"shock-reactions" (Mast). They even contend (p. 9) that if this classification had been formulated earlier, the controversies concerning Loeb's theories would have been to a large extent avoided.

But in spite of their contentions it must be said that they did not well succeed either in avoiding anthropomorphic implications or in precision in defining terms. They say, *e.g.* (pp. 64 and 77), "klino-taxis involves comparison of intensities at successive points in time" and "tropo-taxis simultaneous comparison of intensities on the two sides." How, it may be asked, is an animal to compare intensities at successive points in time without reason and memory? Aren't these phrases fully as heavily loaded with anthropomorphic implications as those which the authors reject?

The authors (p. 134) define "klino-taxis" as "attainment of orientation indirect, by interruption of regularly alternating lateral deviations of part or whole of body, by comparison of intensities of stimulation which are successive in time; examples, fly larvae, *Euglena,* larvae of *Arenicola, Amaroncium.*" It so happens, however, that in none of these animals are the processes involved in orientation in accord with the definition of "klino-taxis" given. Orientation in photo-positive specimens is brought about by a series of responses to shadows cast on the photo-sensitive tissue by opaque structures in the body and rotation on the longitudinal axis, *i.e.,* by a series of shock-reactions. These continue until the organism faces the light, after which rotation no longer produces shadows on the photo-sensitive tissue. There is no indication whatever of "comparison of intensities of stimulation." They say: "photo-taxis means respectively movement straight toward or straight away from the light." Animals, however, rarely, if ever, take a straight course. They say (p. 93): "When the frontal ommatidia alone are stimulated, the bee walks straight forward." But they present no evidence indicating that these ommatidia are actually stimulated. Then, too, light, gravity, etc., are frequently referred to as stimuli in place of stimulating agents.

It is indeed questionable whether the new nomenclature is superior to the old, either in avoidance of anthropomorphic implications or in precision in meaning. Moreover, terms like taxis and tropisms often tend to inhibit investigation; for they encourage placing phenomena in categories as an ultimate aim rather than knowledge concerning the processes involved in the phenomena. Then, too, they readily acquire the status of causal agents. Has not every scientist experienced this? Indeed, it is not difficult to ascribe causality to taxis in the following quotation (p. 298): "Negative photo-taxis takes it [*Litorina*] inward on the floor, negative geo-taxis upwards on the end of the wall, and positive photo-taxis outwards."

The authors are a bit careless in reference to credit for priority; and the accuracy of a considerable number of statements is questionable. For example, the first analysis of photic orientation should be credited to Ray, 1693; in place of De Candolle, 1832 (p. 5); the idea that the enlargement in the flagellum in *Euglena* is photo-sensitive should be credited to Mast, 1911, in place of Tschakhotine, 1936 (p. 70); the fact that blow-fly larvae "give the same response to changes of intensity when the light is all from above . . . and when it is presented as a horizontal beam" should be credited to Mast, 1911, in place of Gunn, unpublished (p. 67); the nature of the response of Hydra in a horizontal beam of light should be credited to Mast, 1911, in place of Haug, 1933 (p. 74); the fact that insects after one eye is covered gradually go more directly toward the light should be credited to Radl, 1903, in place of Minnich, 1919 (p. 93). The authors say that Loeb "uses the term (tropism) in two senses," whereas he uses it in at least four (p. 9). They say Mast calls orientation in fly larvae a shock-reaction, whereas he maintains that the larvae orient by means of a series of shock-reactions (p. 64). They contend (referring to orientation of *Euglena*) that it is not known how "a turn away from the light is responsible for causing the path to curve toward the light," whereas Mast, 1911, has described this in detail (p. 72). They say the larva of *Arenicola* has but one eye, whereas it is well known that it has two (p. 73).

Classification of responses is obviously a difficult and an important problem. The more thought devoted to it, the better. The volume under consideration is at least a worthwhile attempt to contribute to its solution. It will doubtless arouse interest in the study of the nature and the significance of responses as well as in their classification.

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RAMANUJAN

Ramanujan. Twelve lectures on subjects suggested by his life and work. By G. H. HARDY. 236 pp. Cambridge: at the University Press, 1940. New York: The Macmillan Company, 1941. $6.00.

IN 1936, as part of the Harvard Tercentary celebration, the author delivered two lectures on the subject: The Indian Mathematician Ramanujan and his work. The first lecture, much the more biographical of the two, was published in volume 44 of the *American Mathematical Monthly,* and is reprinted in the present book as Lecture I. The original second lecture, which dealt more with Ramanujan's contributions to mathematics, has now been expanded to make the other eleven lectures. Most of this expansion, naturally enough, is the result of having adequate space to tell

more than the bare facts about Ramanujan's work. Some of it, however, is due to the fact that since 1936 much new work has been done on certain of his problems. Lectures VIII and X on the asymptotic theory of partitions and on Ramanujan's function $\tau(n)$ contain a great deal of recent mathematics. The connections between Ramanujan's work and that of other writers, especially those who came after him, are traced in each lecture with many interesting comments. Each lecture closes with a set of valuable notes, and there is a bibliography of over 100 papers on problems suggested by Ramanujan.

Ramanujan surpassed all other men in his ability to produce striking formulas. Opening the book at almost any place one is sure to find some arresting equality, something typographically complicated with bizarre exponents and coefficients. In this respect Ramanujan differed from the typical modern mathematician who is trying to find the simplest possible relationships between extremely general concepts. The actual source of one of these startling formulas is often mysterious, and the author frequently indulges in interesting speculations. It is true that Ramanujan discovered a number of interesting results experimentally, but his experiments were never on a large scale. Many of the formulas which he gave as approximately correct are not as accurate as he had surmised, as a little experimenting would have shown. Perhaps his most interesting use of the experimental method occurs in connection with the study of his function $\tau(n)$, defined as the coefficient of x^{n-1} in the expansion of the 24th power of $(1-x)(1-x^2)(1-x^3)\ldots$. After examining the first 5,000 of these coefficients $\tau(n)$ and finding only one divisible by 691 he had the courage to conjecture that $\tau(n)$ is divisible by 691 for *almost all n*, a conjecture which later proved to be true.

The reader who is unable to appreciate Ramanujan's fields of endeavor, but who is interested in what constitutes and causes mathematical genius will find the book absorbing. There are several interesting passages on the subject of "proof" and what it meant to Ramanujan. The book is written in the best Hardy style.

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SOCIETIES AND MEETINGS

THE ILLINOIS STATE ACADEMY OF SCIENCE

THE thirty-fourth annual meeting of the Illinois State Academy of Science was held at Northwestern University, Evanston, Illinois, on May 1, 2 and 3. Cooperating as hosts to the State Academy were the museums and other interested organizations in the Chicago area. Over 500 registered for the meeting and 150 lectures, scientific papers and reports were given.

Some of the high-lights of the meeting were the addresses at the general session on Friday morning, the lecture given to both the Senior and Junior Academy members on Friday evening, and the tours of the museums on Saturday morning. Dr. V. O. Graham, the retiring president, gave an illustrated lecture Friday morning on "Fungi and Man." This was followed by a description and records showing "Patterns in Negro Music" by Dr. M. J. Herskovits. "Wood Duck Studies in Illinois" by Dr. T. H. Frison completed the Friday morning program.

The afternoon was devoted to section meetings. There were twelve of these, Botany, Physics and Zoology holding double sessions. The symposium on "Animal Geography in Illinois" and one on "Endocrinology" planned by Dr. W. V. Balduf, chairman of the Zoology section, were particularly well received. The Association of Physics Teachers of Illinois, an affiliated society, sponsored the Physics program, and Dr. P. A. Constantinides, the chairman, arranged two interesting sessions, the main theme being applied physics. Almost all the sections were well attended and the academy is pleased to announce the formation of a new section for Illinois in Social Science. All those interested in this group are urged to get in touch with the chairman for 1941–42, Dr. John Kinneman, of Normal, Illinois.

At the banquet in the evening the American Association for the Advancement of Science awards were announced, grants in aid being made to C. L. Furrow, of Knox College, Galesburg, Illinois; C. C. Hoff, of the University of Illinois, Urbana, Illinois; J. F. Stanfield, of Chicago Teachers College, Chicago, Illinois; and P. H. Kinsel, of Edwardsville High School, Edwardsville, Illinois. While these grants can not be large, they have always served to stimulate research interest.

The evening program consisted of an illustrated address and colored moving pictures given by Dr. Ralph Buchsbaum on "A Summer in a Tropical Rain Forest of Barro Colorado Island, Panama." A group of nearly a thousand Junior and Senior Academy members attended this lecture. After the lecture the awards given by the Junior and Senior Academy to winners in the Junior Academy exhibits were presented. Altogether over 300 certificates were awarded, as well as cups for unusually worth-while work in the various sciences. The American Association for the Advancement of Science Junior Academy awards went