parts of the beautifully illustrated monograph on British Annelids by Professor W. C. McIntosh, a work that will probably be priced to the public at over two guineas.

The income of the society is derived almost entirely from its list of subscribers and it is imperative, if the society is to continue its activities, that this list be enlarged. It is, therefore, hoped that American naturalists will show their appreciation of the good work of the Ray Society by giving it their hearty support. The annual subscription of one guinea should be sent to the secretary of the society, Dr. W. T. Calman, 1 Mount Park Crescent, Ealing, London, W. 5, England.

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SCIENTIFIC BOOKS

The Analysis of Mind. By Bertrand Russell, F.R.S. New York: The Macmillian Company. Pp. 310. 1921.

It would not be difficult to show that in the course of the centuries mathematical developments were much retarded, sometimes arrested or diverted from their natural course, by an unenlightened psychology and especially by a crude psychology of mathematics. The fact is evident both in the history of algebra and in that of geometry. Not only was the development of the number concept hampered, but the advent of the concepts of hyperspace and non-Euclidean geometry was delayed for two thousand years, by a psychology that in things mathematical often did not know a knee from an elbow. It is, therefore, a special pleasure to note and to welcome the appearance of a psychological work by an eminent contributor to the literature of mathematical foundations. Compared with the work which has been done in the logic of mathematics, that which has been done in the psychology of the subject is exceedingly meager, and the explanation is obvious: mathematicians have been psychologically incompetent, and psychologists mathematically incompetent, to deal with the matter. The work in hand is indeed not specifically concerned with the psychology of mathematics; its scope is general; but it is likely to awaken psychological interest among mathematicians and may incite some of them to study the psychological aspects of their own science.

This volume consists of a course of lectures given in London and Peking. Its motive is a primarily logical one for the work has sprung out of the seeming discordance of two present scientific tendencies, one of them in psychology, the other in physics; the former may be called a tendency to materialize mind; the latter, a tendency to "spiritualize" matter; they are both of them methodological rather than metaphysical. The former tendency, most notably represented by the behaviorist school of psychologists (like Professor Watson, for example), is manifest in the distrust of introspections as a means to knowledge of mental phenomena and in the growing dependence of psychology upon external observation of animal and human behavior and upon physiological experiment, as if matter were regarded "as something much more solid and indubitable than mind." The other tendency, most notably represented by workers (like Professor Einstein, for example) in physical theories of relativity, is manifest in the increasing inclination of physicists to regard "events" as primary and to derive "matter" from them, or to make it out of them, by the processes of logical construction.

If we regard both of these counter tendencies as being in the main sound, as Mr. Russell regards them, they confront us with a certain logical problem which every one must feel the challenge of and which Russell, owing to a highly refined logical sensibility, feels with especial keenness. The problem is that of reconciling the two tendencies, seemingly so inconsistent; it is the problem of determining their joint significance; the two tendencies face each other, move towards each other, and, pointing in opposite directions, seem to indicate a common goal—some important truth lying, so to speak, between them, and the problem is to ascertain that truth, if such there be.

The problem is not men. From the psychological side it was assailed by William James especially in his later years and since then it has been attacked from the philosophical and logical side by the American school of so-called new realists, Professor R. B. Perry, Mr. E. B. Holt, and others. With what results? By James, consciousness regarded as an entity, was rejected outright. According to his view, the world is not fundamentally composed of two different things, mind and matter; it consists of one "primal stuff," which he called, somewhat unhappily, "pure experience"; between portions of the primal stuff there are various sorts of relations, which are parts of the stuff and of which the portions are the terms; one kind of the relations is called "knowing"; such a relation has two terms, one of which is called the "knower" and the other the "known." In James's view, that is the common goal of the two tendencies I have mentioned; that is the truth that is being approached by psychology from the one side and by physics from the other. And the finding of the new realists is much the same. Rejecting the unfortunate term "pure experience," they maintain that what is called mind and what is called matter are both of them composed of a "neutral-stuff" which is in itself neither mental nor material, neither mind nor matter.

Russell deals with the problem in the light of the foregoing views but he handles it afresh, in a way that is quite his own, bringing to the task a native and acquired equipment—logical, mathematical, philosophical—that gives his work surpassing importance. What is his main conclusion and how is it related to that of James and his American disciples? Russell, like James, rejects consciousness regarded as an entity; neither is consciousness an essential quality or a simple companion of mental phenomena. "Consciousness" he finds to be "a complex and far from universal characteristic of mental phenomena." In holding that "sensations are what is common to the mental and physical worlds," that sensations are literally "the intersection of mind and matter," he agrees with the American realists and with Ernst Mach;[1] and so, with respect to *sensations,* he agrees with the realists in the thesis that the world is composed of a "neutral-stuff"; but he does not agree with them in his maintaining that *images* are not reducible to sensations and in his conclusion that "images belong only to the mental world." The final conclusion is:

> All our data, both in physics and psychology, are subject to psychological causal laws; but physical causal laws, strictly speaking, can only be stated in terms of matter, which is both inferred and constructed, never a datum. In this respect psychology is nearer to what actually exists.

How are the results arrived at? The answer can not be given in a brief review, and the reader must be referred both to this volume and to its companion "Our Knowledge of the External World" published a few years ago. The earlier work, which deals with the physical aspects of the same problem, is chiefly concerned with the question whether, how, and to what extent the so-called constituents of matter are constructible out of sense-data by logical processes. The two works are thus complemental, together constituting a whole.

Suffice it to say that, so far as the present volume is concerned, the results are reached by a diabolically ingenious analysis of such things as instinct and habit, desire and feeling, psychological and physical causal laws, introspection, perception, sensations and images, memory, words and meaning, general ideas and thoughts, belief, truth and falsehood, emotions and will; and by an equally ingenious synthesis, or logical construction, making many familiar things seem strange —desire, for example, appearing as a mere "fiction" like force in dynamics—and showing many seemingly simple and primitive things to be complex and derivative. It is noteworthy that the least original and weakest part of the analysis is that of the emotions and will, commonly regarded as mental

[1] "Analysis of Sensations, 1886."

phenomena *par excellence,* while curiosity or wonder, which Aristotle regarded as the very beginning of knowledge, is not discussed at all in terms.

It seems a bit strange that the book does not mention the recently published works ("The Principles of Natural Knowledge," and "The Concept of Nature") of Professor Whitehead, for these works are weighty contributions to the problem Mr. Russell is trying to solve.

I wish finally to say that as a model exhibition of the scientific spirit, this work would be highly valuable even if its conclusions were unsound. Mr. Russell's notably frequent public recantations of opinion, of which there are no fewer than five instances in the present work, are regarded by some as a token that he does not know his own mind or that he publishes prematurely. Such critics are no doubt mistaken. The frequency of recantation in Mr. Russell's writings is due partly to the exceeding difficulty of the fields in which his researches lie, partly to his ceaseless re-examination of seeming certitudes, and partly to an unsurpassed intellectual candor.

Cassius J. Keyser

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TESTIMONIAL TO DEAN H. L. RUSSELL

(From a correspondent)

At the October meeting of the Wisconsin branch of the Society of American Bacteriologists, Dean H. L. Russell was presented by his former students with a volume entitled "Papers on Bacteriology and Allied Subjects." This memorial was given in commemoration of the twenty-fifth anniversary of his doctorate. The real anniversary day occurred several years ago but due to the war conditions immediately following, the publication of the volume was delayed.

It is a comprehensive volume containing contributions from thirteen of the leading bacteriologists who were among the early students of Dr. Russell. E. G. Hastings, of the University of Wisconsin, reviews the dean's scientific career and points out the strategic opportunities presented to pioneer bacteriologists. Dr. Russell was the first full-time agricultural bacteriologist in America. He was likewise one of the first men to be employed in this country to teach and do research work in bacteriology outside of the medical school. His scientific papers, books, and bulletins number well over 125 and are of fundamental importance.

A development of the city milk supply problems is the contribution of H. A. Harding, formerly of the University of Illinois. He states the problems past and present in an interesting way and concludes by saying of Dr. Russell,

> This pioneer bacteriologist in person and through his students has taken an honorable part in the solution of these problems.

That the greater prevalence of mold spores over bacteria in the air is due to the fact that most bacteria are readily killed by the sun's rays while mold spores are only slightly affected is the conclusion reached by John Weinzirl of Washington State University in his treatise on the resistance of mold spores to sunlight.

In a series of experiments carried on at the University of Minnesota, C. H. Eckles found that the percentage of fat in milk could be markedly increased for the first twenty to thirty days when it is followed by underfeeding during the period of lactation. Underfeeding of the cow must be taken into consideration in the interpretation of data involving variation in the composition of milk and butter fat.

L. A. Rogers, chief of the dairy division of the United States Department of Agriculture, summarizes the work done in his department on the characteristics of the *colon-aerogenes* group of bacteria. He regards *B. coli* and *B. aerogenes* as very distinct types. He discusses the taxonomic position of other members of this group in relation to these two varieties.

D. J. Davis, of the medical school of the University of Illinois, presents evidence and argues convincingly to show that the fungus which causes sporotrichosis disease affecting