wounds and in other ways. While the course usually is favorable, an epidemic described by Siegel had a mortality of 8 per cent. The manifestations are fever, digestive disturbances and vesicular eruption on the lips, the oropharyngeal lining ("aphthous fever") and sometimes on the skin. Where there is danger of contamination of the milk with the foot-and-mouth virus, thorough pasteurization of all milk and milk products is doubly indicated.—*Journal of the American Medical Association.*

SCIENTIFIC BOOKS

Perception, Physics and Reality. By C. D. BROAD, M.A., Fellow of Trinity College, Cambridge. Cambridge University Press. 1914. Pp. xii + 388.

The essay of Mr. Broad is the outgrowth of a dissertation presented to Trinity College, Cambridge, at the examination for fellowships. As now published it is an enquiry into the information that physical science can supply about the real. Evidently the speculative tendencies of recent science have attracted the attention of philosophers, and to some extent their envy. As Mr. Broad says: "When a certain way of looking at the universe meets with the extraordinary success with which that of physics has met it becomes the duty of the philosopher to investigate it with care; for it is likely to offer a very much better cosmology than his own unaided efforts can do." This success is due to the fact, he thinks, that most scientists start from a position of naïf realism. The only successful rival, at the present time, to this realism is the phenomenalism which has resulted from the work of Mach and his followers. And this phenomenalism which holds that the objects of our perceptions are non-existent except when they are perceived is not according to Mr. Broad, an adequate foundation for a scientific system. He thus disapproves of the modern physicists who are regarding energy and electricity as entities rather than as attributes.

The essay begins with a discussion of the arguments which have been advanced against naïf realism, and after weighing the evidence he comes to the conclusion "that none of these arguments which are so confidently repeated by philosophers really give conclusive reasons for dropping even the crudest kind of realism." Since it is difficult to advance in science without a belief in some law of cause and effect, he next discusses the arguments which philosophers have advanced against causation. This is followed by chapters on the arguments for and against phenomenalism and the causal theory of perception. The essay closes with a comparison between Newtonian mechanics and the so-called new mechanics which is based on variability of mass with speed. Mr. Broad is quite conservative, for while he does not say that the principles of mechanics which have become classic may not require revision from time to time, yet "the more general laws will still be laws about positions and velocities of some extended quality or qualities, and, as such, will be capable of the same sort of defence that I have offered for the traditional mechanical physics." His opinion is not of great value to the physicist who is not asking for a defence of traditional mechanical physics but who is much worried about the nature of "some extended quality or qualities" which has position and velocity. He is anxious to know whether it is matter, electricity or energy.

The philosophical method of Mr. Broad is that of the neo-realists and he owes much, as he acknowledges, to the lectures and conversation of Mr. Bertrand Russell. His point of greatest departure from Mr. Russell's teaching is perhaps the substitution of the criterion of probability for certainty. This is to make philosophy approach more closely to science. As he says in his introduction: "I have constantly put my conclusions in terms of probability and not of certainty. This will perhaps seem peculiar in a work which claims to be philosophical. It seems to me that one of the most unfortunate of Kant's *obiter dicta* is that philosophy only deals with certainty, and not with probability. So far is this from being the case that to many philosophical questions about the nature of reality no

answer except one in terms of probability can be offered; whilst to some there seems no prospect of an answer even in these terms. Few things are more pathetic than the assumption which practically every philosopher makes that his answer to such questions is the unique possible answer; and few things are funnier than the sight of a philosopher with a theory about the real and the nature of perception founded on numberless implicit assumptions which, when made explicit, carry no conviction whatever, telling the scientist *de haut en bas* that his atoms and ether are mere economical hypotheses." This is a rather long quotation, but it gives very vividly Mr. Broad's philosophical standpoint. While it is a good and safe attitude, one can not help wondering what the value of a philosophical determination of reality may be. Reality which depends at best on its *probable* truth is a doubtful reality and must continue to be a question of dispute. Does it not become ultimately a question of temperament; one either is convinced of the reality of the external world, or he is not, and logic will have but little effect on his judgment?

Mr. Russell and his followers are able to give a specious appearance of certainty to their deductions by employing an esoteric system of mathematical symbols and analysis. He, himself, is both a mathematician and a philosopher. As the former, he must know that mathematical analysis will not give correct conclusions if the postulates contain an error. He must also know that even if the postulates be correct, the conclusion is without meaning if the idea represented by a given symbol should change to an appreciable extent during the transformations. For example, if V represents a *constant* velocity and if, during an experiment, the velocity should change by a measurable amount, then no conclusion could be drawn from our analysis unless V is changed to V', and in addition we know the exact relation between V and V'. The reason why mathematics can be applied to interpret physical and astronomical phenomena so satisfactorily is because the ideas represented by the symbols in those sciences are simple and can be measured with great accuracy. Now this is not the case, except to a much more limited degree, even with the other sciences, and it certainly does not obtain for the far more complex questions of philosophy.

While Mr. Broad employs the method of Mr. Russell more or less throughout his essay, yet he rarely goes so far as to use the very irritating symbolism of his teacher. He has in fact only two specific examples, and of these the one on page 318 applies to a complicated problem of motion; the other example, on page 165, is better suited as an illustration for criticism. Here p is the proposition, phenomenalism is true; and q is the proposition that the objects of our perceptions depend on the structure of our organs. Can we prove p from this? By a manipulation of p and q which is printed so as to resemble a bastard kind of mathematics, he arrives at the conclusion that we can not prove p from the argument. We know that Berkeley was so shocked when he arrived at the same conclusion that he created God so that there might be a reality which could always perceive our organs of perception and thus give them a kind of pseudo-reality when no one else was near enough to perceive them. But that is not the point. It is pretty certain that q stands for so complex an idea or proposition that each of Mr. Broad's n readers will have received an idea differing sufficiently from the others to make it advisable to represent the proposition in these varying aspects by the series $q_1, q_2, q_3, \ldots q_n$. And furthermore, during an extended argument, each one's idea will, I think, change sufficiently to require changes in his q. The result is that q becomes the highly complex series $q_1, q_2, \ldots q_n; q_1', q_2', \ldots q_n'; q_1'', q_2'', \ldots q_n''$, etc. Not even the mathematical laws of probability can cope with such a problem.

The fact is, no philosophical method has been devised which can settle the questions involved in realism and phenomenalism. But much can be gained by a discussion of the arguments for and against these ideas. And it is in this discussion that the interest and value of Mr. Broad's essay are displayed.

Scientists, especially, should read the book, if for no other reason than to convince themselves how metaphysical their scientific hypotheses are.

LOUIS TRENCHARD MORE
UNIVERSITY OF CINCINNATI

Essentials of College Botany. By CHARLES E. BESSEY, Professor in the University of Nebraska, and ERNEST A. BESSEY, Professor in the Michigan Agricultural College. American Science Series. The eighth edition revised and entirely rewritten. Henry Holt & Co. 1914. Pp. xiv + 409 with 206 illustrations.

The authorship of this essentially new book is unique in American botanical literature, and as a fitting foreword it is a pleasure to recall that the senior author has spent over two score of years in the constant and very fruitful pursuit of botany. The junior author, the son, was therefore reared in an invigorating atmosphere of phytology, since which he has been at the head of the department of botany in the Michigan Agricultural College, the very place where the father began, as an undergraduate, the serious study of the subject conjointly expounded in this text-book fresh from the press.

As a winning football team is sometimes built up around a star player, so here it is quickly noted that the book in hand has a dominant feature, namely evolution, and its title might well be phytophylogeny. In other words in the groundplan one sees fourteen phyla (branches) of the vegetable kingdom arranged in the order of the probable appearance of their members (species) in point of geologic time. The senior author has long specialized in taxonomy, publishing his results from time to time in pamphlet form, as, for example, "A Synopsis of Plant Phyla" (1907), and now the botanical world welcomes the appearance of the present work in which phylogeny is made the keynote of a text-book.

The phylum is the group unit employed for expanding the fundamental doctrine of evolution, namely, that the first species were low plants and from them have evolved all others, thus making all species genetically related, whether far or near, low or high. The lowest of the fourteen phyla is the myxophyceæ (slime algæ)—(the slime fungi find no place in the plant kingdom), and ends with anthophyta (flowering plants). Each phylum has its separate chapter, in which the dominant feature is considered through "laboratory studies" of types followed by a short bibliography. Thus, for example, "phylum V., phæophyceæ—the brown algæ" has for its characteristic idea the addition of the brown pigment, with which certain structural features are associated. This phylum is a lateral divergence from the main evolutionary stem. Again "phylum VIII., bryophyta—the mossworts," is derived from the Chlorophyceæ (simple algæ), shows (*a*) obvious alternation of generations, (*b*) beginnings of conductive tissue and (*c*) the members grow upon land. "Laboratory studies," as usual, are given under the classes, namely, liverworts and mosses.

The last chapter, and last phylum, deals with anthophyta (flowering plants) and includes more than a half of all known plant species. In the laboratory the pupil will here receive the instruction that usually is found in the early pages of the less modern text-books. This chapter closes with a tabulation of the "greater steps" in the development of the highest from the lowest plants.

While the method here followed is logical from the evolutionary viewpoint, as a matter of fact many pupils get into college seriously deficient in botanical perspective, and therefore a few preliminary lessons upon the more evident parts of the higher plants and something of their functions would be advantageous before "making the plunge" into the depths of protoplasm, the most complex of all substances when measured by its boundless activities and possibilities. Therefore it might not be a crime to begin the class with a portion of this last chapter, thus bringing the pupils even by way of review in closer touch with the world-wide out-of-door botany. Next to kinship is social relations, and one wishes that the pupils might be introduced to plant societies, that is, to the environmental factors, namely, ecology,