ROBERT SIMPSON WOODWARD

BIOGRAPHICAL material in regard to the career of R. S. Woodward is being compiled, and the undersigned would be grateful for any data which the readers of SCIENCE can furnish.

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QUOTATIONS

TWO ASTRONOMICAL AUTHORITIES ON THE WANING OF PURE SCIENCE RESEARCH IN THE UNITED STATES[1]

Two of the world's recognized astronomical authorities, Henry S. Pritchett, of New York, and George E. Hale, of Pasadena, California, view as dangerous the limited opportunities for pure science research in the United States.

Fearing that fundamental scientific investigation in this country is waning, these two notables are participating in a national project to promote and encourage research in the field of natural science. Associated with them are representatives of other important scientific fields, financiers, diplomats, lawyers and philanthropists. This group of twenty-six men were appointed by the National Academy of Sciences to raise a fund of $20,000,000 for research in pure science. Herbert Hoover is chairman of the undertaking and is devoting much personal attention to the successful realization of the project.

In his strictly academic days as a college professor and as president of the Carnegie Foundation for the Advancement of Teaching, President Pritchett has had ample opportunity to observe the crying need for funds to aid pure science investigators; to supply them with teaching assistance, with laboratory equipment and other necessities to carry on their work.

"It is a fact," President Pritchett says, "that the number of men who are competent to conduct scientific research of the highest order is limited. In order that research may be fruitful the problem which is being attacked must be significant and the man who engages in it must be a man of real ability. The presence in scientific research of men of the first order is indispensable to genuine progress. Whenever such men shall cease to appear amongst them who are devoted to research, the movement will lose its force."

Few men are more ably qualified to express an opinion on the value of pure science investigation and its need of financial support than Professor Hale, who during his seventeen years as director of the Mt. Wilson Observatory of the Carnegie Institute [*sic*] and as its organizer, has had ample opportunity to observe the disastrous drawback to progress, which frequently result [*sic*] from lack of funds to complete an investigation.

Professor Hale's own contributions to fundamental science, described in many of his important works, such as "The Study of Stellar Evolution," "Ten Years Work of a Mountain Observatory" and "The New Heavens," are among the most notable of the present day. The National Research Endowment is fortunate in being able to include among their board of trustees such particularly well-qualified authorities in the scientific world as Professors Pritchett and Hale.

The plan of administration will be to determine who among the ablest and most productive investigators, engaged in effective research in pure science, are in need of assistance. They will be asked to present their plans of research to the trustees of the fund, stating their exact needs, such as more time for research; the aid of scientific assistants; computers or technicians as well as the special instruments or accessories which may be needed. Appropriations will be made to them for a fixed period of years, subject to renewal if circumstances warrant it.

[1] Sent for publication in SCIENCE from the National Academy of Sciences, B and 21st Streets, Washington, D. C.

SCIENTIFIC BOOKS

The Biology of the Protozoa. By GARY N. CALKINS. Lea and Febiger, Philadelphia and New York, 1926, 623 pp. $7.50.

A NOTABLE work, "founded on thirty years of research on the Protozoa and on an equal number of years of teaching Protozoology" and worthy of such a foundation; a work of great value to students of Protozoa and to every one interested in the general problems of biology. Outstanding is the successful attempt to bring unity into the usually disconnected treatment of this heterogeneous group, through centering the whole about the general concepts of organization and vitality—particularly the latter. A book results that is consecutively readable, as well as valuable for reference.

There are detailed chapters, with illustrations (many original) on structural features and nuclei; on general physiology and reproductive processes; on the special morphology and taxonomy of the main groups of Protozoa. In these latter chapters are keys to genera, for the Mastigophora, Rhizopoda and Infusoria. The treatment is up to date and is throughout informed by the results of the author's own investigations.

Of special interest are the three chapters on "Vitality"; on "Phenomena accompanying Fertilization" and on "Effects of Reorganization and the Origin of Variations in the Protozoa." It is in these fields that the author has made his most notable contributions, and about concepts derived from these the entire book is centered. Further, these are the subjects that are of most general biological interest, and on which there has been most discussion and divergence of conclusion: potential immortality, senescence, rejuvenescence, the causes of decline and death. Calkins had early made his own the doctrine that the organism becomes old, "deteriorates, uses itself up, simply by prolonged exercise of its functions" (Maupas); that "the life process contains within itself the germ of death" (Hertwig) and that conjugation remedies this deterioration; produces rejuvenescence. In opposition to Maupas, Calkins held that after decline had occurred, vitality is brought by conjugation back to a high level, so that life runs in cycles, beginning at a high potential and gradually running down, until either death or conjugation occurs; the latter restores the vitality to a high level, whence again it runs down. As a measure of vitality the rate of fission is employed; this plotted shows a curve steadily descending to death or conjugation.

But the validity of this doctrine was gradually shaken. Through the work of Enriques, Woodruff, Metalnikoff and others, the necessity for this decline became doubtful; by them it was attributed, not to processes necessarily bound up with living, but to certain environmental inadequacies. When the latter were remedied, infusoria lived indefinitely, not running down, even though conjugation did not occur. The rejuvenating effect of conjugation was therefore brought strongly into question and direct evidence given, by the reviewer and others, that it is nonexistent.

But the balance was soon restored. Calkins triumphantly unearthed in Uroleptus an ideal exemplar for all the postulates of his doctrine; it regularly declines in fission rate, and conjugation restores the reproductive power. Woodruff with Spathidium confirmed this. Calkins therefore holds in the present work to his point of view.

Yet the significance of the whole was much changed by Woodruff and Erdmann's discovery of endomixis, a process in which the physiologically active macronucleus is replaced from the micronucleus (as in conjugation) but without amphimixis, or the union of two individuals or two nuclei. Endomixis restores the waning vitality as does conjugation. Calkins therefore admits that "Woodruff is quite right in stating that amphimixis is unnecessary for continued life of a ciliate" (p. 545). What is the function of amphimixis? The truth that it is "a means of inaugurating variations is undeniable" (p. 553); but Calkins still inclines to hold that it "arose in connection with some fundamental protoplasmic need," and hankers for the doctrine that this need is "a result of vital activities and changes in organization which render them (the organisms) unable to continue metabolic activities without fusion" (p. 553). And yet on an earlier page he has set forth that amphimixis is unnecessary for continued life, even in organisms in which it occurs; and that there are large groups of Protozoa in which there is no evidence of its occurrence. There are other respects also in which the presentation reflects the present unsettled state of knowledge. Calkins's "fundamental thesis" is "that continued metabolism leads to functional weakening and ultimate cessation of vitality" (p. 552). Woodruff, Enriques and many others hold that such weakening is avoidable, and due, where it occurs, to faulty metabolism resulting from environmental conditions not adapted to the organism. Calkins agrees that supplying certain environmental conditions may remedy the weakening; "individuals might thus be 'doctored' at intervals with a resulting repression of cumulative differentiations and a corresponding maintenance of youth" (p. 478). The diversity of view on this matter, so far as possible experimental detection of differences is concerned, is whittling down to an extremely fine point.

On other questions, as on these, the discussion inclines to a conservatism that is undogmatic and at times wavering; with full presentation of opposing points of view. The book will serve, not only as a compendium of the significant knowledge on Protozoa, but as an excellent guide to the present situation in many fundamental problems of biology.

H. S. JENNINGS

The Elements of Physics and Chemistry. By VERNON BOSMAN. Pp. XI, 295; Juta & Co., Ltd. Cape Town; Johannesburg.

SEVENTY to one hundred years ago it was customary to begin text-books of chemistry with a presentation of the more important laws of physics. At the present time the fields of chemistry and physics overlap at so many points that several of the most important advances in chemical science have been contributed by men who were trained primarily as physicists. This is so true that it is scarcely profitable to ask of some topics whether they belong to physics or chemistry. The book we have before us is intended to supply the necessary information and training for students to meet the requirements of the matriculation examinations in South Africa.

The portion of the book on physics confines itself