period of excavation it was observed that the two "pits" would join. The one to the west (started as pit 61) seemed to be a series of connected pockets, varying in cubic contents from 1 to 10 yards, connecting in turn (to the east) with a fairly continuous deposit some 15 feet in diameter which formed the major portion of the excavation originally called pit 67. Adjacent to and southeast of this major section of pit 67, the matrix was fossiliferous but broken by blocks of hardened asphalt that may, according to the field notes, have caved in from the banks in past times. At least 13 of the approximately 17 artifacts recovered from pit 61–67, and a great variety of shells, were found in a strip about 30 feet long by 3 to 6 feet wide, at depths of 11 to 18 feet, in this latter portion of pit 67 and its extension into pit 61. In recording the occurrence of the artifacts and shells, the field notes include the following comment under date of 26 April 1915: "There is in this a suggestion that an Indian camp was once located very close to this spot."

The artifacts are listed and discussed by Woodward (*9*). He found that the bulk of them correspond to artifacts known from Indian sites in southern California dating into the historical period. Four of them (all wooden), however, suggested an earlier culture, not previously recognized in southern California. These consist of a bunt foreshaft for an atlatl dart and three atlatl dart foreshafts. It was a section of one of the latter that was tested at the La Jolla Laboratory as sample No. LJ 121 and dated 4450 ± 200 years B.P.

Although scattered fossils were found near the artifacts, the contemporaneity of artifacts and fossils has always been questioned. In the first place, the whole south portion of the excavation was subject to such frequent crumbling and caving-in that one is inclined to question the validity of grid and depth notations for materials from this area. Furthermore, the irregularity of the matrix in this southeast portion and the occurrence of numerous pockets throughout the entire pit 61–67 deposit suggest that this area was extremely unstable over a long period of time and that there was probably considerable intermittent activity.

The appearance of new surface vents of tar is, even today, characteristic of the entire Hancock Park area. These vents represent chimneys formed by gas pressure from subterranean petroleum deposits. As they enlarge, they can become channels for conveying surface materials downward as well as for bringing tar upward. In some of the excavated deposits, "chimney" accumulations could be detected from the character of the matrix. It is, therefore, possible that vents occurred beside or through the ancient pit 61–67 deposit at a somewhat later time. The presence of large chunks of hard material intermingled with softer matrix in the southeast section suggests, further, that a fracture of some extent may have existed, causing the edges of the banks to crumble and fall as they were undermined by fresh tar or weakened by heavy rains. These observations, together with the comparatively recent date now recorded for one of the artifacts, substantiate our previous contention that the artifacts and fossils in pit 61–67 were not contemporaneous. Obviously the artifacts were not of Pleistocene age; the condition of the pit seems adequately to explain their association with fossil bones without assuming that the animals represented existed up to 4500 years ago.

From this brief discussion of two of the Rancho La Brea deposits, which have been sampled for carbon-14 dating, it will be obvious that age determination for the complete La Brea section is far from complete. It is quite possible that other samples from greater depth in pit 3, and samples of nonhuman origin in pit 61–67, will yield dates different from those yielded by the samples already tested. It is also of particular importance to obtain knowledge of the relative ages of the several other active Pleistocene pits. Wood from three of the most important of these is on deposit at the Scripps laboratory, and results are eagerly anticipated (*10*).

References and Notes

1. See C. Stock, *Los Angeles County Museum Sci. Ser. No. 1* (1930), pp. 16–20; *ibid., No. 11* (1946), pp. 13–16; and *ibid., No. 13* (1949), pp. 15–17.
2. C. Stock, *ibid., No. 13* (1949), p. 17, Fig. 5.
3. W. F. Libby, *Radiocarbon Dating* (Univ. of Chicago Press, Chicago, Ill., 1952), p. 88 (dating of wood and peat samples taken under glacial drift in Wisconsin).
4. ———, *ibid.*, p. 85 (dating of samples from Gypsum Cave, Nevada).
5. D. L. Douglas, *Gen. Elec. Rev.* **55**, 16 (1952).
6. One test was made in the center of the large tar and water lake on Wilshire Blvd., but the lake was drained first, and the hole was dug in bottom sediments. The fossils obtained were in a poor state of preservation.
7. C. Stock, *Los Angeles County Museum Sci. Ser. No. 13* (1949), pp. 18–20, 24; *ibid., No. 15* (reprint ed., 1953); *ibid., No. 20* (reprint eds. 1956, 1958).
8. E. S. Deevey, L. J. Gralenski, V. Hoffren, *Am. J. Sci. Radiocarbon Suppl.* **1**, 151 (1959).
9. A. Woodward, *Bull. Southern Calif. Acad. Sci.* **36**, 41 (1937).

10. I wish to thank Edward S. Deevey and Hans E. Suess and their associates for aiding the Los Angeles County Museum in these important tests. I am also very grateful to Carl L. Hubbs of the Scripps Institution of Oceanography, through whom the arrangements were made for the tests at the La Jolla Laboratory.

Edward Chace Tolman: A Life of Scientific and Social Purpose

The era of the grand system-builders of American psychology draws to a close with the death of Edward Chace Tolman in Berkeley, California, on 19 November 1959.

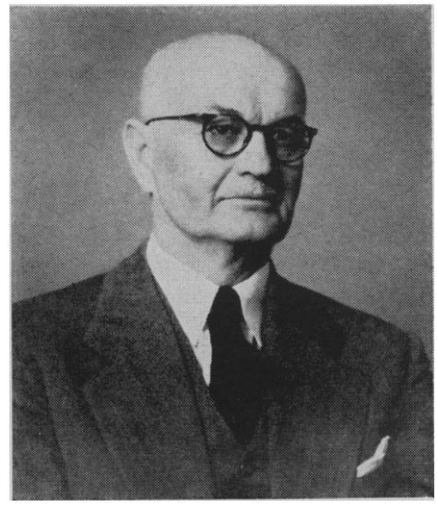
Edward Tolman was born in Newton, Massachusetts, in 1886. He graduated from the Massachusetts Institute of Technology in 1911 with a B.S. in electrochemistry. Pursuing his combined interests in science and the philosophy of human conduct, he entered into graduate study in the joint department of philosophy and psychology at Harvard. After receiving his Ph.D. in 1915 and after a brief period of teaching at Northwestern University, Tolman came in 1918 to the University of California in Berkeley, where he remained for the rest of his career. It was here that he began the experimental and theoretical work that was to continue for four decades. It is fitting that his pioneering work started when he moved West. For the characteristics of the West that he came to love—its open expansiveness, its free and stimulating spirit—also became the characteristics of his system-building.

He built on a grand scale, and the stimulating conceptions of his system, ceaselessly changing and growing over the years, have had a profound influence upon the science of psychology and upon the generations of psychologists who studied with him.

To understand Tolman's systematic contributions it is necessary to understand the state of psychology when he entered the field. There was a ferment of ideas, new "schools" of competing theory were in process of growth, the "mentalism" of traditional psychology with its insistence on the methods of introspection was under attack from several different directions, most notably by Watson's behaviorism.

The behaviorists' attempt to make the study of psychological processes into an objective science appealed deeply to Tolman. He plunged into active research on the learning behavior of the rat, but he quickly came to reject the narrow behavioristic conceptions of stimulus and response. He also objected to Watson's notion that stimulus-response connections come into being through sheer frequency of conditioning and to Thorndike's hypothesis that stimulus-response connections are explicable in terms of accidental coupling of action and "reward" (Thorndike's "law of effect").

Tolman saw that these conceptions omitted the essential core of behavior—its purposiveness. The criteria of purposiveness he took to be the persistence of behavior toward a goal and its docility (teachability) with respect to goal achievement. And it was these characteristics that he insisted on putting back into a "purposeless" behavioristic model. He sought to do this in a manner which was scientifically sound and philosophically sophisticated. What he did, in effect, was to enlarge the scope, redefine the units of analysis, and alter the experimental techniques of behaviorism. He rejected the single, elementary "muscle-twitch" (behaviorism's original unit of analysis) as an improper unit and proposed instead a larger unit of behavior in which its essential purposive nature was preserved. Stimuli he conceived of in terms of environmental objects rather than as simple sensory impressions; responses he conceived of as adaptive rearrangements between organism and environment. He introduced the term *molar* behavior to characterize these larger and more functional units, as contrasted with the narrower *molecular* behavior of the muscle-twitch.



Edward Chace Tolman

Tolman's great achievement was that he was able to do all this without in any sense regressing to the earlier "subjectivism" of psychology. What he sought were *objective* measures of purpose—that is, those dependent upon the immediate observables of behavior. Unacquainted with Bridgman's contemporary writing on operational definition in science, Tolman proceeded independently to show the value of such objective definitions in dealing with complex psychological phenomena.

This is clearly shown in his treatment of cognition. Above all else Tolman insisted on a model of an organism that thinks and adapts as it learns. He endowed the rat, no less than man, with "expectations," "hypotheses," "means-end-readinesses." But he firmly insisted that these (whether applied to rat or man) be objectively defined and objectively measured. Thus he sought, and believed that he found in his challenging "latent-learning" studies, experimental evidence that the rat in learning to run a maze is learning "what leads to what" (a "cognitive map" of the maze) and not merely acquiring a fixed set of stimulus-response "connections."

The culmination of those early years of Tolman's experimental and theoretical work came in 1932 with the publication of his monumental book, *Purposive Behavior in Animals and Men*—a book which has been described as marking behaviorism's coming of age. This book represented his first major attempt at a comprehensive system of psychology. It was unprecedented in its scope, its wealth of experimental data, and its sheer originality. Here for the first time in a single system are put forth Tolman's views on molar behavior and its purposiveness, on the cognitive nature of learning, on the multidetermination of all behavior. A scheme is offered to encompass the lines of interaction among *all* of the many types of variables determinative of animal behavior. And the concepts are extended, with the greatest of tentativeness and sensitivity, to include unique aspects of human behavior.

But because Tolman was an experimentalist as well as a theoretician, he could not write *finis* to any theoretical effort as long as new experiments were being done in psychological laboratories. In the years after 1932 he continuously revised and extended this first systematic structure. To a degree unmatched among the great systematists he open-mindedly incorporated and transmuted contributions from the most diverse psychological sources: behaviorism, functionalism, Gestalt psychology, psychoanalysis. McDougall, Watson, Thorndike, Lewin, Köhler, Brunswik, Freud—the ideas and data of all these men (not always in forms they would recognize) find their places in Tolman's systematizing. Above all else Tolman was impressed with the complexity of behavior and therefore refused to shut his eyes to any reliable data—whether from the clinic, the field investigation, or the laboratory experiment.

The flow of Tolman's theoretical papers has reflected this ceaseless innovation and growth in his thinking. A major theoretical step forward came in his introduction of the concept of intervening variables. In seeking to analyze the complex relationships between stimuli and responses he recognized the indispensability of inferring "inner" processes mediating between stimulus and response. His aim was to deal with such intervening variables with objective rigor, and this he attempted to do by first separately determining the functional relationships between the independent variables (stimulus conditions) and the intervening variables (needs, cognitions, and so on) and then, secondly, determining the relationships between the intervening variables and the dependent variable (behavior). In this way he sought to break down the complex psychological analysis into manageable experimental steps.

The extraordinary professional esteem in which Tolman was held is shown by an unending flow of scientific honors bestowed on him. He was elected president of the American Psychological Association and three of

its divisions. He was vice president of the AAAS. He was co-president of the International Congress of Psychology. He was elected to the National Academy of Sciences, the Society of Experimental Psychologists, and the American Philosophical Society, of which he was also Penrose lecturer. He received many awards, including the Kurt Lewin Memorial Award and the Distinguished Scientific Contribution Award of the American Psychological Association. A number of honorary degrees were bestowed on him.

But these honors cannot convey a proper sense of the affectionate place Tolman occupied in the minds and hearts of his students and colleagues and of psychologists everywhere. He was a rare teacher, gentle and humane, capable of instilling permanent scientific enthusiasms in his students. Yet the enduring imprint of his ideas on his students made them not into disciples (this would have been the antithesis of all that Tolman stood for as a teacher) but into independent thinkers, who spread into fields of psychology far removed from the animal laboratory. He was generous of aid and faithfully supportive in his relations with his students and colleagues. His wit, warmth, and wisdom in departmental affairs helped, over the years, to build the department at Berkeley into one of the world's foremost, a reputation inseparable from the name of Edward Tolman. No description of the growth of the department can, however, be complete without reference to his wife, Kathleen Drew Tolman, whose grace and charm contributed so much to the camaraderie of the department.

Tolman the respected scientist, Tolman the beloved teacher, and Tolman the citizen were one and the same. As one of his colleagues at the university has put it, "No man was ever less divisible." His steady faith in the scientific method led him to regard all major problems of human behavior as properly susceptible to rational study by psychological means. Thus, his life-long abhorrence of war led him as a scientist to seek to contribute something to our understanding of the psychological sources of warlike behavior. His book *Drives Toward War* (1942) was the significant result.

His firm belief in the responsibility of the scientist to participate in the affairs of the human community is manifested in his long record of dedicated liberalism in the service of civil rights and individual justice. He served for many years on the national board of the American Civil Liberties Union. Most widely known to those in academic life was his effective leadership in the loyalty oath controversy at the University of California in 1950–52. Tolman never wavered in this fight for academic freedom, and the partial victory won at Berkeley benefited the cause of academic freedom everywhere. For, as the Washington *Post* pointed out in its editorial published on his death, "The fight led by Dr. Tolman challenged and helped to arrest a dangerous trend toward forcing a stultifying conformity on teachers." Despite his difficult role Tolman retained the respect of the university as a whole. Only last year the regents of the university bestowed upon him the honorary LL.D. degree.

In Edward Tolman's own behavior at significant choice-points in life there was little evidence of the vacillation that he often found in his rats in a maze. His own behavior at such choice-points was cognitively clear and purposively directed toward the goal of truth and humanity.

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Science in the News

Committee Assesses Dangers That Accompany Government Support of University Research

The American Civil Liberties Union called recently for a nationwide review of the effect on college and university freedom of private and governmental grants for research projects. The question posed by the union in a report of its Academic Freedom Committee was this: "Is it in the interest of society to permit the universities to lose a large measure of their authority in shaping the development of their own affairs?" The report emphasizes that this is a question "of the first importance to the nation and to society, and that developments rendering difficult a wise decision are multiplying at such a rate that no time should be lost in instituting an objective review of the situation on a nationwide scale."

The ACLU committee estimates that at present two-thirds of the expenditures for all research and development performed by colleges and universities comes from the federal government and that in certain fields, such as physics and chemistry, 90 percent or even more of research budget funds are provided by government and private foundation or industry sources.

Some of the Problems

These are some of the problems touching on academic freedom that are discussed in the Civil Liberties Union statement:

1) ". . . The application of government security procedures in universities in which classified research is conducted on campus under contracts with federal agencies can lead to situations in conflict with the personal rights of faculty members, including even those who are not engaged in classified research, and can effectively limit the freedom of the university in applying its own proper criteria in the selection of its staff."

2) "Funds for sponsored research are more readily available in some fields of knowledge than in others, so that important areas of scholarship may be neglected." Continuation of emphasis