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RELATIONS OF THE AMERICAN ASSOCIATION TO THE NATIONAL ACADEMY[1]

THE advancement of science, for which both the National Academy and the American Association stands, has, in the last century, come to represent a great profession of many branches. The number of professional scientists has increased very remarkably in the last half-century in our country, and it continues to increase at an accelerated rate. Science is becoming recognized as one of the important professions. A young man may now look forward with assurance to a professional career in science.

The new science profession embraces both research and teaching, the securing of new knowledge and the distribution of knowledge that has already been secured. The two are obviously closely allied, but they represent different aspects of the advancement of science, both of which are necessary. Scientific research includes investigations of both the "pure" and the "applied" kinds and these also represent different aspects of the same general endeavor, although they are not readily separated when one attempts a categorical classification. And science teaching embraces many kinds of work; from elementary instruction to the guidance of candidates for the doctor's degree of a university, from special consultation to the giving of public lectures, from the writing of popular stories on science subjects to the preparation and editing of technical contributions in the several special branches.

Coordinate with the development of this complex professional field has developed an increasing need for the organization of scientists, which has been met by the formation of many special societies, each aiming to hasten the advance of science along a particular line or group of related lines. These are devoted to the advancement of the sciences rather than to the advancement of science. Their journals and their meetings are of and for specialists.

Before the advent of these societies mathematics and the natural sciences had their general organizations in the National Academy, the American Association, the American Philosophical Society, the American Academy and a number of state academies. Their meetings tended to bring together specialists

[1] Address given at the dinner of the National Academy of Sciences, at Urbana, Ill., October 19, 1927.

in widely different fields and their publications aimed to present scientific advance in the several branches of research without too much classification into specialized groups. In their later development these organizations have maintained themselves and some of them have retained great prestige and importance, but the growth of so many special societies, with their journals and their meetings and their dues, has undoubtedly detracted from the generalizing influence of the broader organizations.

In recent decades it has been realized and remarked by many minds that the unquestionably great gain to science that has resulted from the formation and activities of the special societies has not been secured without considerable and serious losses in the realm of scientific synthesis, in the broad appreciation of knowledge as a whole. I touch here on the frequently discussed problem of over-specialization in individual intellectual workers, which is reflected in our organizations. Modern specialization in science tends to promote remarkable ignorance and even intolerance in regard to fields not closely related to the one specialized in. I am reminded of a brilliant schoolmate of mine who did not care even to dip into the writings of Thomas Carlyle because he had not yet read all of what Charles Darwin had written. I am also reminded of a pungent remark once made to me by a Russian agricultural scientist trained under the imperial régime. "The staff members of your American bureaus and stations for agricultural research," he said, "are mainly uneducated experts." It has been very aptly said that "a specialist is a man who knows more and more about less and less."

Under the analytical influence, the American Association became subdivided into sections similar to those of the National Academy. Under the synthetic influence, as the special societies came forward, an arrangement was perfected by which, as affiliated organizations, they take part officially in directing the affairs of the association.

A further movement toward the interchange of ideas between different groups of specialists was inaugurated just before and during the Great War. Through cooperation of the National Academy and the American Association were organized the beginnings of the National Research Council, which has subsequently developed so satisfactorily and fruitfully under the leadership and sponsorship of this academy.

The association tries to further the interchange of ideas among scientists working on apparently divergent lines and it enjoys the cordial cooperation of the National Research Council. Wherever it has been in a position to do so the association has been glad to aid in work undertaken by the council. I must add, however, that my Washington office has, I fear, thus far received more help from Dr. Kellogg's office than his has received from mine. It is a pleasure to acknowledge at this time many valuable aids that have been had by the association from the Research Council.

Toward a further broadening of scientific specialization, if you will permit me to employ such an expression, we may work, I think, in about six general ways: (1) by bringing together scientists from different fields of science, as in committees of various kinds that may inaugurate and direct large movements and cooperative research projects, (2) by arranging and maintaining general-science publications for scientists, (3) by arranging scientific meetings for all kinds of scientists and others interested in science, (4) by encouraging an *esprit du corps* among scientific workers in general, (5) by undertaking to secure such modifications of the methods of school and college education and university training as may be promising and feasible, and (6) by aiding and encouraging the publication of popular but truthful accounts of scientific knowledge. All these lines of work are represented in projects that are engaging the attention of the National Academy and the association. The first is exemplified in the scientific divisions of the Research Council and in the sections of the association, in their efforts to maintain a sort of perpetual exchange among the different special societies and among different groups of research workers as well as among the individuals of each group.

An excellent example of a general-science publication calculated to encourage individual cooperation and to promote broader appreciation, is the American Association's official journal, SCIENCE. Throughout a third of a century, under the far-seeing and efficient guidance of Dr. Cattell, SCIENCE has added its increment of broadening influence week by week. It has played an important part in gaining and maintaining the membership of the association and one of the most tangible of the association's accomplishments is the arrangement by which this journal has so long been its official organ. As you all know, the present owner has generously made an agreement with the association by which the journal will eventually become the property of the organization. You are familiar with the *Proceedings* of the National Academy, which aims to secure wide circulation of original announcements of the results of American research among investigators in all branches of science. The publications of the National Research Council are also to be mentioned here with great appreciation.

The scientific meetings of the academy bring to-

gether many kinds of scientific workers and have always tended toward the end we are here considering. In a broader way the annual meetings of the association contribute in the same direction. By combining its meetings with those of many of the special societies the American Association has brought together probably the largest gatherings of all kinds of scientists that have ever occurred. The salutary influence of these conventions, where workers in widely different fields have opportunity to become mutually acquainted, can not, I think, be overestimated.

With their continued increase in size and complexity the annual meetings of the American Association are becoming a serious financial problem. Locally raised funds are generally very inadequate and dues and registration fees are purposely kept as low as possible. The association very much needs a substantial endowment for the holding of the annual meetings, which are surely almost a national necessity now and which can not be expected to be self-supporting. I should like here to make a personal suggestion that the National Academy might perhaps be interested to aid in finding means by which the effectiveness of these annual conventions may not be curtailed through too great economy.

Through the democratic nature of its organization and through the publication of its official journal the American Association cultivates the feeling among all of us scientific workers that we all belong together, no matter how wide may be the apparent separation of the scientific details with which we deal individually. We are now a happy family of nearly 15,000 members. In this part of our endeavor to bring science home to the scientists the National Research Council is also actively engaged.

The very fundamental project of improving the education of those who are soon to be the future scientists and appreciators of science is of course primarily the concern of the Education Section of the association. With that section are affiliated several societies, including the National Education Association. Other sections deal with the same project. A special committee of the American Association as a whole, on the place of science in education, is making a special study of present trends in this very important branch of scientific work, for the science of the future will depend on the education of the present. The National Research Council has also taken a prominent part in this line of work.

The general education of the public at large, in scientific matters, and the cultivation of public appreciation of what professional workers in science are trying to accomplish are being carried on especially by Science Service, for the guidance of which the National Academy, the National Research Council and the American Association are jointly responsible. An important feature of recent annual meetings of the association is a well organized news service, which aids the representatives of the press and other non-technical writers to secure information about the papers presented at the meeting and to make personal contacts with the scientists.

I have tried to bring before you some of the main ways in which an important present trend of the best scientific thought is being jointly supported by the National Academy and the American Association. The two organizations cooperate in many other ways and we hope that new ways may be developed from time to time. The select nature of the academy and its consequent reliability and prestige make it logically the upper house in the parliament of American science workers, as Cattell has remarked, while the democracy of the association and the fact that most young scientists, as well as those of riper experience, are enrolled as members and are actively interested in its work, make it logically the lower house.

BURTON E. LIVINGSTON

THE ACTIVITY OF NERVE[1]

UNTIL the nineteenth century practically all hypotheses as to the nature of conduction assigned to the nerve fiber a passive rôle. Energy or substance entered at one end and was carried to the other, where it produced its effect. In the middle of the eighteen hundreds the production of an electric change by nerve during activity was discovered; and later were found, first, the existence of a refractory phase for a few thousandths of a second after an impulse had passed during which a nerve could not transmit a second impulse, and, second, the independence of the intensity of the effect produced from the intensity of stimulus applied. These facts indicated the active participation of the nerve fiber in carrying the impulse. In the early years of this century it was further found that a nerve slowly lost its conductivity under conditions of asphyxia and recovered with oxygen, suggesting an oxidative basis for this activity. Attempts to follow the respiration of nerve were partly successful, but careful experiments failed to demonstrate the production of heat (which must accompany oxidations) during nervous activity, so the interpretation of chemical findings was rendered very uncertain.

The series of researches to be described,[2] carried out in the laboratories of Professors Hill and Meyerhof,

[1] Summary of a lecture delivered at the Biochemical Laboratory, Cambridge University, August 2, 1927.

[2] See R. W. Gerard, *Am. Jour. Physiol.*, LXXXII, 381, 1927, for further details and literature.