This conference hopes this work will be extended.

10. *Isostatic Investigations*

Investigations in the theory of isostasy have thrown much light on the subject of deviation from the normal densities in the outer portions of the earth, which is of importance in the study of geology, and in other branches of science.

Much can be added to our knowledge of this subject of isostasy by a mathematical reduction of existing field data, following well-known methods, which would involve only slight expense.

This conference urges, in the interest of geophysical and other sciences, the early reduction of existing geodetic data and the extension of geodetic field work to those regions of the Pacific where such data are now lacking.

This conference commends the Coast and Geodetic Survey of the United States, the Trigonometric Survey of India, and the Geodetic Survey of Canada for work they have done in isostatic investigations.

(To be continued)

BIOPHYSICS

THE need of liaison or coordination between the different but related branches of science is coming to be felt; and indeed may soon prove as great as the need of specialization. The physiologist has long been wont to consult the anatomist about the materials with which he deals, but though his subject consists largely in the physics of living matter, his contact with the physicist has been limited and often unsatisfactory. It is usually hard for the physicist and physiologist to speak the same language. Almost at the outset of the attempt at cooperation the physicist plunges into an entanglement of mathematical formulæ into which the physiologist can not follow him and from which he can not coax him out, and negotiations have to be broken off. The biologist—especially the physiologist—ought to be better grounded in physics, and the physicist would profit much if he knew something of the behavior of living matter and the physical properties in which it so strikingly differs from inanimate matter. Physiologists, even from good laboratories, often reveal ignorance of the physical terms they use by such mistakes as calling a pair of electrodes "an electrode," or transposing the terms abscissa and ordinate. Many use the electric current without sufficient understanding of its behavior to avoid some of the pitfalls into which it may lead them. Physicists on the other hand are usually so drilled in the analysis of the behavior of inanimate matter, which best lends itself to mathematical treatment, that it is hard for their minds to cope with such things as colloids, ameboid motion of protoplasm, action currents in nerve and muscle, reflex inhibition, color sense and many other phenomena which present features peculiar to life. I have seen a physicist, attempting to reduce the nerve impulse to the laws of electrical conduction in insulated cables, greet the suggestion that one must reckon with the electro-chemical condition of the protoplasmic colloid, with the answer that this was merely to relegate the nerve impulse to the realm of things we know nothing about and therefore can not analyze, and that consequently it was better to ignore colloidal chemistry. Thus ignorance of a great field of significant knowledge led to setting aside the kernel of the whole thing. I have heard of physicists being quite incredulous when told of certain well-established facts concerning the behavior of electrical charges in colloidal matter. The physicist who might have his eyes opened and his understanding broadened by a careful examination of vital phenomena, is apt to think these things are too vague and too impossible of quantitative study to merit his notice.

Physiology has sometimes been divided into bio-chemistry and bio-physics. Most research in physiology to-day is concerned rather with the chemical side of the subject than the physical side. Physiologists have effected better coordination with chemists than with physicists. But the branches of physiology abutting on the field of physics are many, and possibly offer as great a wealth of knowledge as those on the chemical side. For example there is the rich field of study concerning the permeability of cell membranes and the viscosity of protoplasm, subjects bearing intimately on the life and activities of all cells, and involving the methods of physics rather than chemistry; there is the study of stimulation and functional response in the excitable tissues, which, especially in its electrical aspects, requires much of the technique and knowledge of the physicist; there is the whole field of the special senses including physiological optics and color vision, all of which may properly be called biophysics; and there is the study of the effects of radiation of various sorts on cell structure and function. All these are large fields offering great possibilities of future development, into which the average biologist is but meagerly equipped to penetrate far without the aid of a physicist with whom he can cooperate in a state of mutual understanding.

How is the situation to be met Undoubtedly most biologists—especially physiologists—would do more effective work if they had given more time to the study of physics, but it is a question how much time they can afford to divert from biological study for this purpose. The physiologist who tries to approximate the training of the professonal physicist, will not have time to acquire the thorough knowledge of biology which he should have. The physicist who must first of all be expert in his own line, can not digress to explore the field of biology with the thoroughness necessary to see where his methods would yield a harvest of data valuable to biology and instructive to himself.

The best answer is probably to be found in cooperation between experts in the two fields. A well-trained physicist with more than average knowledge of biology, cooperating with a physiologist with a good elementary knowledge of physics, should make a team capable of doing valuable work in the field where physics and biology touch—the analysis of vital phenomena.

To this end there should be courses of instruction in biophysics adapted to bringing together the workers in the two fields. Physiology as taught in the best laboratories offers the nearest approach to this which at present exists in most universities. But in physiology the biological side strongly predominates; the physical technique taught is crude compared with that of the trained physicist, and there is little attention given to physical theory. Moreover, physiology is usually taught in medical schools, where it is made to conform to the needs of the prospective physician. Thus it is treated as an applied science rather than as a pure science; it is not primarily adapted as a preparation for research.

A course is being developed at Harvard which, it is hoped, will prove a useful step toward meeting this need. It is offered by the physics department under the designation "biophysics." Through cooperation between members of the departments of physics, zoology, botany and physiology and the Cancer Commission, it is intended that this course shall serve the students of both physics and biology, introducing to the physicists those phenomena whereby living matter shows its chief differences from all other matter, and some of those applications of physics to biology which promise to add substantially to our knowledge, and enabling the biologists to learn something of those aspects of physics which it is most important that they should know.

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SCIENTIFIC EVENTS

THE POWER RESOURCES OF CANADA

The Canadian Commission of Conservation is issuing a series of reports upon the power resources of the Dominion, the latest being "Water Powers of British Columbia." According to a review in the *Geographical Journal* it is a large volume of over 600 pages, illustrated by maps and photographs, and it deals with the subject (so far as present knowledge goes) in an exhaustive manner. A "General Introduction" discusses the value of water as a natural resource, explaining the