

"The Outline of Science"

Editor's Note:—We have seen only parts of Prof. J. A. Thomson's "The Outline of Science," but this review, from "The Freeman" (N. Y.), seems to merit reprinting and will be of use and interest to students primarily. Students in the various cities where there are public libraries should insist upon books such as these being placed on the shelves.

SPECIALIZATION in modern science has become so great that the scientist speaks a language unintelligible not only to the layman but even to his own colleagues whose researches lie in other fields. Every one owes a debt of gratitude to the editor of "The Outline of Science" for attempting to bring into a small compass the results of modern research. Professor Thomson is known as a writer of numerous popular and semipopular works on biology, of which the most recent is the delightful volume on "The Haunts of Life."* The "Outline" itself is very interestingly written; the style is lucid and straightforward though often somewhat jerky; in places the reader's head is being continually twisted about to contemplate some new marvel. The illustrations are always vivid and clear, and the two volumes so far published, especially in the sections dealing with natural history, are very readable indeed.*

But natural history is the easiest part of science to write about because it is the least technical; we have long had interesting and accurate books dealing not only with animals and plants, but also with astronomical and geological subjects. It is the less descriptive and more theoretical parts of the work that constitute the real test of its success; and these, it must be admitted, are not so well done. The evidence is not always properly marshalled or critically handled, the reasoning is sometimes confused and incorrect, verbal descriptions are made to do duty where diagrams are needed, parables take the place of plain speaking, and difficult subjects are quickly passed over with statements so condensed that the reader is given a false impression. The bibliographies also often show important omissions. Moreover, the commendable attempt to maintain an impartial attitude sometimes breaks down at critical points. Thus, while the book avoids being dogmatic about the non-inheritance of acquired modifications, a subject on which scientific dispute has practically ceased, the discussion of vitalism versus mechanism, a question on which scientific opinion leans decidedly toward the latter side, is characterized by a definitely vitalistic bias. Of course the editor might be forgiven or even commended for being frank about his own views; but to the reader Professor Thomson's beliefs are of less importance than an adequate presentation of the mechanistic theory.

Moreover, "The Outline of Science" fails to convey an impression of unity. The great achievement of science is its correlation of apparently unrelated facts, its disclosing of connexions where none have been suspected. To the unsophisticated reader it might well appear from the "Outline" that each science is a law unto itself. Except in that portion of the first volume which relates to the history of the earth and its inhabitants, the articles are arranged with no pretence to any system. The "plain story simply told" becomes a series of stories, each of which is simple merely because its relations to the others have been overlooked.

In another way also the editor of these volumes has shown a lack of a truly philosophic grasp. For although there have been nationalistic controversies over the credit for various discoveries, and in times of stress scientists have, like their non-scientific fellows, been swayed by their political emotions, nevertheless science has always constituted an international fellowship. The fact that, as in the case of wireless telegraphy, an idea may be theoretically

worked out by an Englishman, experimentally demonstrated by a German, and practically applied by an Italian, is not only typical of the method of scientific progress but teaches a lesson of international co-operation which ought not to be neglected. The "Outline," however, seems loath to take the world for its province; it is national in the sense of being British, and sometimes even provincial in the sense of being Scots. The casual reader might well receive the impression that only rarely have contributions to the advancement of knowledge been made outside the boundaries of Britain. Not that credit is given to those who do not deserve it; but it seems strange to read the section on physiology without seeing a mention of Claud Bernard or Johannes Muller, or to go through the discussion of energy without meeting the names of Mayer and Helmholtz. Moreover continental scientists get very scant representation in the picture gallery; in fact almost the only non-British portraits are those of prehistoric men.

The same defect appears in the sections on natural history. Here "our birds" are always British birds, "our mammals" British mammals, "our insects" British insects. These sections might have been utilized to give a more general idea of the life of the earth and to bring out some of the results of geographical distribution. Instead there seems to be rather too much emphasis on the United Kingdom even at the expense of the Dominions beyond the seas.

But after all, as Professor Thomson says in his preface, scientific information is less significant than the scientific habit of mind. As W. K. Clifford pointed out in his essay on the "Ethics of Belief," and as Mr. Bertrand Russell maintained in a recent issue of the Freeman, it is of the utmost practical importance that people should harbour no views for which there is no evidence. If the "Outline" contributes towards such a rational attitude, all its weaknesses may be cheerfully forgiven it. However, a habit of mind, like any other habit, can be acquired only by practice; with all due regard for the services rendered by popular scientific treatises, we must admit that such works often produce a habit of mind quite the reverse of scientific. The over-technical exposition puts the reader under the impression that he has fundamental knowledge where he really has only superficial information. Hence this type of writing may defeat its own purpose. The general reader who is not capable of weighing evidence critically, comes to be easily swayed to any notion that is plausibly trapped out in the paraphernalia of learning; and as a result, he may be induced to hold very definite ideas on subjects concerning which there is no real proof. Professor Thomson himself can scarcely contribute to clear thinking when, for example, he says: "The human sense of race is so strong that it convinces us of reality even when scientific definition is impossible."

Those who greet popular expositions and compilations so enthusiastically as providing a remedy for ignorance lose sight of the fact that reading can never furnish that familiarity with scientific materials and methods that results from work in the laboratory or training in the solution of scientific problems. It may be unfortunate, but it seems to be a fact that we can learn only by taking ideas at intervals, by turning them over in our minds until all their aspects are familiar, by establishing a system of relation between them and our own interests. An outline of history may be both scholarly and readable because the notions with which it deals are familiar to every one; but any general treatment of science worthy of the name must be so full of ideas unfamiliar to the layman as to be quite unassimilable if presented in the guise of ordinary reading-matter. Whatever it may be that the uneducated person can read as he runs, it is not science.

I do not wish to be understood as criticizing Professor Thomson's ability as a scientific expositor. But I do wish to suggest that the subtitle, "A Plain Story Simply Told," is a mistaken one. Science is often a very complicated story requiring complicat-

ed exposition, and no amount of expert teaching can take the place of actual thought on the part of the student. The question it not so much whether one can explain Kant's philosophy to a peasant in his own language, as Tolstoy said that one could, but whether, after one has done so, the peasant can understand one's explanation. So far from being always capable of enunciation in plain English or French or German, science has, in many cases, in order to make any progress at all, had to emancipate itself from the ordinary form of speech and to construct a language of its own. This is particularly true of mathematics and mathematical physics. It is generally recognized that their advance has been due largely to the invention of such notations as the decimal system, logarithms, the calculus, and the vast array of higher mathematical symbols that are utterly meaningless to the layman.

It is in those fields where ideas have become most precise that new methods of recording thought have been found necessary; and if great and highly trained minds like Newton and Einstein have required special languages to formulate and solve particular types of problems, is it likely that lesser and untrained minds can express these problems and present their solutions in terms of everyday speech? It is no mere accident of history that the attempts to popularize mathematics have been very few indeed: "The Outline of Science," at least so far as its contents have been announced, makes not even a pretence at including this subject. Neither is it an accident that those who have written on birds and flowers have left the modynamics, a much more fascinating topic, rather severely alone.

In his preface, Professor Thomson quotes Leibnitz to the effect that as knowledge advances, it becomes possible to condense it into little books. The implication is that, as the books would be little, they would be easy to understand. But this conclusion does not necessarily follow. In fact the "Outline" itself, far from being compressed in its treatment, is quite discursive and its material is spread very thin. Professor Thomson might have quoted a more extreme opinion even than that of Leibnitz, for Laplace said that with sufficient knowledge he could condense all science into a differential equation. Yet we have never seen it suggested that this question would be easy to grasp. The nearest that science has come to such a mathematical formula of the universe, is in the equations of the general theory of relativity; and not even the most sanguine of popularizers has pretended that these are intelligible to any but the expert mathematician.

We have, in modern times, come a great distance along the road of popular education. Yet we must not be deluded into making a fetish of the ordinary man and his everyday speech. It is no injustice to the average intellect to point out that it is incapable of thinking scientifically for very long at a time. Some would claim that this trait can not be altered at all, that the great majority of individuals would under no circumstances be capable of straight thinking. But although there is, of course, a large range of variation in inherited mental ability, yet the general increase in rational thought that has occurred in the course of history does not seem to warrant an attitude of extreme pessimism. It ought to be possible to abolish what we call education, which seems to be a scheme invented for the purpose of preventing the young from learning too quickly until it is too late for them to learn at all, and to devise some system for teaching people what constitutes scientific method, and for giving them the elementary notions of mathematics, physics and chemistry, of biology, and of astronomy and geology. Until we do something of this sort, popular science can scarcely be anything more than an outline—form without substance. We must realize that knowledge, like death, is no respecter of persons; and if there is no royal road to science, neither is there a special highway for the bourgeoisie or the proletariat.

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1. "The Outline of Science: A Plain Story Simply Told." Edited by J. Arthur Thomson. In four volumes. New York: G. P. Putnam's Sons. Vols. I and II. \$3.75 per volume.

2. "The Haunts of Life." J. Arthur Thomson. New York: Harcourt, Brace and Company. \$2.50.

3. The third and fourth vols. are now off the press. (Ed. Clarion).