with aging and old age; the work being done by public authorities and voluntary organizations, and the public and private resources that exist for the care and comfort of old people in Great Britain; the provision made for old people in those countries which have given special consideration to these problems; medical research on the causes and results of aging, and on the lines on which action might usefully be taken in the future by public authorities and private organizations, including the foundation. The chairman of the survey committee is Dr. B. Seebohn Rowntree, chairman of Rowntree and Company.

DISCUSSION

IS BIOLOGY A SCIENCE?

IN "Life: Outlines of General Biology" Sir J. Arthur Thomson and Patrick Geddes say: "It is a regrettable fact that there is relatively little education in biology in the universities of the British Empire! There is abundance of first-class zoology and first-class botany, but there is relatively little general biology. No one can seriously pretend that a little zoology plus a little botany make a course of biology. One might as well say that a whiff of oxygen and a whiff of hydrogen will serve as a drink of water." These authors then tell of a student guide who was asked by a visiting professor the meaning of the word "biology" which he saw engraved over a door. After a bewildered pause the student replied: "Oh, yes! I remember now; biology is the dogfish and the bean plant."

Unfortunately general biology often is "the dogfish and the bean plant" or some other set of extractions from the biological sciences. Sometimes it is a little botany, a little zoology, a little physiology, a little anatomy, a little embryology, a little taxonomy, a little genetics, a little ecology, a little everything—a parade of discrete biological topics. If one may judge the biology course from some text-books it is an encyclopedia of biological terms, concepts and principles, which might be more conveniently arranged in alphabetical order.

Perhaps Dr. C. A. Shull, in approving of Report No. 15 of the U. S. Office of Education (SCIENCE, March 10) has been misled by courses and texts that are biology only in name. It is my opinion that Dr. Shull's anathema will not deter teachers of introductory and general courses in the biological sciences from continuing their efforts to develop biology courses which give promise of showing that biology is a science. After all, a science is a man-made category rather than an immutable compartment of knowledge imposed from above. Any science or subdivision thereof is an isolate from the totality of scientific knowledge. Under certain circumstances and for certain ends it may be convenient and appropriate to deal with a very restricted field of knowledge which can be fully and intensively explored by a specialist.

The old field of natural science has been subdivided into finer and finer categories as each former subdivision becomes too unwieldy to comprehend intensively. With no intention of decrying this tendency, which has been necessary to the expansion of knowledge and without which our conquest of the unknown would be impossible, I wish to suggest that other circumstances and other purposes demand broader and less penetrating viewpoints. I refer to present circumstances and to the purposes of general education. The present circumstances are the conditions of the democratic society in which we live and which we hope to improve; chief among the purposes of general education, I believe, is the preparation of an intelligent citizenry for the responsibilities of citizenship in our democracy. In this preparation the biological sciences must be recognized as essential to the understanding of the responsibilities, both personal and social, of the citizen. Good health, adequate growth and development, nutrition, food production, reproduction, heredity and environment, and the conservation of natural resources for use and for recreation are some of the topics appropriate to general education. These are biological rather than zoological or botanical topics, for they require fundamental knowledge drawn from both plant and animal kingdoms.

The more specialized a course is, the more difficult it becomes to select facts and principles which are most pertinent to the objectives of general education and to eliminate those of academic interest and those which have exaggerated significance in the minds of specialists who are unable to appreciate other objectives than their own. Biology, because it is more generalized than botany and zoology, thus lends itself better to general education than these specialized courses.

Furthermore, from a pedagogical standpoint, there is much to be gained in understanding and appreciation by the student if the living world is synthetically rather than analytically treated. Through common physiological phenomena and especially through ecological connections plants and animals, not excluding man, are bound in one great unit. Animals can not be thoroughly understood or appreciated without knowledge of plants; neither can plants be isolated from animals without losing much that is essential to a knowledge of their place in the world of man.

Because most of us have been trained as specialists it is easy for us to lose sight of the broader aspects of

the living world. Because biological knowledge was delivered to us in tight compartments, it is very difficult to reconstruct a unified science of biology. But such a science is possible and such a science, perhaps far from the perfection we desire, is being taught by many former zoologists and botanists who are becoming biologists. The process is not easy. It requires a thorough reeducation of the teacher. It may require new knowledge from unfamiliar fields; it demands a reassessment of values appropriate to new objectives; it means the discarding of some cherished "fundamentals" and the adoption of new ones; it may call for a rearrangement of topics and materials; and it may well suggest the exploration of new methods and techniques.

Admitting that some of the courses in general biology have been, as Dr. Shull declares, "a fraud against the student" and that many are not well unified, which are criticisms that might reasonably be directed towards other subjects, I am not ready to accept the dictum of Dr. Shull that biology is non-existent nor the pronouncements of others with whom biology is in disfavor. I think it will be found that courses in botany and zoology, on which Dr. Shull places his *nihil obstat,* are frequently no more unified than the worst of the biology courses.

It is true that the "existence of the word 'biology' does not mean that there is a well-unified science which can be so designated," but my own experience and that of others leave me with a strong conviction that much progress has been made towards unification and that " a better day will dawn" for the teaching of biological science as a result of the continued efforts of the general biologists to construct a unified course in biology.

As scientists, however, we should not be content to judge the merits of biology solely on the basis of opinions, pro and con. The opposing groups may have quite different objectives in mind, and we must first decide what we expect to accomplish by teaching the biological sciences. What I have in mind may differ from the ideas of other proponents of general biology. Even if we can agree on general objectives, it should be patent that subjective opinion for or against biology is not a sound basis for a final decision. Both hypotheses can and must be tested by properly planned and conducted educational experimentation before we can know whether we are accomplishing what we desire.

If I may be permitted to add a personal note, I should like to explain that I embarked unwillingly on the teaching of biology with ideas that were quite in agreement with those of Dr. Shull. In spite of early antagonisms which had been strongly conditioned as a result of my own specialized training, I have come to an entirely opposite opinion and a firm conviction that general biology courses merit the continued support of their adherents and greater tolerance on the part of those who oppose them.

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"HORSE SERUM" A COMPOUND WORD

THE discussion of "horse serum" has already reached considerable length, but it may be permissible to make one more point—namely, that every one concerned has misinterpreted the nature of the disputed phrase. It is not a case of one noun being used as an adjective to modify another; it is a compound noun, exactly analogous to such Greek compounds as thermometer. The first member takes the place, not of an adjective, but of a phrase. "Horse serum" is serum from a horse; "fence post" is post of a fence; "rat poison" is poison for rats. Thermometer, if its first member were adjectival, would mean a "hot meter," not a measure of heat. In most such cases, the compound has a special and definite meaning, not conveyed by an adjective and noun. Had this been understood, neither the original editorial faux pas nor the resultant burst of argument need have occurred. The author (or, if he forgot it, the editor) would merely have inserted a hyphen between "horse" and "serum" and all would have been well.

That the situation was not understood is partly because, though the use of compounds in place of prepositional or other phrases in English has increased in recent years by leaps and bounds, we have not yet developed a consistent or in any way adequate orthography for indicating them. This is admirably illustrated by the playful contributor who wrote "horse sense" and "horse-laugh" in the same sentence. The makers of the Century Dictionary perceived the usefulness of the hyphen as an indicator, but few have followed them. So long as we offend the verities by writing compounds as separate words—which they are not—we shall have confusion and wrangles like the present.

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CONCERNING THE RATE OF EVAPORATION OF WATER THROUGH ORIENTED MONOLAYERS ON WATER

I HAVE read with the greatest interest the monograph on "Surface Chemistry" just published by the American Association for the Advancement of Science. The excellent foreword by Dr. Moulton, emphasizing the importance of this new branch of science, reminded me of the man who, I think, can rightly be considered as the founder of this science, my old and