ALL DONE BY GRAPHS (undirected)

MICHAEL THOMPSON

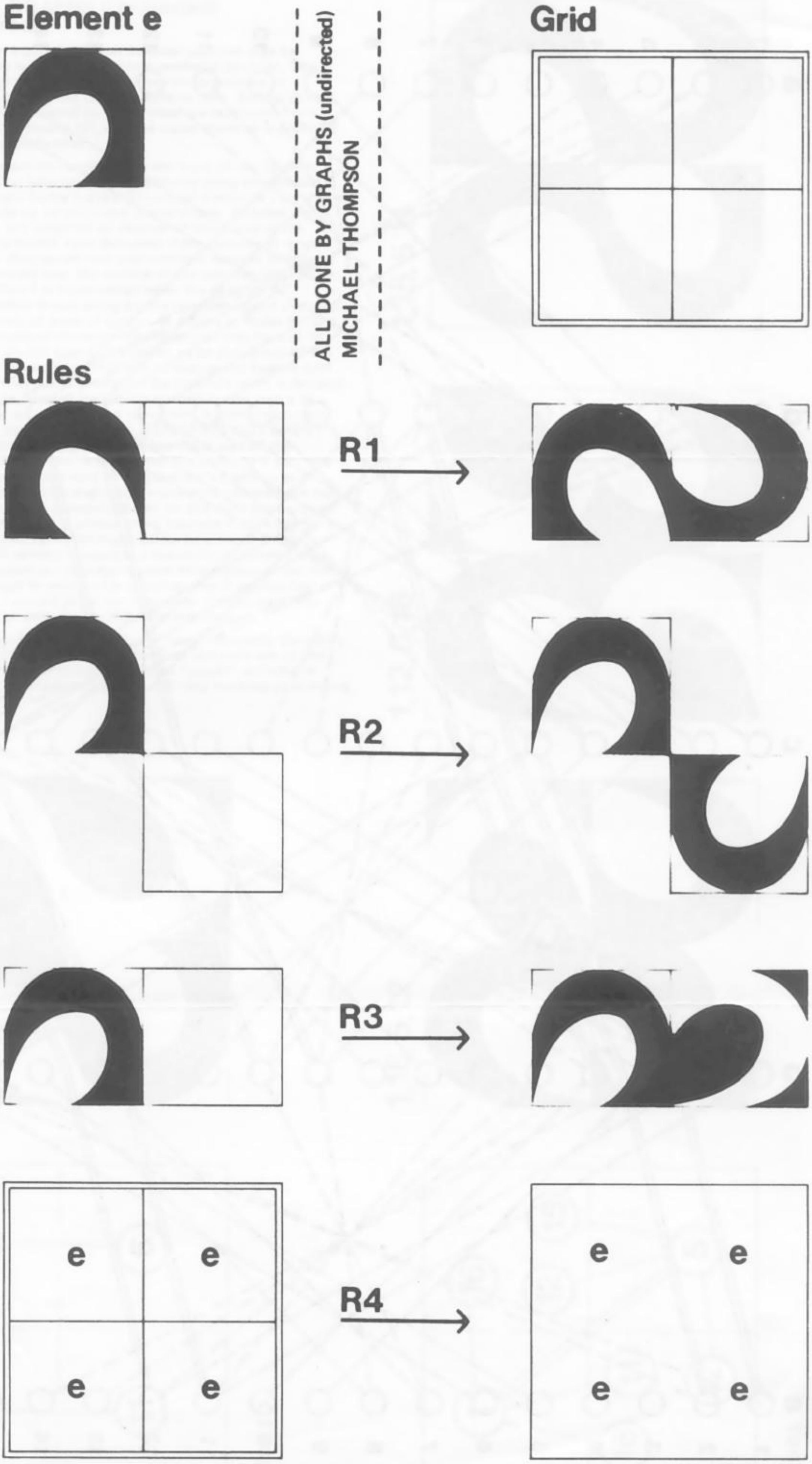

FIGURE 1

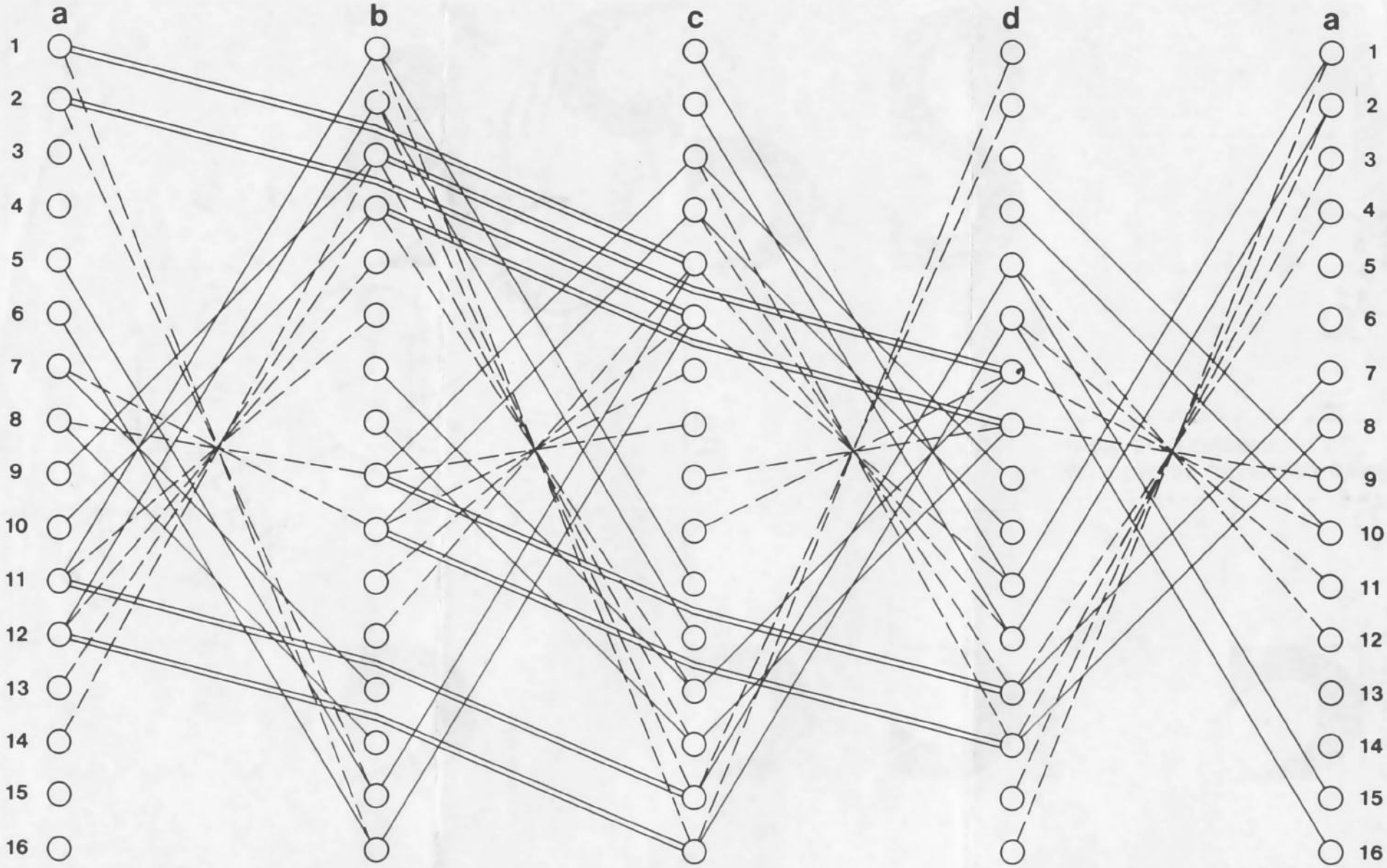

FIGURE 2

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This note describes an example of how modular pictures may be synthesised directly so as to contain certain aesthetic qualities. The method is direct and does not use explicit search techniques or sampling (random numbers); but rather generates only those pictures the user is likely to be interested in. Some ideas are borrowed from linguistics (1) and graph theory (2), and the visual material is provided in the work of Manuel Barbadillo.

By now many readers will be familiar with the work of the Spanish artist Manuel Barvadillo, who has painted pictures using the module shown in Figure 1. Eight forms (called 'Structural Elements') are shown and have been obtained by rotation and mirror-image. Another eight, which are not shown, are obtained by reversal of black and white. Manuel Barbadillo and myself have discussed these pictures at length and I find it useful to distinguish two characteristic ways in which the observer's attention moves over the surface of the pictures (4). Firstly, TRACKING MOVEMENT is experienced when the observer's attention seems smoothly drawn along by the contents of the pictures. Typically it follows lines of areas of colour. In Figure 1, Rules R1 and R3 show how two structural elements may be placed side by side to encourage tracking. I do not expect the reader to be convinced of the existence of tracking merely from this, but to discuss the twenty odd 'rules' I use and how they occur in Manuel Barbadillo's work is beyond the scope of this article. Manuel Barbadillo himself is well aware of tracking but feels that another form of movement is more important, although less easy to understand. We call it SKIPPING MOVEMENT. This is a switch of the observer's attention from one part of the picture to another. Subjectively, it seems that the shape of a part of a coloured area is perceived, and held in the observer's memory as a 'perceived object'. An example might be a movement between the two white lobes in the structural elements shown on the right hand side of Rule 2 in Figure 1. Of course, a similar thing happens if the observer's attention happens to rest upon the black coloured areas of these elements. Skipping movement is possibly a search for symmetry that will enable the perception to more easily store information in the mind. About thirty rules could be written for skipping, and if readers feel this to be many then I should point out that given sixteen elements one can arrange pairs of elements in 256 different ways.

If the concepts of tracking and skipping are "open" concepts then they cannot be exactly defined (5), and as they most certainly are of this type, they cannot be used in computing. Some "closed" definitions must be made, which although not exactly defining tracking or skipping,

1,16,6,11

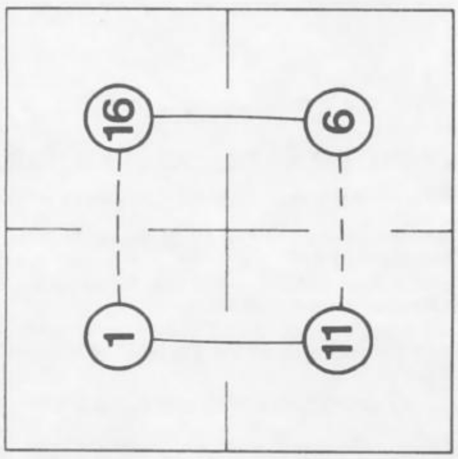
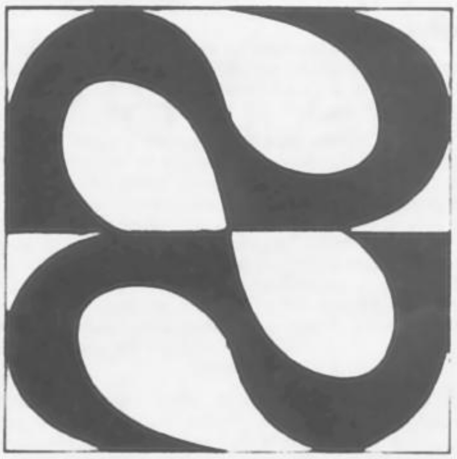


FIGURE 3

1,15,5,11



1,12,5,16

1,16,5,12

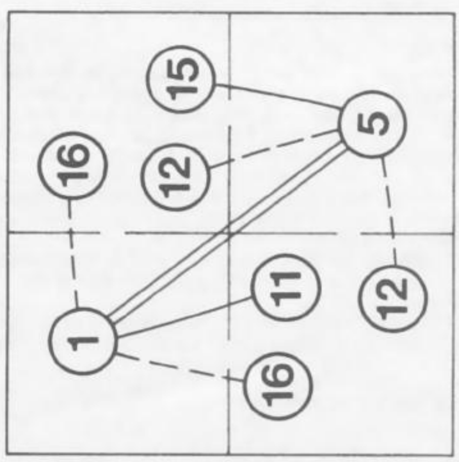


FIGURE 4

do present to the computer an exactly defined model. I call this a 'SUBJECTIVE VISUAL MODEL' because it allows the computer program to work with subjective concepts connected to the way we think we see things.

The particular model here used 'rewriting rules' (Figure 1) borrowed from linguistics (1). A picture is built by replacing a single structural element (left hand side of a rule) by a pair of elements (right hand side). The procedure is to find in the picture a shape like the left hand side of the rule, then find the geometric transformations (translation, rotation, mirror image, and black-white reversal) that make the left hand side of the rule identical to the shape in the picture. Lastly, these transformations are applied to the right hand side of the rule, to enter it into the picture. Once an element has been added to the picture it cannot be erased. The process ends when no more rules can be applied to the picture. Note that rule R4 clears the grid from the picture as soon as it has been filled with elements.

These 'rewriting rules' will now be applied to a visual problem. Manuel Barbadillo has written to me: 'The function relative to the joining of edges, I have always felt to be one of the most important ones in my work. Yet I have found it very difficult to work with ... Sometimes two elements located in neighbouring squares which again fit with others would be part of a combination that finally originates a continuous form with good rhythmic fluency'. Constructing a picture of only four elements is formidable with 16 possibilities for each of them. It is easy to match two of them or even three, but to choose the fourth so as it integrates with the three others is not easy. I shall refer to a picture of size 2x2 elements as containing a 'cycle' if each element integrates with all its neighbours.

The procedure for picture generation starts with the preparation of rewriting rules to represent the kind of visual phenomena in which we are interested. The rules in Figure 1 happen to be particular instances of pairs of elements that, I feel, give rise to tracking and skipping movements. Next a graph is constructed which contains an arc for every possible way of using these rewriting rules. Such a graph represents every possible picture that can be generated using these rules. The set of rules may be called a 'grammar' and the pictures that can be generated by them then comprise a language .

The graph in Figure 2 was constructed from the rules R1, R2 and R3 in Figure 1. The columns a, b, c & d represent the grid positions in a 2x2 picture starting at the top left hand side and proceeding clockwise. The list of numbers (for each code) in each column represents the structural elements that could be used in the corresponding grid position. For instance, arc 1,16 between columns a and b means that if element 1 occurs in grid position a then element 16 may occur in grid position b, and if element 16 occurs in grid position b then element 1 may occur in grid position a. This is an example of the application of rule R3.

Pictures are selected by finding various sorts of structures within the graph, for instance, the cyclic paths that visit every grid position exactly once. One might expect these pictures to be well integrated aesthetically. One such cycle is 1- 16- 6- 11- 1, following the route a- b- c- d- a, which generates the picture in Figure 3. The graph structure is also shown and uses only tracking rules R1 and R3. There are seven more cycles but they merely represent simple transformations of the illustrated picture (such as rotation, mirror image, etc).

Another structure of interest is a path that visits every grid position exactly once but is not cyclic. Some of these are shown in Figure 4, illustrating the employment of rule R2, and exhibiting (in my opinion) more skipping movement than those in Figure 3.

This work has been done by hand, but a computer becomes valuable if more than, say, four rewriting rules are used and it is a necessity for the investigation of pictures of size 4x4 elements (the size preferred by Manuel Barbadillo). The computer program should permit the use of arc values, so that each rewriting rule might be given a score depending on the apparent intensity (subjective) of the phenomena it represents (see 4). The advantage of this scheme would be that despite the large number of cycles that would result from many rewriting rules, the computer could use the total of the arc values in each cycle as a discriminator, to reduce the number of pictures in the output. Indeed, the computer might only output pictures represented by cycles of maximal value.

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CONTROL MAGAZINE ISSUE NO 7

A major concern of Control Magazine has been the evolution of standpoints by the artist that are directed at proposing theotetical and operational frameworks for art practice, which are appropriate within the present social setting. The notion is generally expressed in the magazine that methodologies from Behavioural, Social Sciences are applicable to the aforementioned concern, and projects that demonstrated this point have been described in past issues.

Implicit in any coherent standpoint is an articulate foundation, which if it is to be useful as a prescription needs to be rigorously defined.

The need to further such an investigation has played a large part in influencing the selection of contributions to the latest issue of Control Magazine, No 7. These contributions are seen as providing theoretical discourse and methodological direction in areas that have received little attention on the part of artists previously. This issue of the magazine is therefore seen as being particularly relevant to artists, students and other concerned people, who are interested in the potential of applying methodologies from the Behavioural and Social Sciences to art practice, and the effect this might have on the social function of art.

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