spatial discordance of vision in relation to the other spatial senses (intersensory discordance), (iii) the unusual motion parallax on moving the head, and (iv) disturbances of behavior associated with those objects which normally maintain a constant orientation to the observer (behavioral polarity).

The technique of reversing or inverting the visual array as used by Stratton, Ivo Kohler, and others produced all these disturbances at the same time, making definite conclusions impossible. The recent trend has been to isolate each component and to use behavioral measures rather than observations.

Irvin Rock has been in the forefront of recent work in this area and has now produced a thorough and lucid review. Rock directs his attention to "the problem of how things appear, both before and after prism adaptation." His theory is that memory traces relate the orientation, size, and shape of proximal stimuli to the appearance of objects. Adaptation or recalibration of these systems occurs when a subject wearing the distorting device is allowed (a) sight of his body, (b) movement, (c) sight of familiar objects.

This emphasis on appearance has, in my opinion, sometimes led Rock astray. He does not clearly set out the various behavioral consequences and behavioral measures of visual distortions, and the very title of the book implies that perceptual or phenomenal changes are the one and only problem. Rock ignores behavioral polarity; he writes that "the strangeness or unfamiliarity of objects or of the entire scene is not the issue. The issue is egocentric orientation. . . . With sufficient experience, familiar objects would undoubtedly cease appearing strange, but this does not imply a righting of the scene" (p. 64). But the strange appearance of things must be behaviorally defined and measured to have meaning, and Rock himself discusses how this can be done, for instance by recording the subject's responses to the letters M and W or to ambiguously oriented shapes such as the Schröder staircase. The changes which these sorts of behavior indicate are just those that most people would refer to as "righting of the scene." In any case, there is no reason for considering these problems less important than that of egocentric orientation. Indeed, apparent egocentric orientation is not a distinct category, for it may be defined in terms of visual-motor and intersensory behavior.

Rock's theory of orientation- and size-specific memory traces is best suited to deal with behavior associated with objects having a normal orientation and size, for this must surely be learned. It is more likely than Rock seems to suppose that visual-motor and intersensory coordinations (of which egocentric orientation is an example) are largely built into the organism. This is certainly the case in submammalian species. All animals must be capable of some modification of their coordinations, for they would otherwise be incapable of adapting to changes in the size of their own growing bodies, but this fact is not incompatible with the idea of a basically built-in system. The fact that human beings can learn to grossly modify this basic system does not prove that it was originally learned. It is more likely that this learning depends upon the control of basic mechanisms by higher-order cortical mechanisms.

The chapters on adaptation to altered image size and distortion of form are particularly valuable because much of the material has not been previously reviewed. I find the analysis of straightness and the relationship between Gibsonian adaptation and movement-induced adaptation to distorted shape especially useful. The book as a whole is a valuable discussion, and while the theoretical treatment may not always satisfy those who seek a "harder" behavioral approach, all must agree that Rock has given us many new theoretical insights into one of the most difficult questions in psychology.

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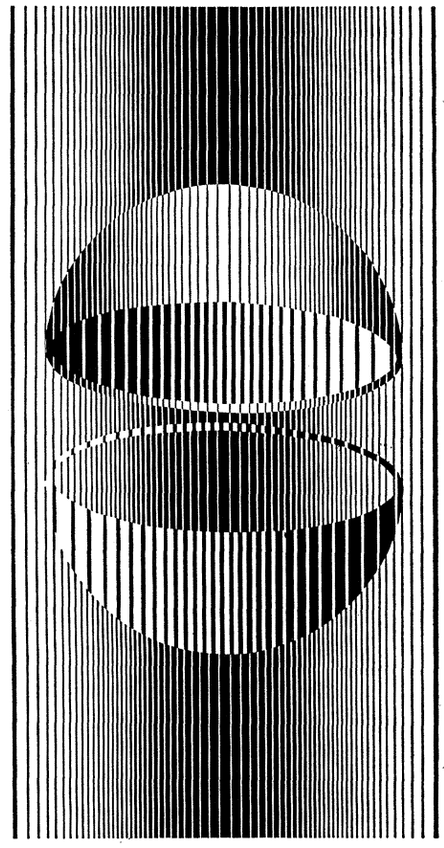
Tricks of a Trade

Optical Illusions and the Visual Arts. RONALD G. CARRAHER and JACQUELINE B. THURSTON. Reinhold, New York, 1966. 127 pp., illus. $7.50.

This book, described as "a creative guide for artists, designers, photographers, teachers, and students," consists of over 100 illustrations and virtually no text. The illustrations are well printed in black and white. They include examples of the traditional distortion illusions; op art pictures, notably ones by Bridget Riley and V. Vasarely with various repeated line effects; ambiguous figures open to alternative perceptual interpretations,



"Conics." Serigraph by Ronald G. Carraher, 1965. "Fascination with this form is related to gradient patterns and the role such unit structures have in creating an illusion of the third dimension. A bowl shape within a system of graduated lines is inverted and reversed to suggest both a solid and a void." [From *Optical Illusions and the Visual Arts.*]

reaching the greatest sophistication in the work of M. C. Escher, represented by one example; and numerous very striking commercial designs. Among the more interesting examples are normal photographs, especially one of contour ploughing in which the curved parallel lines seem to undulate above the field and off the page of the book.

The authors' intention was evidently to produce a portmanteau of visual effects for the benefit of artists and designers; the book is not aimed at scientists interested in the reasons for disturbances of the visual system. Explanations are not attempted, and no references are given to the experimental literature, which is in fact large and in places worthy of consideration. The lack of text is unfortunate, for there is a strong current movement in art schools to consider the underlying processes of visual perception and not to be content simply with learn-

ing in an *ad hoc* manner which techniques and tricks of the trade can produce various effects. There is indeed some return to the Renaissance attempt to understand the techniques of art in physical and biological terms, which we find in Leonardo's notebooks and which could surely be greatly extended with present knowledge of physiological optics. The modern founder of physiological optics, Hermann von Helmholtz, himself wrote some too-little-known essays on the subject a century ago. The present book does not reflect the current intellectual interest in art or help the student to understand what he is doing when he titillates the eye to divert the mind.

Nevertheless, it is a nice collection of examples and well produced. No text is better than a poor one—provided the total absence of explanation does not lead students to assume, wrongly, that visual illusions are necessarily beyond the province of scientific explanation.

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An Ontological Debate in Logic

Selected Logic Papers. W. V. QUINE. Random House, New York, 1966. 260 pp., illus. $6.95.

The Ways of Paradox and Other Essays. W. V. QUINE, Random House, New York, 1966. 268 pp. $6.95.

Willard Van Orman Quine is the distinguished Harvard logician and philosopher who for more than a generation, and in prose as fresh and provocative as it is precise, has contributed fundamentally to the substance, the pedagogy, and the philosophy of mathematical logic. Modern logic and set theory are significantly the richer for his influential 1937 paper "New Foundations for Mathematical Logic" and his treatises *Mathematical Logic* (1940; revised, 1951) and *Set Theory and Its Logic* (1963). To these must be added the many papers that have appeared in such technical periodicals as the *Journal of Symbolic Logic*, the inaugural issue of which (March 1936) opened, appropriately enough, with a paper by Quine. Instructors in logic, and particularly those of us who are logic teachers rather than logicians, continue to learn as well as to teach from his introductory text *Methods of Logic* (1950; revised, 1959) and from his simplified survey *Elementary Logic* (1941; revised, 1965). Finally, Quine easily counts, along with Rudolf Carnap, as one of the dominant figures in contemporary philosophy of logic. No writings in this area have been more widely cited, quoted, attacked, defended, and anthologized than Quine's "On What There Is" (1948) and "Two Dogmas of Empiricism" (1951), reprinted with other essays in the philosophy of logic and language as *From a Logical Point of View* (1953; revised, 1961). And his *Word and Object* (1960), a full-length study of the notions of meaning and reference, is a basic addition to the literature of semantics.

The two newest Quine volumes assemble 40-odd papers and essays hitherto lodged in several dozen scattered journals and books of the period from 1934 to 1964. About half are technical. Allocated to *Selected Logic Papers*, these deal mostly with sets, Boolean functions, and quantification and are best appraised by specialists in mathematical logic. This is not to say that all the papers are only of "narrow" technical interest: the collection includes Quine's "Whitehead and the Rise of Modern Logic" (1941), with its marvelously ingenious thumbnail analysis of *Principia Mathematica*, as well as his much-discussed "Frege's Way Out" (1954).

The nonspecialist, however, will find more ready sustenance in *The Ways of Paradox and Other Essays*. This volume opens with accounts of paradoxes (the title piece) and of the foundations of mathematics, which are attractive examples of the art of popularization. It ends, to quote Quine, "in an expansive mood with an essay on mental entities and three on science and reality." The central portion—three-fifths of the book—is given over to topics in the philosophy of logic, and it is to these that the following comments will be directed.

Quine has instructive things to say about a variety of problems—belief sentences (1955), modal logic (1953, 1962), implicit definitions (1964)—but his main interest focuses on two questions: logic and ontology ("what there is"), and the nature of logical truth. These, indeed, have occupied Quine greatly since the '30's and have been at the center of a protracted but inconclusive discussion between him and Carnap. The approach to ontology by way of modern logic is tested in two early short essays (1934, 1939), the second of which contains Quine's famous dictum: to *be* is to be the value of a variable. In a third essay, "On Carnap's Views on Ontology" (1951), Quine succinctly and deftly presses the dialogue with Carnap in an effort to "isolate and reduce our divergencies."

The substance of the controversy, briefly and very roughly, is this. In "On What There Is," Quine had argued that adoption of a theory (or a language) commits us to those and only those entities (things, classes, numbers, and so on) "to which the bound variables of the theory must be capable of referring in order that the affirmations made in the theory be true." This is the sense of the formula that to be is to be one of the values of a quantified variable belonging to a given theory. By the values of a variable Quine means, of course, the *individuals* over which the variable ranges and not, as Gilbert Ryle seems to have supposed, the *expressions* that denote these individuals and that we substitute for the variable; Quine did not assert that the only things there are are expressions. His formula, moreover, is intended to tell us not what there is, but simply what a theory says there is. Where rival ontologies compete for our favor, the choice, according to Quine, can only be a pragmatic one. And since, in his view, this is also true of scientific questions generally, questions of ontology are thus on a par with questions of science.

By contrast, Carnap, in his widely