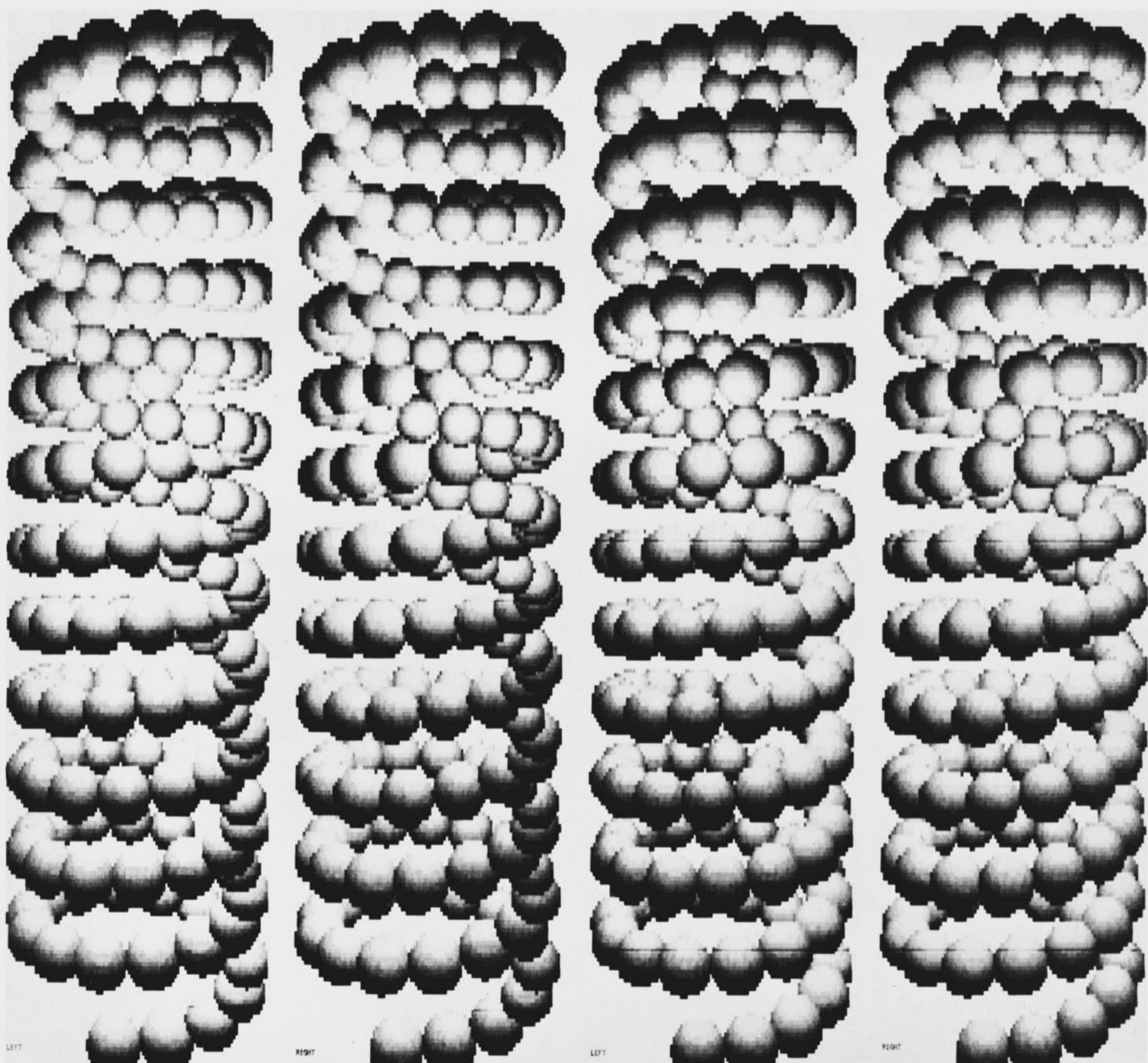


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COMPUTER ARTS SOCIETY QUARTERLY

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CHRIS FRENCH: COMPUTER ART – A LOAD OF QUASI-SPHERICAL OBJECTS?

COMPUTER ART – A LOAD OF QUASI-SPHERICAL OBJECTS?

(Piss-artystry – the computer as a tool, or Just more screwball research?)

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In recent years in Britain it has been quite common to hear the cry go up "What a load of balls!" This popular ejaculation appears to have its roots in the sad malaise which has recently afflicted the British Isles and England in particular. Our continuing financial crisis and loss of self-confidence seems to me to be traceable to one source – the decline and collapse of the British national sports of soccer and cricket. The games were of course invented by the English so that there would be at least two fields of endeavour in which they were supreme and victorious. To some extent this acted as a psychological bulwark against losses such as the erosion of the British Empire and even the corruption of the rules of soccer and cricket into American football and baseball (games which are played virtually exclusively in a small region of the Western Hemisphere – if you cannot win a game then change the rules so that you can). So, despite the losses of Empire and other adversities, the British morale remained high until an insidious change of fortune crept into these fields of sport. The culmination was when England failed to even qualify for the 1974 World Cup Soccer Finals at a time when its cricket was totally lacking in distinction. Recent history has seen England fail to qualify for the 1978 World Cup, Scotland exit ignominiously from these Soccer Finals, and the spectre of big-money professionalism (American-style) hover over our cricket. Naturally a lack of prowess in such important sports led to other failures – London stopped swinging, mini-skirts became extinct, Rod Stewart joined the brain-drain to America, the value of the pound plummeted and thousands of American tourists flooded across the Atlantic. The whole syndrome, emanating as it did from ball sports, led to the application of that one phrase to characterise anything which is lacking in quality, disappointing, worthless or pseudo – even though it may not itself relate to sport or the loss of British self-confidence. Indeed nowadays people other than the British also use the phrase. Frequently it is shortened to one word – "Balls!"

Recently we have seen the phrase applied to psychology and computer art. As a psychologist with a strong interest in the computer-for-art movement, I was naturally concerned at this denigration of two areas of activity which are close to my heart and which I consider important and fine. I therefore decided to initiate my own investigation. Could computer art really be "a load of quasi-spherical objects" as had been alleged? And could that excellent young science of experimental psychology be implicated? My starting point was a short article by Alan Parkin in 1968 on how to draw a ball using a plotter. My intuition told me that here might lie the key to the whole problem. Alan Parkin's routine enables a computer to plot a picture of an illuminated ball after its size, its position relative to the observer, and the direction of the illumination have all been specified. My first step was to rewrite the routine in Fortran IV modifying it at the same time. The changes mean that the ball produced is illuminated by a point source instead of a parallel beam of light. This provides for more varied and attractive specular effects. Another simple modification enables one to use a lineprinter or typewriter as an output device. Printers are quicker and more available than pen plotters although the illustrations to this article were in the main performed on a microfilm plotter as this helped the photography. The final change means that the routine can plot more than one ball ... in fact a *load* of balls. This last change is deceptive. It has subtle implications which are easy to overlook and which this article hopes to make clear. The major implication is that it enables us to produce "Oddball" pictures – pictures which are illusory or ambiguous – pictures which are "impossiball" (sic).

Experimental psychologists concerned with understanding how people see a three-dimensional world when confronted with a two-dimensional stimulus to the retina have anal-

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C          10
C  BALLIT BY CHRIS FRENCH      20
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C          90
C          100
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C  BALLIT IS AN EXTENSION OF ALAN PARKIN'S ALGOL PROGRAM WHICH WAS
C  WRITTEN TO DRAW A BALL ON AN INCREMENTAL PLOTTER USING A PEN. THIS
C  PROGRAM DIFFERS IN A NUMBER OF WAYS: IT USES A LINEPRINTER OR TELETYPE
C  AS AN OUTPUT DEVICE, IT DRAWS A COLLECTION OF BALLS - NOT JUST ONE,
C  IT IS WRITTEN IN FORTRAN IV, AND POINT SOURCE ILLUMINATION IS USED
C  AS OPPOSED TO A PARALLEL BEAM OF LIGHT.
C          70
C          80
C          90
C          100
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C          120
C          130
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C  THE USER SPECIFIES THE SIZE AND POSITIONS OF THE BALLS ALONG WITH THE
C  POSITION OF THE ILLUMINATION SOURCE. WITH A CAREFUL CHOICE OF DATA
C  VERY PLEASING EFFECTS CAN BE PRODUCED.
C          140
C          150
C          160
C          170
C          180
C          190
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C          210
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C  THE MATHEMATICS BEHIND THE PROGRAM ARE NOT VERY DIFFICULT AND ARE
C  EXPLAINED IN PARKIN'S ARTICLE.
C          140
C          150
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C          600
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C          660
C          670
C          680
C          690

C  THE ONLY NON-ANSI FEATURE IS THE INCLUSION OF A RANDOM NUMBER
C  GENERATOR. THIS IS INITIALISED BY THE SUBROUTINE RANSET AND CALLED
C  USING THE FUNCTION RANF WHICH RETURNS A VALUE BETWEEN ZERO AND ONE.
C  THE R.N.G. IN CONJUNCTION WITH THE CONTENTS OF THE ARRAY KEY WILL
C  PRODUCE A VARIETY OF WAYS FOR PRINTING THE BALLS.
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
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C          670
C          680
C          690

C  REFERENCE - PAGES 84-85 OF
C          CYBERNETIC SERENDIPITY EDITED BY JASIA REICHARDT
C          LONDON - STUDIO INTERNATIONAL - 1968
C          HOW TO DRAW A BALL BY ALAN PARKIN
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
C          320
C          330
C          340
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C          640
C          650
C          660
C          670
C          680
C          690

C  BRIEF EXPLANATION OF VARIABLES
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
C          320
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C          340
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C          620
C          630
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C          650
C          660
C          670
C          680
C          690

C  BALLS           - NUMBER OF BALLS IN PICTURE /CURRENT DECLARATION
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
C          320
C          330
C          340
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C          620
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C          640
C          650
C          660
C          670
C          680
C          690

C  AZ           - GIVES A MAXIMUM OF TEN
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
C          320
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C          620
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C          640
C          650
C          660
C          670
C          680
C          690

C  DIXT, DIYT, DIZT   - DISTANCE OF EYE FROM LINEPRINTER PRINT PLANE
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
C          320
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C          620
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C          660
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C  R(I)           - COORDINATES OF I-TH BALL
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
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C  CX(I),CY(I),CZ(I) - COORDINATES OF CENTRE OF I-TH BALL
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
C          320
C          330
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C  BACK            - BRIGHTNESS OF BACK-GROUND /HERE SET TO ONE
C          210
C          220
C          230
C          240
C          250
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C          270
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C          290
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C  0.0, 0.0, 0.0    - COORDINATES OF VIEWING EYE /VIEWPOINT IS ORIGIN
C          210
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C          670
C          680
C          690

C  KEY              - THREE-DIMENSIONAL PRINT KEY ARRAY WHICH CONTAINS
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
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C          690

C  NOTE CAREFULLY THAT WHETHER OR NOT A BALL IS OBSCURED FROM VIEW BY
C  ANOTHER BALL DEPENDS IN THIS PROGRAMME ON THE ORDER IN WHICH IT IS
C  READ IN AND NOT ITS POSITION IN THREE-DIMENSIONAL SPACE. MODIFICATIONS
C  TO REMEDY THIS ARE TRIVIAL. THE UNITS USED ARE THOSE OF PRINT
C  POSITIONS - TYPICALLY 0.1 INCH.
C          210
C          220
C          230
C          240
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C          260
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C          280
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C  REAL AX,AY,AZ, DIXT,DIYT,DIZT, NX, NY, NZ, T,U,V, LAM, MISS, BRI,
C          210
C          220
C          230
C          240
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C  INTEGER BALL,BALLS, LINE,LINES, COLUMN,COLS, I,J,K,L, IBRI, BACK,
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
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C          330
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C  1IN,OUT, BUFF(136,3), KEY(10,8,3)
C          210
C          220
C          230
C          240
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C          260
C          270
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C          660
C          670
C          680
C          690

C  DATA BACK/1/, DUD/0.5/, COLS/136/, IN/1/, OUT/2/
C          210
C          220
C          230
C          240
C          250
C          260
C          270
C          280
C          290
C          300
C          310
C          320
C          330
C          340
C          350
C          360
C          37
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C PRINT PLAIN, AND ILLUMINATION SOURCE COORDINATES          700
 5 READ(IN,11)LINES,BALLS,AZ,DIXT,DIYT,DIZT               710
  IF(LINES.EQ.0.OR.BALLS.EQ.0.OR.BALLS.GT.10)STOP 0000      720
 11 FORMAT(2I3,F6.0,2X,3(F6.0,1X))                         730
C                                                       740
C READ IN THE COORDINATES OF EACH BALLS CENTRE AND ITS RADIUS 750
  READ(IN,12)(CX(BALL),CY(RALL),CZ(BALL),R(BALL),BALL=1,BALLS) 760
C ELIMINATE PROBLEM OF NEGATIVE Z BALLS                      770
C   IF(CZ(BALL).LE.0.0)STOP 1111                            780
 12 FORMAT(3(F6.0,1X),1X,F6.0)                           790
C                                                       800
C                                                       810
C SAMPLE DATA FOLLOWS                                     820
C-----          830
C (NB DATA HERE FILLS COLUMNS 3-80 WITH ORIGINAL COLUMNS 79 & 80 BEING LAST) 840
C                                                       850
C HHHHHHHHHHHHHSH*+. HW$H*+. HW$H*+. HW$H*+. HW$H*+. HW$H*+. 950
C SSSSSSSSSSSSM    $M     $M     $M     $M     $M     $M
C XXXXXXXXXXXXX    X      X      X      X      X      X
C 66 05 100.     10.    10.   -50.                           960
C   0.     0.    300.   100.
C  -20.   -30.   250.   40.
C  +10.   +15.   200.   30.
C  -10.   +20.   150.   20.
C  +15.   -5.    110.   10.
C                                                       970
C                                                       980
C CALCULATE ILLUMINATION VECTOR (DIX(BALL),DIY(BALL),DIZ(BALL)) FOR EACH 990
C BALL. D(BALL) CAN BE USEFUL FOR SUPERPOSITION DECISIONS.         990
  DO 3 BALL=1,BALLS                                         1000
  DIX(BALL)=DIXT-CX(BALL)                                    1010
  DIY(BALL)=DIYT-CY(BALL)                                    1020
  DIZ(BALL)=DIZT-CZ(BALL)                                    1030
  D(BALL)=DIX(BALL)**2+DIY(BALL)**2+DIZ(BALL)**2           1040
  D(BALL)=SQRT(D(BALL))                                    1050
  DIX(BALL)=DIX(BALL)/D(BALL)                                1060
  DIY(BALL)=DIY(BALL)/D(BALL)                                1070
  DIZ(BALL)=DIZ(BALL)/D(BALL)                                1080
  3 D(BALL)=CX(BALL)**2+CY(BALL)**2+CZ(BALL)**2           1090
C                                                       1100
C
  DO 41 LINE=1,LINES                                         1110
  AY=(LINES/2-LINE)*5/3                                     1120
  DO 42 COLUMN=1,COLS                                       1130
  AX=COLUMN-COLS/2                                         1140
  IBRI=BACK                                                 1150
  IBRI=BACK                                                 1160
  DO 43 BALL=1,BALLS                                         1170
  T=-2.* (AX*CX(BALL)+AY*CY(BALL)+AZ*CZ(BALL))           1180
  U=AX*AX+AY*AY+AZ*AZ                                         1190
  V=CX(BALL)**2+CY(BALL)**2+CZ(BALL)**2                     1200
  MISS=T*T-4.*U*(V-R(BALL)**2)                             1210
  IF(MISS.LT.0.0)GOTO 43                                   1220
  LAM=(-T-SQRT(MISS))/(2.*U)                               1230
  N0X=(LAM*AX-CX(BALL))/R(BALL)                            1240
  N0Y=(LAM*AY-CY(BALL))/R(BALL)                            1250
  N0Z=(LAM*AZ-CZ(BALL))/R(BALL)                            1260
  BRI=N0X*DIX(BALL)+N0Y*DIY(BALL)+N0Z*DIZ(BALL)           1270
  IBPI=BRI*8.999999+2.0                                     1280
  IF(IBRI.LT.2)IBRI=1                                      1290
  43 CONTINUE                                              1300
  J=7.999999*RANF(DUD)+1.0                                1310
  DO 42 K=1,3                                              1320
  42 BUFF(COLUMN,K)=KEY(IBRI,J,K)                           1330
  41 WRITE(OUT,20)((BUFF(COLUMN,K),COLUMN=1,COLS),K=1,3)    1340
  20 FORMAT(1H ,136A1/1H+,136A1/1H+,135A1)                 1350
C                                                       1360
C                                                       1370
  GOTO 5                                                 1380
  END                                                 1390

```



Figure 2



Figure 1

ysed the effect of "depth cues". These cues provide information which enable us to see the third dimension with some objects nearer than others, and enable us to assess relative size and distance. One of these important cues is interposition or covering. If one object partially covers another then it is seen as being closer to the observer. Normally this information is accurate but on occasions it may be misleading and lead to illusory perception. A well known and elegant demonstration of this effect involves the use of two playing cards. In figure 1 the Queen of Clubs appears much bigger than the Eight. This is in fact an illusion. Both women are actually equally well endowed and the Queen of Clubs is closer. The effect has been achieved by cutting off a little of the Queen's bottom which would otherwise partially cover the Eight. This is made clearer by the hearts in figure 2 where the Queen of Hearts has been snipped as before but the two cards have been placed side by side. When the brain sees the image of figure 1 it assumes that the Queen is intact and that she is therefore behind the Eight and bigger. An illusion of size and depth has been created and three-dimensional space has been distorted.

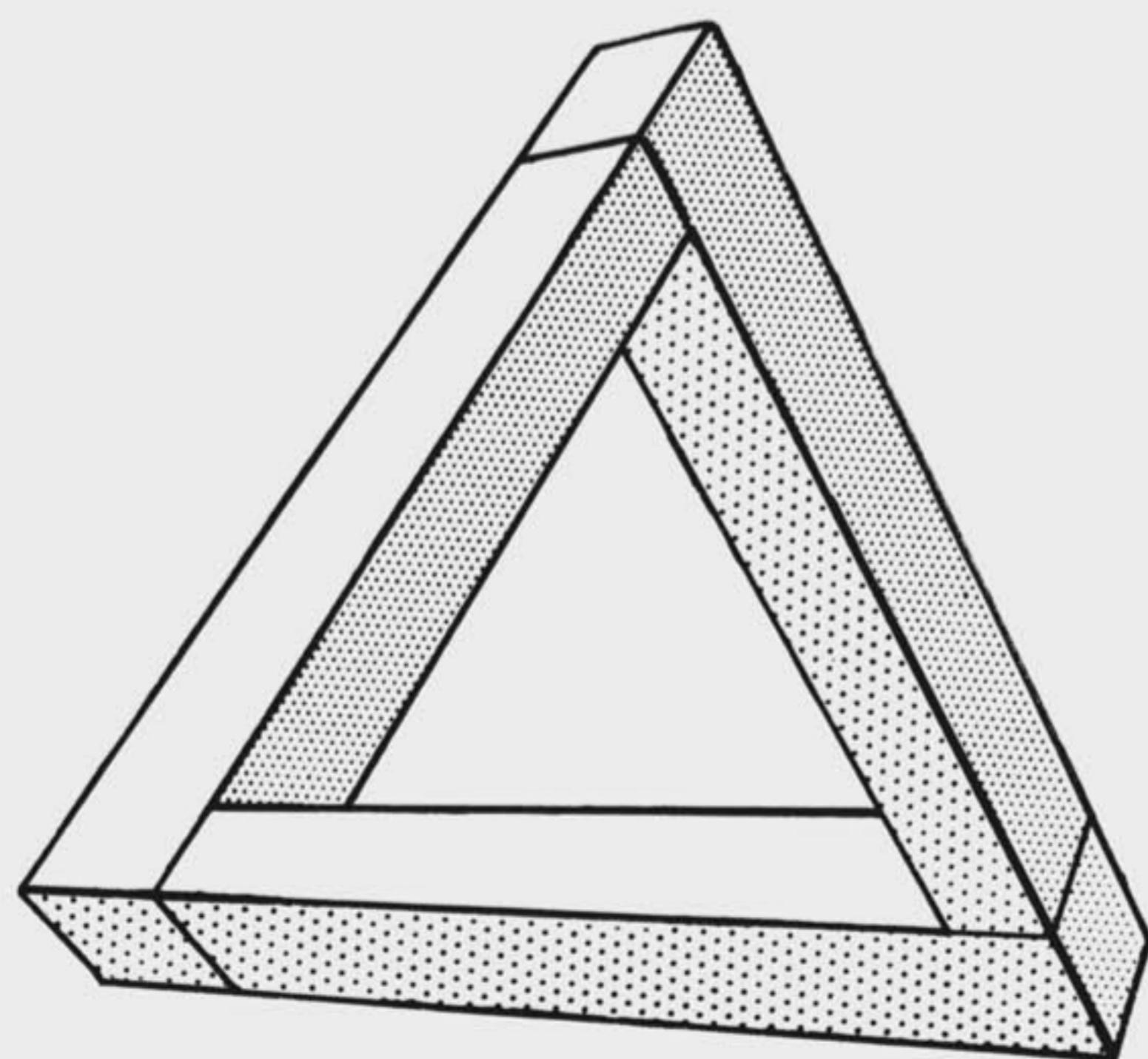


Figure 3

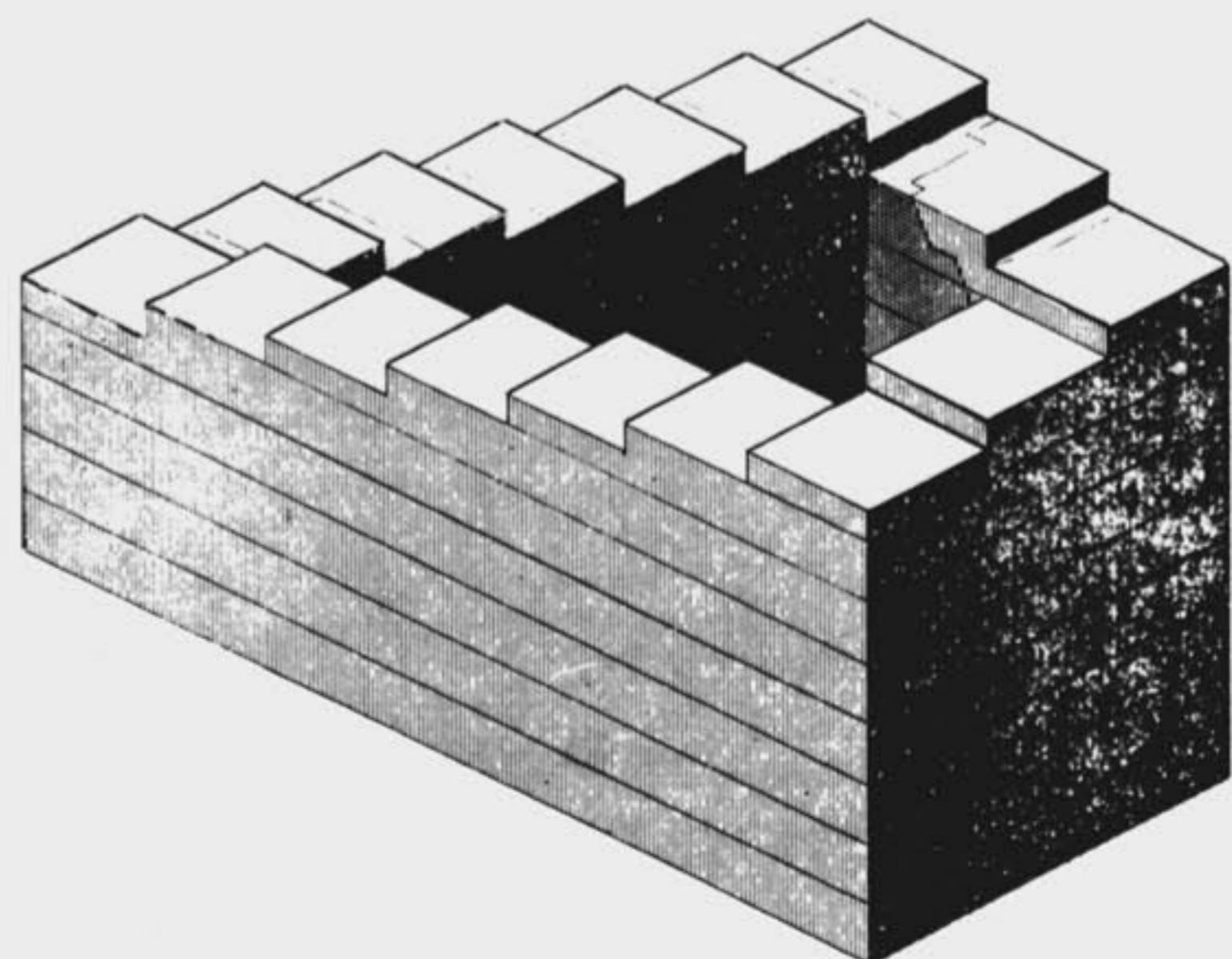


Figure 4

Over the last twenty years interest has focussed on a particular form of this type of illusion. In this a two-dimensional figure is presented which the eye interprets as a representation of a three-dimensional object. The problem with these is that in a sense of the word the objects are "impossible" (Penrose and Penrose). Each part of the figure is a correct two-dimensional representation of part of an object, but when put together the parts make a whole which is incongruous. Figure 3 is the first that Penrose and Penrose presented. It is possible to view one or two apices of the "triangle"(?) without any problem but if we view the whole then we find we have an object we cannot entirely comprehend. Another example is their ascending staircase (figure 4) which goes up and up but cannot get any higher because it goes round in a circle coming back to its starting point. Although the objects represented are called "impossible" it is in fact *possible* to construct them. However, when viewed from different angles these objects appear quite unlike the two-dimensional figures which initiated them. These impossible figures have been brilliantly exploited by the artist, Escher, who has presented them at their most fascinating (see Teuber, 1974). Figure 5 shows his "Belvedere". Note how sections of the building are "in front" in the middle area of the picture but "behind" in the upper part. It should perhaps be emphasized that Escher was not the first artist to tamper with depth cues and perspective, and contemporary experimental psychology did not invent impossible pictures. The general principles at work have been known for centuries. A rather good early example is the picture shown in figure 6, which is an 18th century drawing by Hogarth: "Whoever makes a DESIGN without the Knowledge of PERSPECTIVE will be liable to such Absurdities as are shewn in this Frontispiece." In all the examples presented in this article – from Hogarth's fisherman to the playing cards – the viewer carries with him or her non-conscious "expectations" as to the form of the real world. We expect playing cards to be rectangular and not have bits cut out of them and we expect buildings to be vertical. When perspective cues and interposition cues in particular are carefully manipulated we may end up with impossible pictures.



Figure 5



Figure 6

Now we can return to our ball program and see how we can produce "impossiball" pictures. Very simply, the program will on request take a ball which is "behind" and print it "in front". And if we do this in a context where the observer has an "expectation" about what he is viewing then we can produce an impossiball type of illusion.

Perhaps this can be made more clear by the example given in figure 7. Two helices on the right are constructed of chains of balls. If you examine them closely you will see they differ slightly. The left one is the view seen by the left eye and the right one is the view for the right eye. Together they form a stereo pair and if suitably presented to the observer he or she will see a normal helix composed of balls in three dimensions. To enhance the stereo-effect a close point source of illumination has been used in this instance. Two helices on the left, however, are quite different. A first glance may give the same impression but closer inspection, even with only one eye, will reveal differences. Generally, the first thing noticed is a "break" in the pattern of balls near the middle. The bottom halves of the chains seem to go round and round as in the thread of a screw but the top halves do not. Closer inspection reveals that even the bottom halves are more screwball than you first thought. Only the lower left quadrants of each of these two left helices are normal. In the other quadrants the balls have the correct size, shape, position and illumination you would expect for the helix. The problem is that you would not expect to see some of the balls shown and others which you would expect are missing. Some balls have been printed in front when they should be behind. The effect is to give the observer the impression of a paradoxical object. It looks like a helix but it isn't! The balls appear to weave continuously towards the eye but they can't! The object portrayed is "impossiball". As with other impossible objects it should be possible to physically construct this one, but for a non-dextrous programmer it is easier to produce a pair of stereo images which is what these two left pictures are. When the left eye is shown one image, the right the other and the two are fused into one, the object is seen in three dimensions although the precise percept will depend on how good the observer's binocular vision is. In the lower left quadrant, part of a normal helix is seen, while in the upper left half the interposition depth cues are suppressed and the tendency is to see part of the helix, but with the front balls transparent or cut away so as to show the ones behind – much as you sometimes have in engineering drawings designed to show hidden parts. One might expect to find the same effect with the right half of the helix but here one tends to find that the interposition depth cues are dominant and the impression is given of quasi-spherical objects coming towards the viewer and getting smaller. This is despite the fact those balls which are seen in front are actually behind as far as the computations and the information supplied by the binocular depth cues are concerned. It is as well to mention one limitation of the balls portrayed here. They have a somewhat ethereal quality. They are on a "higher" plane than your "everyday" ball as they cast no shadows. This useful feature is simply a limitation of this programmer.

The next stage is to turn from questions of perception to aesthetics and ask how figures such as these can be made more interesting to the viewer. If we make the angle our helix subtends at the eye larger than an eye's normal field of view we obtain a distorted helix and balls as in the middle upper section of figure 8. We have also done two other things in this figure to generate interest – (i) the horizontal and vertical scales have been made different so that our balls are now ellipsoids, and (ii) the negative image has been presented with the highlights now appearing as dark spots. The lower half of this figure is in fact simply the illumination levels – the numerical data for the print in the upper half. The banded effect results from the varying densities of the digits 0 to 9, of which the picture is comprised. There is no distortion in the outer helices as the angle subtended at the eye is within normal limits.

Just considering interposition or covering, there are four main ways of printing chains of balls. One may use the normal convention and print those which are closest to the observer on top or one may reverse this and print the most distant ones on top. Alternatively we can see where each ball comes in the chain of generation and print the first on top, or do the reverse and print the last on top. All four of these possibilities are shown in the four columns of figure 9. An added dimension of change to those already mentioned has also been incorporated by varying the position of the point source of illumination.

The reader may consider by now that we have been going round in circles long enough, but in fact we have hardly begun to exploit the potential of balls. If we turn our helix around and look down into the tunnel so formed we obtain the pictures in figure 10. These are again wide-angle views with the balls distorted near the edges of the pictures; the vertical and horizontal scales are unequal; and positive and negative pictures are presented. Also by presenting the ground to

* Cover

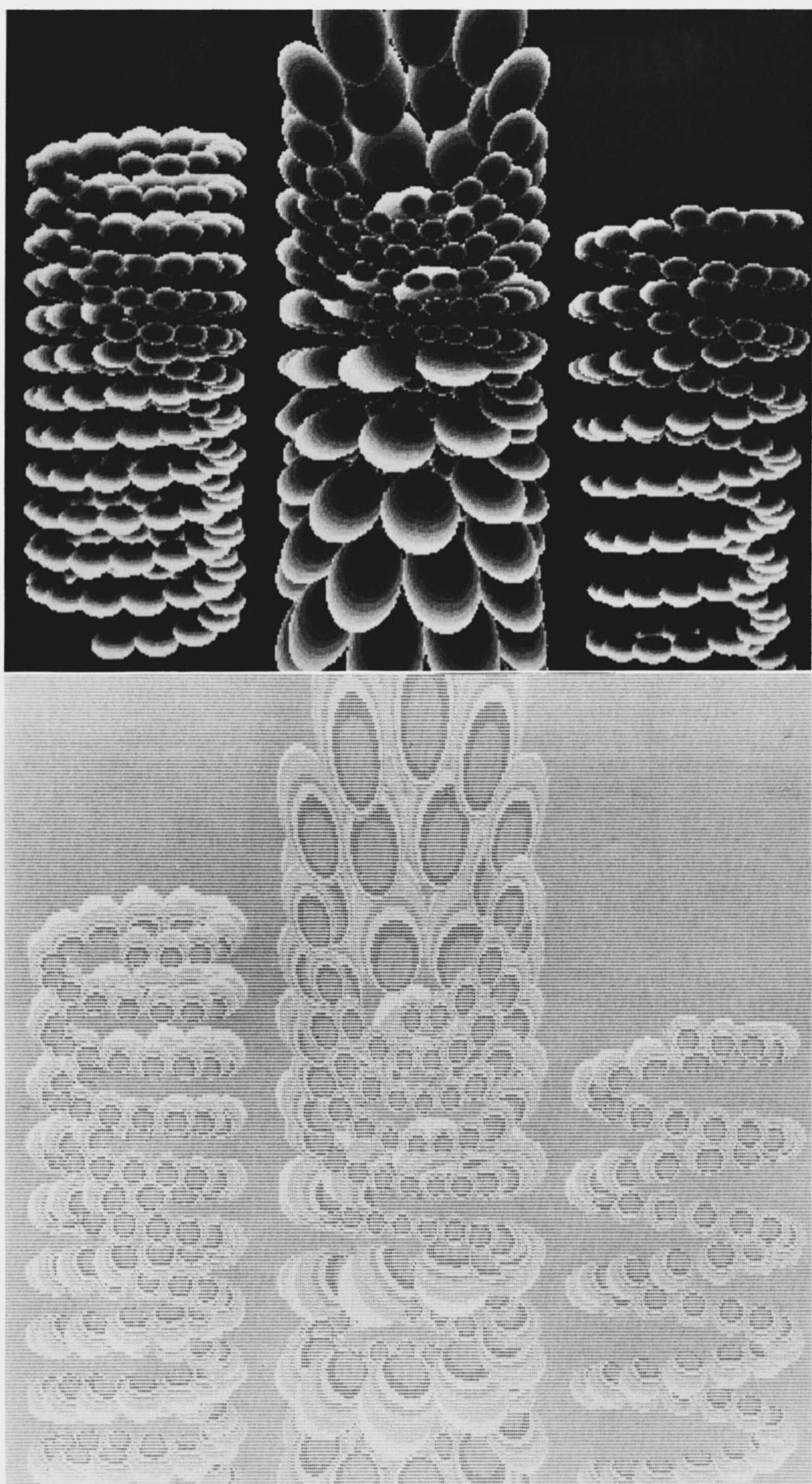


Figure 8

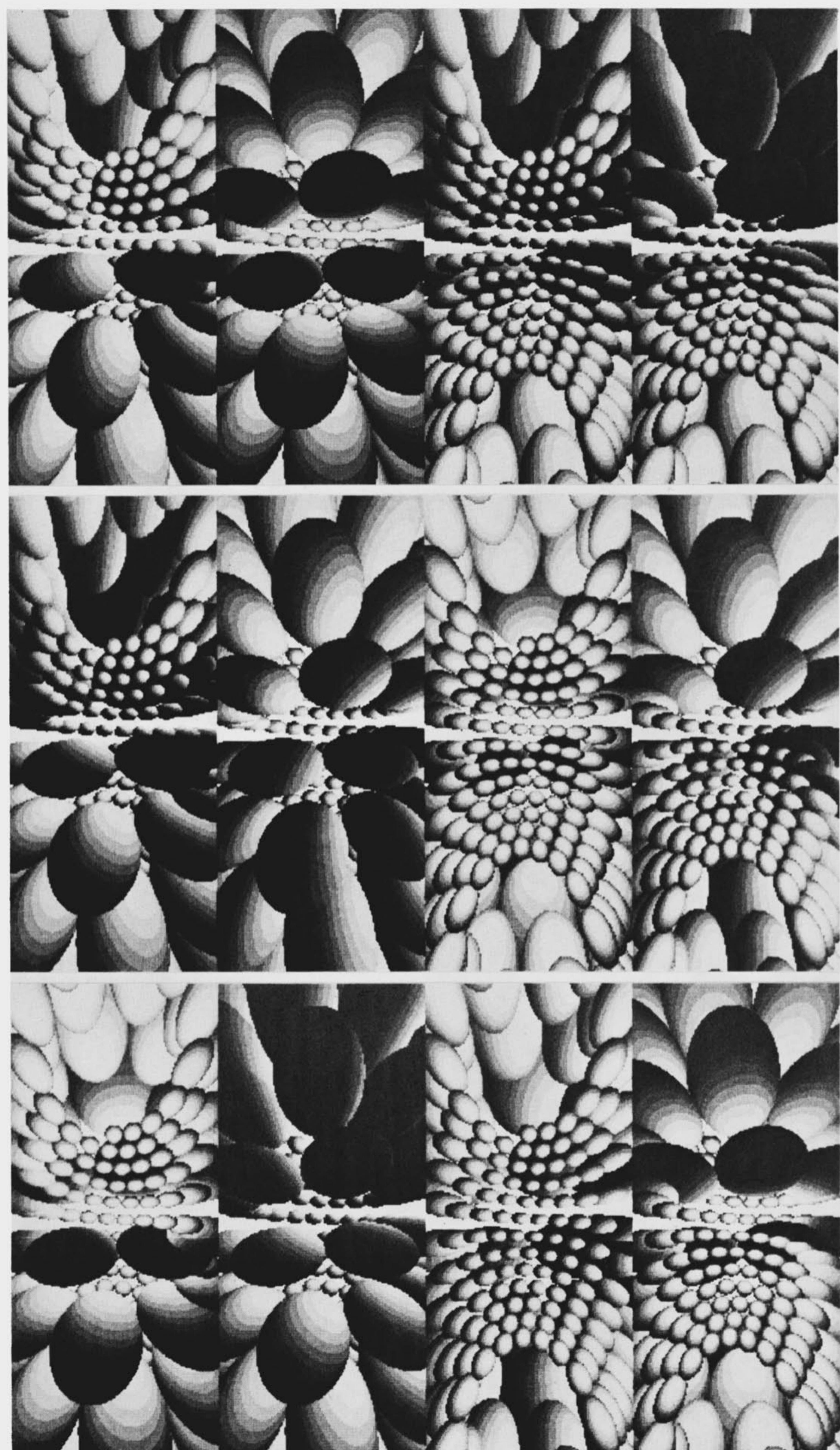


Figure 9

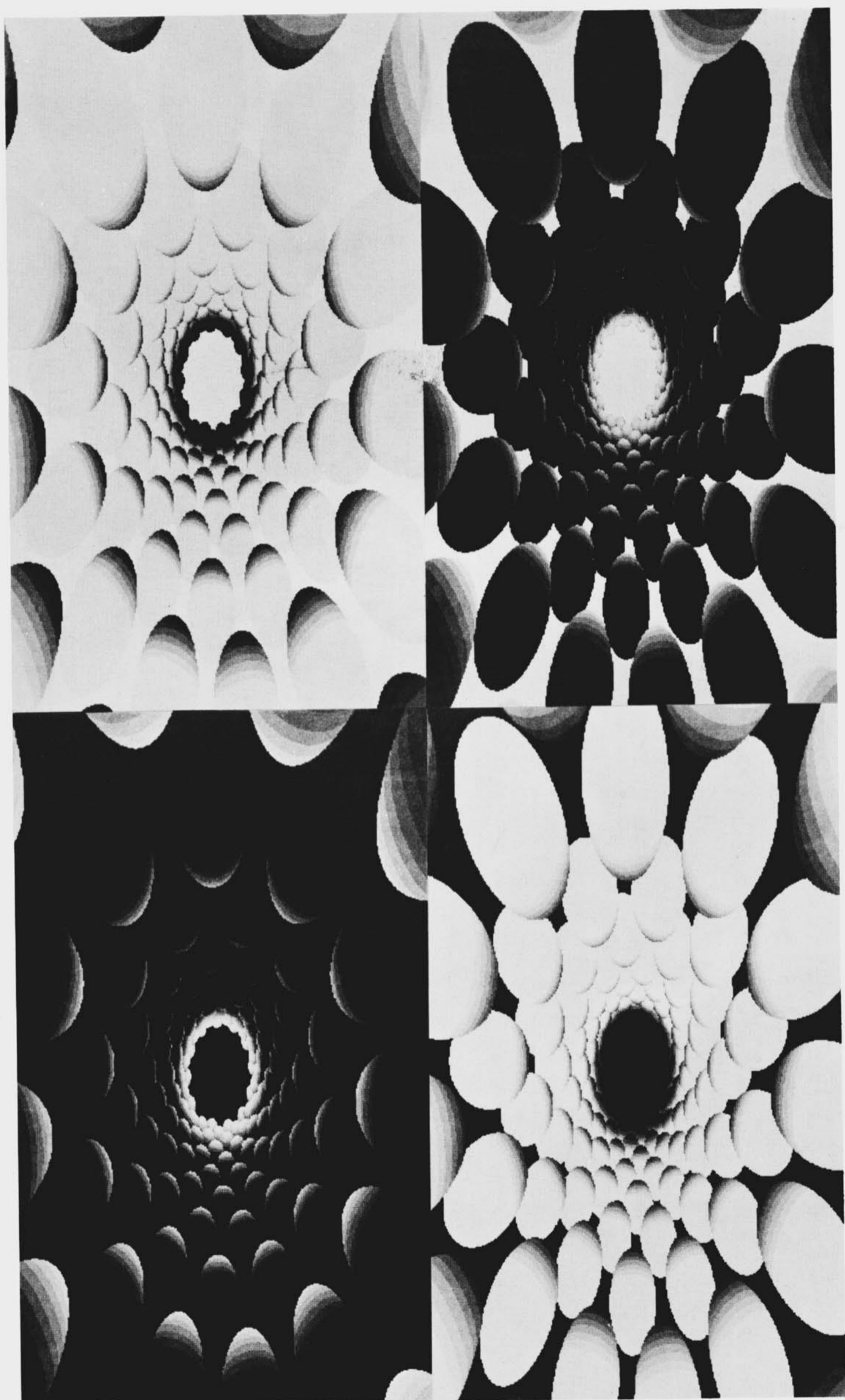


Figure 10



Figure 11

each figure (the “sky” if we consider our balls as celestial in nature – “the music of the balls”?) as either dark or light we obtain quite different effects. Perhaps if we consider this art we could begin venturing titles – “Sperm’s eye view”?

Serendipity as a factor cannot and should not be ruled out. Indeed program errors should be encouraged in moderation as they frequently act as a catalyst to the creative process. They were responsible for figure 11.

There is one last interesting possibility to mention. What happens if we try to print balls which overlap each other’s position in space? Plotting such concatenations of balls can lead to tube-like effects which are quite intestinal (sic). In some cases the effect becomes rather removed from what one might expect. Figure 12 is part of a double helix of balls much like you would find with some electric light filaments, except that the balls have been placed so close to each other that they overlap.

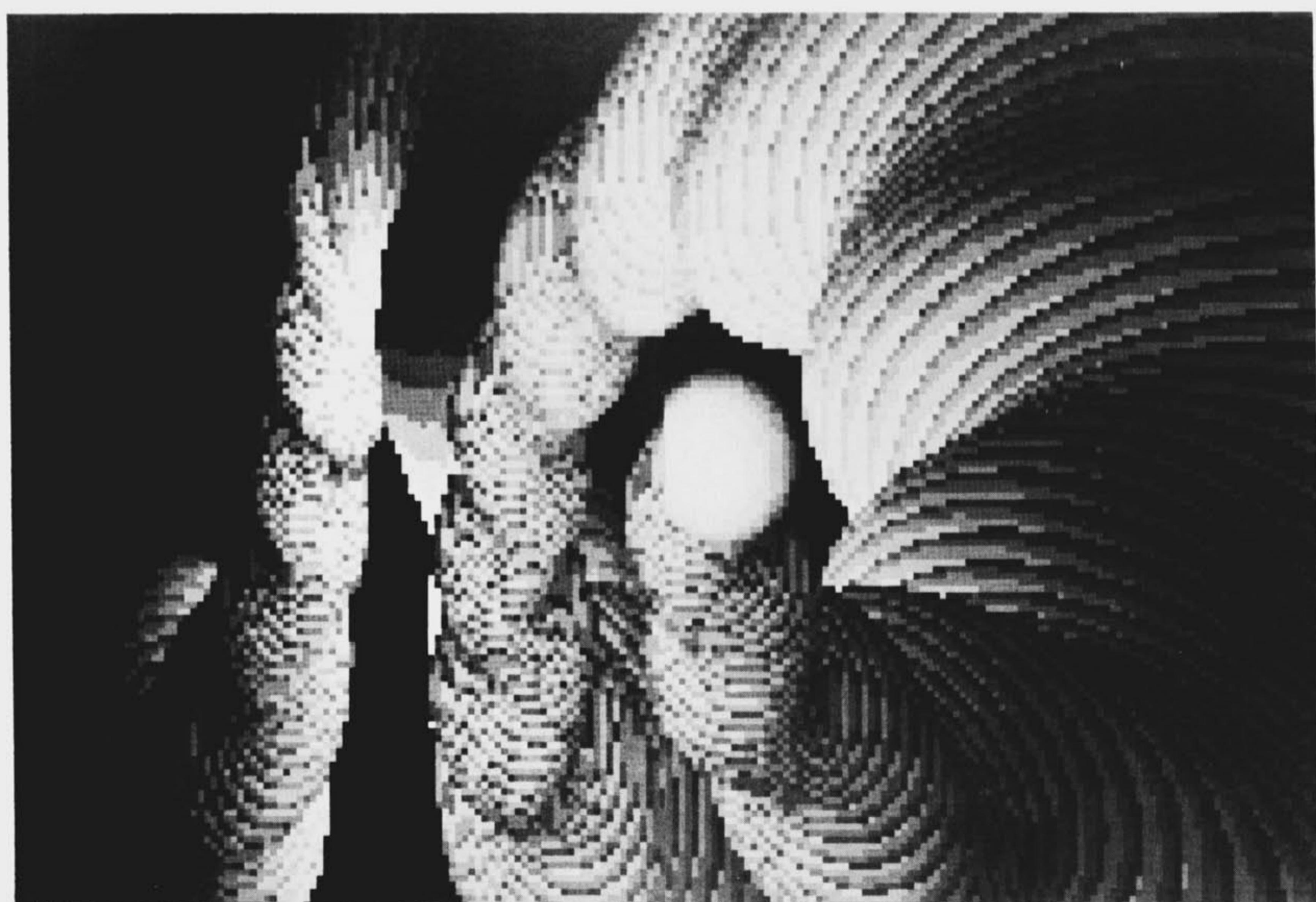


Figure 12

Of course, in the end we have to ask the perennial question – “But is it art?” My answer is “Yes”. To my mind, in the future personal computers will enable even the most ham-fisted individual to express his ideas graphically and artistically. Piss-artistry need not restrict itself to the spray-can and factory wall. The computer can provide a more socially acceptable tool and medium and provide “art” within the pocket of everyone. It seems to me that computer art can indeed be a “load of quasi-spherical objects”, and this article attempts to illustrate a few of the ways in which this may be achieved. “Achieved?” Yes – “achieved” because being a load of balls doesn’t appear to be such a bad thing really. Does it? As Shaw has argued so persuasively, Art could do with a little less pomp and ceremony.

ACKNOWLEDGEMENTS

Figures 3 and 4: Penrose and Penrose. Reproduced by courtesy of the British Psychological Society from: “*Impossible objects: A special type of visual illusion*”, *British Journal of Psychology*, 49, 1958. pp.31-33.

Figure 5: Belvedere by Escher. Reproduced by courtesy of the Escher Foundation – Haags Gemeentemuseum – The Hague.

Figure 6: Hogarth. From a Meriden Gravure Company photograph of a print now in the W S Lewis Collection. Reproduced by courtesy of the publishers of a book in which it appears. Paulsen, R. *Hogarth: His Life and Times Volume II*, London: Yale University Press, 1971, 159, plate 245.

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FOOTNOTE

The computational aspects of this work were aided by an SSRC grant to the author for an investigation of the aesthetic reactions to value keys. Some of the illustrations were produced during the testing of programs written to produce output with equal-spaced grey scales.

Every day, café, I wander through stardust.
I am a derailed artisan, the deregulator of logical machines,
Seeker of emotion in the metal memories,
I force and compute the space of their game.
Voyager in dust,
I follow them without respite to the bottom of their silent desert.
Plugged in to keyboard, I immolate like the Japanese
The infernal black hole of the Constellation of the Swan.
Tracer of a course in the shadows of random spaces,
I plunge without rest, luminous brush,
Into their intimate rituals.
Hired applause of the particles which vibrate in my body,
I sharpen the minuscule cancers which go astray,
To flash brutally on the magic screen.
Emotion – Despair – Immersion.
It moves, it lives, there under my eyes,
It develops, outside of me, it exists . . .
Fascination . . . Spaghetti contemplation . . .
I am a creator of dust,
Random medium, blacksmith of intimate expansions . . .
I bathe in space.

Bernard Demio 1979



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Department of Computer Science, University of Edinburgh 8–11 April 1980

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S.R. HOLTZMAN (University of Edinburgh) – discusses the application of 'context-free' and 'context-sensitive' grammars in composition, with examples in Generative Grammar Definition Language (GGDL).

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MICHAEL GREENHOUGH (University College, Cardiff)

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PETER MANNING (Durham University)

Keele University Studio Report

TIM SOUSTER (Keele University)

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Demonstration of sound generating techniques on the ITT2020 (Apple II) microcomputer

KEVIN JONES (The City University, London)

A Digital Synthesis Module for live performances
LAWRENCE CASSERLEY (RAM, London)

The Edinburgh GGDL composition/synthesis system
S.R. HOLTZMAN (University of Edinburgh)

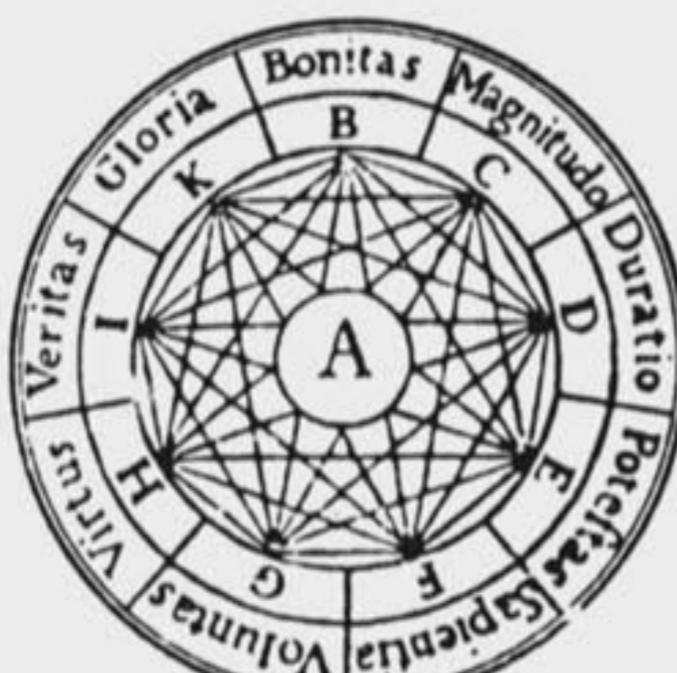
A microprocessor synthesis system
D. FINLEY (The City University, London)

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The organization of CAS activities, including exhibitions and the publication of PAGE, depends entirely on the voluntary help of a few members. At present the exchange of information, both through members' correspondence and through the publication (and circulation) of PAGE, is far less efficient than it might be. PAGE in particular would benefit enormously from someone with enthusiasm and a little time, who would be interested in co-ordinating information and increasing sales. Is there anyone who lives within reach of Russell Square or West Kensington, who would like to take a more active interest in the Society by helping out one afternoon or evening a week? Please contact Dominic Boreham (address on back page).

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