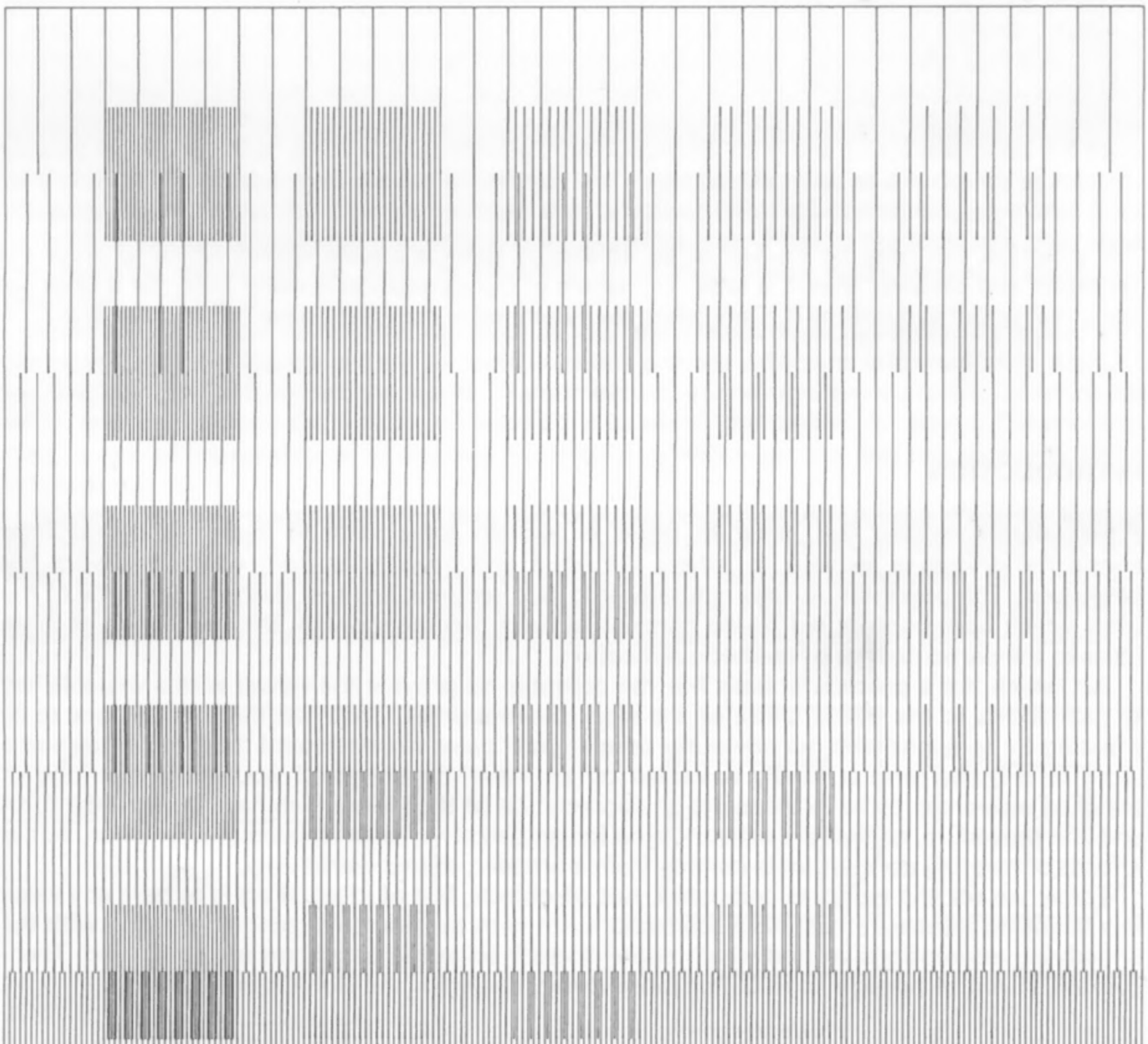
PAGE 42

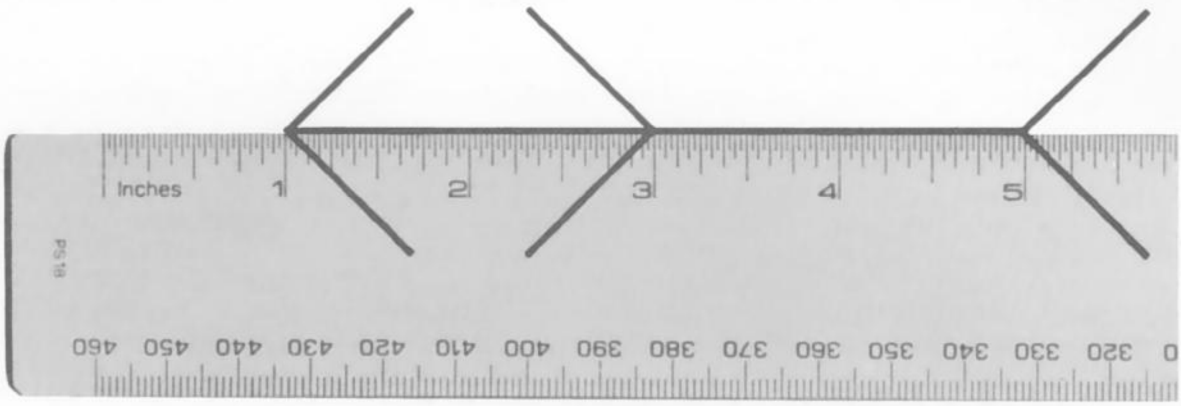
JUNE 1979

BULLETIN OF THE COMPUTER ARTS SOCIETY



THE PERCEPTUAL INTERPRETATION OF STRUCTURE

Some notes on recent drawings by
DOMINIC BOREHAM



"A sensation can only be known to be illusory if there is a scale against which to judge the sensation and discover that it is false. The whole of our perception is really false, for it does not copy reality but symbolizes it. Only when the falsehood is manifest do we call it an illusion."[1]

INTRODUCTION

I first started writing this paper in order to explain some ideas to myself, and only later considered trying to explain to others the ideas and procedures from which my work has developed. The presentation falls naturally into two sections, the first dealing with some of the ideas which have contributed to the conceptual basis, the second with the application of those ideas to the particularities of aesthetic reification.

Art which has a procedural basis has the potential to provide the viewer with a valuable key to gain access to the raison d'être of the work. Several times I have had the good fortune to be standing by someone who has obviously been at great pains to understand the internal logic of a work of art, and who is finally rewarded by an "aha" experience. I would like that kind of enriched awareness to be extended to an appreciation of the ideas which have inspired the form and the procedure, so that the artwork is no longer perceived as an isolated phenomenon, but as a focus or meeting point of ideas coming from a broader, shared world-view.

Today we see the world as composed, not of objects, but of ideas. If art is to have any value in a scientific culture, it must have connections not with the resultant technologies, but with the underlying assumptions around which contemporary scientific paradigms are structured. Then, perhaps, it will be possible to re-define more closely an Art of the Non-Objective World.

D.B. 1979

Cover: Dominic Boreham: STOS55 Computer-assisted Drawing, 1978 398mm x 398mm

PART 1: PERCEPTION AS INTERPRETATION

Many significant developments in contemporary thinking stem from the realization that we can never be aware of the world as such, but only of the nervous impulses arising from the impingement of physical forces on our sensory receptors. Unfortunately, the easy acceptance of this statement is frequently less a reflection of a major transformation of awareness, than a non-awareness of the difficulties which ensue when attempting to explain the correspondence between what is perceived and what is there.

In the past, most of the prominent perceptual theories have agreed that, even though much of this correspondence may be due to learning, at some basic level there exists without learning an absolute, one-to-one correspondence between perceptual experience and the material world. The belief in the possibility of absolute objectivity underlies much of our thinking. It leads to dichotomies, such as subjective versus objective, organism versus environment, fact versus value, etc. The experiments of such psychologists as Kilpatrick and Itellson, based on the Ames Demonstrations, have shown that it is a view which appears tenable only by reasoning from object to organism. If one begins with an object in the "external world", it is always possible to demonstrate an invariant correspondence between that object and the retinal stimulus pattern.

But if one turns matters around and begins, instead, with a given physiological stimulus pattern, and attempts to predicate a uniquely related external configuration, the invariant relationship immediately disappears. Ames has provided elegant demonstrations that, in visual perception, a given visual stimulus-pattern can be produced by an infinity of different external conditions. But we never experience an infinity of configurations; usually we see just one.

In a piece of apparatus known as "The Chair Demonstration",[2] Ames arranged three groups of strings in different configurations and at different distances, inside a viewing box. When viewed from any other point except through the peepholes, only one group resembles the form of a chair. Of the other two groups of strings, one might be described as a curiously elongated, squashed chair, whilst the other is no more than a collection of dis-connected, unrelated lines in space. Even the knowledge that only one set of strings is arranged in the form of a chair does not help the viewer to see them as anything other than chairs when viewed through the peepholes.

From very practical demonstrations such as this, the Transactional psychologists argued that the physiological stimulus pattern in itself does not provide sufficient information to account for the way in which we see the world. There must be, in addition, some process by which we select one from among the infinity of conditions to which the pattern is related. The problem then, is one of interpretation, to discover the criteria by which we interpret raw data into useful information.

Sometimes we can catch this process of interpretation in action. Ambiguous drawings, such as the Necker Cube (Fig. 2. a) present us with something of a problem. We adopt first one interpretation, then another, and since we cannot resolve these conflicting views, (4 altogether, if we try to locate the dot on a particular surface of the cube. Fig. 2, b, c, d, e) must continue to waver between them, never coming to any final conclusion. The important point, of course, is

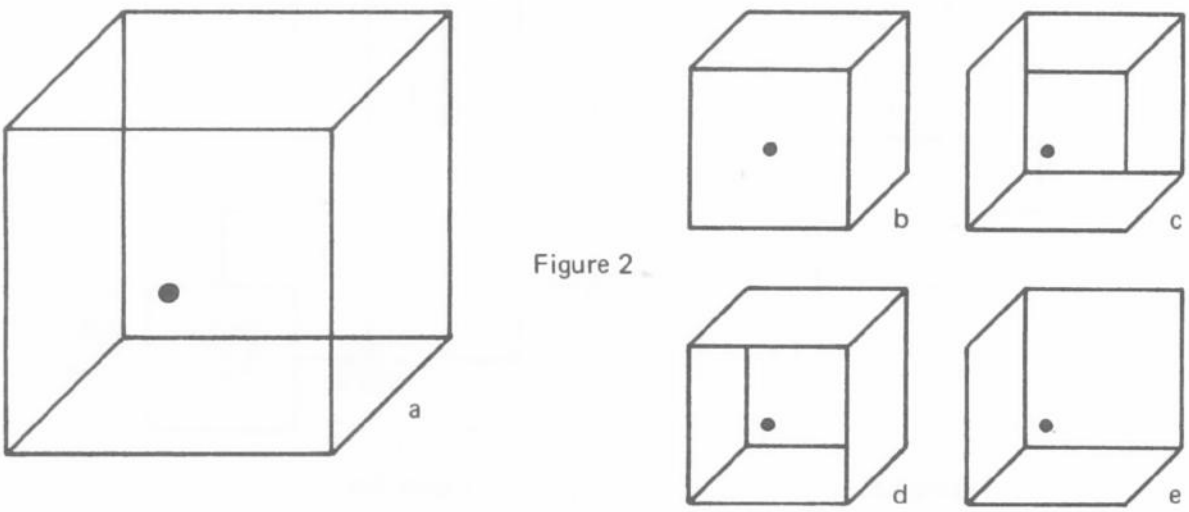


Figure 2

that the drawing — and hence the retinal stimulus pattern — is constant; the conflict arises in the process of interpretation. There is yet another, 5th interpretation of this figure, which, as it were, has the final say. This is the recognition that we are looking not at an extraordinary cube which has the disconcerting habit of existing in different locations without moving, but at a two-dimensional line drawing on a plane surface. It is only this view, whereby the object ceases to be ambiguous that enables us to correlate the experience with our general understanding of the world. For the world itself cannot be ambiguous; only descriptions or representations of it can be ambiguous. This is sufficient reason to regard perceptions as descriptions or hypotheses.[3]

This conception of the perceptual process is not new, since the pioneering work of Helmholtz[4] introduced the term "unconscious inference" in 1867, but:

"Until recently the notion of unconscious inference seemed to many psychologists to be self-contradictory — as it used to be assumed that consciousness is necessary for inference to be possible. Perhaps . . . through the influence of computers (for no one regards them as conscious though they are capable of at least some kinds of inference) this objection no longer has force. To hold that "unconscious inference" is a self-contradictory notion now appears as mere semantic inertia."[5]

Perception, then, is not a simple reflective process of "direct intuition", but the result of inferences based on the available data which in turn is derived from sensory stimulus patterns. By referring to perceptions as "hypotheses" we may observe a strong analogy (perhaps more than merely analogy) between how organisms infer a practical knowledge of the world from sensory data, and how science infers a practical knowledge of the world from experimental data. I would suggest that it is possible to entertain this view without in any way over-estimating the authority of scientific enquiry, since it is possible to argue full-circle and see science as a rationalized extension of our innate processes of perception.

Gregory[6] has drawn attention to a number of factors which are common to both scientific hypothesizing and to perception, giving considerable weight to the argument that we might employ our knowledge of the rationale of science to investigate the processes of perception. It is not without significance that the revolutions which occurred ±1960, in both scientific theorising and in perceptual psychology, had their roots in a common realisation. Previously it had been assumed that scientific theories and instrumental observations reflected the order of the world as it actually exists. Similarly, perceptions were assumed to reflect the concrete world of objects as they actually exist; such an assumption formed the cornerstone for the whole edifice of Empiricism. Gradually there developed an awareness that neither scientific theory nor even perceptions

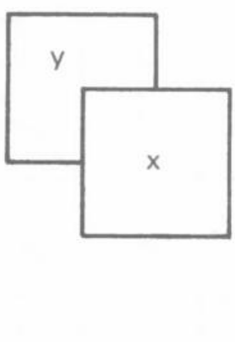


Figure 3.a

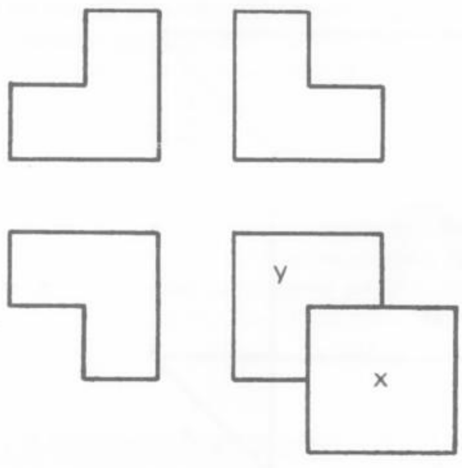


Figure 3.b

could be regarded as reflections of structure existing "in reality", but that they were paradigms, useful in proportion to the degree of successful interaction they allowed with the environment.

In 1962, Thomas Kuhn[7] described science not as a cumulative, objective progression toward truth, but as an invention of paradigm structures which are progressively more complex than those they usurp, but which are not any closer to the ideal of objectivity. The concept of perception as a process of inferring usable information from the interpretation of sensory data, was developed by the Transactional Psychologists during the late 50's and early 60's. According to Kilpatrick, inference proceeds on the basis of assumptions about the probable import of sensory data. An assumption may be described as a weighted average of past experience in relation to a particular context. Assumptions are built up according to "functional probabilities", i.e., the probable significance for action of a particular stimulus-pattern, built upon past actions, checked by action, and modified as the consequences of these actions are registered in relation to purposes. The sum total of all our assumptions together form our "assumptive paradigm" of the world; a kind of working mental model of how we believe the world to be. This assumptive paradigm provides a complexity of interrelated generalisations which are not dependent for their operation on any specific situation. Our picture of the world, then, provides whatever constancy and continuity there is in our experience.

Although, as Andrew Forge has pointed out,[8] our perceptions are shaped by the scientific view of the world, the process is not merely a one-way transition from scientific theory, to paradigm, to a new awareness. For though it may be true that we see what we believe, the acceptance of new paradigms, at least in a more profound sense depends on believing what we see. Art has the power to make us see ideas, and by transforming our awareness, not only enriches our seeing, but makes us see ourselves and our relationship to the world in a new perspective.

PART 2: THE DRAWINGS

It would be possible to show the connections between the ideas outlined above, and the work that I had been doing in the studio even before 1977, although at the time my approach was more oblique and intuitive. Since that date the development of ideas, and their reification as artifacts has increasingly been guided by a more conscious consideration of the implications each has for the other. It would be wrong, however, to assume that the creative process is anything like as straightforward and deterministic as the present retrospective description may suggest.

The drawings shown here resulted from a consideration of 3 main factors:

Ambiguity or indeterminacy
Abstraction
Overlay

Figure 4

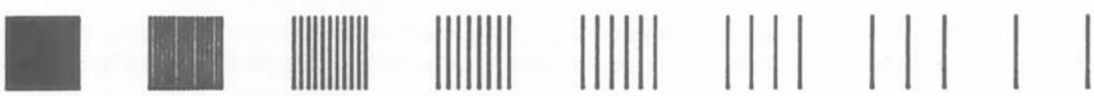


Figure 5

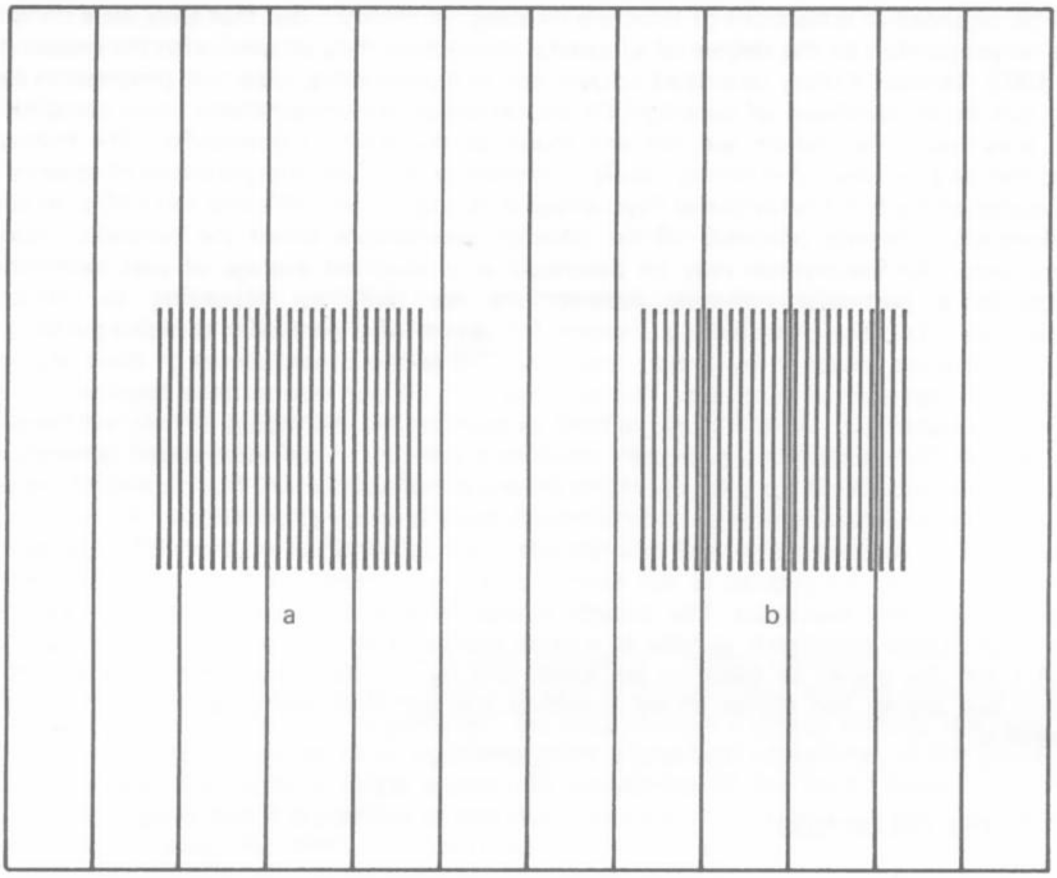


Figure 6

I had been much impressed by Ames' Chair Demonstration, described above, and became interested in realising structures whose interpretation would be indeterminate; that is to say, they would present probabilities rather than certainties. Consequently I sought a way of making ambiguous 2D images, whose ambiguity did not rely on, and was thus not limited by, geometry or isometric projection.

The second requirement, abstraction, is an optimum condition for investigating the processes of perceptual interpretation, without confusing the issue with all the other factors that allow us to identify objects with established identities. Here it was necessary to begin with two-dimensional visual stimuli that were not projections of previously known unique real objects. [9]

The third factor arose out of the need for a connection with some aspect of the appearance of objects, otherwise the incentive for, and the possibility of, interpretation, would be negated, or at most occur only by chance in an uncontrolled way. One such possible connection is provided by "depth cues", such as overlay, texture-density gradients, relative size, linear perspective, illumination direction, etc. Artists have, of course, for centuries used these depth-cues in representing the appearance of the phenomenal world, but in our own time they have become the subject of much research by perceptual psychologists. The isolation of an individual depth-cue allows a high degree of control over relationships operating within the visual display, without pre-determining or suggesting any references to the identity of unique real objects.

Overlay is perhaps one of the less complex depth-cues, and may be rendered quite effectively in two-dimensions by simple line-drawings. However, the very effectiveness of such economical closed figures allows few possibilities for interpreting them in more than one way.

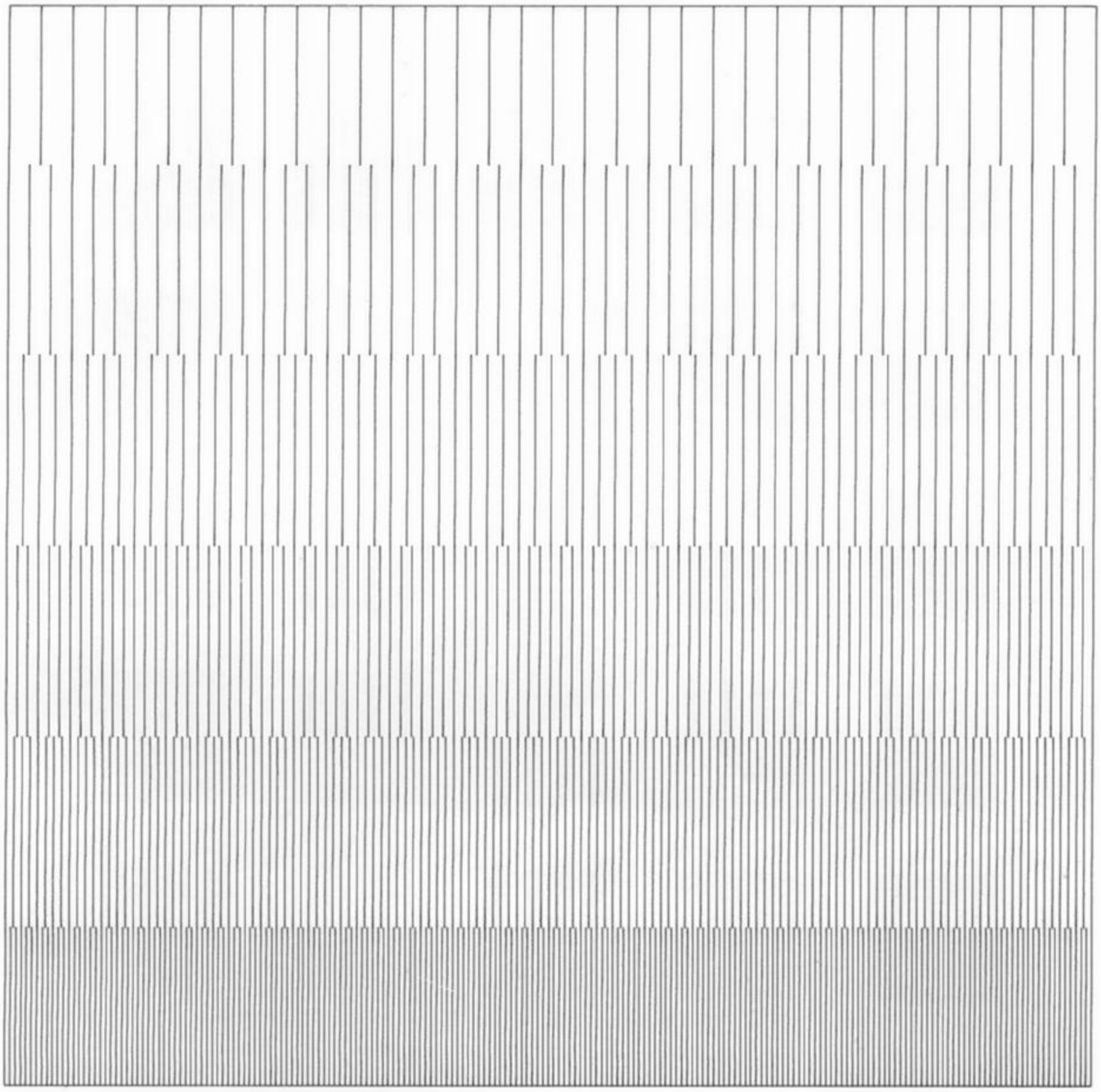


Plate 1. STOS38: "Ground" only

As illustrated in Figure 3.a, the probability of (x) being located anywhere other than in front of (y) is so loaded that quite complex strategies are necessary (Figure 3.b.) in order to achieve a situation that could be called ambiguous.

To avoid the limitations imposed by the closed figure, the same area may be indicated by a series of parallel lines. (Fig.4). This arrangement has a great degree of versatility. One might describe it by analogy as standing in relation to the closed figure rather like an infinite grey-scale in relation to black and white. (Fig.5). Taken in isolation, its propensity for suggesting a unified figure increases in inverse proportion to the distance between the lines. The use of this basic motif to suggest "figure-ground" relationships immediately gave some interesting results in the context of overlay. (Fig.6).

In figure 6, (a) is interpreted as an opaque square overlaying a ground of lines. (b) is interpreted as either being behind a grill, or as a transparent plane. The number of lines making up the square, and the intervals between them, are the same in both squares. Their difference is the result merely of their placing on the "ground".

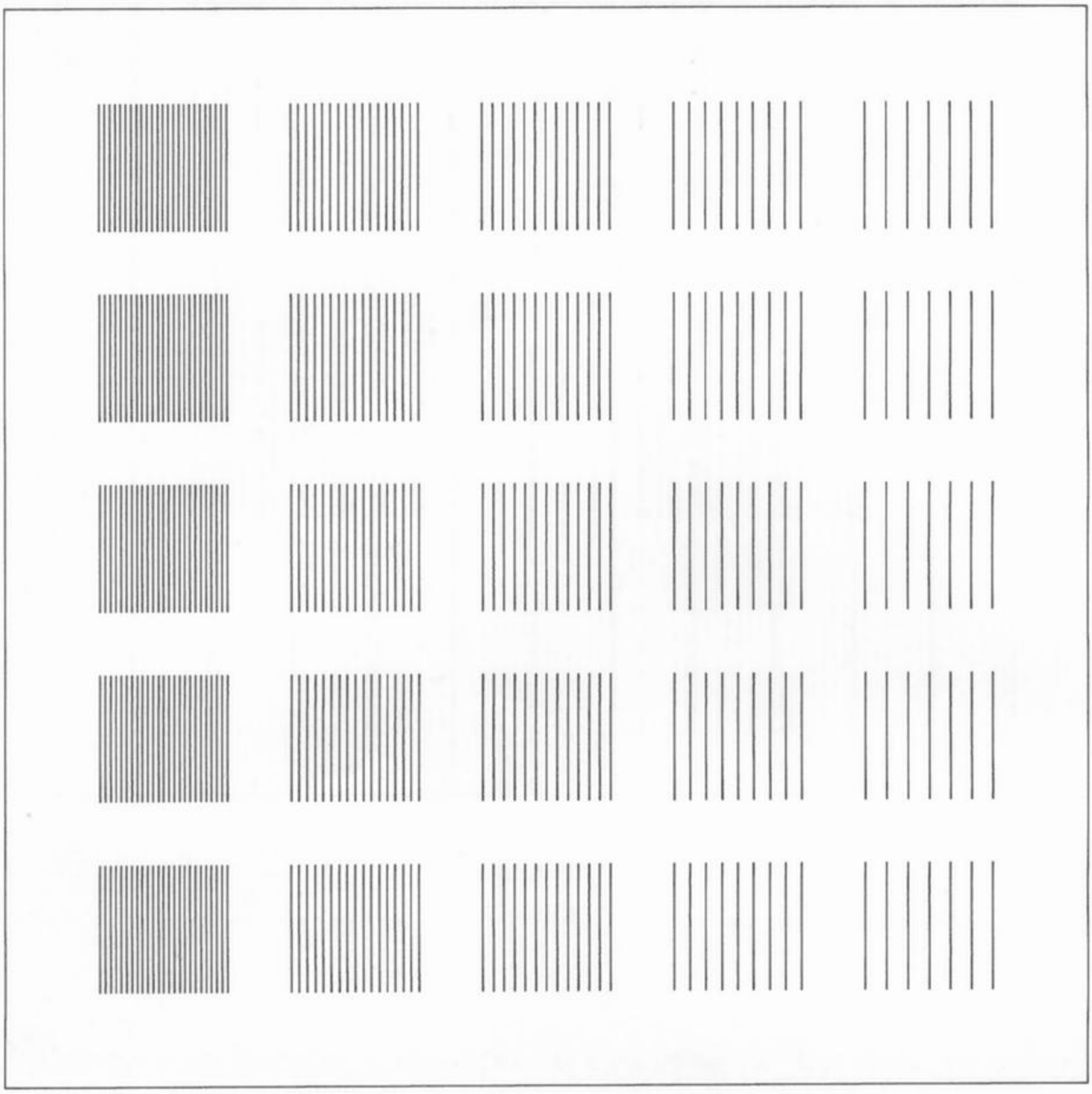


Plate 2. STOS38: "Overlay" only

From this germinal situation the "STOS" series of drawings developed. "STOS" being a mnemonic for "SOLID/TRANSPARENT OVERLAY STUDY", used as a file-name for a series of computer programs. The drawings are essentially composed of two parts, the "ground" and the "overlay". The "ground", shown in the Plate 1, consists of six rows of parallel lines. In each row, the interval between the lines is constant, and bears a mathematical relationship both to the intervals in all the other rows, and to the overall area of the picture.

The "overlay" (Plate 2) consists of a matrix of 25 groups of parallel lines, whose intervals are related to, but independent of, the intervals of the "ground". In the matrix, groups in the same column are identical, whilst intervals increase from left to right.

As the structure developed, additional constraints arose out of the procedure itself. A mathematical constraint was imposed by the need for a common denominator between all the intervals in the series. Optically, the chief considerations were to maximise the occurrence of diversity in, for example, weight, texture, tonality, density, and to minimize optical side-effects, such as retinal-overstimulation and after images reminiscent of Op-Art.

Plate 3 shows a completed drawing, which results from the superimposition of the "ground" and "overlay" shown in Plates 1 and 2. Where the lines of the matrix co-incide with those of the

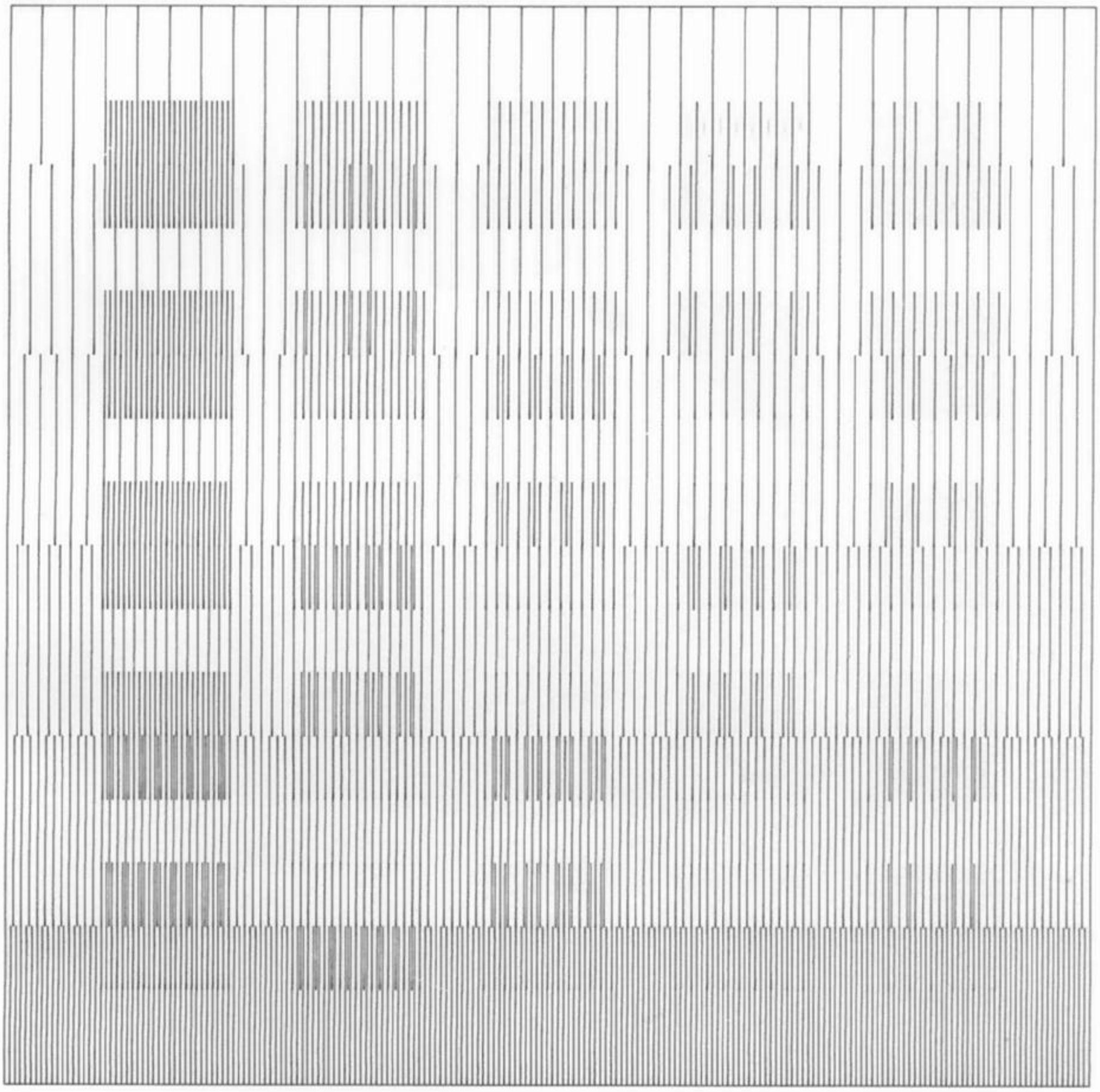


Plate 3. STOS38 Computer-assisted drawing 398mm x 398mm Dominic Boreham 1978

"ground", they merge with the ground, only revealing their presence on closer inspection. All of the information explicitly presented in Plates 1 & 2 is therefore recoverable in the final drawing. This relativistic structure, formed by the interaction of two distinct ordering procedures, has its own structural relationships which operate on a different level from the simple intervalic relations of the substructure. As the intervalic structure is organised according to a gradient, there is no sharp distinction between that which is interpreted as material, and that which is interpreted as line. The interpretation of groups of lines at top left as square forms overlaying a striped ground, has a feeling of certainty about it which rapidly diminishes with regard to the other groups, as the eye travels towards the right or downwards. Nevertheless, the probability for this assumption is strongly biassed by the regularity of the matrix, which retains a formal integrity. The uncertainty of the interpretation, whether as line or as material, is matched by the uncertainties of the square forms as planes – are they opaque or transparent, in front of the "ground" or behind it; or do they exist at all?

Dominic Boreham, 1979
Slade School of Fine Art
University College London

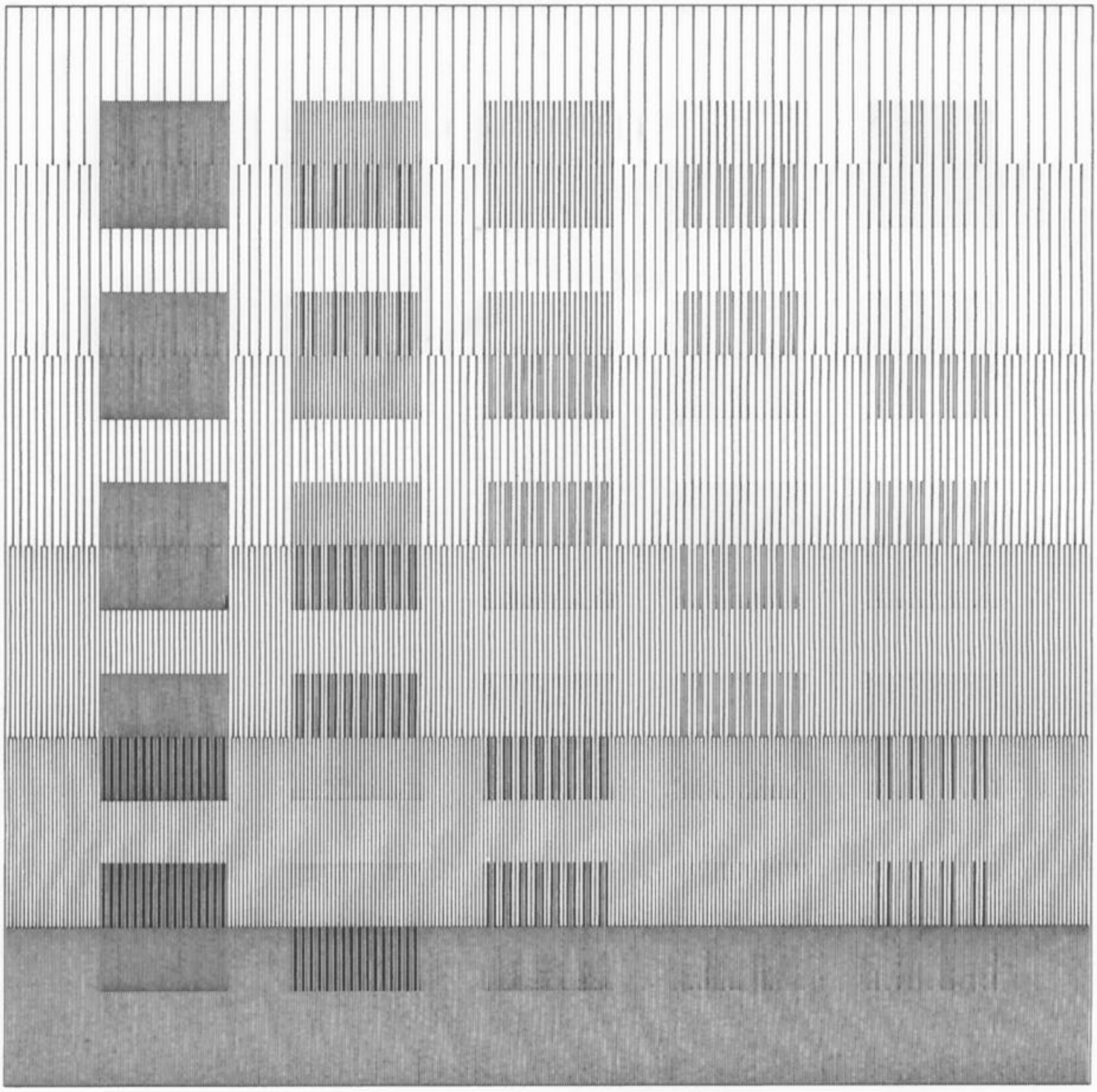


Plate 4. STOS43 Computer-assisted drawing 398mm x 398mm Dominic Boreham 1978

NOTES

1 Colin Blakemore: *The Baffled Brain,* in: *Illusion in Nature and Art,* Duckworth, 1973, p.35. (Drawing by Dominic Boreham: "Müller-Lyer with ruler.")

2 For constructional details see: William H. Ittelson: *The Ames Demonstrations in Perception,* Princeton University Press, 1952, pp. 26-29 For theoretical implications see: F.P. Kilpatrick: *Explorations in Transactional Psychology*, New York University Press, 1961.

3 See: R.L. Gregory: *The Intelligent Eye,* Weidenfeld and Nicolson, 1975, pp. 56-60.

4 Hermann von Helmholtz: *Handbuch der Physiologischen Optik,* Leipzig, 1867.

5 R.L. Gregory: *The Confounded Eye,* in: *Illusion In Nature And Art,* Duckworth, 1973, p.51.

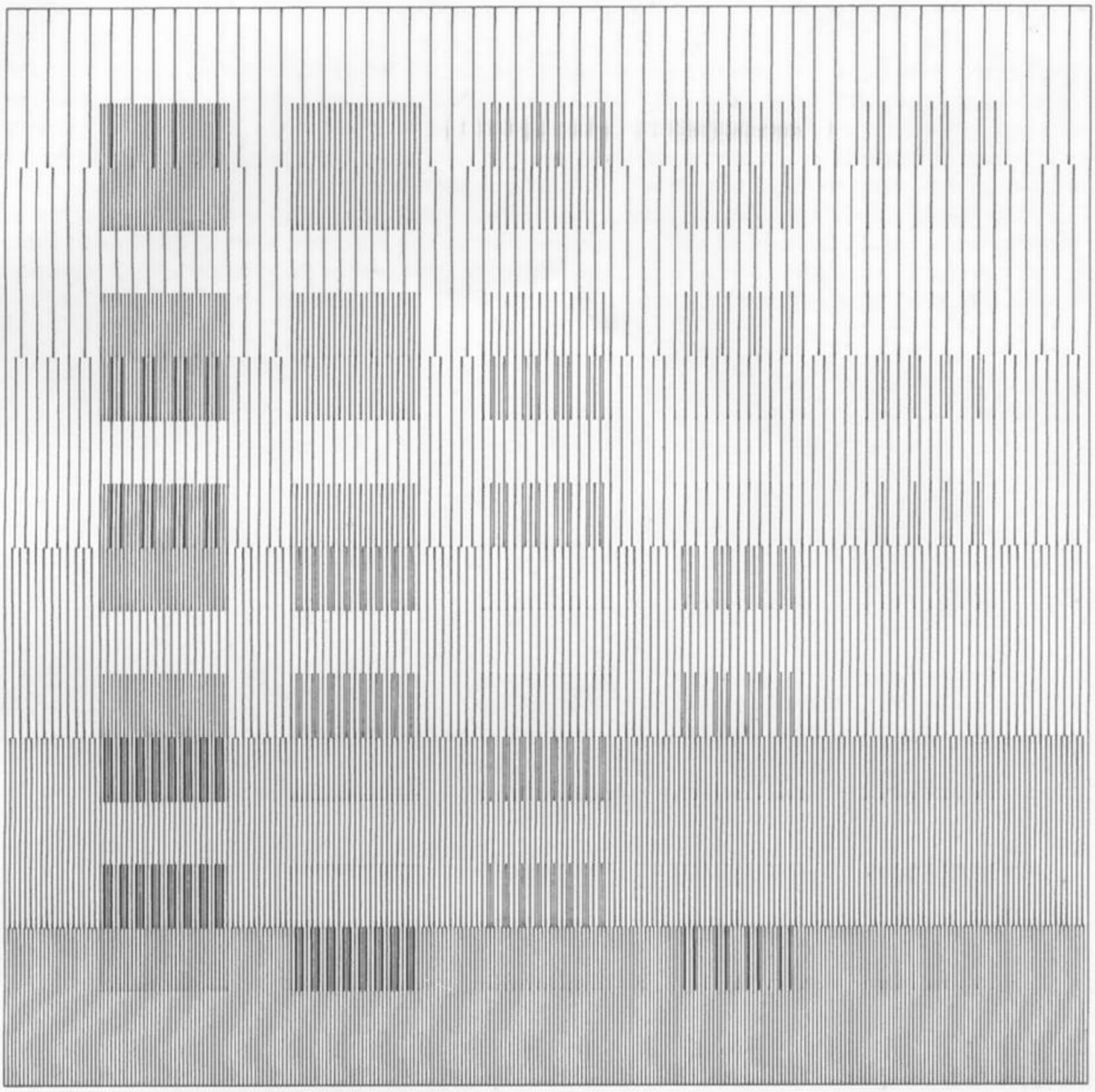


Plate 5. STOS53 Computer-assisted drawing 398mm x 398mm Dominic Boreham 1978

6 *Ibid.*, pp. 61-69.

7 Thomas Kuhn: *The Structure of Scientific Revolutions,* International Encyclopedia of Unified Science, University of Chicago Press, 1962.

8 Andrew Forge: *On Kenneth Martin's Writings,* in: *Kenneth Martin,* Tate Gallery, 1975, p.8.

9 This assertion is supported by experiments such as Ames' "Thereness – thatness Table", which showed that objects which do not have standard sizes, such as stars, blurrs and lines, cannot be located in space with the same accuracy as familiar objects which have standard sizes. See Kilpatrick, pp. 49-57.

PAGE 43 SPECIAL ISSUE

The Society will hold their second annual exhibition at the BCS80 Computing Fair in January. To co-incide with this event, PAGE 43 will be published as a special edition. The issue will be devoted to statements (both artistic and verbal) by those involved with computing in the arts. It is hoped to include all the artists who have made a significant contribution to the state of the art, and/or who wish to make a statement of their position, beliefs, etc.

PAGE 43 will therefore document two main areas, encompassing an international survey of contemporary computer-assisted art, and a statement of the attitudes, aims and beliefs of those actively engaged in creative computing today. Anyone who wishes to contribute to this edition is invited to send typescripts and photographs to the Editor by 30 September 1979.

CONTRIBUTIONS TO PAGE

Articles, papers, news, reviews, pictures, should be sent to the PAGE EDITOR. Copy should be typewritten. Photographs should be of good quality, high contrast, and preferably the actual size intended for publication. A4 pages will be layed out with 1 inch margins, leaving a maximum size for photographs of 6¼ x 9¾ inches. Please document photographs clearly on the reverse, with author, title, subject, etc., and indicate which way up they should be. PAGE is printed on A4 paper in Univers.

Contributions for PAGE 43 must reach the Editor not later than 30 SEPTEMBER 1979.

AIMS AND MEMBERSHIP

The Society aims to encourage the creative use of computers in the arts and allow the exchange of information in this area. Membership is open to all at £2 or $5 per year, students half price. Members receive PAGE four times a year, and reduced prices for the Society's public meetings and events. The Society is a Specialist Group of the British Computer Society, but membership of the two societies is independent.

Libraries and institutions can subscribe to PAGE for £2 or $5 per year. No other membership rights are conferred and there is no form of membership for organisations or groups. Membership and subscriptions run from January to December. On these matters and for other information write to John Lansdown or Kurt Lauckner (U.S.A.)

COMPUTER ARTS SOCIETY ADDRESSES

Secretary: John Lansdown, 50/51 Russell Square, London WC1B 4JX

PAGE Editor: 42 Glisson Road, Cambridge CB1 2HF, England.

Dutch Branch (CASH): Leo Geurts and Lambert Meertens, Mathematisch Centrum, Tweede Boerhaaverstraat 49, Amsterdam, Holland.

US Branch (CASUS): Kurt Lauckner, Mathematics Department, Eastern Michigan University, Ypsilanti, Michigan, 48197, U.S.A.

LONDON MEETINGS

7.30pm on the 1st Monday of each month at John Lansdown's office, 1st floor, 50/51 Russell Square, London WC1. Members and guests welcome. No charge.