Not quite computing—almost art

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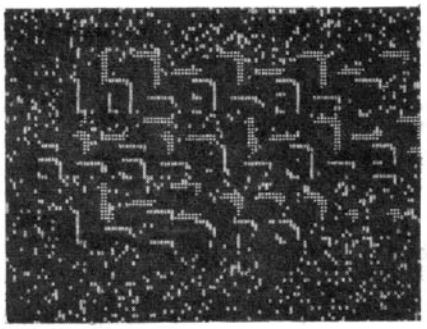
And Ken Knowlton

If you look at any catalogue of computer graphics or films you will probably find the name of Ken Knowlton figuring more frequently than any other; and not only as an artist in his own right but just as often as a collaborator with others particularly Lillian Schwartz and Stan Vanderbeek.

Ken works at Bell Labs, Murray Hill, New Jersey and has spent many years devising computing systems to aid artists in the production of still and moving images and probably knows more than anyone else about the problems and potential of computer usage in this field. As far back as 1964 he devised a programming language BEFLIX (written in macro FAP) which was used for the production of a number of films on a Stromberg Carlson 4020 microfilm printer and led to further developments of the languages TARPS and EXPLOR. TARPS (Two-dimensional Alphanumeric Raster Picture System) written in BEFLIX, grew out of Ken's work with artist and film maker, Stan Vanderbeek and is used for the production of designs, diagrams and textures. So far eight films, titled *Poemfield No 1* to *Poemfield No 8* have been produced using this system and, judging from the ones I've seen, TARPS suits the medium admirably.

Essentially, TARPS pictures are held in the computer as a 132 × 96 array of 3-bit numbers which refer to a set of eight available alphanumeric characters. Combining the numbers in codes gives rise to 64 different patterns, four of which produce what are called *twinkles*, that is spots which are determined at random with either a blank or a particular character. Various operations form part of the system, for example, XLATE, which changes some or all the eight internal numbers into others; WORDS (Figures 1,2) which progressively displays textual information in a sequence of positions and shades of grey; ZOOM, which enlarges the image or SPZOOM, which



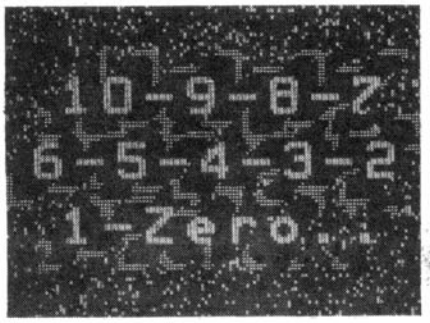


Figure 1 (top)
Figure 2 (above)

gives a clockwise or anticlockwise spiralling zoom (Figures 3,4). Combining these, and other operations and settings gives rise to some interesting and striking patterns (Fig 5).

EXPLOR (for the production of images from Explicit Patterns, Local Operations and Randomness) has been used by Ken to teach computer graphics to undergraduate students at the University of California, Santa Cruz and by the Computer Arts Society to teach artists at Imperial College. Knowlton has concluded, and we support his findings, that

(1) this particular language makes it possible for relatively inexperienced programmers to produce a wide variety of interesting designs, (2) that a rather significant scope and quality of computer graphics can be done with a line printer as the only output device and (3) that teaching of the important concepts of computing can be facilitated by the use of graphic output so that graphics can be considered as an effective approach as well as vice versa.

Like TARPS, EXPLOR also works with the normal line-printer characters arranged in a two-dimensional array and has similar facilities. In addition, however, are some other very powerful operations which make the language unique in its ability to help artists generate graphics dynamically. Of these, the most fascinating is LOCOP which allows the computer to examine the character in a given square of the array and act upon it in accordance with the identity of the characters in the nine neighbouring squares. By simply specifying certain parameters in LOCOP it is possible to, for example, say 'if between 3 and 5 (inclusive) of the neighbours are characters with code numbers at least 7 but not more than 12, then change the character in the given square to a blank, otherwise leave it alone.' By an ingenious coding system it is also possible to specify *which* neighbours should have the given characteristics. These, and similar operations, combined with the ability to overprint characters to provide grey scales (Figure 6), makes EXPLOR a powerful tool for exploring such things as the visual aspects of Cellular Automata and it is not surprising that it has been used extensively to present Conway's Game of Life (Figure 7), crystal growth and similar dynamic patterns (Figure 8). Recently, Knowlton has prepared a version of the language for use on minicomputers, MINI-EXPLOR. Coded in only 430 lines of Fortran, it has many of the facilities of EXPLOR and can run on most 16-bit word (or larger) machines having 8K to 16K of core storage.

No university department catering for artists should be without this or the larger version. Details may be obtained from the Computing Information Service Group, Room 2C-548, Bell Laboratories, Murray Hill, New Jersey, USA 07974.

Figure 3

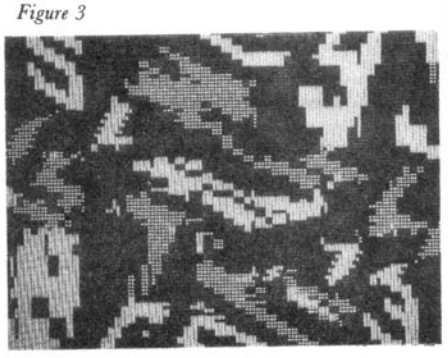


Figure 4

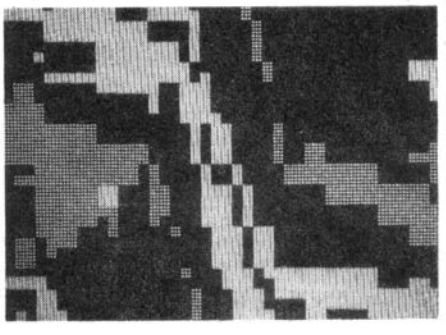
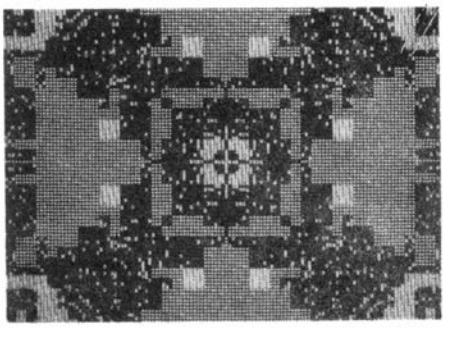
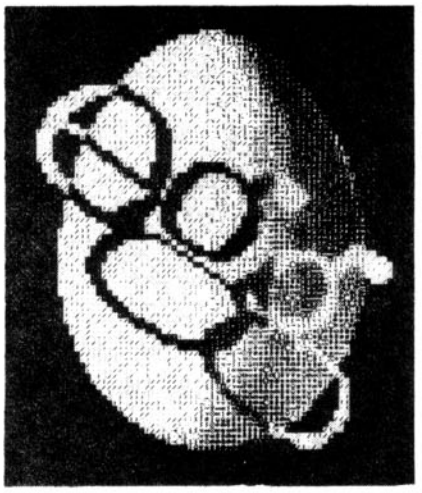


Figure 5





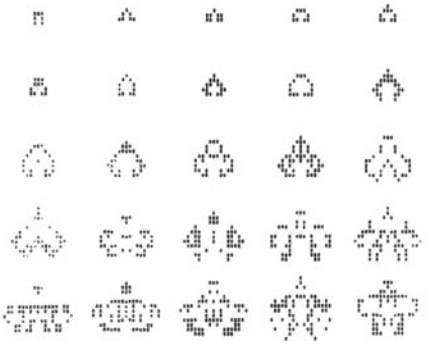


Figure 6 (top)
Figure 7 (above)

Keyboards soft and hard

This year Knowlton has come up with another brilliant idea: a software keyboard and, as with all great ideas, you wonder why you didn't think of it first. Imagine a blank keyboard with a CRT display above, in front of which is a partially silvered mirror angled to allow an image of the keyboard to appear in front of the display. Now by outputting on to the screen a picture of the keyboard with its characters shown on it one sees an image of both the keys and the characters as if they were actually printed on the keys!

It is now a comparatively simple matter to change the keyboard *by software* so that, at one moment it is a conventional QWERTY, at another an APL and, at yet another, some specialised keyboard wherein each key has a non-alphabetic function. It is clearly ideal for testing new character layouts or functions and an added bonus is that your hands do not interfere with the picture on the screen which is visible at all times! Even if Ken had not done any other work, this idea surely justifies the Computer Arts Society's belief that computer firms should employ artists whenever possible.

Dr Peter Zinovieff too is no slouch when it comes to generating ideas and he has also recently implemented a software keyboard but in this case for music. Attached to the computer music and voice synthesis system at his studio in Putney, his device looks like a conventional piano keyboard but each key can not only have its normal function as a note selector but can, by program, be given any function which is appropriate to the needs of the moment. In this way, the keyboard can select timbres; change rhythms or tempi; give numerical parameters to subroutines or anything else which needs doing, even switching the machine on or off!

Whilst it is not appropriate for every function—and Zinovieff's keyboard also has sliders and switches, the conventional piano keyboard is so well designed ergonomically that it is a very natural input device which should perhaps be more fully exploited as a computer peripheral. I believe early typewriters and teleprinters actually used piano type keyboards but these were soon abandoned for the sort we use at present. I wonder why? The piano keyboard seems to present a mnemonically almost perfect input medium but, as Alan Sutcliffe has pointed out, had the computer industry invented the piano keyboard, they might have used black and white keys but it is unlikely that they would have come to the conclusion that we needed the very easily locatable arrangement of two and three black keys we have at the moment. What do you think?

Figure 8 appears on page 18
Figure 9 (below)

The guy who found the lost chord

Yet another piano keyboard input device has been used by Dr Phil Mars and a team at Robert Gordon's Institute of Technology, Aberdeen. Here the object is to transcribe automatically piano or organ performances by musicians, particularly jazz musicians, whose improvised works are notoriously difficult to transcribe in a conventional way.

Essentially, the device consists of an electronic scanning and timing system connected to any normal keyboard together with a digital magnetic cassette recorder (Figure 9). The keyboard action is sampled 20 times a second and, each time a note is depressed, this fact is recorded on the tape together with the length of time the note is held down. The recording is entirely digital activated by depression of the note and no audio information is used. On completion of the performance the digital information is computer processed off-line and a script is automatically produced. Just at the moment the system only reproduces the pitch and length of the notes so that all expression marks, phrasing and rests have to be added by hand but the system certainly deals with the really difficult, time consuming and error prone part of the job.

Not surprisingly, a number of musicians have shown great interest in the system notably Leonard Bernstein, Oscar Peterson and Dudley Moore and it seems likely that this device is going to prove very useful indeed. There is no doubt in my mind that computing and computer technology have only just begun to have an impact on the arts and in time, we will see enormous changes to the way in which art is generated.