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

read paper "Empiricism, Semantics, and Ontology" (1950), had maintained that the acceptance of a "linguistic framework" does not involve any ontological commitment. In support of this position, he had introduced a distinction between two kinds of questions of existence. Internal questions of existence ("Are there prime numbers above a hundred?," "Are there unicorns?") are meaningful and are settled by logical or empirical inquiry, depending upon whether the framework is formal or factual. External or "ontological" questions ("Are there numbers?," "Are there things?") are not real questions at all but, as the Vienna Circle had contended two decades before, are strictly meaningless. The selection of linguistic frameworks is a practical question, then, rather than one of theory. Thus what is "pragmatic" for Carnap is not the choice of ontologies but the choice of frameworks.

A year later Quine replied. He pointed out a number of obscurities in Carnap's internal-external dichotomy and concluded that the distinction was of no use whatsoever. Besides, he noted, it was unnecessary. Welcoming Carnap's "pragmatic" approach to the problem of choosing linguistic frameworks, Quine suggested that all that was really needed was for Carnap to cast the protective mantle of his "pragmatism" over ontological and scientific questions as well. The suggestion, needless to say, was not adopted.

Quine's case has seemed rather persuasive against the devices marshaled by Carnap in his renewed rejection of ontology. But since Quine's own pragmatic ontology is still to be presented in a comprehensive and explicit manner, the debate has remained inconclusive. It is therefore good to learn that the inquiry and the dialogue continue: in March of this year Carnap lectured at the University of Hawaii on the subject "Semantics and Abstract Entities," and at Princeton in the same month Quine read a paper which bore the working title "Existence and Quantification."

Thus far Quine has had a slight edge, perhaps, in the argument over ontology. As to the problem of logical truth, however, there is some question. Here the relevant material includes two lengthy essays, "Truth by Convention" (1935) and "Carnap on Logical Truth" (1954), a short general statement "Necessary Truth" (1963), and a brief but sharp treatment in "Mr. Strawson on Logical Theory" (1953), which is Quine's review of Peter Strawson's *Introduction to Logical Theory* (1952). The 1935 paper foreshadows the main points of controversy. It questions the sense, if any, attaching to the common assertion that mathematics and logic are "purely analytic or conventional," in contrast to the physical sciences with their supposed "non-conventional core of doctrine." It suggests that the real contrast is only that between more or less firmly accepted statements.

The issue with Carnap over logical truth is directly joined in "Two Dogmas of Empiricism" (1951). One dogma is the empiricist belief in a "fundamental cleavage between truths which are *analytic*, or grounded in meanings independently of matters of fact, and truths which are *synthetic*, or grounded in fact." The empiricist characterizes a sentence as analytic if it either is a logical truth or becomes one when synonyms replace synonyms. To this Quine objects that synonymy is as much in need of clarification as "analyticity." He then enters similar complaints about Carnap's alternative accounts of analytic sentences. Thus, according to Quine, the analytic-synthetic distinction fails, and with it the attempt to draw a sharp boundary between the (formally) analytic truths of logic and the factual truths of empirical science. The difference is one only of degree, and "turns upon our vaguely pragmatic inclination to adjust one strand of the fabric of science rather than another in accommodating some recalcitrant experience."

The fullest account of Quine's view of logical truth occurs in his extremely interesting 1954 essay on Carnap, first published complete in English in 1960. This paper is a sustained attack on what Quine calls "the linguistic doctrine of logical truth." He rests his own notion of logical truth on the concept of logical particle (such as "not," "and," "all") and on the general notion of truth. Accordingly, logical truths are true sentences that involve only logical particles essentially, the latter thought of as being given in some enumeration. He then seeks to show that such truths (whether the word "logical" is confined to elementary logic or is extended to embrace set theory) are no more "true by convention" than are the hypotheses of natural science. Both involve choice, both involve "confrontations" with experience however indirect or remote. Hence no sharp line can be drawn between them. Short of *all* truths being true by convention, none are. Thereafter, Quine reviews and finds unavailing Carnap's various attempts to characterize logical truth first syntactically and later semantically. Again rejecting the analytic-synthetic dichotomy, Quine closes with:

> The lore of our fathers is a fabric of sentences. . . . It is a pale gray lore, black with fact and white with convention. But I have found no substantial reasons for concluding that there are any quite black threads in it, or any white ones.

It is not likely, however, that the last word on analyticity and logical truth has been said. Has Quine really succeeded in showing that "analytic" truths do not differ in kind from empirical ones? Is the difference between "All black dogs are black" and "Some dogs are black"—to use Carnap's example—only one of degree? And if so, what are we to understand by "degree"?

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Without Benefit of Computer

Thought and Choice in Chess. ADRIAAN D. DE GROOT. Translated from the Dutch edition (Amsterdam, 1946). Basic Books, New York, 1966. 479 pp., illus. $10.50.

Here is a translation of a book written in the early '40's by a Dutch psychologist working within a framework created by a German psychologist, Otto Selz, whose work was published in the early '20's. Can it be relevant to living science, *anno* 1967? The answer is yes, and thereby hangs partly a minor tale in the history of psychology but mostly a tale of the viability of data when the time is ripe.

To the minor theme first. Written as history a science gives the appearance of orderly movement performed to a stately dialectical minuet. Prior to the turn of the century psychology emerged from its subordination to philosophy. It was experimental, viewed itself as the science of the contents of the mind, and held to a theory of the association of ideas. Then occurred the reactions. Behaviorism kept the mechanistic flavor but rejected the mentalism, especially the use of introspection as an experimental technique. Gestalt theory, contrariwise, rejected the mechanistic analysis. This makes a rather pat picture of German and American psychology. But