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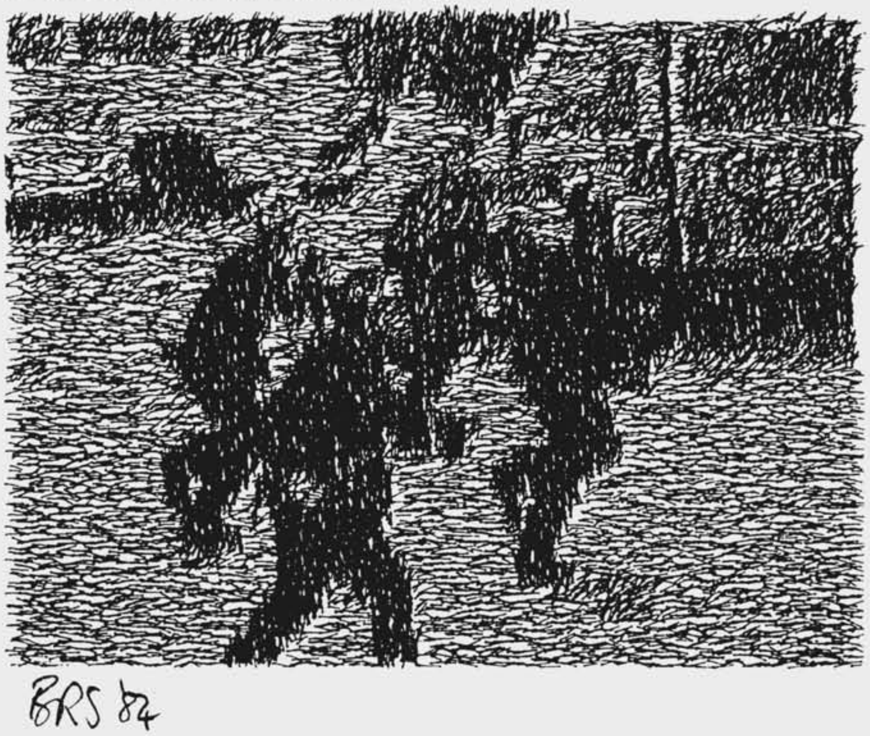
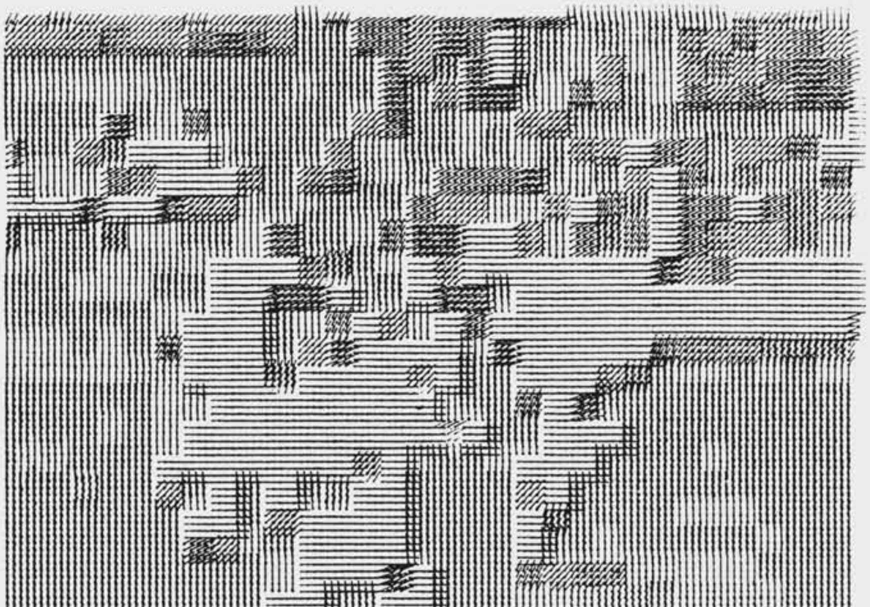
COMPUTER ARTS SOCIETY QUARTERLY SPRING 1985

ARTISTS FROM THE ROYAL COLLEGE OF ART, LONDON: COMPUTING ARTWORKS





Police rushing to attack computer graphic representations of themselves.
by BRIAN REFFIN SMITH

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COMPUTER ARTS SOCIETY QUARTERLY

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Production Editor & Designer SUSAN IVERSEN

Copy Editor MARY POWELL

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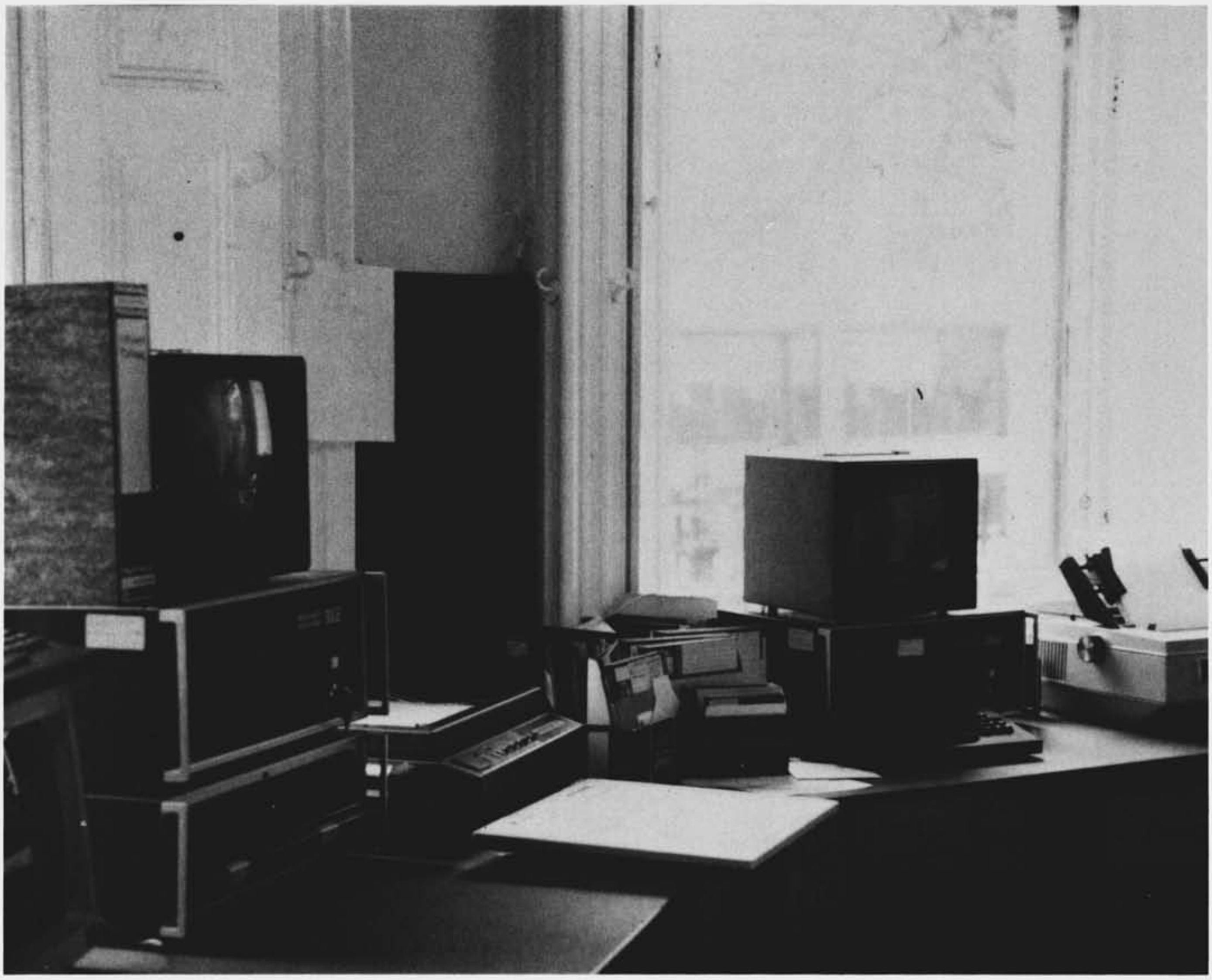


Department of Design Research computing studio at the Royal College of Art.

In this the first of the new issues of PAGE, the focus is on artwork created close to home, the Royal College of Art; where the magazine is now produced.

Computers have a place in many departments of the College and are used for various purposes some of which are described below. At present the computer network of the College is undergoing a revision and all departments are being encouraged to take advantage of new computer graphics facilities. The inclusion of the new Bleasdale computer, in the Design Research department, with the Imperial College computer network enables access to all the computing facilities of Imperial College by students at the RCA - forging a tangible link between the arts and the sciences!

The Textile School uses computers in many aspects of its work. Computer controlled or computer programmed machinery is now available, or being developed for all methods of textile manufacture - knitted, printed and to a lesser extent woven textiles - and the same is true for the manufacture of certain garments. In many areas of textile manufacture the use of some form of CAD/CAM system is standard practice.

The Textile School has computing equipment which is dedicated to operating particular machines, usually in the form of a system that allows the textile designer to input information about the product (pattern, structure, colour, shape) and then to manipulate the information once it is in the system. The interaction of the designer with the stored information is facilitated by drawing on a tablet with a light pen and selecting functions on a keyboard - the results are displayed on a colour monitor. Information can be added or subtracted, shapes can be changed, enlarged, mirrored and viewed together with previously stored information - in effect, providing most of the variations that a designer might require in the design of textile products.

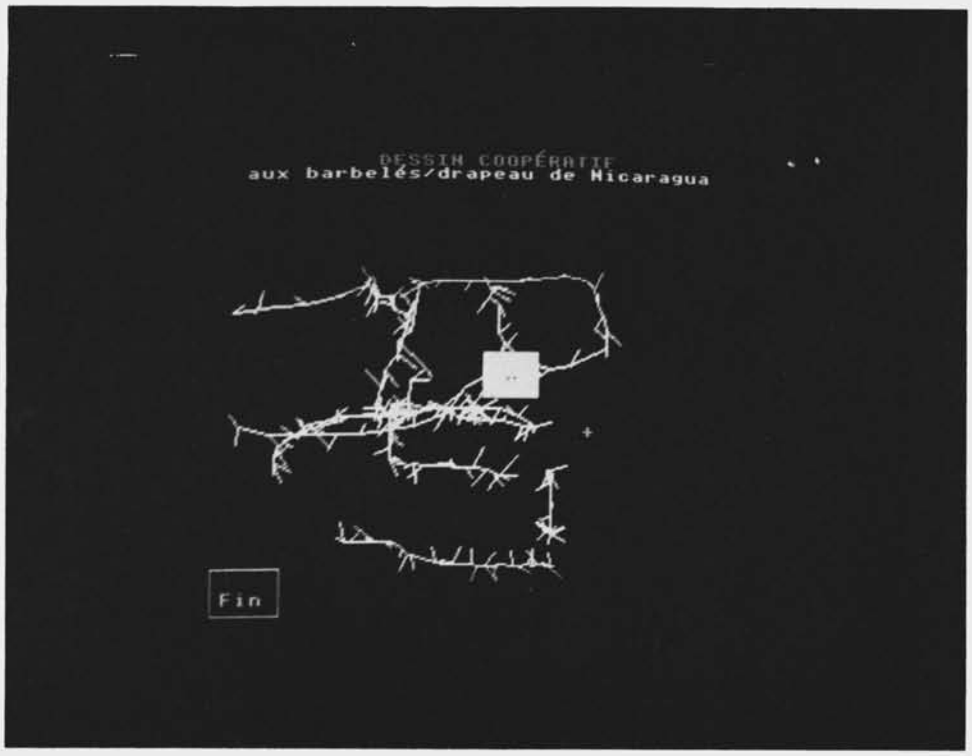
In the School of Industrial Design students use computers to design and build three-dimensional models. The system includes a VAX 11370, two solid-modelling programs - GEOMOD and EUCLID, as well as three high resolution colour graphics terminals; LEXIDATA Solid View, LEXIDATA 2410 and Tektronix 4027A.

The School of Furniture Design is prepared for the new generation of students who have learned computing at school. The School now has a BBC micro with a CUB monitor and printer with several programs specifically written to aid students with their designs. For example, mathematical formulae can be used to determine the precise dimensions for any given shape of a piece of furniture.

The Furniture Design school also has the benefit of a program that calculates some basic design factors such as the material weights and lengths for woods, steel, fibreglass and various other materials that the designer may wish to use. The development of the program, called "Deflections: for furniture and industrial designers, a simplified guide to structural calculations", was funded by the RCA research committee and written by Frank Matthews, Senior Lecturer in Aeronautical Structures at Imperial College.

Other departments at the RCA that use CAD systems are Photography and Graphics. The work of William Latham from Graphics will be presented in the Summer issue of PAGE; included in this issue is some work by photography student Bill Baxter.

BRIAN REFFIN SMITH Artworks for liberation



A screen shot of "Co-operative Drawing with Nicaraguan Flag"

My work is divided between visual representations - drawings, photographs or large blow-ups on canvas - and computer-based installations. The same ideas, however, underlie both modes of presentation.

I am interested in 'In-betweening' - not in the cartoon sense of going from one animation form to another, but rather in the sense of going from some idea, image, text et cetera to another, through a space which may be 'real', for example along a gallery wall, or conceptual.

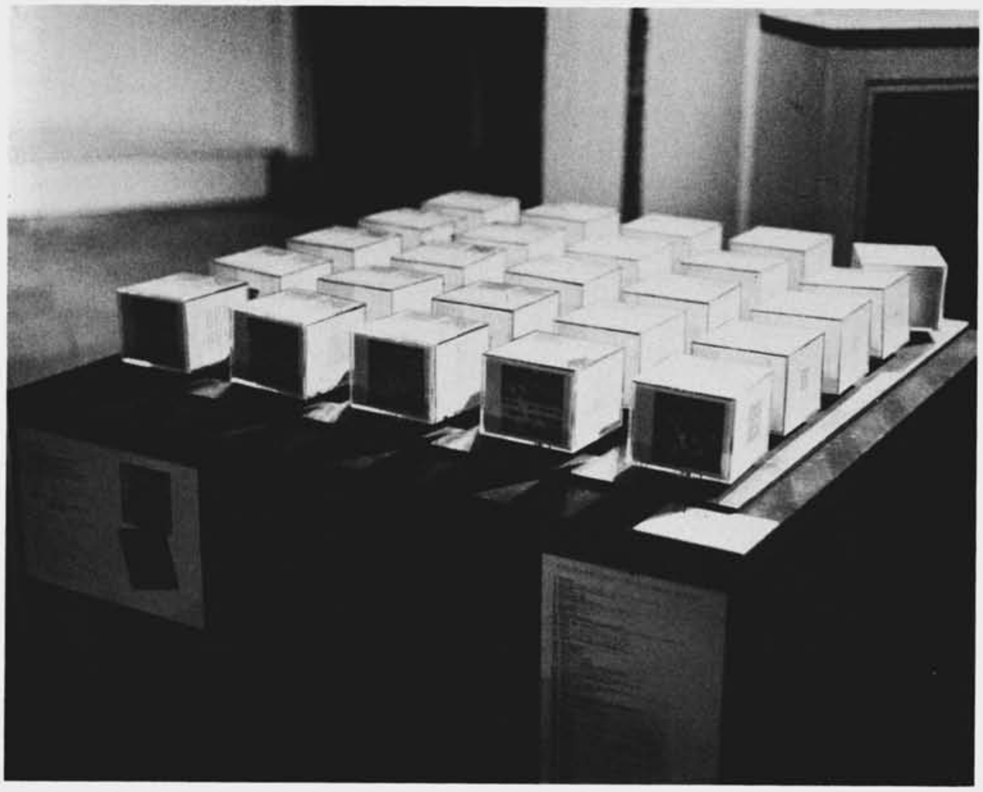
The 'Co-operative drawing with Nicaraguan Flag', shown in 1983/4 at the Paris Museum of Modern Art, allowed two people to produce a drawing on a colour monitor using a computer's joysticks. The computer averaged the two participants' movement, as if two people were guiding one pencil on a sheet of paper. The computer would only 'draw' barbed wire; and in the middle of the screen was a small Nicaraguan flag so there were two problems: a) how were the participants to co-operate to make the drawing and b) what could they draw given the barbed wire and the flag. This work has been exhibited in Paris, Amsterdam and London with different types of response tending to occur in each place.

Installation shot from the Paris Museum of Modern Art showing 1983, showing "Co-operative Drawing with Nicaraguan Flag" along with the aluminium figure of a dead soldier that accompanied the exhibit

In another work, '25 Computer Graphic Cubes', the cubes were covered on each face with colour computer-produced drawings as well as French and English texts. The cubes were arranged in five ranks of five; each cube rotated and contained a music box, and each rank played a different tune. There were in all, nine different dimensions of 'in-betweening' - for example, not only did the images change, but the text changed from French to English by the gradual replacement of letters. The subject of the text and the images is an incident where a Malaysian woman was being attacked by police for protesting about the conditions under which she assembled silicon chips for multi-national corporations - the same chips that allow me to use a computer in my work. The drawing is taken from a newspaper photograph, frame-grabbed, processed and then drawn using one of my drawing algorithms on a Calcomp 84 plotter. The work was exhibited at the Paris Museum of Modern Art 1983/4.

In general, to produce artworks using representations of labour and struggle, is not to be part of that struggle, or to contribute to it. Whilst one is searching for a means by which the most powerful art tools ever invented can be used for people against repression; for change against statis; for revolution against reform; for art against meretricious nonsense, one should at least employ images of significance from the world - images that are vivid for the artist and hopefully the viewer.

Brian Reffin Smith's book 'Soft Computing: Art and Design', which deals at length with the issues in this article is published by Addison Wesley in the UK.



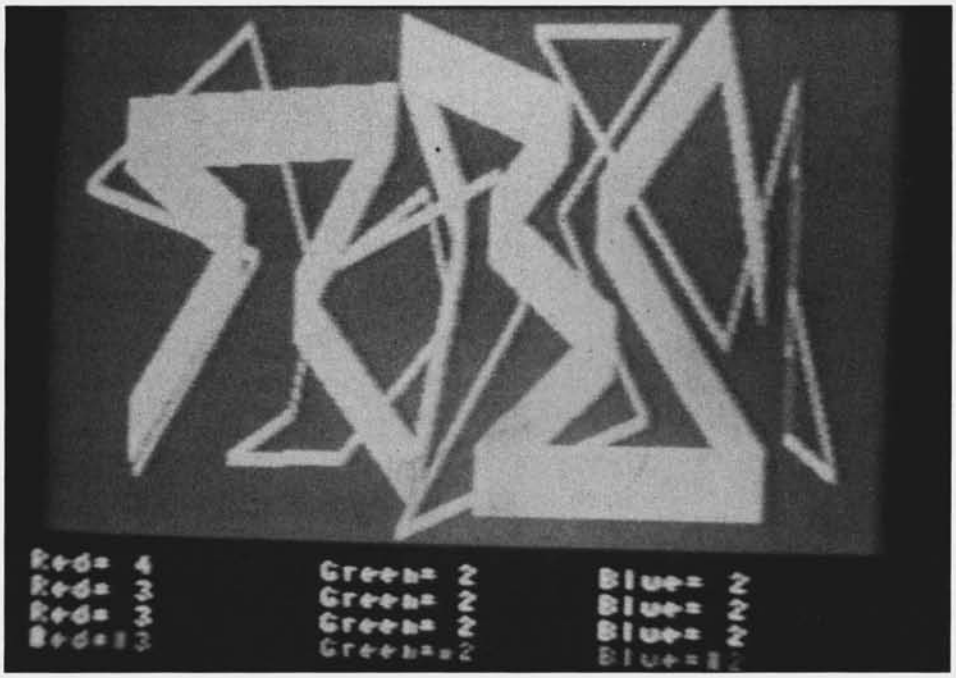
"25 Computer Graphic Cubes" exhibited at the Paris Museum of Modern Art, 1983

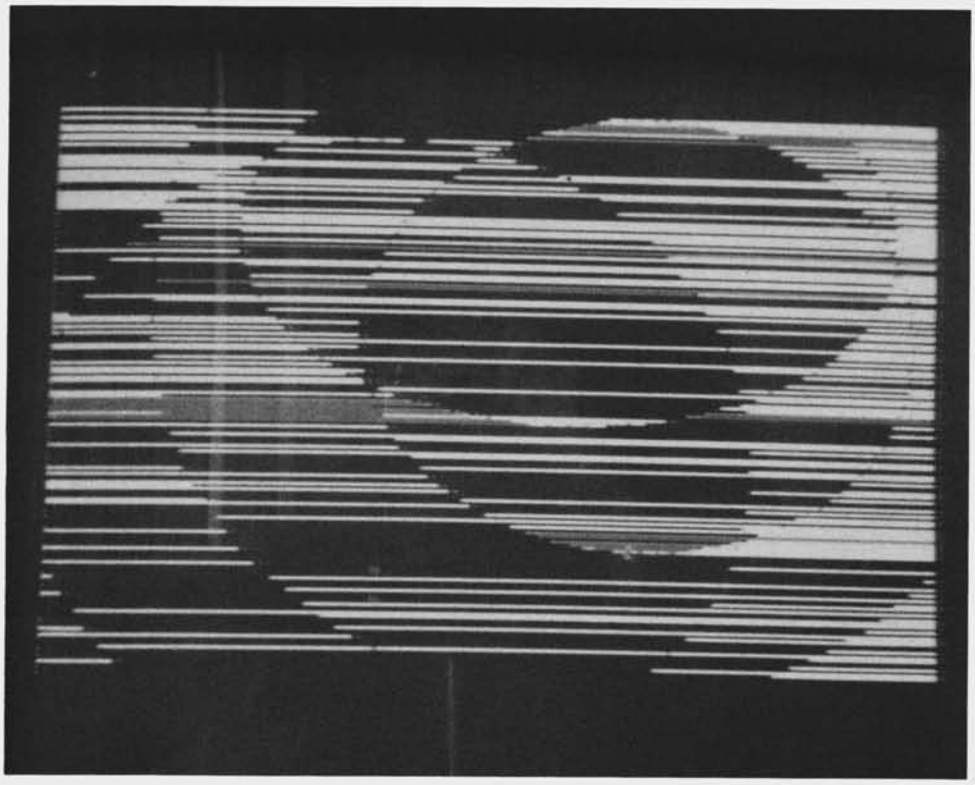
SUSAN IVERSEN Switch on to paint

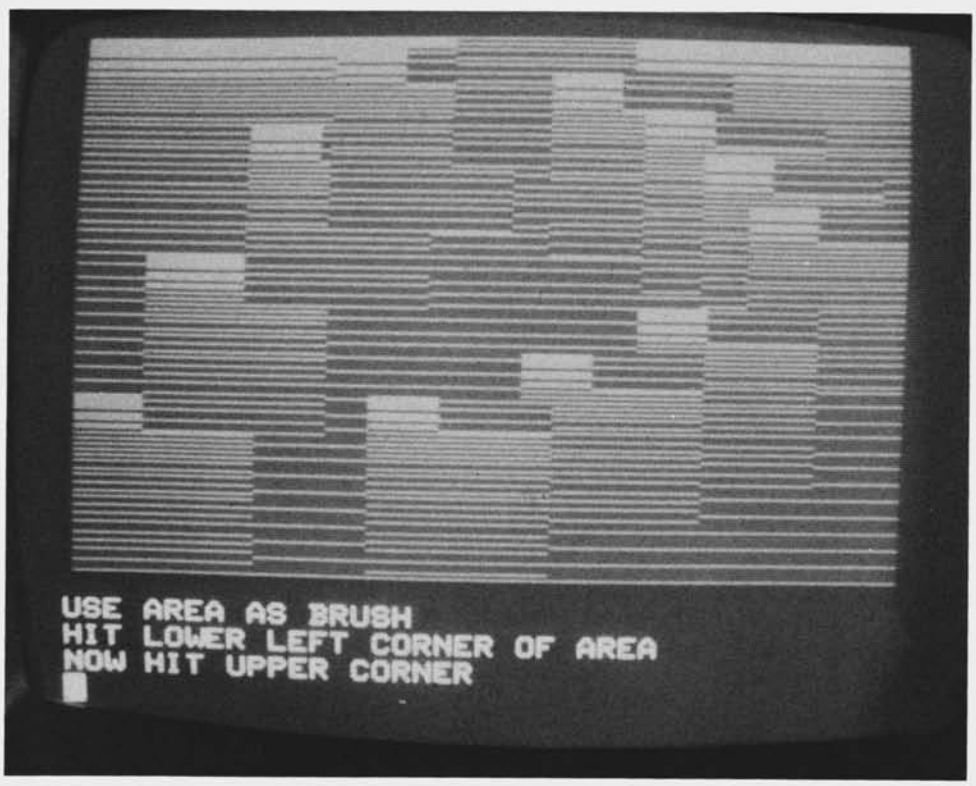
I am both an artist and a designer. My design experience is in "synthesising information" - laying out type and photographs and generally designing the presentation of information. With the advent of computers as design aids, I became interested in the opportunities of this new medium both for my design and for my art work. The photographs presented here are some of the results of my experimentation with the "Jackson" computer graphics program developed by Brian Smith at the Royal College of Art Department of Design Research.

I feel that the computer can produce its own special kind of visual image and for this reason I do not try to use it in the same way as I would use paint or crayons in producing a picture. The restraints of the computer pose, what for me, are interesting problems. The possibilities for using the computer to create art work seem endless, and the real restraints few.

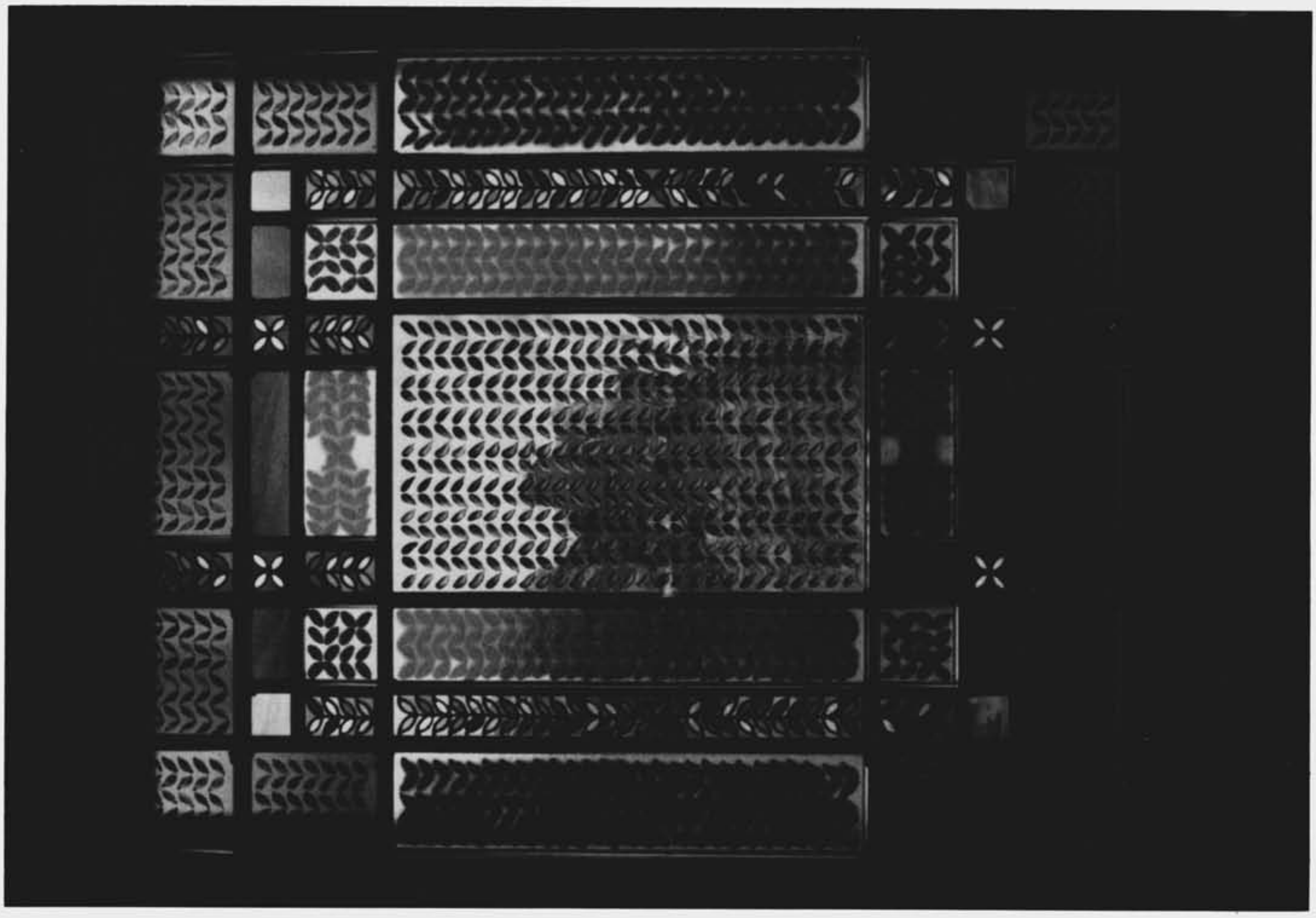
Computers have also provided me with new possibilities for my work in synthesising information. Writing a computer program in a logical, step by step procedure, is, in a sense, a process of synthesising information. I find that designing a simple program is a good exercise in thinking things out clearly. Computers, then, have provided me with new avenues of experience, both in my art work and my work as a designer.






USE AREA AS BRUSH
HIT LOWER LEFT CORNER OF AREA
NOW HIT UPPER CORNER

"Moving Birds" a computer design by Susan Iversen



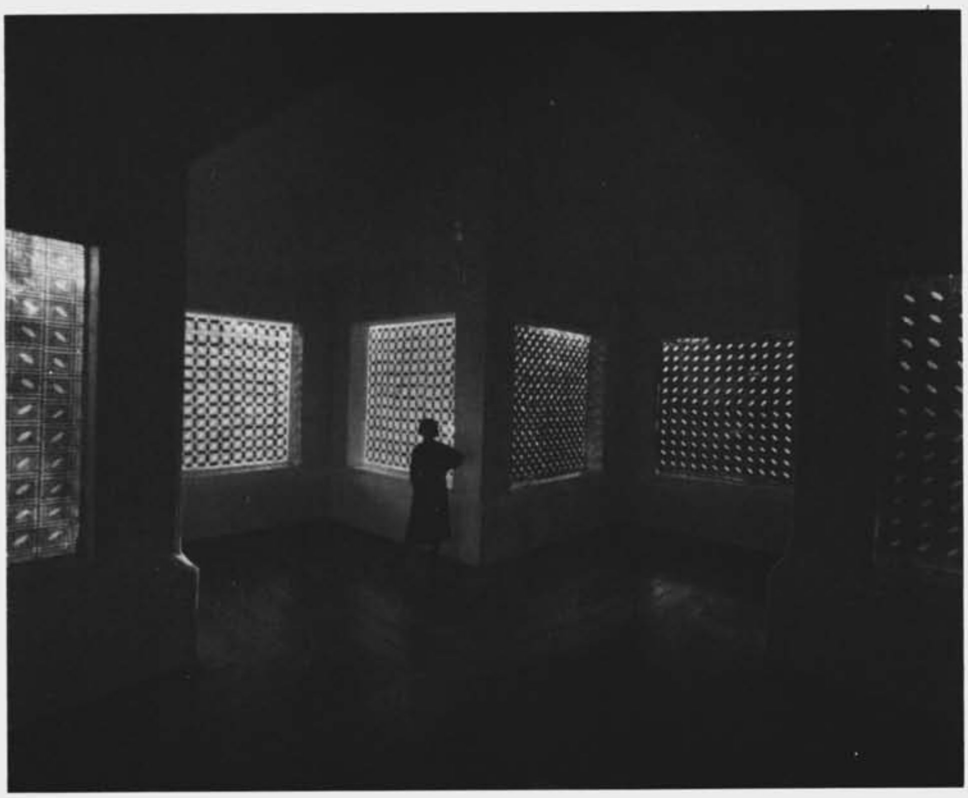
A design for stained glass by Deborah Coombes

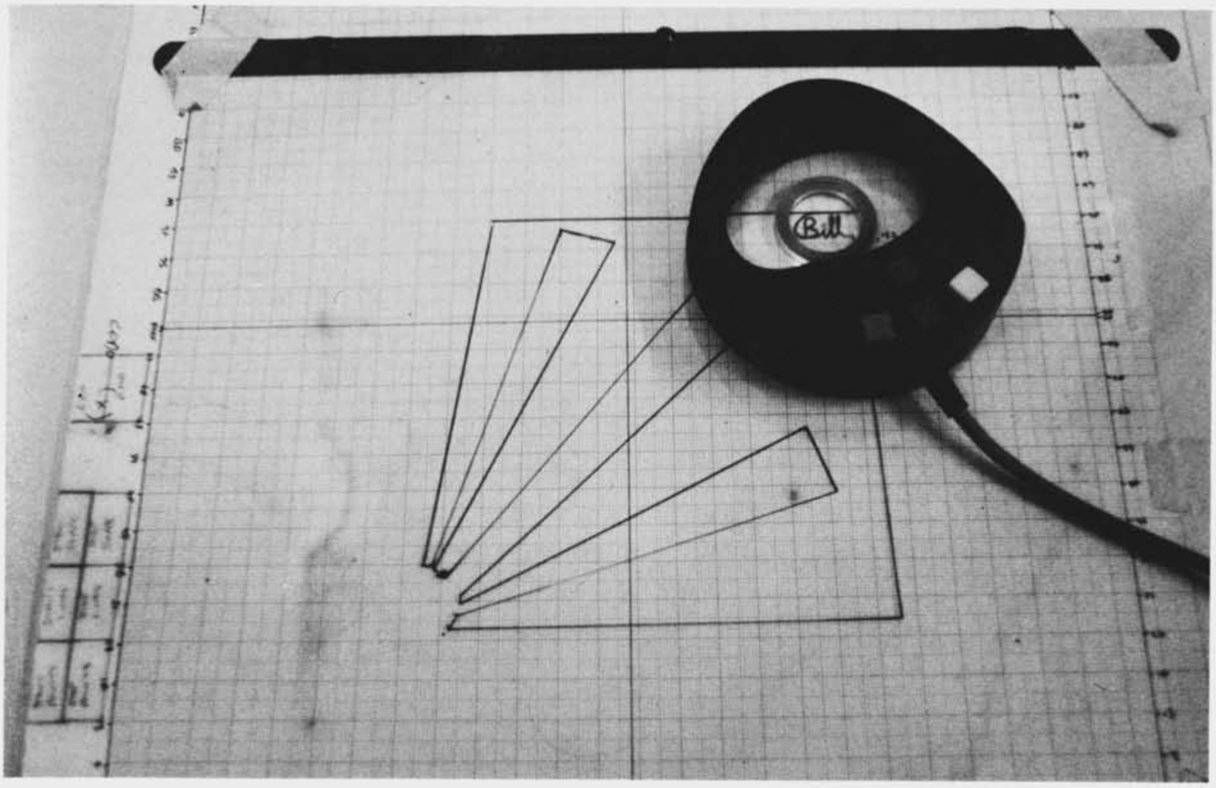
DEBORAH COOMBES Soft options for glass

Deborah Coombes is a student in the Department of Glass at the Royal College of Art. Deborah specialises in designing and constructing stained glass windows - some examples of her work are presented here.

Over the past two years Deborah has been using the 'Jackson' graphics program in the Design Research department to generate her designs. Deborah has found the Jackson program easy to use and extremely useful for the sort of work that she produces. Deborah was already working with geometric patterns that she produced by hand but using the computer has enabled her to experiment with different colours and shapes much more quickly than by a collage method.

Apart from the benefits of the computer as a tool to allow her to work more efficiently, Deborah has also found that producing designs with the Jackson program opens up new ideas for her glasswork designs that she may not have found if working in other media.





The original artwork on the graphics tablet.

Bill Baxter, an M.A. student in the Photography Department, is developing a laser projection system which will either work with the College's Audio-Visual (AV) equipment, or as a stand-alone device. The budget (and hence equipment) is fairly modest, but the device is not as limited as at first appears.

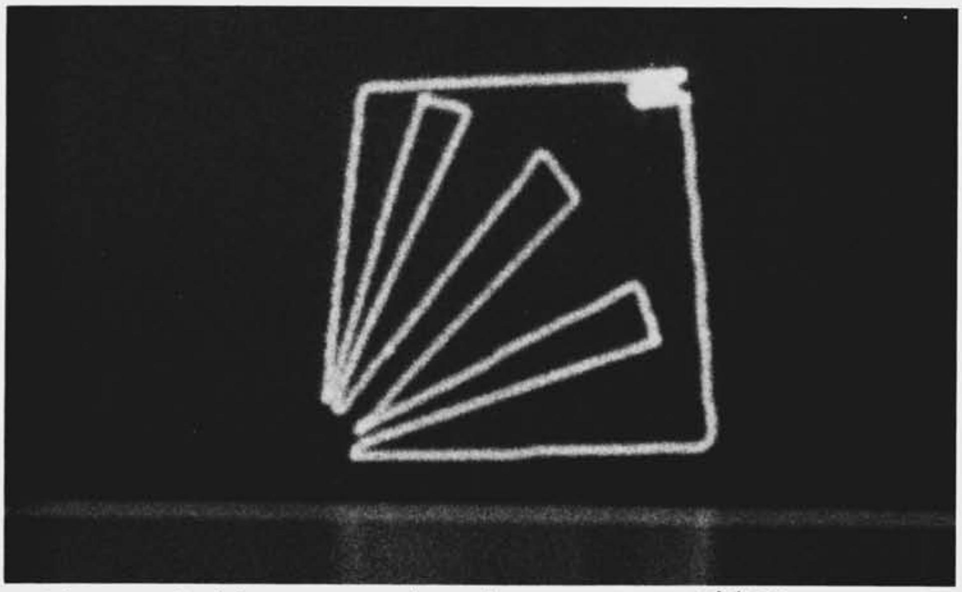
A laser is "any device which can be made to produce or amplifiy electromagnetic radiation in the wavelength range from 200nm to 1mm, primarily by the process of controlled stimulated emission." Basically a laser yields a very narrow beam of bright, monochromatic light. The College owns a Laserscan Minimirror system, in which a pair of very small (approx 1mm squared) mirrors can steer the beam at high speeds along X and Y axes and, using an Apple //e computer with a Digital/Analog converter card, enable an image to be seen (in much the same way that whole pictures are visible on television screens and not the moving spot from which they are formed).

Images are drawn via a TDS graphics tablet and can be saved on floppy disk for future display or manipulation. Images can be loaded into the memory of the system and stepped through at varying speeds to provide animated displays. This process can be run in real time using the same clock signals used by Electrosonic, the AV equipment manufacturers - a short show has already been created using laser and conventional slide images in register and in time, as both the slides and laser were working from the same clock track recorded on tape. The software for this show was written in Machine Code but a show-compiling program is under development which anyone should be able to use quite quickly when familiar with the system. Also, a forthcoming program will allow users to type in text from the keyboard to be displayed with the laser. (This feature is available from commercial laser projector manufacturers).

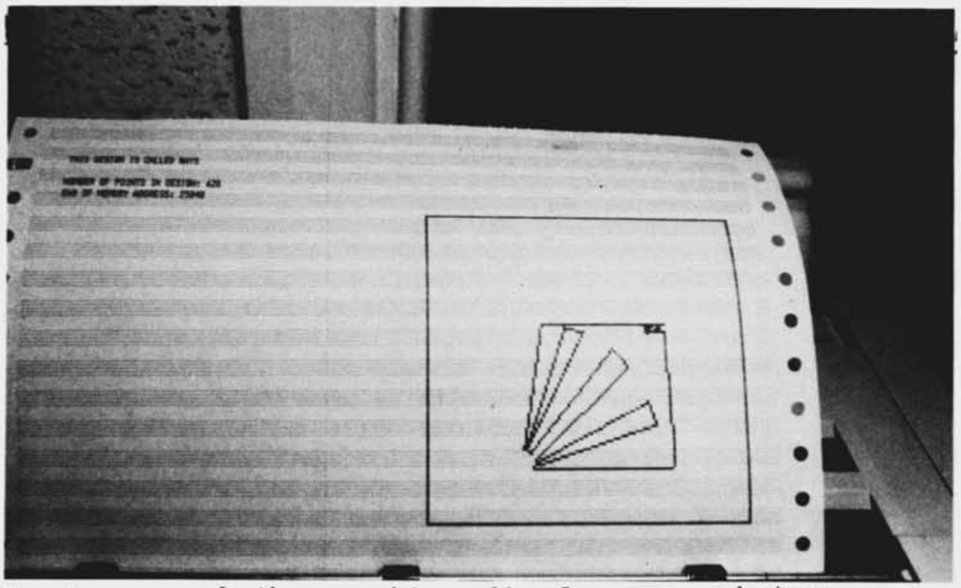
Some research has been undertaken to evaluate the laser's potential for holography. In holography, there must not be any movement of film or object while an image is being exposed, so unless a very expensive pulsed laser is used, a vibration isolation table is necessary as well as exposures of 30 seconds or more. Some holograms have already been created using a scanning laser beam with no isolation - these require only a fraction of the normal time taken to set up and expose.It is hoped that further research in this field will be undertaken next year in cooperation with the Holography Department. The possibilities of computer generated holograms also require further investigation.

For those who are interested, the equipment used is an Apple //e computer with Apple's new ProDOS system (which permits the use of a RAM disk drive and so greatly increases the flexibility of the system). The computer is linked via a Mountain D/A converter card to a Lascerscan laser projector. The computer also has Electrosonic AV and clock cards, loaned to the College by Electrosonic, as well as the D/A card. The T.D.S LC12 Graphics tablet is linked to the computer with an RS-232 interface. A computer representation of the image drawn can be printed out on an Apple Dot Matrix printer.

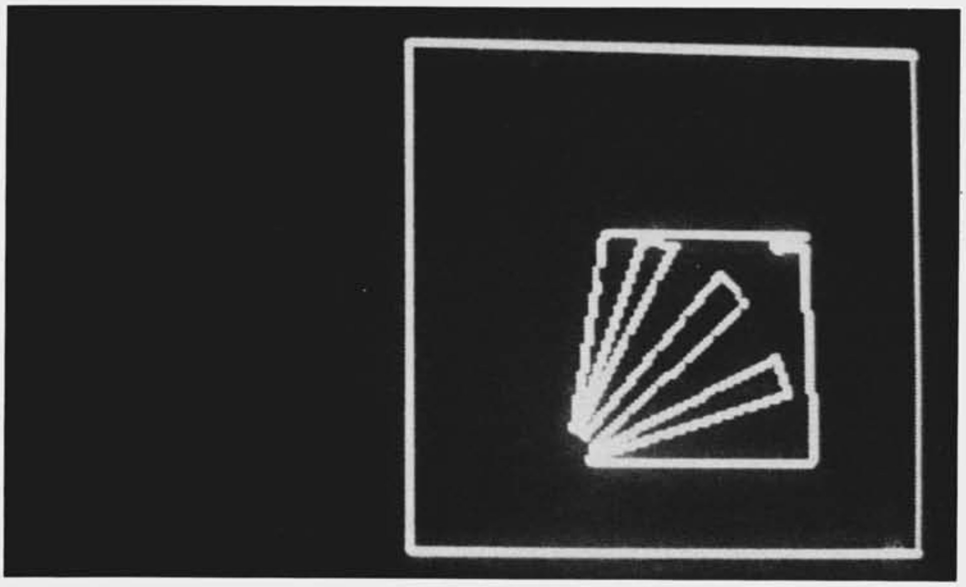
Looking further into the future, the College is purchasing both Krypton and Argon lasers which will allow colour images to be produced. A further refinement of the Tablet operating software will allow regular patterns to be created at the touch of a button. Some special software has already been written; for example, a routine that allows images to be 'drawn' (that is, the images gradually appears starting from a small dot) on to the screen.It is envisaged that a library of such routines can be stored on the system disk for whenever they are required.



Half resolution computer image on monitor.



Hard copy of the monitor display on printer.



The final projected laser image - it becomes clearer when larger and the word 'Bill' becomes visible.

CHRIS STEELE   Transforming art

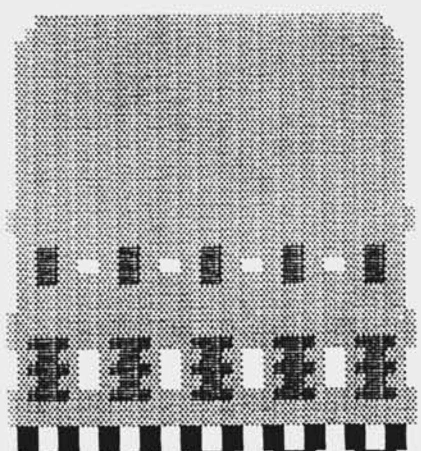
My particular interest is in the way that computers can be used as tools for developing images.

Rather than using highly complex data systems to represent objects in an attempt to model their visual characteristics, I choose to manipulate the display data itself. The software I use is almost entirely devoted to providing the facility for putting areas of colour on the screen and manipulating them once there.

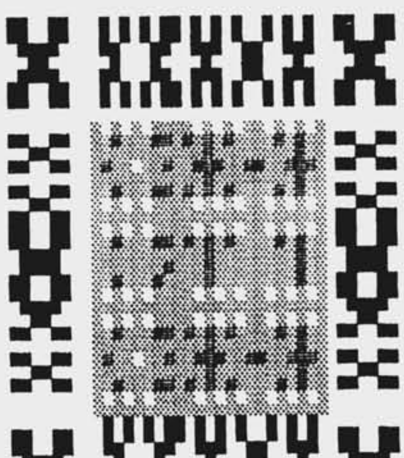
The short series presented here is an example of my work. Each image is derived from a standard original pattern through transformation of the data that describes the original. Although all the processes for describing the images are numeric the results are often unexpected.

The courseness of the pixel grid highlights the media used rather then attempting to conceal it. The small number of pixels also make it difficult for the viewer to distinguish the ways in which each image has been changed. The images created are, I think, additionally interesting because of the way in which they are produced using the computer as the medium.

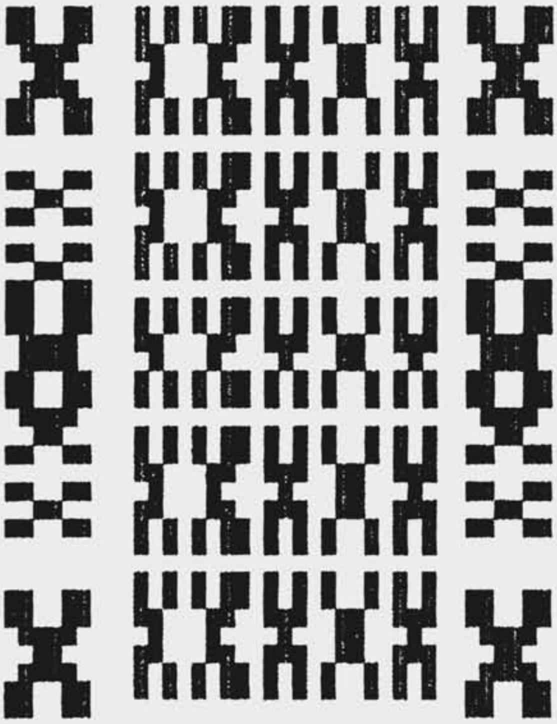
Various processes are used to transform the images. One routine used will squash or stretch any rectangle of pixels in order to map it onto any other rectangualr area. Another routine will set the value of a pixel to be the average value of those that surround it. A general mapping routine is also used which will map any area bounded by four straight lines onto any other area with a similar boundary. These routines have been used singularly, repeatedly, in conjunction with each other and recursively in producing images.



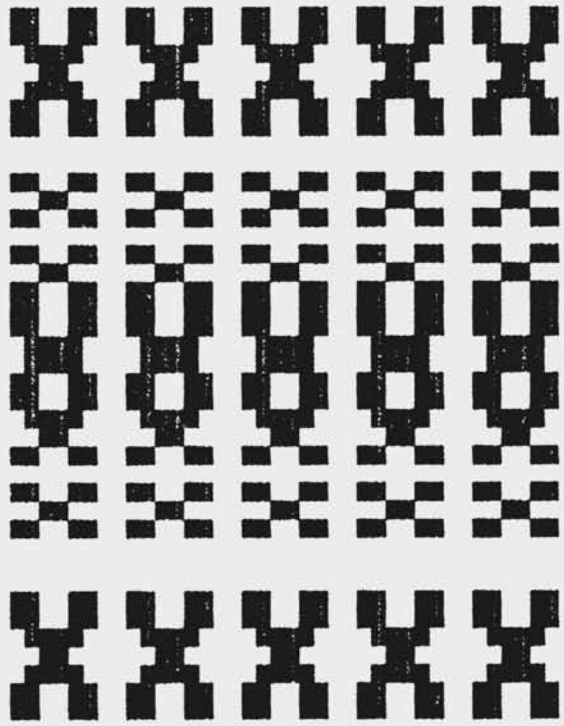
Chris Steele '85



Chris Steele '85



Chris Steele '85



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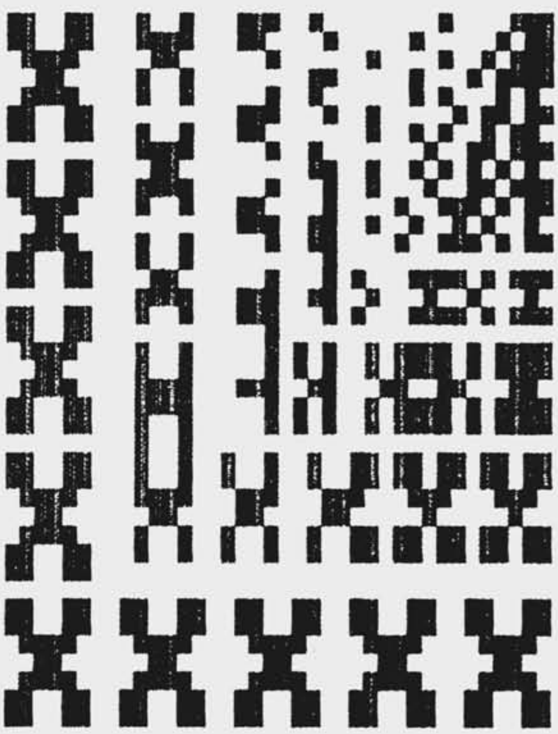

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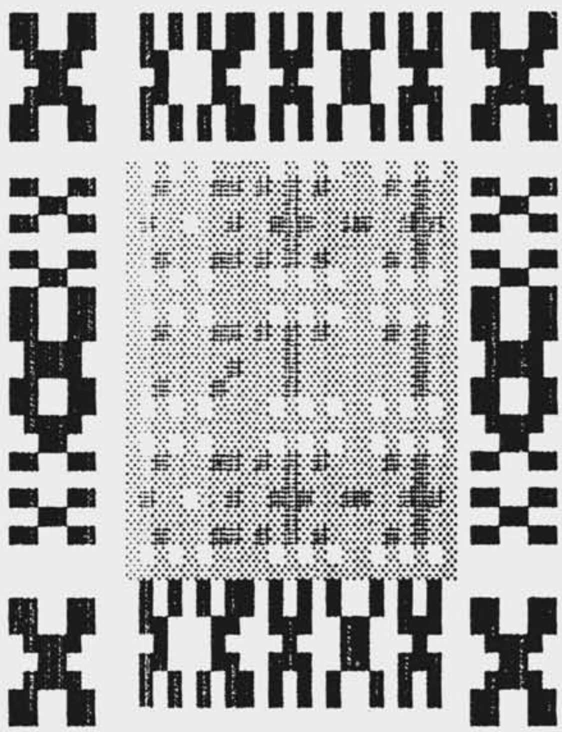

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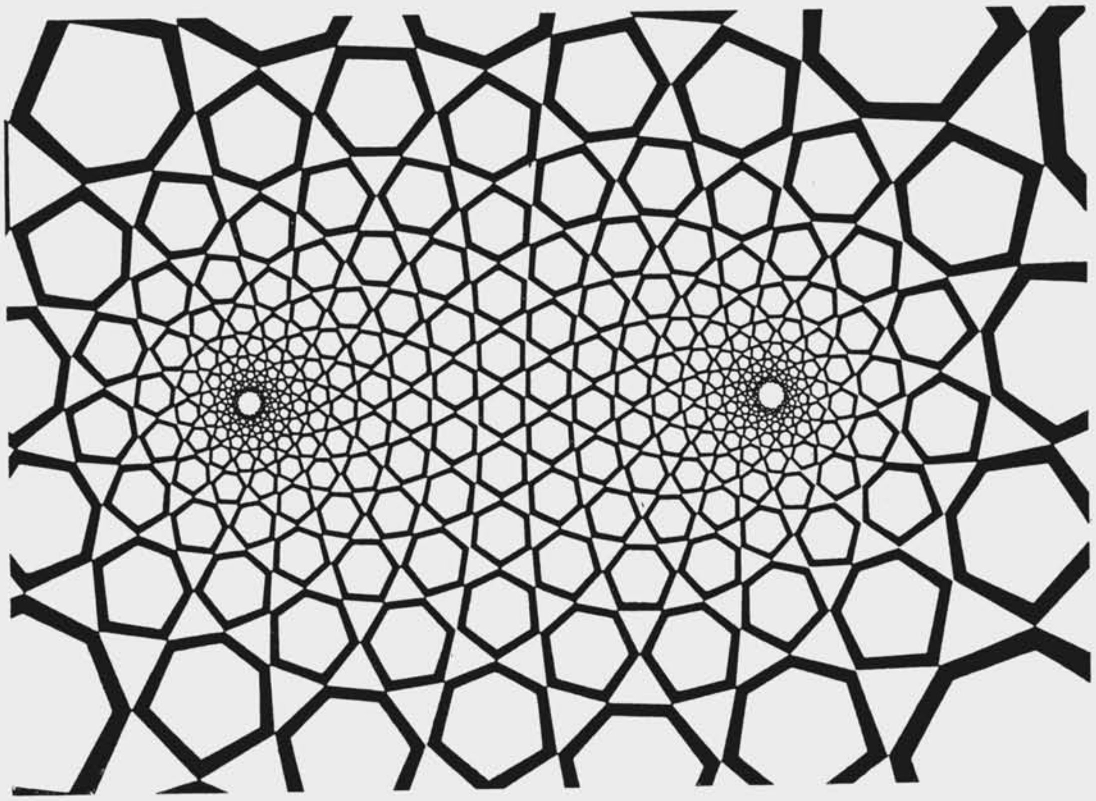


"Turtle geometry" A surprising richness of surface waves can be achieved by forming the sum of a few simple sine waves that match the true physical behaviour of water. As with all the other pictures, the short program is written in BASIC and calls upon elementary school geometry, trigonometry and algebra.

MATHOGRAPHICS — Making sense of mathematics with the help of a small computer

ROBERT DIXON

Through computer graphics a child can learn mathematics. That was the message of Seymour Papert's best-selling book, "Mindstorms", and it aroused a great deal of interest within the mathematics teaching community. Five years later however, and with many more micro-computers in our homes and schools to test the proposition, how far have we progressed with Papert's idea?

The main problem seems to be a lack of focus, both literally - that is, in the graphics output - and theoretically, in our grasp of the central idea. Commentators mostly argue about Papert's more specific proposals of LOGO versus BASIC, Turtle Geometry versus Euclid, and de-schooling versus schooling, without coming to terms with the fundamental proposal that mathematics can be found embedded in picture-making, and in other practical activities. Meanwhile the graphics in question remains firmly tied to the domestic television screen for its output device. This simply will not do. If a drawing is to satisfy the eye as well as some mathematical theory then the picture must be sharper. Current alternatives to domestic video graphics that offer greatly improved resolution include the simple pen plotter, about which I shall say more later. In order to appreciate what picture resolution has to do with mathematics, we need to consider the philosophical background.

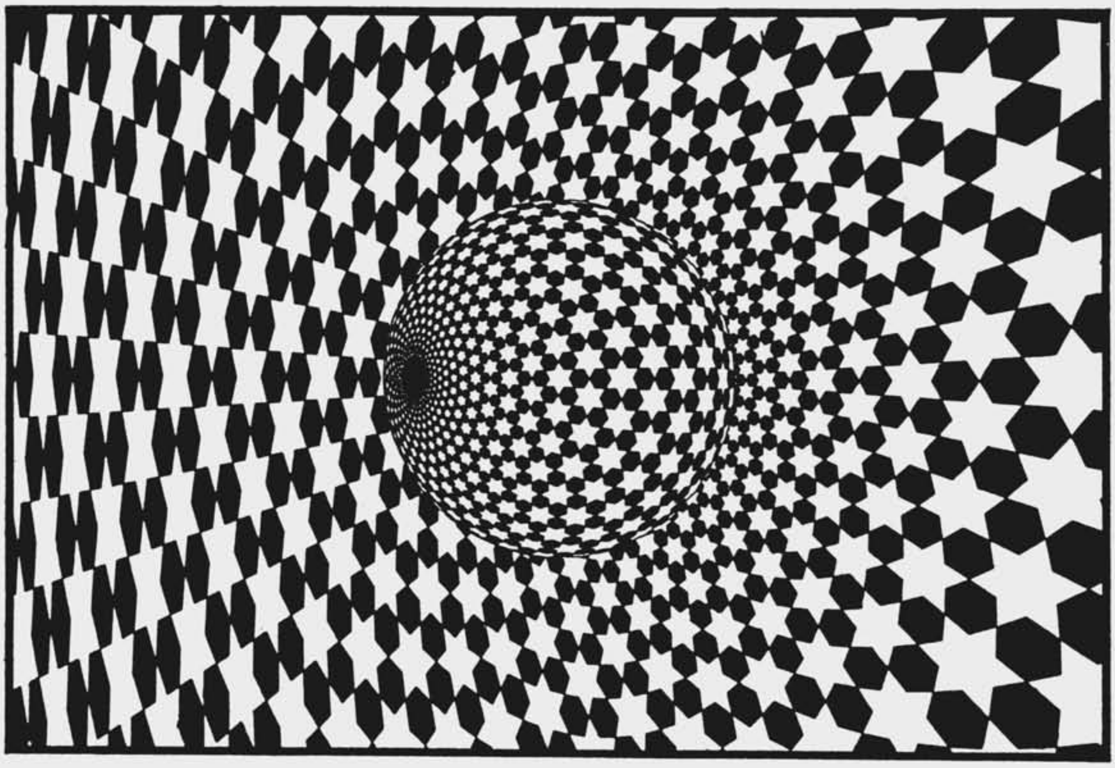
Papert studied and worked with Jean Piaget, the founder of cognitive psychology who took epistomology (theory of knowledge) out of the philosopher's chair and into the laboratory. From Piaget's observations emerges a developmental conception of knowledge in which our intelligence with manipulating objects and with recognising patterns forms the basis of our abstract knowledge and symbolic skills.

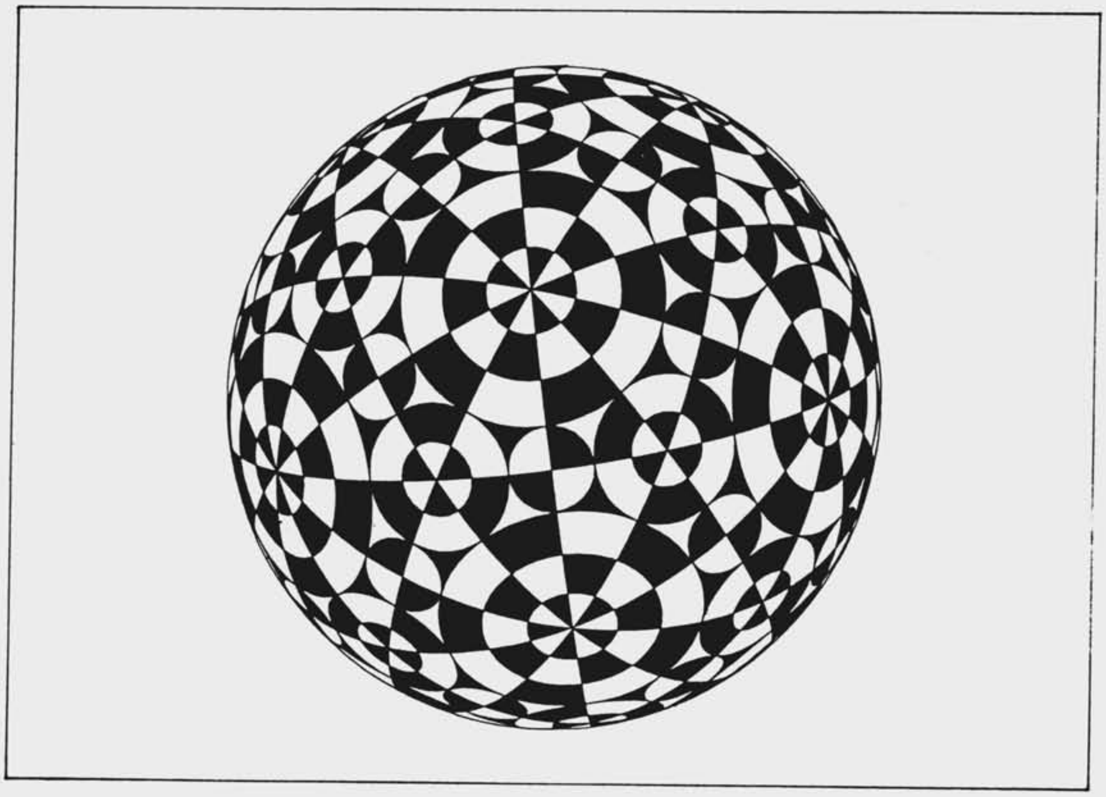
This account of learning runs in direct opposition to the philosopher's account of mathematical knowledge which tries to separate totally symbolic abstractions from the phenomena of the real world. The sterility of this idea, however, became apparent in the 1930's particularly with the publication of Godel's papers. Since this time, the conflicting viewpoints have never been resolved, and what is needed is an alternative account of mathematics that is able to connect pure theory with the world of the senses.

Primary school teachers have always been aware of the ideas presented to us by Papert and Piaget. Faced with young children who have not yet learnt such symbolic tricks as adding numerals, let alone performing quadratic equations, teachers are obliged to centre classroom learning on the practical activities of counting, measuring, weighing, building, drawing and so on. If mathematics is the science of number and magnitude, it is also an abstraction from the physical world where we learn how to count and measure.

Another point to bear in mind, and one which Papert stresses, is that the counting and the measuring will arise quite naturally as inevitable features of some activity, such as making a sundial or building a bookcase. Under these circumstances, mathematics is essential but of secondary importance to the activity as a whole.

Papert describes how as a child he took a great interest in clockwork machinery and gearing mechanisms and how this knowledge of something completely tangible provided the basis for his abstract mathematical reasoning. By citing an example that is not from the world of computing, Papert makes it clear that his basic concern is with concrete experience not the new technology.





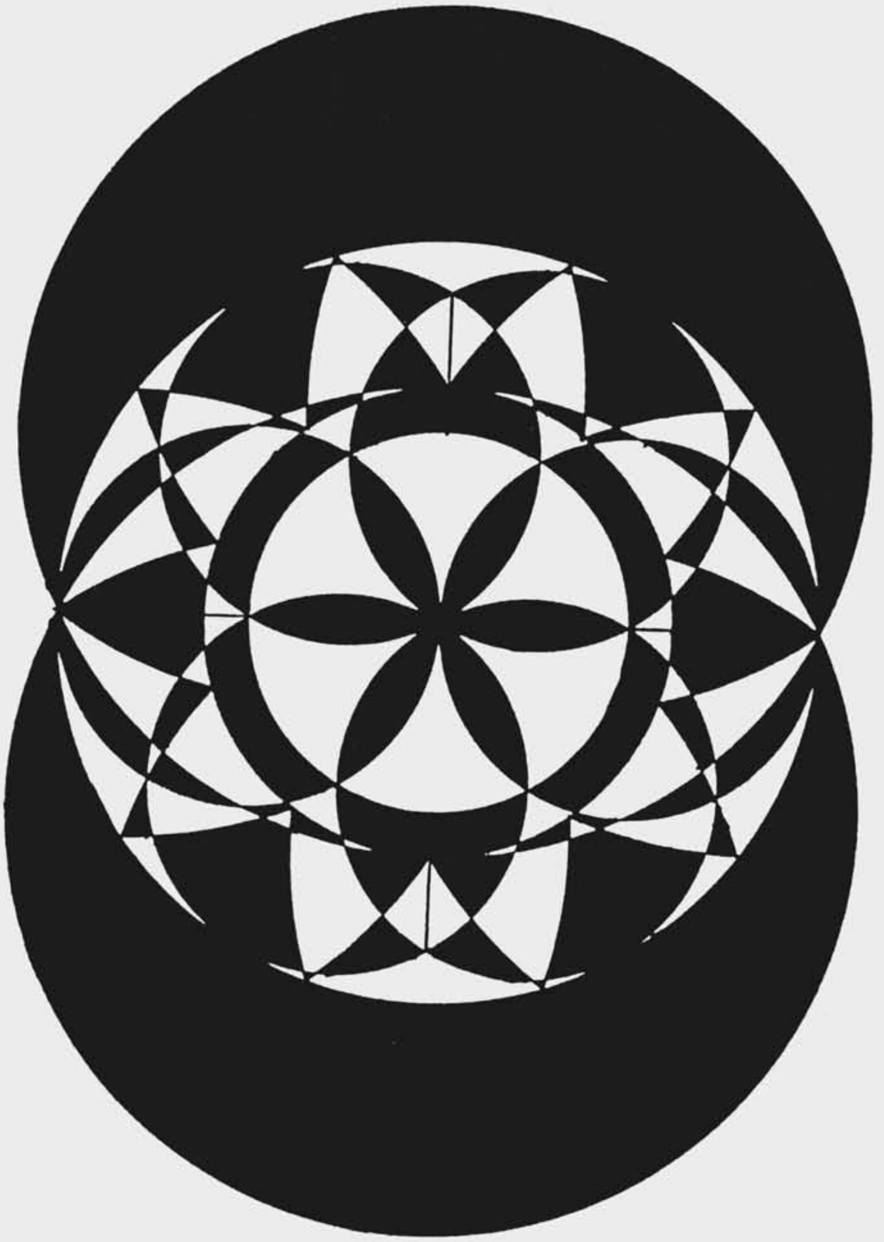
"Spherical symmetry" The fivefold, threefold and twofold rotacentres feature most prominently on this spherical pattern. They correspond in pairs to six axes of the first kind, ten axes of the second, and fifteen axes of the third. This is the maximum number of poles of symmetry that can be arranged on a sphere together. When the fifteen equators are added, the whole surface is divided into 120 identical 'triangles' and as you can see, in a spherical world, angles in a triangle add up to more than 180 degrees.

A perennial complaint about mathematics is that it is too abstract - children can learn how to manipulate symbols without any real understanding of what they are doing. The Cockroft Committee report to the government on mathematics teaching in UK schools called for a greater "feeling" for number and for measurement. No obvious remedies were suggested to meet the deficiencies in prevailing mathematics teaching.

The difficulty facing the pupil is that the information encoded in mathematical formulae is not easily extracted.There is nothing in the patterns of symbols on the printed page that offers any clues as to the meaning; the symbols are a set of conventions that must be learnt. This, together with the highly recursive manner of mathematical definitions, means that it can take a very long time indeed to teach people the meaning of mathematical formulae, even simple ones. For example, consider, $\sqrt{-i}$; or this formula famous to mathematicians, $e^{\pi i}=-1$; or the type of mathematical question taught to children,

$$f : x \longmapsto x + 1 \Rightarrow f \quad : x \longmapsto ?$$

Mathematicians, though, do take great care to make clear patterns with their symbols. After all, mathematicians are 'visually-motivated creatures'. It is well known, if quietly contained, that mathematics is taught through pictures and models. Creative mathematicians, when reflecting on their work experience, frequently testify to the importance of mental imagery and physical interpretation in their work. The stark symbolic formulae of higher mathematics thus represent only the final stage of thought processes that began with specific and concrete ideas. Intuitions of space, movement and physical interaction play a fundamental role in this process.



This compass and ruler drawing comes straight from the textbook method of constructing the regular pentagon. I completed all the necessary circles, together with their symmetrical counterparts, and finished it off by blacking in the alternate regions. This last step is possible when all graph nodes are even and look! an unexpected ten-petal flower emerges.

The history of mathematics repeatedly shows that abstract theory originated in a concern with tangible subjects of every conceivable variety, from astronomy to gambling, or from picture painting to gravity. There is clearly no shortage of practical activities with mathematical content. The main difficulty for those seeking learning experience of a tangible nature, is knowing where to begin.

Euclid's book, "The Elements" was written in about 300 BC and remains not only the oldest but also the most influential book on mathematics. Until about twenty years ago, when the New Maths scheme for schools declared it old fashioned, Euclid's geometry had always been at the heart of any mathematical education. It still provides the best model we have of the mathematical idea of axiomatic systems and more importantly, it is rich with the imagery of lines, points, circles, spheres, planes and so on. Perhaps the old style of teaching Euclid overemphasised its logical aspects and neglected the practical aspects. Euclidean geometry is not only about proving theorems, it is also about drawing.

Euclid himself was a strict academic whose main goal was to construct a complete flow of logical argument from a handful of principles to all known geometrical results, such as the theorem of Pythagoras. It was this achievement that inspired all future mathematics in its search for systematic and abstract knowledge. The origins of this knowledge are concrete and clear.The compass and ruler constructions are there for all to see and to perform. Now that extremely good instruments can be bought at relatively low cost, it is possible to attempt accurate drawings with a fair hope of success. Anyone wishing to meet mathematics 'in the concrete' would do well to start with line and circle constructions. They provide plenty of scope for practising manual skills and, contrary to the popular impression that the subject of geometricl constructions is a closed book, there is room for creative spontaneity. Immediate results cannot be expected - like any art, drawing requires both time and practice.

Today, computer graphics can be made to draw anything that can be achieved by compass and straight edge as well as very much more. Computers are also fast, accurate and consistent. From an educational viewpoint however, the new technology does not replace the old tools, rather they can be considered as complementing each other nicely. The older instruments engage our manual skills whereas computing calls for programming - a formal skill.

Good compass drawings exhibit a high standard of image quality. Their precision and degree of resolution invite an equivalent show of accuracy and detail from a mathematical use of computer graphics. Would this be possible on a television screen? Surely not; the television was not designed for drawing lines, circles and curves and although suitable for some forms of graphic output, it is not suitable for the type of work being discussed here. What computer people call "the jaggies" is immediately obvious when observing curved lines on the television screen. This is because the smallest pictorial unit, the pixel or scanline, is visible and therefore too large in relation to the whole picture.

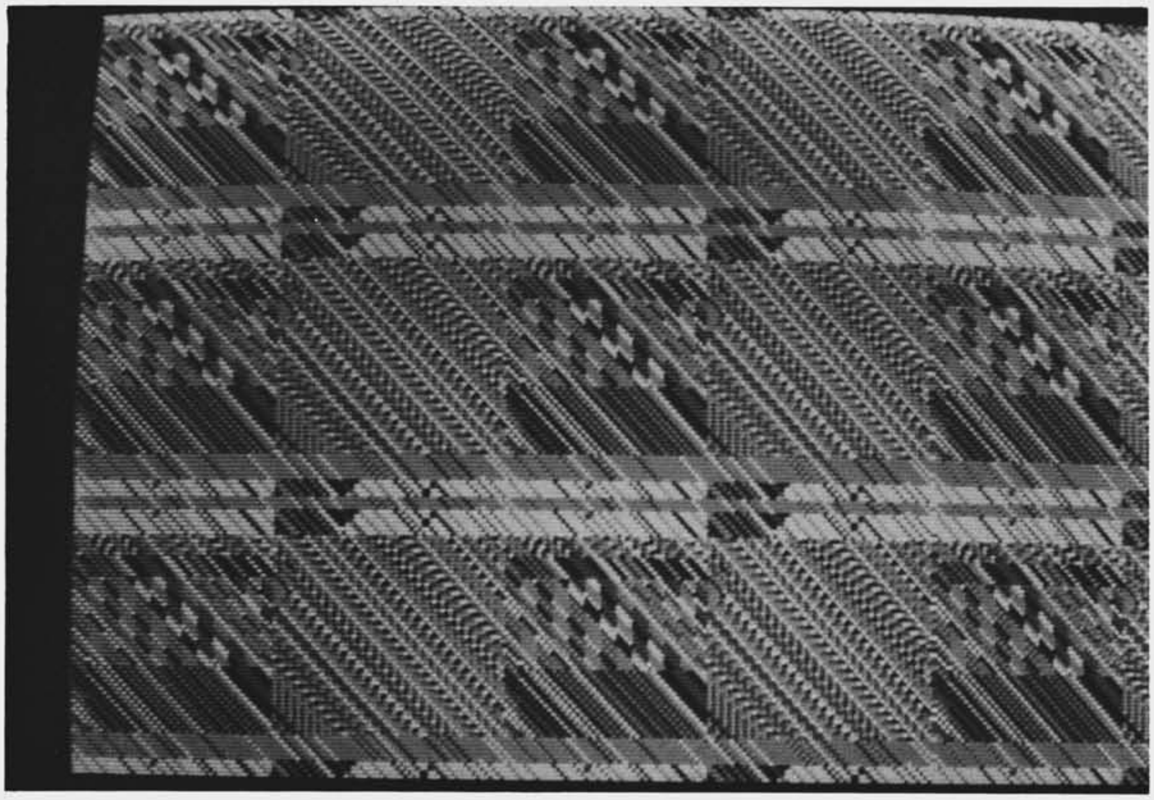
Compared to the high standards of picture resolution attained in professional printing and professional photography, those of domestic television are very crude. However, we are unlikely to notice this graphic crudity while watching "Kojak" or "The News" where the sound and animation provide additional information for our senses. If the picture is frozen, its inadequacies soon become apparent.

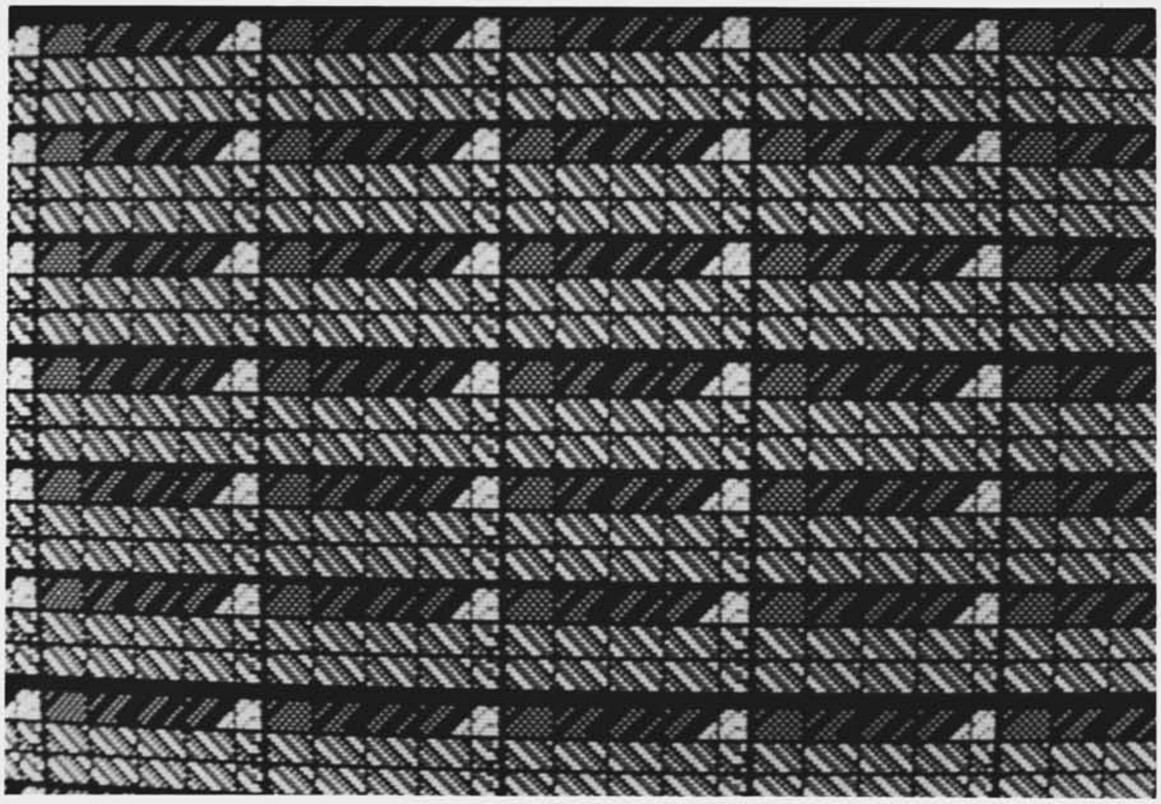
The opportunities for graphic animation are only available with expensive computers. The would-be maker of fine drawings must look elsewhere for an output device. Very high resolution video, the type used to construct electron scanning micrographs, may offer one solution if and when the technology becomes widely available. Another option is the simple plotter; a combination of precision engineering and a few circuit boards, the plotter is less complicated than a sewing machine and a desk-top version can produce accurate pen drawings with good resolution.

The versatility of computer graphics to draw in almost any form makes it an unprecedented development with particular relevance to mathematics. Those familiar with graphics will know the problems associated with its simple mathematics. Perhaps a change will occur and mathematics will become more pictorial. As one programmer once said; if you can describe it in algebra, the computer can draw it.

The traditional toolset, useful as it is, has hardly improved since prehistoric times and consists of rigid templates for drawing a few special curves, lines and circles. In contrast, computer graphics opens up the possibilities of drawing in mathematics. Polynomials, wave functions, geometric transformations, random density functions and fractals are all of significance to recent graphics research.

Recent advanced work centres on the formidable task of simulating natural phenomena, such as the morphology of mountains or galaxies, or the subtle artistic challenges of perspective, shadows, reflections, refractions and so on. There is also a great deal of imagery to explore in 'pure' mathematics and it is this area that attracts me most.The tools required in this latter case are fairly simple; the accompanying illustrations were all drawn using a desktop plotter, driven by an ordinary micro-computer. They illustrate my point that mathematics is clearly a visual subject.





Designs for stained glass by Deborah Coombes. These are photographs of the computer screen showing designs created using the "Jackson" program.

COMPUTER ARTS SOCIETY

BRITISH COMPUTER SOCIETY SPECIALIST GROUP

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Treasurer:Dr George Mallen, 50/51 Russell Square, London WC1B 4JP
PAGE Editor:Susan Iversen, c/o Department of Design Research, Royal College of Art, Kensington Gore, London SW7 2EU

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