole week of a programming language course. To make sure that students had a more general picture of the subject, lectures were given by tutors who used computers in their work, with illustrations of their output. The historical and theoretical aspects of the subject were developed by the Cultural History Department, that ran a course on the subject.

There was a very limited set up of equipment at the computer studio at Gwent, the equipment consisting of: one Radio Shack TRS-80 Colour Computer, two Colour Computer mini disk TRS-80's, a Sony tape recorder, Sony Colour Monitor, a printer and joysticks. The TRS-80 Colour Computer has 16k memory but is expandable to 62k on disc. The system has 9 colours from which one could have four on the screen at one time plus the background colour. Its uses the Basic language. The software that was available included a filing system, and the 'Art Gallery', a limited paint system. (The

future looks much more promising at Gwent as a telematic communication system is to be installed connected with a 380Z Research Machine.)

From the author's note book made during the period of her visits to Gwent one could make a list of the practical activities involved in the setting up of a course in computer art, which , because they depend on outside factors, are already constraining and helping to determine the process. For example:

- Books had to be found on subects such as Basic programing and other techniques.

- Peripheral equipment such as a disc drive and printer had to be installed, connected and made to communicate with the computer.

- It was necessary to find out what equipment was available in other departments, that might save money even if it was not necessarily ideal.

- Arrange a booking system for the equipment

- Set up and maintain a regular a user interest group.

- Arrange visits to other art institutions to see their set-up.

- Contact the manufactures of a video 'frame grabber' to discuss the compatibility of existing equipment with it.

These items are just taken at random from a long list of necessary actions, and it excludes the talking and persuading that took place with the staff and students as part of the introduction of a new subject. The Head of Department was keen to introduce the new technology into the curriculum but, as is typical in such institutions, there were limitations due to budget etc.

To sum up the author's experience at Gwent, the following questions arose: Is it worth it to start so small? Do you need an artist to teach computer art, or a computer programmer, or both ? Is it important to teach the student to program? Or does one need a sophisticated paint system & frame grabber, or library of graphic sub routines instead? These questions will be faced later in this section of the report.

As the author's experience was only with fine-art students and in a very small computer studio, the author thought it relevent to bring in another tutor's experience in setting up a more general computer studio . Aine Spiers from Ulster Polytechnic ,Northern Ireland, is a programmer in the computer graphics studio at the Art and Design section of the college. Her responsibilities are training and supervising the students in CAD and computer graphic practices, as well as developing software. She is a graduate in resource management and has studied data processing as a postgraduate. Her paper "Introducing computer graphics into an art & design studio: trials and tribulations"(Spiers 1983) was submitted as part of the"COMPUTER GRAPHIC 83" conference proceedings, and the paper discusses the process of introducing computer graphics into the world of an art and design college. Emphasis is placed on the training of art and design students as users of computer graphics and CAD systems.

The following emerged from Ms. Spiers experience:

They took 6 years. for research and development of the graphics software on Textronix equipment before they

unveiled the computer studio in 1982. The software was developed by watching other students work on existing graphics software and noting their suggestions for future development. Such suggestions included ways of making the system more use friendly and extending its power through the number of manipulations it could do, and what they wanted it to do.

They found that more and more students became interested in what the studio can offer. This generated the problem of providing work-stations to give adequate access to all those who entered the studio. All the cheaper systems were medium resolution and did not have the quality that a graphic studio demanded. Research led to the a installation of plotter/digitizer-based system. Using just a small plotter as a high resolution graphics output instead of a screen proved successful. These low-cost systems were appreciated by the students because they have immediate access, they can fully comprehend what is going on and can see it happening. The students can themselves put special paper in the plotter and can change pens and the colour of inks. They can explore and interfere in ways that would be impossible if

computation and plotting were taking place on the screen. Financially these workstations, complete with disc unit and plotters, were costing, for four, no more than one new ,advanced, high resoulution, screen graphics system.

The graphic software which has been developed and is now avaliable to the student at Ulster Polytechnic includes:
AUTOPLAN, a two dimensional manipulation package.
SHAPEPROCESSOR, a two dimensional graphics package.
INBETWEEN, an animation package.
PERSPECTIVE and SUNLIGHT, a three dimensional archictectural and interior design package.

The training programmes at the computer studio were based on a two week block workshop. The students were introduced to the Autoplan (two dimensional manipulation package) graphics system through a series of demonstrations ranging from simple transformations on a shape to the output of a drawing consisting of an assembly of manipulated shapes. These demonstrations of the power and capabilities of the system were followed by the students themselves doing tutorials and exercises, based on the Autoplan system commads. These

tutorials gradually took them through the graphic system. The tutorials taught how to perform transformations, how to create, edit and store shapes, and finally how to put togther a complete design made of different components and transformations.

Ms. Spiers believes that in the process of educating art and design students in computer graphic and CAD practices they should be able to:

a. Obtain more feedback about proposed solutions in terms of performance, appearance and cost.

b. Explore a wide range of design solutions

c. Explore alternative routes to design solutions such as public participation in creativity nd design

d. Move more rapidly to the prototype stage.

Through the experience of helping to set up the course at Gwent and the experience the present author gained through her own experiments in different institutions as a student (RCA, Middlesex Polytechnic, Imperial College) of computer image making, and from reading other peoples' works on the subject, and from the questionnaires, the following conclusions emerge:

a.It is advisable to spend time researching to find out the kind of implementations you will need your system to perform, and to make sure that the equipment obtained is capable of it.

b.It is advisable to visit other institutions that are working in similar ways to avoid having to 'invent the wheel' all over again .

c.If the college is part of a bigger institution such as a polytechnic it will be advisable to find out what hardware they are using and to buy compatible equipment, as one could share the relevent software that was already developed by other departments, thus making more available. If the college owns a main-frame or a powerful mini computer, one might be able to get a connection to the system through the phone and use a terminal in the studio, as well as or instead of small computers located in situ.

d. It may be advisable to develop joint projects with the computer studies department in the Polytechnic or University or to employ a computer programmer in the same way that one needs to employ technicians in art colleges.

e. Buy a system that can be expanded, and develop a long term strategy about what is required, thus avoiding a piecemeal approach.

f. In the research period, write courses for the different departments in the college, as painting students will need different routines to furniture students. Arrange an advisory programming clinic once a week to help students that get involved with their own programming, and regular tutorials. This can ease many of the problems faced by those who have difficulties with programming.

g. Write a user friendly manual to the system as much time can be wasted looking through badly designed manuals.

h. Keep a record of student work on disc and/or video to build a library of the visual experince gained using the system.

i. Be open to new suggestions from the user/students as with their changing needs the system is going to mature.

j. Keep in touch with new developments in the field by going to exhibitions and conferences, as it is still a growing area with dynamic changes.

k. Join the Computer Art Society and the perhaps British Computer Society, which also will help you to keep in touch with other artists in the field and with recent local events like arts shows or artists' seminars.

l. Slow response time of the system is often a problem facing existing graphics and CAD users. Unfortunately, even many popular 32-bit systems show a marked decline in performance when trying to support as few as five graphics terminals. Keep it in mind when you choose your computer and look for those 'superminicomputers' which manufacturers promise will deliver the power of a mainframe at a fraction of the cost.

4.5 Some indications for future developments

As our knowledge of language and intelligence increases computers will become more intelligent and increasingly relieve us of some of our more tedious intellectual work. Artists will become involved in this process as they have an important role to play in developing the intelligent machine systems of the future decades.

The artists' role as master creator will remain, however, because even though the physical limitations of the medium will be different from traditional media, his training, devotion, and visualization will give her/him a higher degree of control of the artistic experience. As an example, the artist's particular interactions with the computer might be recorded and played back by the public on their own computers. Specified amounts of interaction and modification might be introduced by the individual, but the overall course of the interactive experience would still follow the artist's model. In this way, and for the first time, the artist would be able to specify and control with

certainty the emotional state of each individual participant. Only those aspects deliberately specified by the artist might be left to chance or to the whims of the participant. All this would be possible because the computer could monitor the participant's emotional state and change it according to the artist's specifications. The artist's interaction with the computer would be of a new order because the physical restrictions of the older media would be eliminated.

This is not to say that the traditional artistic media will be swept away; but they will undoubtedly be influenced by this new active medium. The introduction of photography - the new medium of the last century - helped to drive painting away from representation, but it did not drive out painting. What the new creative computer medium will do to all the art forms - painting, writing, dance, music, films-should be exciting to observe.

4.6 Some notes on software specification

This section is written to suggest ways in which factors emerging from earlier sections may point to the kind of software desirable for image-making applications. For most of us, designers ,artists and users alike, we have to live with software which is driven by keyboard commands, and whose output is chiefly lines of text (as well, of course, as the graphics). The new generation of graphics display using touch screens or 'mouse' -driven software, is still in its infancy. Some design effort has been put into screen display and data entry. Some of them have a set of files, which are all pulled togther by a menu program, and which can be called upon by doing no more than touching the space bar to select each appropriate instruction and hitting the return key to execute it.

But there are still many software producers who do not take this sort of trouble. Some seem to lack experience in using software in real life, and do not realise how time consuming clerical activities like having to type in file names can be, and lack the

imagination to see how these processes can be made simpler.

Sensible screen-handling is only one aspect of good software design. There follow some other considerations that apply in general to a whole variety of different software packages:

- How easy is the software to install? Does the designer show reasonable foresight about problems and opportunities presented by your hardware?

- How well does the software do what you want it to do? Do you have to adapt your work methods, or can you mould the program?

- Your relationship to the software is going to change as you get to know it better, and as your own needs change. If there are many 'help' messages, will you be able to override them when familiarity renders them unneccssary? If you upgrade, for example to a 'hard disk', how easy will it be to reorganise the program for its new environment?

- How well will the package fit in with the other

software you are running? Are you going to have to learn several different sets of cursor-control commands, or can you modify all your programs to work similarly? What data format does the program read and produce? Is there any hope of compatibility between, say, the new graphic package one has acquired, and the simpler programs one is already familiar with ?

- How often does one need to use the manual when trying to use the software? How good and simple to use is the software manual? Many well-thought-out menu-driven programs do not need a manual at all. A menu is paricularly useful to find your way around a facility you call upon rarely, and save having to go back to the manual each time to remind yourself what it is all about.

Some examples of bad design software:
One package advertised widely in the USA refused to be adapted to the hardware in an educational institute, beacause the writer had not realised that many terminals require strings of characters to drive the graphics cursor, rather than just one control character.

Another example: programs which require their input in upper case letters. If you happen to make a mistake and use the lower case it will wait until you have finished filling in the line then wipe out your entry and sit there dumbly with the cursor repositioned at the beginning of the line. No error messages, no explanations, no assurance that something has not gone horribly wrong with the program.

The author and any user alike, could go on listing bad examples of software programs. But what is more important is the recent realisation of software manufactures that writing software is a highly professional business, which requires teamwork and thorough testing. And consequently a better response to calls from users for changes.

This need for flexibility, sensible design and above all the taking into account of the needs of image-makers is just as true when one person is designing software for one other, in a computer studio, design environment or elsewhere.

4.7 Conclusions

Chapter 2 (the historical context) - this section looks at the relation the technology has with art. It was established that virtually all art uses technology of a kind. The author has divided the history of computer art into two periods: one is the nineteen sixties period where mainly non-artists have used computers to produce images, people like W. Fetter, Michael Noll, and Gustav Metzger. The second period is the nineteen seventies onwards where more artists got involved in production of art with the aid of the computer, artists like M.Mohr, V.Molnar, H.Franke, H.Cohen, R. Ascott etc. The author points out two new developments in the late seventies beginning of the eighties, the introduction of the 'painting system' software which allows artists and designers to use a computer without excessive knowledge of programing, and the adaptation of telematic systems to art practice. On the question of whether the computer is merely a tool or not, the author has shown examples of different practices where

the computer is used merely as a tool to help in mathematical calculation or as a device to manipulate data, and other examples where one tries to use computer as a more equal partner in the creation as J. Lansdown, H. Cohen,E. Ihnatowicz, V.Banacic etc., have shown. The author found that most of the artists that have tried to use the computer to simulate human behaviour tend to have done it with 3-d work rather than with graphics. H. Cohen is the only example that the author found of someone exploring with AI in two dimensions. The author has shown diagrams and explanations of his program AARON which is using what is called in the AI community an 'expert system'. The author questions the potential application of AI in visual art as long as questions like "What is creativity?" or "What are the characteristics of asthetic qualities of artworks?" are not answered. Chapter 3 is the experimental programme which the author carried out in order to enable her to understand the problems involved in the use of computers as creative media. This experience was needed also when the author was engaged with the formation of the questionnaires, and during the interviews. The programme is in 4 parts in which each of the procedures and equipment used are stated. An illustration of the

work plus a video tape was produced to demonstrate the experiments carried out. The author did not cover everything, but did choose a range of techniques, that were manageable. The author summed up her own feeling and experience by saying that the limitations of time the author had on each system, the need to learn different operations and procedures for each system, and the different computer languages one needed to know to enable one to program on each of those system, had the tendency to get one to accept the limitation of the set up in which one operates, which could be a disaster for any artist. Much was learned from this work, however, which informed the discussions with artists in the questionnaires.

Chapter 4 is dealing with the interview findings:

- The majority of the people interviewed had art or design training.
- None of the people had any training in computer science.
- They were all self-taught in computer programming.
-They all came across computer graphics/art in the late 60's to mid 70's.
- Most peoples' age was mid 20's to mid 30's.
- Most of the people saw the role of the computer as a

tool - a labour saving device.

- Most of the artists did not have their own personal computer: they used whatever they could get hold of in educational institutions or their work place.

- A lot of the people the author interviewed had stopped doing work other than their computer image-making activity.

- Most of the people felt that doing one's own programming is as important as using other peoples' software has its limitations.

- Most people felt that they were going to go on using computers.

- Most people would recommend the use of a computer to other artists when it's relevent to their work.

- All artists interviewed felt that they could obtain sufficient visual feedback from the screen during their creative work.

- The majority of the people felt that artists do not need to be restricted to one medium.

- They all felt that good computer work is more likley to be produced by an artist coming to computing rather than by a computer person who "finds" art.

- Most people felt that the computer had most influence on design and music, rather than on art.

- Most people felt that computers can simulate an

artist's style, but they can not 'really' be creative.

There are a set of questions into which the interviews were divided in sub-sections 4.2a-4.2h. This chapter using the experience of the investigation has suggested some outlins (4.4) for setting up a course in the use of computers for image-making and (4.6) some notes on software specification.

To sum this chapter up we can say that what is needed is :

- Hardware systems oriented to the user/artist's needs.

- Computer graphic systems which fulfill a wide range of media requirements while remaining cost-effective.

- More standard systems on which you could play back discs from different machines.

- A standard language for graphics designed specially for that use. (There are examples in existence, but these are rarely available on smaller machines.)

- Sophisticated software which is flexible enough to

answer the users' needs.

- An education system which is aware of changes which are taking place and which can act upon them in reasonable time.

- More money from funding bodies to subsidize expensive experimental projects.

From the questionnaires, and from the author's own experience, the following factors emerged which appear to affect the use of computers for image-making.

1. The user's experience and skills with computers in general, and with particular equipment.

2. The user's view of the nature of the process, and the role of the computer. If the computer is 'merely a tool', then it must be an effective and appropriate tool. If it goes beyond this into areas of use, then the user's own views about art, computers, creativity and so on will determine the criteria by which the system is judged.

3. There is thus a need both for flexible systems, to

match users' perceptions as well as, for example, to suit them physically.

4. Further, much care needs to be taken when introducing people to graphic computers, and computers to art or design departments. Again, since there is a range of needs and perceptions, even a small machine should not actively hinder these, even if it can not approach the power of a large computer, dedicated to advanced modelling and simulation.

5. Much work has been carried out on the physical and ergonomic design of computer systems; it is to be hoped that research will be initiated into systems that are capable of approaching the needs and expectations of users, and of fitting their psychology, as well as their physique.

6. Perhaps surprisingly, it appears from the limited data available that artists can accomodate quite well to what already exists, in certain respects. The computer screen provides adequate feed-back, for example, and few people mentioned the need for more colours, finer details, and faster output etc. Instead, it seems that problems lie in the area of the

theory as well as the practice of computer image-making: in methods of approach, in soft - or hardware determining or conflicting with a perception of the process or system, and in the support provided with respect to the computer, its software, or the context of its use.

This study tries to provide a context and understanding from within which further, more detailed studies could proceed.

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APPENDIX

QUESTIONNAIRE

1. Name Age Sex

2. How/Why/When did you become involved with computers in producing Art/ Design ?

3. What is your Art/Design background ?

4. Which computer do you use ? Do you own a computer?

5. What role does the computer play for you....simulation, tool, etc ? What is your role ?

6. Are your computer works related to your non-computer Art/Design activities ?

7. Could your work be done without the aid of computers ? If yes, why use the computer ?

8. To what extent are you involved in the technical production of your work, for example programming ?

9. Do you feel that Art/Design work created with a computer has now or will have an impact on Art as a whole ?

10. Do you intend to continue using the computer to create Art pieces ?

11. Do you recommend the use of the computer to others in creating works of Art or Design ?

12. If you find that you need constant visual feed-back during your creative work, does the computer affect this ? If so, how ?

13. Do you find activities like study of manfacturers' reference manuals & debugging of programs, remote from your normal artistic activities ?

14. To what extent do you think computer artists were/are able to produce works of artistic merit ? (give examples)

15. Do you think that the computer artist need or need not resort to traditional methods and media if he/she encounters difficulties with new technology ?

16. Do you think that computers can simulate human behaviour and be artistic in the same way humans are ? (give examples)

17. Dominic Boreham (1983) has argued that in the past certain artists were able to come to terms with the limitation imposed by programming vector graphics, to the extent that they were able to make sucessful works of art, because their approach has the following qualities::

a. Clear objectives

b. Logical and closely defeind procedures

c. Pre-defined visual structure

d. Absence of a need to manipulate the image during or subsequent to its generation

Do you find that you can fit into these categories ?

INTERVIEW

1. ROBERT DIX ON 36 MALE

2. Three years ago I saw E. Holliday's computer graphics. E. Holliday is a geometer who started to use computers as a drawing instrument, and my work has a lot in common with his. Mr. Holliday is a graduate of Chemistry , and he will not call himself an artist . Geometry is the Mathematics of space and you call yourself a geometer if you are dealing with any mathematical ideas that have an exact spacial interpretation . A lot of Mathematics is abstract, and much of it refers specifically to spatial ideas, and if you are doing that kind of Mathematics you are a geometer.

3. I am a graduate of Mathematics and worked at various visual media for years. I would not call myself self-taught, as I worked with number of people who I regard as my teachers.

4. I don't have my own computer, and at the moment I am using the 380z Research Machine here at the RCA/DDR.

5. I see the computer as a mathematical drawing instrument. You can do things with the computer, from a mathematical point of view, that were never possible before. My role is that of conceptualizing an idea , formulating it and translating it into computer language. When I get the results (output), I compare it to the original conception and modify accordingly. The only training I got with computers is through a one week course at the Middlesex Polytechnic in computer graphics.

7. The link is extremly tenuous. The link is my interest in shapes, and I see Geometry as a way of dealing with shapes. But apart from that link you would not regard my other art work as looking like computer art.

8. No.

9. I do my own programming, and I use mainly Basic.

10. I think that computer graphics can only be compared to the invention of photography . It is a major break through in visual technology, quite a part from the

fuller meaning of simulation, even just from the point of view of computer graphics.

11. Yes.

12. Depends on their interest and intention. But if the work is suitable for mathematical analysis then the computer is an ideal tool. It is rather like if you wanted a perfect realistic picture, the use of the camera in this case will be a resonable device . By analogy, if the kind of picture you want has a great deal of patterns that can be analysed in mathematical terms, then use a computer to realise it.

12. Yes, I do need visual feed back and I am getting it from a VDU screen and a plotter.

13. Yes, I never read them. I occasionaly refer to manuals but on the whole they are pretty remote from visual thinking.

14. It is just another medium, therefore, works of artistic merit will depend entirely on the individual talent of the programmer and his or her creative imagination. But it is a very new medium , and

therefore if one needs to point to the fruits of such creativity they are a bit thin on the ground.

15. Probably, there are all sorts of ways of using the computer as part of a mixed media project. But I can see that completly pure computer art is perfectly possible, but often the difficulties in software and programming are going to be very difficult and very hard to solve.

16. Almost certainly, and as we are dealing with new technology. If you could possibly imagine the developments in the next 1000 years, who could put a limit on what it's going to be doing. At the same time you could say that human behaviour maybe becoming more machine like.

17. I would agree with clear objectives, but then I don't think it's any different to any other art activity. Logical and closely defined procedures seem at the moment to be in the very nature of using computers. With respect to pre-defined visual structure , certainly. If you are a visual artist you ought to have a pre-defined visual structure. It is the next one that is very doubtful (d). I think at the

moment I fit into the category of not trying to manipulate the images as they are pre-defined. But the possibilities of interactive graphics are great.

INTERVIEW

1. BRIAN SMITH 36 MALE

2. I became involved with computers in Art & Design in general,as I stopped using just science and technology in my Art and started to concentrate on systems and cybernetics, and other things involving the use of computers.I did not have a computer then, but I was using other people's computers. I got to use computers in Art & Design when I came here as a student.I used the big computer that D.D.R. had in the basement and also the I.C. link over the telephone.

3. I had no Art & Design education formally until I came to the R.C.A. and then did a post graduate degree. Informally,I have been teaching myself Art & Design since I left University. Before that,I was painting and making sculptures. My first degree was in Material Technology.

4. I have a 380Z research machine and a BBC at home, and I use these computers here that are the 380Z's also.

5. It's really a big question. A computer helps me to model or simulate a process. I am more interested in getting the computer to model and simulate things in art & design, than I am in using the computer just as a tool to solve small or big problems. I am more concerned in trying to see what happens, and what you need to do to get the computer in some more general art & design problems. I am interested in it as a complex, general and conceptual tool, rather than just as a tool for drawing a straight line from A to B

6. A lot of metaphors and analogues come out from the use of computers. I started out being interested in a particular type of art which was much more computerish even though I never used a computer for it. I've got much less mechanistic and systems orientated to my Art since I have been using computers paradoxically. Before I used to be interested in systems Art using systems, numbers and a very mechanistic rigid type of process to get results. But now when I use computers I am much more soft about it. I try to use it qualitatively instead of quantitatively, and to get me, as a person, to do things rather than to try and get the computer to do things which machines do.
7. I am not interested in what machines do but in what

I do and in what people do. I use the machine to help me.

8. Completely. I write the program to do the things that I want. I use Basic.

9. Yes, it has, and it is, but not very much yet, mostly negative. People have avoided it like a plague because it was mostly nonsense. It has a much bigger effect on design I think. It won't be that the work itself has much effect on art, but the fact that people are using computers day to day in our life will make art different in so far that art is to do with life. It is a part of life and it will be bigger and bigger part of life. It will be involved in art so far as that reason stands if not others. But in design terms since it is so much easier to use computers in various parts, but not all parts, by any means for design process, that they are beginning to colour the kind of design that is coming out. Also, it is trendy now to use images that look as if the computer made them.

10. Probably, but less and less. I am much more interested in the ideas, metaphors, analogues and other things that come out due to the use of thinking about the use of computers in art & design, rather than the use of computers per s 60% to 70% of my work for next year is not using computers at all.

11. Not for everybody and not every time. But I recommend that people have a go at it on their Foundation Courses at Art Colleges, just as they have to have a go at photography, silkscreen or painting.

12. I can imagine cases where this (continuous visual monitoring) isn't necessarily the case. If you're developing a film in a container, you don't know what is happening on the film. You hope you do but you can't pick it out and look at it, and if you're sending off some slides to be processed or if you've got a film in the labs - if you're making a feature film - and if you have to wait for the rushes to know, so you are not monitoring everything that is happening then. Yes, I do take your point. Often you do want to be able to interact in as wide a range of ways as possible with the visual effects of what you're doing, whatever kind of artistical design tool you're using. And I think it depends on how the software is designed. If it is designed well it will give you as much opportunity as possible, that is to say, not too much of the wrong

sort and not too little. It will give you enough visual feedback from what you're doing, so that you can do what you want to do. I can imagine a situation where you might have too much, you might get overwhelmed with all the visual stuff going on, so that you panic and you can't control it properly, so it is got to be appropriate.For me, if I'm using my own software then it works like that by definition, because I try to get it right. As far as other people's software is concerned, you just hope that is the case but one does not know. For me, when I'm using software it gives me what visual feedback I need but I can imagine situations where it might not.

13. Yes. To expand on it, if you want to drive a car from here to Glasgow it isn't much use looking at a manual of how the engine works. The important thing is you've got to know how to drive it and know where you're going. So if those reference manuals, and if the debugging in car terms is like making sure the lights are working properly or the engine doesn't run properly - it won't help you to drive from A to B, you've still got to know where you're going. I suppose a lot of artists have problems which are more like how do I get from A to B, than how do I add these two numbers together. I think that, although, if they are actually programming the computer themselves they might need quite a lot of technical information to help them. Quite often, they will be using programs that will be already existing and then they don't need to know any of that. Hopefully, the program has already been debugged, and hopefully the manuals are provided for the program and not for the person using it. Sometimes with 'Jackson',eg, you get a manual that comes with it which shows you how to use it but that is a different kind of manual - that is the kind you get with a movie camera which shows you how to use it.

14. So called computer art has been produced by people who weren't artists and therefore is not all that likely to stand the test of time or even a few minutes as art. However there are some good exceptions to the rule. People like Harold Cohen, Edward Ihnatowicz - who are artists and who are producing good stuff. They tend often to be people who've been artists and have come to computing rather than computer people who have found art or found design. Thus artists are to a very great extent able ,in theory, to produce works of artistic merit, but they don't very often.

15. You do what you like. If you are really into getting paintings as an end result then that is what you do and people do that. People produce silk screens from computer printouts and things like that if they were into printmaking. A sculptor might end up with a lump of bronze which has been cast and a clay model done by hand based on a computer image of some kind. Other people might get images straight out onto paper or screen untouched by human hands as it were. The creativity has not gone in a manual sense into the computer and the craftness of the thing if you like has been taken away to a larger extent but their intellectual abilities as an artist - their ideas and their imaginations either work or don't work and either make a good or bad work. So it is different people for different things. I personally prefer to get stuff out of the computer which does not scream computer graphics at you, but that's just because it frequently turns people off and it turns me off quite often. I'd rather like something which looks more like a painting or a free hand drawing, if I can get the computer to help produce things like that, that's fine. I'm not trying to get the computer to make free hand drawings just for the sake of it. I'm saying that if I wanted a particular artistic exercise using the computer then quite often I'm happier if it doesn't come out looking hard edged and mechanical.

16. Yes to the first part. No to the second part.I do think that a computer can simulate aspects of human behaviour - that's proven - it certainly can. A computer can simulate various aspects though not in totality, not anything like human beings, that is artificial intelligence. But certainly it does not do it in the same way - it is not a human brain sitting in there. On a strictly functional level it is not doing it in the same way. We run on electricity and glucose and things, and the computer works quite differently. We use neurons and the computer uses silicon chips. But if you talk about algorithms and the ways of solving problems, then sometimes we put our ways of solving problems into a computer program or what we think of as our ways, and get it to do things, we might be right and we might be wrong. Sometimes you don't even know how you yourself do things, so how can you get a computer to do that. One aspect of artificial intelligence, for example, is to try to get a computer to do something and if it produces the kind of result that a person might have produced, maybe, just maybe, it's doing it in the same kind of way on some level.

But frequently that will just be an accident or coincidence.

17. No. I think that says more about Dominic Boreham than about computers. Computers need not require any of those things, and I would be very unhappy if only people with those qualities were attracted to the use of computers. All kinds of artists use computers - ranging from people like he has described there, very hard edged systems artists to people who want to do very conceptual soft poetic things.

INTERVIW

1. ANDREW PETROU 27 MALE

2. I first became involved with computers when I was at the Middlesex Polytechic doing my Post Graduate Certificate in Education. It was a development of a personal interest and realisation that as a tool in the Art & Design world, and in the Art & Design Education, a computer can do so many things with a lot less fuss and a lot less preparation.

3. I studied painting at St. Martin's School of Art, but I also had an interest in other aspects of media especially film & video. I always considered myself as someone who produces ideas through a visual medium rather than as a painter.

4. I have a Commodore 64 and that is what I use, but I first learnt and my first programs were written on a 380Z Research Machine.

5. It has many roles and one of them is as a toy. You can get a program once you've got the bugs out of it. You can start putting bugs in on purpose to see what they do to the image or to the output. So in that sense it is like discovering and learning. I see my role with the computer as an attempt to play with ideas, so I give it a certain job to do and then find ways of making it do something else with that job by extending the program or by attempting to manipulate it. The computer also enables me to record certain thought process. I get a feedback from the computer which help me to formulate new ideas to feed back into the computer. Thus there is an interaction - it is like a communication.

6. Certainly, one of my main interests, while I was at St. Martin's, was investigating perspective, because I saw perspective as an aid to the understanding of certain things about painting and about space. I was also in an area which was not definitely art or definitely technology or science, but more where the two met.These border line areas have always fascinated me. I began breaking up spaces rather mathematically using geometry, which the computer is very good at handling. I also touched on the idea of reproduction

and printing which I always liked because it takes you away from the preciousness of the painting. So you can change some things - if you don't like a certain colour you change it, if you don't like a certain shape or size you can reproduce it in different sizes and shapes. Manipulating an image rather than having the image dominate the process. The process is very important, what you can learn on the way or by doing it slightly differently. The computer allows you to have your cake and eat it, because you can record the image you first attempt to achieve and have it on tape or disc, and then you could also have variations of it. So it was an extension of where I was going anyway.

7. I am sure that there are other ways of doing every thing, but the reason I use a computer is that it is so expedient. Once you learn the basic language for what you need to do, it is very fast. And you can make drawings, repeat them, change them, at a speed which could not be possible with any other medium. There are also some things peculiar to the computer - it produces images which I think is worth investigation in itself. There is a certain coldness about the images it produces. You can work with every kind of limited area and explore them very thoroughly. There is a certain look to computer art which you may find a challenge. You want to get it over so that it does look like computer art. You may want to work with it and produce a work of art that is as much do with the medium you are using as it is to do with the idea you got in your head.

8. I write my own programs. I am not at all interested with how the machine works only when there is a problem that comes in which I have to know how the machine works to overcome it. Then I go back to the reference manual and find out where the problem is. I think it is just basically using it as a tool, although sometimes the mechanism of how it works and why it works in the way it does, does grab me and I get quite interested in why you can't have certain colours next to others without it getting distorted. I find the programs more interesting because they open up an area of logic. Sometimes you seem to find that the computer thinks in a very similar way to you in order to solve a problem, and at other times it is very alien.

9. I think it will certainly have an impact, even from the financial and commercial aspects, since the computer can do so much and a lot more quickly and more cheaply than other traditional methods. Already, one can see more and more images that are created with the help of a computer, and in other instances, exclusively through the computer.What needs to happen in the Art and Design world is that we the artists should be able to communicate to the computer engineers and technologists what our needs are so as to enable us to do what we want, otherwise we are going to produce images that look like computer images which are not based on artistic sensitivity. But I think that it will take care of itself. I think that what is happening is that artists and artistic people are getting more and more involved with using the technological media that is available. That in itself will produce the demand necessary to create more specialised software and more specialised machines.

10. Yes, I want to upgrade the computer I work with eventually. I want to thoroughly explore the possibilities of using the Commodore 64. I also want to develope software, partly for use in education and partly for my own use to develope my own work. I do not know what direction it is going to take. I would also like to investigate much more in terms of movement and animation.

11. I will recommend it to anyone who is interested in Art, because I think that Art is as broad as you wish to make it. Art can encompass practically any area. In a sense it is about time that art and techology coincided again. If they can work together then it could be a much more human technology for a start. I would not suggest that the computer be used all the time. There are things that the computer can learn from the paint brush. To produce just computer art would mean a very thin environment artistically and would lack a certain kind of emotional vigour.

12. There is a visual problem when you are creating images with program lines and numbers, but I find that this in itself can be quite exciting.

13. As an artist, I don't feel I am totally remote from those skills. I think that in every artist there is a scientist. From that point of view I am fascinated by how numbers can be translated into images.

14. I think it does blow apart a lot of the preconception we have about what is of artistic merit and what is not. An aspect of what is merit in relation to high art could be blown apart by computer art if we get enough artists producing computer art. Again you see the idea of being able to reproduce it, to create an image that anyone could have on their video screen, or you could print it as many times as you want. I guess to some people, that may seem to cheapen the image, but to me it makes it more accessible. And I think that what computer art could do is to make art all that more accessible.

15. I think what is needed is that when you encounter difficulties you could go back to the problem of asking questions like: have we got the software, and if it is not a software problem then have we got the hardware, and if we don't have the hardware to do what we want, then it is time to go back to the technologists and to communicate to them what we need. We should make technology work for people, and in this case, for artists.

16. No, I don't think that a computer can ever simulate an artistic creative activity because it has no reasons to do so.

17. I don't think that I actually fit into any of these categories at all.
(a) Sometimes I am very unclear about what I want to do when I start programming.
(b) Programming style in itself is very personal.
(c) Often I use the computer to explore, and sometimes I get an idea from the computer of what I want to do.
(d) The computer allows you to do so much in terms of manipulating an image, and it will be a waste not to use this facility.
Artists that use computers have the following in common: they are not afraid of technology; and they have the ability to use the image as an idea.

INTERVIEW

1. John Lansdown. 55. Male.

2. I am an architect and I had quite a large practice. In about 1960, I began looking at computers as a tool for architectural design. That made me interested in actually using computers to generate design and for a while I played about with that idea. There was an exhibition in London called "Cybernetic Serendipity" in 1968 which showed that there are a great number of people interested in using computers and cybernetic machines in order to do art, and at the same time the British Computer Society (BCS) organised a competition for computer music that was quite a success. It was held in conjunction with the IFIP Conference in Edinburgh in 1968, and at that conference Stanley Gill suggested that that there should be a group set up by the BCS, a group that is devoted to work on the computer aspect of music. Those of us that were present thought that to limit it to music would be a mistake, and decided to have it cover all art. That was the start of the Computer Arts Society (CAS), and as the Secretary of CAS I have been interested in using computers for all art, but in particular dance and graphics. I have used computers to generate dances since 1968 and had a dance group that used to perform for me.

3. I am an architect.

4. I use a lot of different computers for doing different aspects of things. When I am working on dance, then I use my own computer or the computer that is part of my business which is the Tekronic 40/54A. I also use that machine for Graphics and for doing computer animation. But I also have access to a lot of other machines - Prince, GEC Machines, Vax's and an LSI 11 Machine - quite a large range of different machines for the use of different things.

5. There are two levels there. When I am using graphics and animation the computer is simply both a tool and a medium for doing the pictures. In dealing with dance I use the computer to generate the output, and the computer acts as the choreographer devising

scripts for the dances. In that sense it is a machine that has a certain amount of knowledge about what a dance is and what a movement is, and how to convey that to dancers.

6. Yes, in architecture it certainly is. I don't do any form of animation except computer animation, and I don't do any other form of choreography except computer choreography.

7. In the case of architecture it is possible, but it is very difficult to design a modern building without the use of the assistance that the computer can give. In animation, some of the sequences I am called up to do are too difficult to do by hand and too expensive. In dance, I am interested in a completely different approach. I am interested in the area of creativity where you can devise procedures that generate art work.

8. Completely. All the programs that I have used have been devised by me, or my close colleagues under my supervision.

9. Yes, it is having a gradual impact. It's having a different impact on different areas. On electronic music, it has a considerable impact. It is now unlikely that anyone would embark on any piece of electronic music without the help of the computer. In other areas it is having only a marginal effect. For example, on choreography, choreographers are using computers to help record dances using notations, but almost no one else uses computers to generate dance. In animation, it's definitely having an effect. We see it on TV all the time. But in general the computer is not having the impact on art that it should have. This is a disappointment to me, because I think that art should normally respond to changes in technology and ideas, and the computer is such a change to the way we look at things, and artists have not really responded to the challenge the computer can make.

10. Yes.

11. It can help them to do things that they could not do by hand. Also, by working with computers it can actually suggest ways and ideas for art work, which you just would not have, had it not been for the use of computers. The sort of drawings that Brian Smith is doing, and the fact that he has got a computer which can take a television picture and manipulate it, allows

him to produce a certain sort of drawing you would have never thought of making if it hadn't been for that technology. I will certainly recommend to artists to look up the whole thing, and not be put off by the idea of programming, because normally if an artist is interested enough in using computers some programmer will help them.

12. Visually, you get a complete feed back with the sort of machines I use, because they are graphic machines dealing with graphics, and so it is constantly giving me a picture of what I want. Even in the dance work where the script output is a visual thing it can be seen and checked as if it were drawn by hand.

13. Yes, the process of programming is quite different from the process of using the machine. It requires a different thought process which is a creative process. It is just as creative as doing an art work. While you are programming there is often very little visual feed back in the art sense of the word. You are doing a technical but creative job when you are programming, which requires a rather different part of your intellect than when you are doing a work of art.

14. It is difficult to point to any work of computer art and say that this will stand forever. But that is the same for any work of art, whether you are doing it by hand or by machine. There have been certain computer art works which I think are memorable and will be considered in the future to be tremendously influential. Certainly, the "Senster" by Edward Ihnatowicz in fine art, and the work of M.Mohr in graphics, fall under this category. The difficulty with computer art is that much of it is produced by people who really are not artists and can't produce art in a reasonable sense of the word. They don't think as artists but as programmers. They think that certain sort of drawings are art. If we had more artists working with computers we could have more memorable work.

15. I am not a purist about this, and they can use what they like. No one, not even the most enthusiastic computer artist would suggest that using computers is the only way to produce art, and frequently it is useful to do some manual work to help the computer. I think that as time goes by, that distinction between hand drawn crafts and computer drawn images won't exist. Even now, some computer output is actually

better in quality from a point of view of simple craft of drawings produced by hand.

16. I would not see the value of making them do that. You could create a computer program that simulated a particular artist's style. Except that, for study purposes it is difficult to see the advantage of it.

17. I don't agree entirely with that, as it is possible for artists to use paint systems to emulate the way they work with other mediums. I think Dominic has forgotten when he was writing that aspect of computer art. If he is ignoring that, then he is right, but I don't think he can ignore that. And I would certainly fall into the category of someone who wants to explore procedures as a way of generating art works, but Dominic does not do that. He is someone who thinks out the output and works towards devising procedures which helps him produce the output. I work the opposite way. I don't consider what the output is, but just consider what the procedure is and see what it produces.

INTERVIEW

1. ALAN RUDGE 23 MALE

2. The first computing I did was with a large three dimensional picture drawing package called "New Picture Package". It was part of a introductory course in my first year(Coventry Polytechnic). At that course you were presented with all kinds of basic drawings commands already put in for you, and you did not actually had to get involved with the programming at all. The computer we used was a large main frame computer used by the whole college. You had to put the information on punched cards, and a lot of them were already pre-punched with commands like draw and rotate. You just used to have to punch a number. It was not a very powerful package as it could only produce B&W wire frame type drawings. It was all done as part of the programme of the computer centre at the college, so you actually never saw the plotter or the computer.

3. I have done a Foundation course at Manchester Polytechnic, a degree in Graphic Design at Coventry Polytechnic and now I am doing a Master in Art here at DDR/RCA.

4. I have used a Pet, 380Z Research Machines, BBC micro and the Apple. I don't own anything bigger than the Sharp pocket computer. I don't think it is very important that one has one own computer as long as you have access to one.

5. I program the computer to be used as a tool by designers, and I am trying to make the programs accessible to them.

6/7. If I find that I've got a design problem that can be best tackled by the use of a computer, then I shall, but if the problem can be dealt with easier without the use of a computer then I shall not.

8. I program all my own work. I use Basic language, Assembler, Lisp, Fortran and Pascal. I program mainly in Assembler. I am self taught in programing.

9. I think it has influence on design. The main impact, is that every-body can see that there is some things that they ought to be doing. I think that one

of the important things is that people just get to know what kind of machines there are around so that they can ask the right questions to the people that are building them in the first place. I don't think you get enough communication between design people and computing people.

10. The kind of work I do is more to do with making a computer accessible to designers rather than using it to design things for myself. So in that sense, I am committed to carry on using computers .

11. I think one should use computers for what they are good at.

12. For the work that I do, I don't need a constant visual feed back. I consider the writing of the routines and procedures of programs to be my work. But when one is using a program to create an image you need a constant visual feed back. The problem in certain cases is that you can't actualy see the visual result of a large amount of work until quite late in the process. But then you reach a point that you can visualize what the program is going to do before it does. It depends on how you write programs, you can write your programs to interactively change the scene while you go along.

13. The objective of most people that are writing programs for artists to use, is to cut out the idea that you need reference manuals and debugging skills to use a computer.

14. What I think differentiates between art and mere skills is the thoughts that go behind the work rather than the finished product itself. I see no reasons why computer artists should not be just as capable as any other type of artists to produce work of artistic merit. I don't think that the fact that you are using a computer makes any difference. But what can happen, is that you can fall into a trap of thinking that you need to use computer art measurement to judge your work, rather than the way you judge any other piece of art.

15. I think that the term computer artist is wrong. An artist may use a computer or not, depending on what they are actually trying to achieve. To say that I am going to be a computer artist as opposed to just an

artist is wrong thinking, because you limit yourself to a medium before you actually think of what you want to do. So obviously I think that someone who uses a computer to produce art will need to resort to other methods which are valid to what they are trying to do.

16. I think computers can simulate human behaviour, but to actually simulate it does not neccessarily mean being that thing. You can simulate artistic creativity, but the very fact that it is a simulation makes it non artistic . The only thing that is artistic about computer programs is the actual element of creativity that went into writing those programs which are still human activities rather than the computer activity. The computer just follows instructions. Therefore the computer is not doing anything creative. It is always the person that programmed that computer who is doing the creative part of the activity. What ever comes out of the machine is put in by humans no matter how many levels back down the line you go.

17. No, I can't fit into these categories because I don't produce computer art.I never tried to produce anything that I would call computer art.I have used computers to do design work but simply because it was the most effective way to do the particular thing that I was producing, but I would not call any of it art.
a. I would hope most artists have clear objectives even if that clear objective is to allow them to wander from one think to another.
b. I don't agree that it is neccessary to have logical and closely defined procedures. In a lot of cases, you have creative ideas thrown back at you by the program.
c. You are working with a pre-defined visual parameter, and with certain constraints placed upon you by what medium you are using to actually display the work, but the actual structure of that information is not at all pre-defined.
d. What everybody wants to do, is to make it as flexible as possible but at the moment it is not.

INTERVIEW

1. SIMON BRADLEY 30 MALE

2. I was interested in the way Islam used geometric structuring for their designs and I knew that there was a three dimensional counter-part to the two dimensional structures which they applied to their design. I began to explore them by drawing plans and side elevations, and from them constructing perspective drawings which was a very laborious process. By chance, I saw a drawing machine at a building exhibition, constructing perspective views from data which made me realize the possible usefulness of the computer to the kind of work I was interested in. The first drawings I made with the use of the computer were at the Middlesex Polytechnic using the 'Picaso' software.

3. I have done a course in Art and Design.

4. I don't have my own computer. I use a variety of machines ,at the moment I mainly use the computer at Imperial College which is a
CDC (main frame).

5. Essentially it is just a drawing tool.

6. I have little other activities other then using the images that are generated by the computer. I am not involved in making any other sort of drawings other than sketches which go in my sketch book to work out an idea. I am not producing art other than with the use of the computer.

7. I could do my work without the use of a computer, but the computer takes away the donkey work.

8. I started by using other people software but the need to tailor those programs to my ideas made me take up programming.

9. Definitely, changes are inevitable.

10. Yes.

11. Yes.

12. I get my visual feed back from the VDU.

13. Yes, they are remote from the normal ways of

working, but those activities can be quite enjoyable.

14. There is a lot of rubbish around, but it's still a young medium and I am not even sure if my efforts add merit to the state of that art.

15. I think it's up to the artist. I think there will always be a spectrum.

16. If a piece of work cannot be singled out as being generated by a machine, then the answer to the question is: yes, computers can simulate human behaviour (H. Cohen's drawings is an example for that).

17. I don't think Dominic is right in saying that all artists that use computers have all those qualities in common. They might have one or more of these qualities but not necessarily all.

INTERVIEW

1. JEREMY GARDINER 26 MALE

2. In 1980, when I was a student at the RCA, I was using technological subjects and themes for my painting. I was trying to create a language of painting that encomposses technology in some way, at that time I realised that technology was moving away from muscle power and moving towards an era of brain power, which is what the computer is all about. At that time I went to a lecture in DDR that Brian Smith gave on the use of computers in art and found it very interesting and useful. Just after that I started a mural project and for the images I have used an in between program. When I finished that project, I realised that the computer can be a very useful tool.

3. I did my first degree at New castle University from 1975-79 Fine-Art and a Master of Art at the RCA from 1980-83.

4. No I don't have my own computer. I did not find it necessary. I found that having to find machines to use helped me to make contacts with people that I would not normally have made. Since I have been using computers, I have used the BBC micro, Prime 550, Textronix terminals,Calcom, and 380Z Research Machine.

5. For me the computer is a tool. It is an instrument of improvisation and a labour saving device. My role is that of an artist who uses the computer as just another medium.

6. I think the two now are inextricably inter-wound. I find that 75% of the activity of making art, for me, is at the moment the actual craft side. The art effect itself is very important in my creative process.

7. No I don't think my work could be done without the use of a computer. I am relying on the computer to create new stylistic devices and to explore possibilities that perhaps I have not thought about. Maybe it is a bit like Leonardo looking at his cracks in the plaster walls and finding images in that.

8. I have not done any programming to speak of, since I have not found it necessary. I think when you are using a computer to have a liaison with the programmer it is an important experience and you have to be prepared to cope with the kind of hard exactnes he has to deal with. The software that I have been using is: Picaso, Jackson and some programs written by Gareth Edwards. It's important to mention that ultimately it is not really the sophistication of the equipment you use, to make your art, which is important, but the attitude you have from the out set.

9. Yes, the computer will have an effect on art and design in the not too distant future. I think it is important that artists who use computers remember that the machine is only a tool. And not like some un-imaginative students, I come across, who tend to rely on the machine completely with their art activity.

10. I am going to continue to use computers because I think that they offer enormous possibilities. There is a potential there that has not yet been explored. And the opportunity to work with them is too important to be missed.

11. I think that Computer Art has a stigma in the art world. There are a number of reasons for that, the primary being that the kind of products that are accepted as computer art has been produced by scientists rather than artists, which shows their total lack of artistic sensability. I don't think one can recommend an artist to use computers. It is up to them to decide for themselves. I think that computers in art and design education have to be explored with caution to avoid a situation where-by students would rely on the machine too much, rather then on their own imagination.

12. This is some thing that the computer is very good at doing, giving you a constant feed back of images so you are able to act upon them immediately.

13. You have to be prepared, if you are going to use computers, to devote some of your time to accepting that kind of discipline.

14. Mention computer aided art techniques to most people, and they immediately think of crude teleprinter

produced printouts of Snoopy and the Mona Lisa which commonly adorn computer room walls. Artists themselves often regard computer coded art techniques with deep suspicion and many have described them as unprofessional. The reasons for that are, the crude efforts of those who have access to computers, such as programmers, scientists and commercial artists, and the prohibitive cost to artists of gaining this sort of access.

15. I would not want my life work to be stored on a video disc.

16. A computer has no intuition, imagination or emotions. It will never be able to create any thing that is truly abstract.

17.a. If you are going to be involved with computers, you are going to be a clear thinker anyway.
b. Logical and closely defined procedures is getting into the domain of algorithmic aesthetics which is not a good idea.
c. Logical and closely defined procedure are, as far as a working process might go, an attitude you might have to adopt if you are using computers.

INTERVIEW

1. GARETH EDWARDS 25 MALE

2. I came across an Apple computer in 1978, and on one of the program tapes there was a program of flight simulation. While I was playing with it, it occured to me that if I could create my own computerised landscape I should be able to manipulate that environment as I was doing with the flight simulation. It took me two or three years to get my act togther with computers. At that time (1978) there was no software for artists or designers (or small computers) and I realised that I would need to teach myself programming to enable me to realise my dream.

3. I did not do art in school. It was not until I left school that I started painting. I have done a BA in Fine-art and a Postgraduate course at Gray School of Art in Aberdeen. At the moment I am doing an MA by project at the painting school at the RCA and working at the Middlesex Polytechnic.

4. In the polytechnic I use the Prime 550 which is a very powerful mini computer and I also use a Dec 10, a large main frame computer. For a personal computer I use the BBC micro.

5. It is a tool for asking questions. I can ask 'What if ?' with a computer, and I can ask, What if ? with a pencil. But the kind of questions I can ask with the computer are the kind of questions I am involved with as an image making person. For example, what if I change the environment to portray a 90 degree turn, what if I turn it up side down etc...

6/7. No I could not do it without a computer as my image making is dependent to a very great deal upon the stimulation I get from examining not only the real world but the world that I find within the computer. I could survive as an artist without a computer but my work would change.

8. I have written all my own programs. I can program in Basic, Fortran, Pascal, Forth and Assembler.

9. Yes I do. I am not sure how. It has made such an

impact on our society that it will be ludicrous if it did not have any impact on art at all. I don't believe that there is a conscious decision in art education to exclude computing. But unconsciously they are doing their best to keep the new technology away.

10. Yes, I see the whole process as being a part of my life, and I don't realy expect ever not be using computers.

11. It all depends on the individual.

12. I am far more aware now of objects in space and their relationship between each other, since I have used a computer.My mental eye is no longer tied to the ground. It can fly away, and I can look down onto buildings while I am walking on the street.

13. Not for me, the process I use to paint 10,000 blades of grass and debugging programs are very similar.

14. In the future we are going to find more artists that will be using computers, and from which some works will take its place among other work of artistic merit.

15. I just don't know. Who knows ?

17. Not really, anything that is pre- defined and absolute is just a waste of time with computers.
a. You have to be always ready to drop everything and start all over again
b. I am a pretty messy programmer.
c. It depends with what system you are working with.
d. Quite the opposite.

INTERVIEW

1. JENNIFER SADLER 32 FEMALE

2. I spent three years just reading around and thinking about the possibilities and I am only now beginning to use computers in any serious way. I tried many times to persuade people who run programming courses for commercial applications that it would be worth training me for design implementations but they always said that there was no real demand. Eventually I found a course designed for engineers, and they were prepared to give me a general overview of microsystems for control and teach me to program. This course had nothing to do with graphics at all but it was very useful nevertheless. All of the graphic work I have done so far has been very simple- I am only at the beginning.

3. My degree is in painting and drawing, but over the years I have also studied various design subjects including: photography, printmaking, furniture, interior design, fashion, jewellery.

4. I will use whatever I can get hold of. I have no computer of my own but access to things like a BBC is relatively simple these days. A machine of my own will probably be my next investment.

5. I think of it and use it as a tool, I can't really see how could it be looked upon as anything else really.

6. Only in so far as I do them all. If I discover something in one area that looks as though it might be useful in another then I will try to use it. I don't see any reason to make a distinction between 'computer' and 'non-computer' in design work, any more that there is a need to make a distinction between 'cooking vegetables' and 'cooking fish'; one would do slightly different things of course, but the basic principles are those of cooking, not of botany as opposed to zoology, and hopefully the end result is a tasty meal ! The final result is what matters, not the route by which one arrives at it.

7. Most, if not all of the things I have done so far would be perfectly possible without a computer but they would have taken a great deal longer to arrive at.

Probably everything that even the most sophisticated machines can do could be done by hand if the artist /designer were persistent enough and could guarantee to live to at least 150 !

8. So far i have only really used other peoples' software, sometimes with small modifications of my own. This is not a satisfactory state of affairs from my point of view because I like to have as much control of the whole process as possible, and also because the kind of images I want to produce require individual programming.
There are software packages available however which are so sophisticated that I doubt if one person could exhaust all of their possibilities in one liftime.

9. Unquestionably. I think its impact will be of a similar order to that of the discovery of perspective in the early Renaissance. The qualities of computer generated material will be what distinguishes the work of this century from everything that has preceded it.

10. Yes, it's great fun !

11. Yes, it's great fun !

12. It depends on what I am doing. If I use a software package then feedback is more immediate usually than it would be if I was working by hand for most things; one can for example change the entire colour scheme with one key. For work requiring its own program of course there are delays while one writes the coding but this is no more of a problem than is having to wait while one's photographs are developing. Less in fact.

13. No more than priming canvas, making frames, mixing paint, cleaning out furnaces or any other routine part of technique in any craft. In fact, the logic of programming can be very beatiful and inspiring in itself, it simply requires patience.

14. To exactly the same extent as any kind of artists are able to produce works of quality. There is good stuff and bad staff in all fields. I think there was a time when most computer images were designed by engineers and therefore the quality in aesthetic terms was sometimes low but now that computers are more accessible to the non-scientist/engineer both in terms of price and ease of use, there is some remarkable work

around. See TRON !

15. To exactly the same extent as someone encountering difficulties with traditional methods need not resort to using a computer I suppose.

16. In the first place 'Art' is almost impossible to define; it would seem to be a perceived phenomenon rather than something which exists independently as a human function. If you accept that art is something that the observer constructs on perceiving an action by someone else then yes it is possible for a machine to be artistic, because it is possible for a machine to produce certain types of event at random which people might perceive as artistic. If however, one thinks of art as primarily a conscious effort to express emotion,(I am considering the process from artist's point of view now), then no it is not possible (at least not yet) for a computer to be conscious or have feelings and therefore not possible for it to be artistic.