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TOWARD AESTHETIC GUIDELINES FOR PAINTINGS WITH THE AID OF A COMPUTER

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Abstract—*The author makes nonfigurative drawings and paintings that are the results of a procedure in which simple geometrical shapes and their combination were successively altered in specific ways. In 1968 she began to use a computer to assist her. The computer displays (on a CRT screen) images in which shapes and/or their arrangement are altered successively. When she sees a pleasing example that she may wish to execute as a drawing or a painting, she instructs the computer to record it on a plotter.*

She has studied a number of such series in which alterations occur successively in small steps to determine which alteration is responsible for the appearance of a picture that she judges to be aesthetically superior to those that preceded it. She includes an example of of her judgment of the aesthetic quality of pictures chosen from a particular series.

I.

I am a painter, an image-maker, in particular, of images of a nonfigurative kind. I 'create' visual forms in the sense that they consist of combinations of shapes that cannot be found in nature.

I decided that I would become a painter when I was 12 years of age under the influence of an uncle of mine who, in his leisure time, painted a number of scenes of woodland nymphs in twilight. I began by making pictures of nymphs and trees but soon I replaced figurative subject matter by simple geometrical shapes. Later I began to make nonfigurative pictures that were the result of a procedure in which initial simple geometrical elements and their combination were successively altered in specific ways, a procedure that I continue to follow. In 1968, I was able to gain access to a digital computer to facilitate the execution of this time-consuming procedure.

I am forcefully impressed by the fact that viewers tend to agree on what they consider as 'beautiful', 'indifferent' and 'ugly' compositional arrangements, in particular arrangements of squares, triangles and dots, which can be produced readily on a computer display. Osgood made psychological tests on artistic taste and found that there is less divergence of taste than is generally believed [1]. Personally, I doubt that 'beauty' is amenable to definition but I shall not explore the question here.

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II.

What I should especially like to know is what changes have occurred in a picture on which I am working when it begins to please me. What are the specific elements of a composition that cause it to give to me aesthetic satisfaction and then later to a viewer? I seek a concrete answer, one that entails experimentation rather than philosophical speculations. I am not interested in my subconscious or unconscious states. I should like to avoid even the notion of consciousness and to follow the objective approach of behaviorist psychology.

Of course, to make good pictures one should know not only about composition but also about the psychology of perception and about experimental aesthetics [2]. It would be most helpful to an artist to be able to apply principles of aesthetics but, despite the efforts of painters and others interested in art during past centuries, such principles continue to elude discovery. There are those who believe that such principles do not exist, that art is solely intuitive. Nevertheless, some of these same sceptics have formulated arbitrary rules that, because there were arbitrary, did not have general utility. The principles that I believe exist are in the form of laws that are determined by human physiology and psychology and recent achievements in the human sciences encourage my belief. But I am certain that in order to find them experimental methods of science rather than philosophical speculation will be required [3, 4]. In effect, art can profitably use experimental methods of the physical sciences. But I do not mean to imply that art will become science.

III.

I do not agree with those who believe that developments in art simply happen. I am convinced that initiative must be applied to obtain an understanding of these developments and I wish to do my part. Whenever I begin a picture, I have an initial idea of it in mind. The procedure that I use to arrive at the final work, to be described below, is tedious, if carried through by hand. Furthermore, the final picture rarely corresponds to my initial idea of it.

I develop a picture by means of a series of small probing steps and each step is followed by evaluation. In my opinion, painters should employ such a procedure, especially if they consciously wish to learn what of aesthetic importance is occurring on the canvas as the painting develops and what effect the work may have on viewers. Making a series of pictures that are alike except for the variation of one parameter is not uncommon. Many painters from those of Mount Athos to those of today have done this. Claude Monet, a good example, painted both a haystack and the Rouen cathedral repeatedly in different lighting.

When I have an idea for a new picture, I make the first version of it rather quickly. Usually I am more or less dissatisfied with it and I modify it. I alter in a stepwise manner the dimensions, proportions and arrangement of the shapes. When simple geometrical shapes are used, such modifications are relatively easy to make. By comparing the successive pictures resulting from a series of modifications, I can decide whether the trend is toward the result that I desire. What is so thrilling to experience is not only the stepwise approach toward the envisioned goal but also sometimes the transformation of an indifferent version into one that I find aesthetically appealing.

This stepwise procedure has, however, two important disadvantages if carried out by hand. Above all, it is tedious and slow. In order to make the necessary comparisons in a developing series of pictures, I must make many similar ones of the same size and with the same technique and precision. Another disadvantage is that, since time is limited, I can consider only a few of many possible modifications. Furthermore, these choices are influenced by disparate factors such as personal whim, cultural and educational background and ease of execution.

IV.

Using an IBM 370 computer, I have been able to minimize the effort required during the preparatory phase of making a picture. This computer can produce a series of images (the shapes and their arrangement may be simple or complicated) on an IBM 2250 CRT screen and/or of

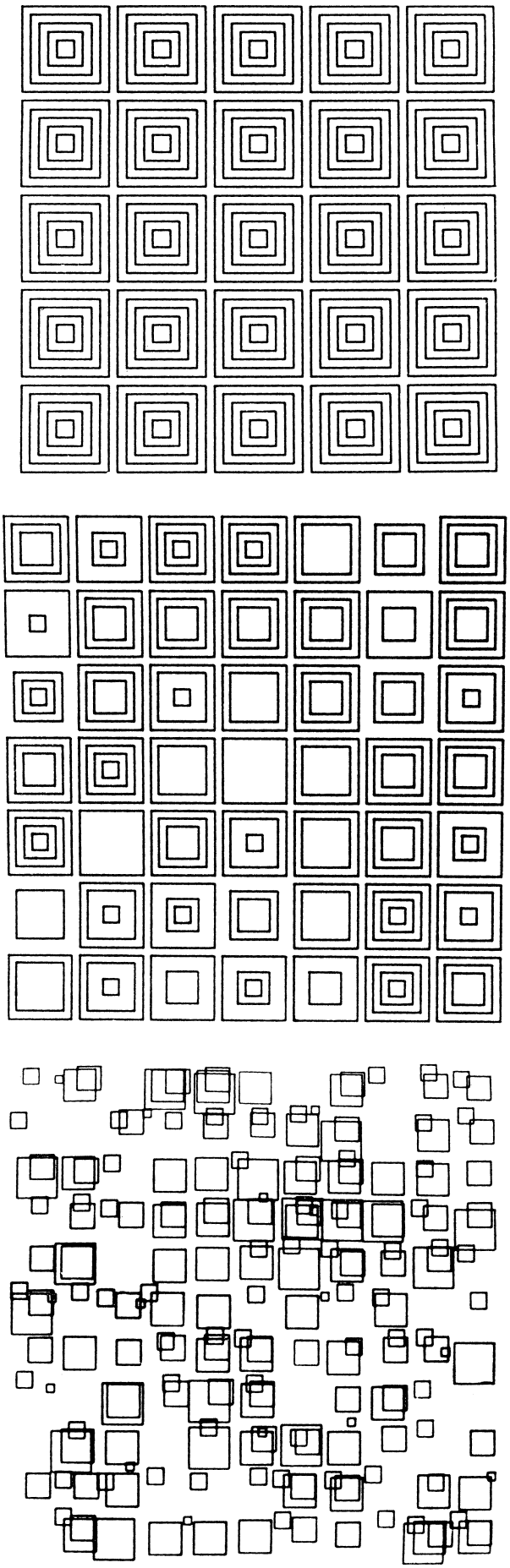

Fig. 1. *Computer drawings*, 25 × 25 cm. Top, '*Carrés, 000072/00*', 1972 (Collection of Brys-Schatau, Brussels, Belgium); center, '*Carrés, 250173/1*', 1973; bottom, '*Carrés, 071273/21*', 1973.

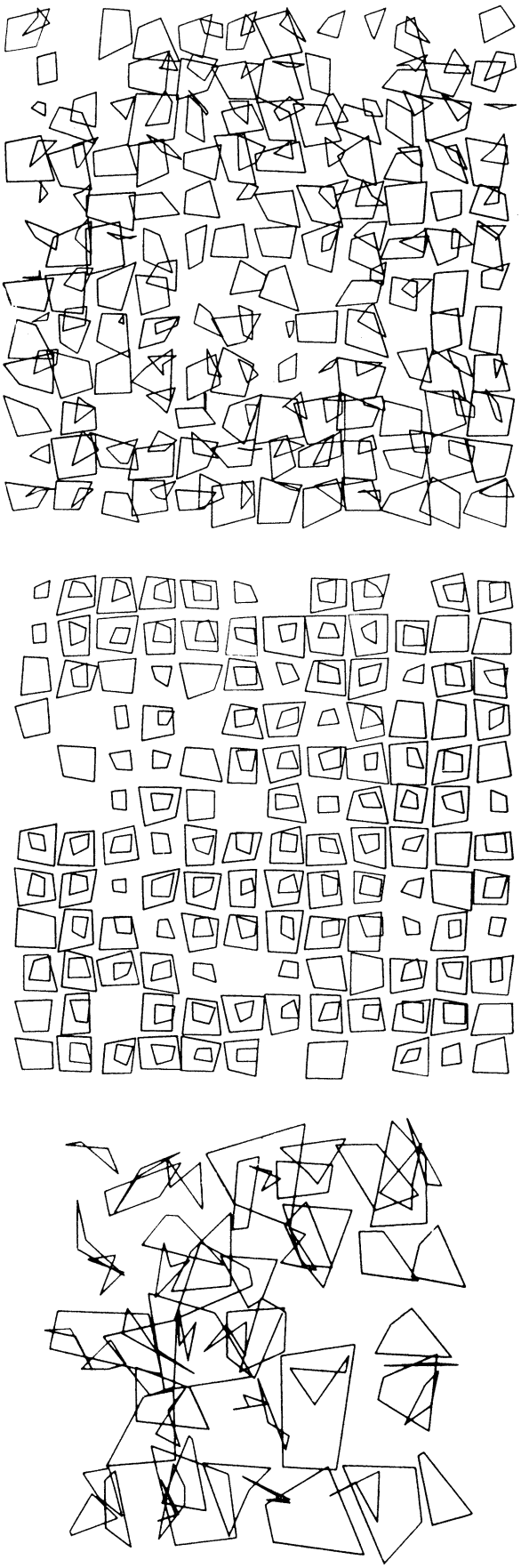

Fig. 2. *Computer drawings*, 25 × 25 cm., 1973. Top, '*Carrés, 071273/26*'; center, '*Carrés, 071273/27*'; bottom, '*Carrés, 071273/34*'.

drawings on a Benson plotter. A program for a specific kind of image determined by a number of selected parameters is employed. The input data consists of instructions specifying, for example, to what extent particular parameters are to be varied and the amount of change in each step. Similar procedures have been described before in *Leonardo*, for example in the work of Z. Sýkora and J. Blažek [5] and C. J. and C. S. Bangert [6]. There are differences, however, between my method and that widely used by other artists. Whereas they begin with an initial set of rules (a grammar) specifying the way parameters are to be varied, I try to elaborate the rules as a work develops.

In a series of pictures drawn on paper by the plotter each version will differ from its predecessor in that only one parameter will have been varied, such as scale, shape, line thickness or color. This control over the stages in the development of a drawing permits me to decide when the picture that I wish to realize is being approached or departed from. When a good approximation has been achieved, then smaller changes are introduced in the succeeding drawings produced by the computer.

Another method, which I mainly employ, is essentially the same as that described above but, instead of making a parameter change and then waiting for a drawing to be plotted (the plotting operation may require several minutes or several hours, depending upon the size and complexity of the picture), I make the parameter changes quickly while viewing the images on the CRT screen. This is the so-called 'conversational method'. I select only a few of the images shown on the screen for recording by the plotter.

This approach is not new; it had been applied long before computers were constructed. Erasing, scraping, retouching or covering part of a picture

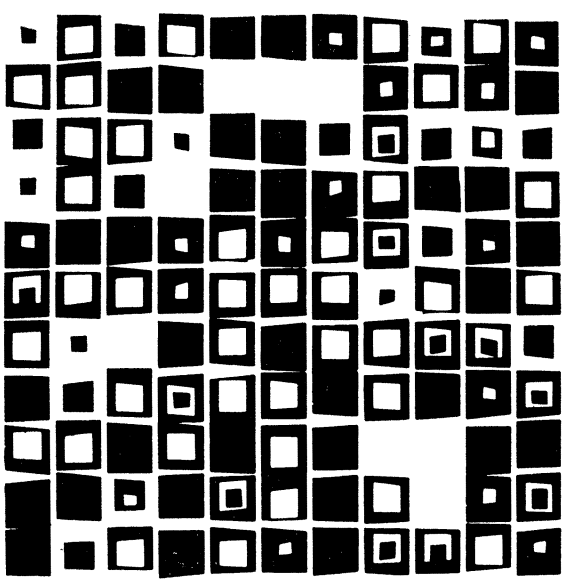

Fig. 3. '*Computer-Icône*', *polyvinyl emulsion paint on canvas, based on a computer drawing*, 110 × 110 cm., 1973. (Collection of J. and J. Mayer, Paris, France.)

are familiar techniques used by painters. Thus my computer-aided procedure is simply a systematization of the traditional approach. I should mention here another advantage in using a computer: it is possible to 'go back', that is, to repeat drawings that had appeared before certain modifications were made.

In spite of their advantages, computers, no more than other simpler tools, do not guarantee that a work of art of good quality will result, for it is an artist's skill that is the decisive factor [7].

V.

The computer drawings that I shall discuss were made by the 'conversational method' with a program called RESEAU-TO, of the type used for composing music, for example MUSIC 5 of Mathews [8]. This program permits the production of drawings starting from an initial square array of like sets of concentric squares. The available variables are : (1) the number of sets, (2) the number of concentric squares within a set, (3) the displacement of individual squares, (4) the deformation of squares by changing angles and lengths of sides, (5) the elimination of lines or entire figures and (6) the replacement of straight lines by segments of circles, parabolas, hyperbolas and sine curves. Thus from the initial grid a great variety of different images can be obtained.

To illustrate the possibilities of this program, I show an initial 5 × 5 array of sets of 5 concentric squares as drawn by the computer plotter (Fig. 1, top). In Fig. 1 (center) is a variation in which the array is now 7 × 7 and the number of squares in the sets is varied. In Fig. 1 (bottom) squares of different size are variously displaced within an

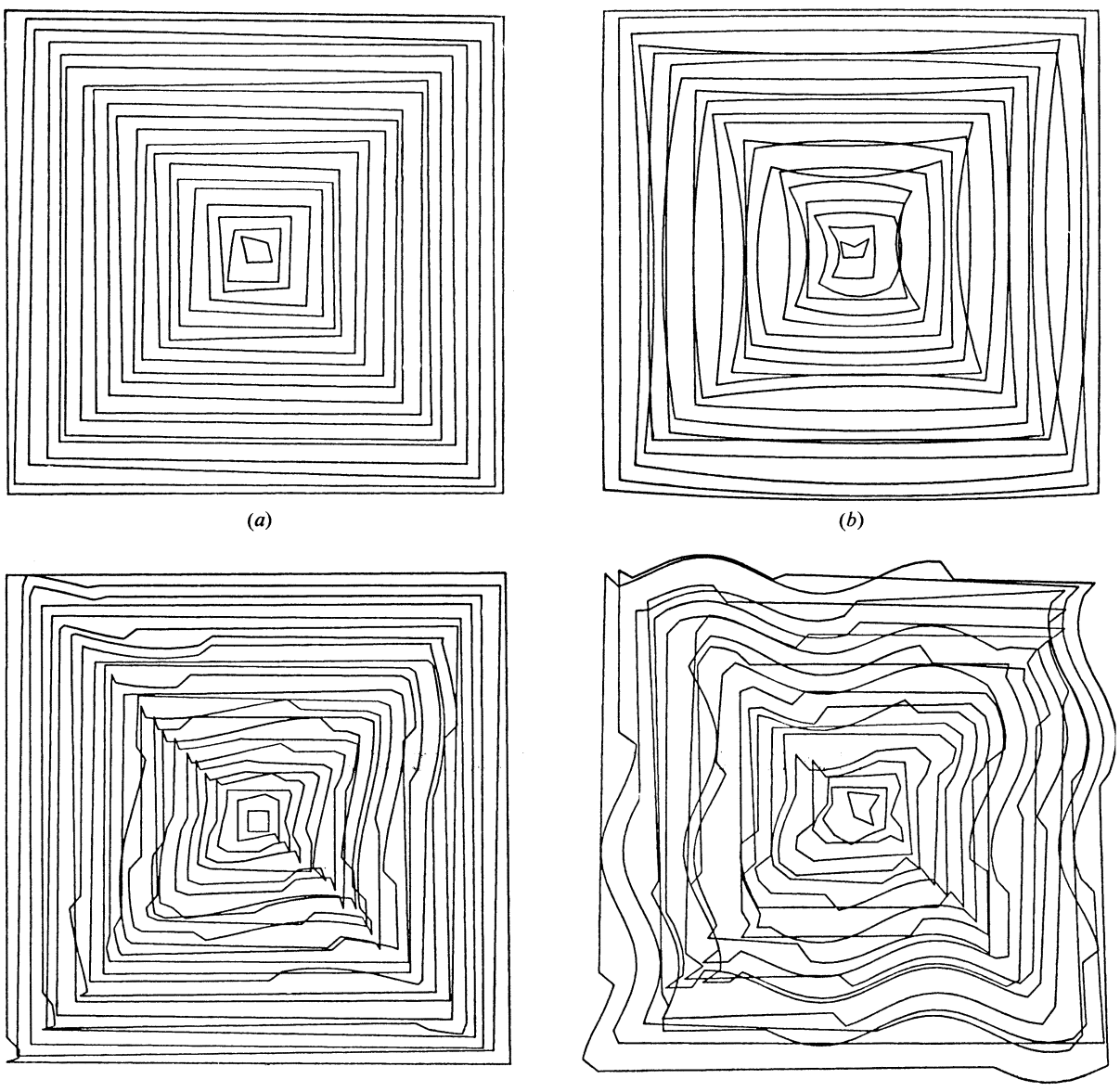

Fig. 4. Computer drawings, 25 × 25 cm., 1974. (a) '*Computer-rosace, 74.338-31*'; (b) '*Computer-rosace, 74.338-39*'; (c) '*Computer-rosace, 74.338-47*'; (d) '*Computer-rosace, 74.338-54*'.

11 × 11 grid. In Fig. 2 are shown variations of distorted squares. A painting that I made by hand in black on a gold background on the basis of one computer drawing is illustrated in Fig. 3.

I have mentioned my desire to learn what particular change in a series of changes to a picture gives rise to aesthetic satisfaction but my study so far has led only to some tentative conclusions. Fig. 4(a) is a picture that I find aesthetically 'indifferent'. Its aesthetic quality seems improved to me when some straight lines are replaced by segments of parabolas (Fig. 4(b)) and even more so when sine curve segments replace parts of the straight lines (Fig. 4(c)) but when the number and amplitude of the sine curve segments are increased, a result is obtained that I find aesthetically disappointing (Fig. 4(d)). I believe that the majority of those who view these examples will agree with my opinion as to their aesthetic quality.

In Fig. 5 (cf. color plate), is shown a reproduction of a painting on canvas whose design corresponds with high precision to a drawing produced by the computer plotter. The two hues were chosen arbitrarily but their Munsell values were kept the same.

VI.

I do not make drawings and paintings with the aid of a computer solely for personal satisfaction; I hope that others will also enjoy them. I do not agree with the notion of art for art's sake and of science for the sake of science. Sartre convincingly explains why this notion is untenable [9]. I, personally, know of no artist who refuses to let people see his work. On the other hand, I do not believe that an artist should go to the extreme of ignoring his own taste and convictions in order to please others. There should be an intermediate ground where aesthetic satisfaction is experienced mutually.

The reactions that viewers voice, often in very diverse and obscure ways, should not be accepted without qualification. Often they do not analyze their own feelings. But even if they did, they would find it difficult to express them in words or they might hesitate to reveal their thoughts because of social pressures. People do not necessarily like what they say they like. Their judgments are influenced by factors that have little or nothing to do with the art object that they behold. They are influenced by the opinion of others, by the bias of education, by an object's price, etc. Yet, in spite of these problems, I subscribe to the belief that the underlying principles for giving aesthetic satisfaction to viewers of drawings and paintings can be found and I hope that my studies will help to verify my conviction.

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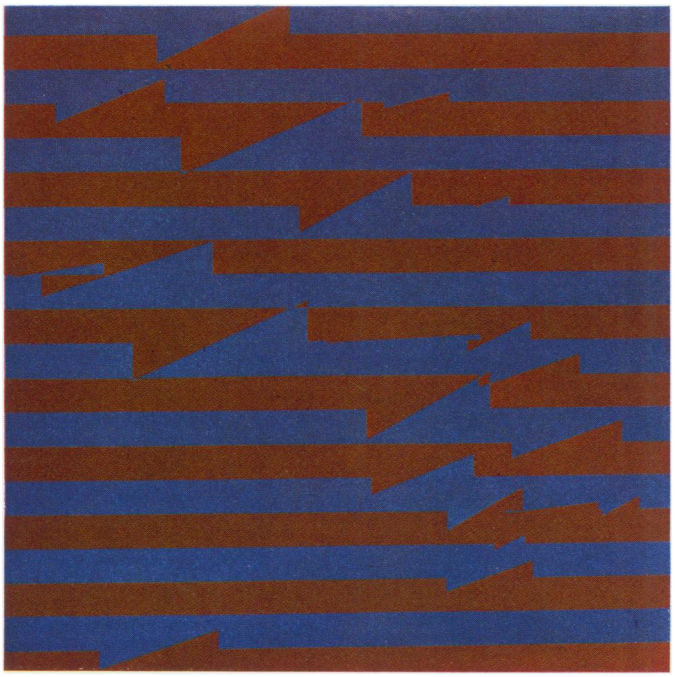

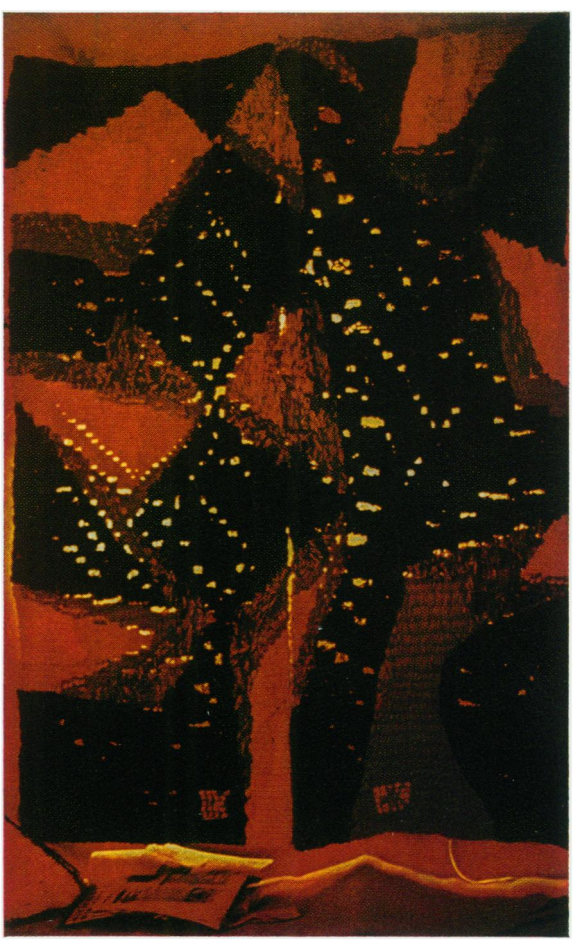

Top: *Vera Molnar.* '*Blue and Brown*', *polyvinyl emulsion paint on canvas, based on a computer drawing*, 110 × 110 cm, 1974. (Fig. 5, cf. page 189.)

Bottom, left: *Peter Lipman-Wulf.* '*Chorus Mysticus*', *one of a portfolio of illustrations for Part II of Goethe's* '*Faust*', *engraving*, 15 × 11 in., 1972. (Photo: John Hensel, New York.) (Fig. 4, cf. page 194.)

Bottom, right: *Robert Moro. Two tapestry modules* (1*B and* 2*A*) *from the* '*Kundalini Shakti*' *matrix with back electric illumination*, each module 188 × 67 cm, 1974. (Fig. 6, cf. page 236).

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