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METHODS OF SECURING BETTER CO-OPERATION BETWEEN GOVERNMENT AND LABORATORY ZOOLOGISTS IN THE SOLUTION OF PROBLEMS OF GENERAL OR NATIONAL IMPORTANCE[1]

THE accumulated experience of nearly fifty years enables the Bureau of Fisheries to speak with some degree of assurance and definiteness on relations with working zoologists of the universities.

It is a pleasure and an honor to have this opportunity to refer to the nature and value of those relations; to indicate the importance of continuing and broadening them; and to commend to less fortunate government agencies the advantage of enlisting in their work the active aid of university zoologists.

While other government institutions may have had intimate and continuous relations with university zoologists, I believe there has been no other federal bureau in which the cultivation of such relations has been such a definite and sustained policy as in the Bureau of Fisheries; and I am confident that no other bureau has secured more noteworthy results in this way. To state that we have had every reason to be well satisfied with this association

[1] A symposium before the American Society of Zoologists, held at Baltimore on December 26, 1918, Professor C. E. McClung presiding, included papers and discussions as follows: Representing the Bureau of Entomology, Dr. L. O. Howard. Discussion by J. G. Needham. Representing the Bureau of Fisheries, Dr. Hugh M. Smith. Discussion by Dr. H. B. Ward. Representing the Bureau of Animal Industry, Dr. B. H. Ransom. Discussion by Dr. Herbert Osborn. Representing the Bureau of Biological Survey, Dr. E. W. Nelson. Discussion by Dr. R. K. Nabours. Relation of the Council of National Defense and the National Research Council to the Advancement of Research, Dr. John C. Merriam.

is to express in mild terms what must be obvious to every one familiar with the facts.

As one consults the early records of the bureau and recalls the later activities and developments, the conclusion is inevitable that our relations with the laboratory zoologists have been not only invaluable but actually indispensable to us. There is some ground for the belief that zoologists have obtained a measure of profit from the cooperation, but there can be no doubt that the balance of benefits is on the government's side.

The mutual relations that have existed from the beginning have consisted essentially of (1) personal service rendered to the bureau by university zoologists for particular investigations or special duties and (2) the extension of facilities to zoologists—professors, instructors, students—for conducting investigations in laboratories, on vessels, or in the field.

The advantages of this arrangement from our standpoint are: (1) That we have been able to obtain the personal aid of men preeminently qualified for studying special problems, often at the time when those problems have been most pressing; and (2) that we have been able to secure this cooperation at a cost to the government that must be considerd merely nominal, for no funds provided by Congress would have been adequate to command such services had it been necessary to compensate them at their full worth.

It was at the very outset of our career that we enlisted the services of the university zoologist Verrill for fundamental systematic work on the invertebrate animals of the northeast coast, which work, though now necessarily obsolete, has remained a standard. Verrill was followed by a veritable host of university men engaged for essential systematic work on the fauna of the fresh and salt waters of the country and its outlying possessions, and by a similar host who dealt with almost every other phase of aquatic zoology. I need not extol or discuss their work. I will merely recall to you, as some of those university zoologists whose labors in behalf of the bureau have been fruitful, Gilbert, Jordan and Snyder in systematic ichthyology; Bigelow, Forbes, Hargitt, Holmes, Linton, J. P. Moore, Osburn, Sidney Smith and Wheeler in systematic invertebrate zoology; Birge, Bumpus, Dean, Grave, Greene, C. J. Herrick, F. H. Herrick, Kellogg, Kofoid, Lefevre, Mast, Mead, Parker, Pearse, Peck, Reighard, Ryder, Tower and Ward in anatomy, physiology, embryology, ecology and life history. This list is not by any means complete.

As for the future relations of the bureau with universities—and this is the important matter before us—we ask for a continuation of the existing cooperative spirit and, further, we hope that, as far as practicable, the university zoologists may adapt some of their own researches to subjects of directly useful application and, whenever possible, let creatures of obvious economic importance receive more attention in the regular laboratory courses. The universities will not fail to appreciate the great need, especially in the immediate future, for affording every possible aid to the material as well as the intellectual welfare of the country. The noble response of the universities to the country's call to service in the great crisis through which we have been passing—when hundreds of members of the faculties placed at the disposal of the government their technical and professional skill and knowledge for practical use in every branch of public activity—has made a deep and lasting impress on the nation and has had a particularly happy influence for government bureaus engaged in scientific work, and, at the same time, should not fail to produce a sympathetic attitude among university men toward laboratories established and maintained at public expense for the conduct of scientific work with a practical object or application. There should result a more general recognition of the fact that government scientific bureaus whose function is public service should properly concern themselves chiefly with the applications of science to public welfare, and should devote their energies to pure science only in so far as may be necessary to launch successful enterprises in applied science.

Without having had an opportunity to confer with university men on this special subject, I venture to offer some views and suggestions regarding a proposed cooperative arrangement between the zoological laboratories of the universities and the scientific bureaus of the government.

The universities can perform an invaluable service to the government by keeping in touch with the progress and demands of the applications of science in operations of the bureaus.

The government can render a useful service to the universities by keeping them informed of zoological problems with which the bureaus are confronted and of subjects in which the researches of pure science would be of value.

The results of university research that are of significant value to the government should be promptly communicated to the respective bureaus.

To render the proposed cooperation effective, there should be some kind of organization in which the universities and the government are adequately represented, to the end that the needs of the government are fully made known and the possibility of the universities' filling those needs is fully canvassed.

There might be maintained a catalogue or register of zoological students and instructors in the universities, with their peculiar qualifications and their special subjects of study, and a statement of the conditions under which they might accept government employment, and a catalog of current and proposed governmental zoological investigations, with an account of their objects, scope, duration, needed personnel, etc.

The definite aims to be met would be to locate men for permanent or temporary service in government bureaus and to encourage the pursuit of promising investigations. It not infrequently happens that the government has need for men of peculiar qualifications and fitness for special zoological work, and the usual method of advertisement fails to reach or appeal to available men well fitted for that work. A central organization or committee could locate such men and bring to their attention the government's needs.

It sometimes occurs that in the course of investigations in the commercial or technical aspects of zoology, lack of scientific data may impede or prevent progress, so that work must be suspended until the required data are obtained. At the same time it may, and probably not infrequently does, happen that advanced zoological students are in position to take up investigations where the subject is not of so much consequence as the training in research. In such cases the government bureaus may supply problems that will afford excellent research training to the students, give promise of definite results for publication, inspire students with the feeling that they are contributing to the general welfare, and at the same time expedite work undertaken by the government.

One of the real hindrances to the proper development of the fishery service is the difficulty in securing assistants who, with such a knowledge of zoology as is imparted in a university course, are willing to enter the lower grades, work their way upward, and make this subject their life work or at least give it serious thought for a reasonable time. In aquatic biology, in aquiculture, in the various branches of technology as applied to water products, there is an inviting field in which there is ample opportunity for interesting and important original investigation.

A drawback hitherto has been the comparatively low compensation paid. There are, however, certain perquisites that must be taken into consideration, and there is reason to hope that Congress will soon make a readjustment of salaries. Pending the time when various schools of fishery may be established at the universities on a par with schools of forestry, the universities can render a distinct service to the Bureau of Fisheries (and to the fishery departments of the various state governments) by making an effort to direct the attention of students and graduates to the inducements and attractions afforded by the government fishery work, and perhaps to adapt parts of zoological courses and the research work of graduate students to practical problems associated with the country's aquatic re-

sources. It can not impair, but may enhance, the value of zoological study or scientific research to have it deal with subjects that may have a direct practical value in commerce, industry, legislation or administration.

In the readjustment of national and international relations growing out of the Great War, the aquatic resources of the world are certain to assume a more prominent place than ever before. It appears to me that for Americans one of the real compensations of the war is going to be an increased appreciation of and dependence on aquatic foods, many of them hitherto neglected or spurned because of our ignorance, prejudice or wasteful habits. This new attitude, evidence of which already exists, if properly encouraged and directed, can become an important factor in our national life. Among the questions that arise are: How can our matchless water resources best be adapted to the country's and the world's needs? How shall they be most adequately utilized and at the same time preserved from dissipation, or, in other words, what steps should be taken by the federal government, in cooperation with the state governments, to secure maximum production consistent with an unimpaired source of supply?

The Bureau of Fisheries will need all possible outside assistance in meeting increased duties and responsibilities that have already begun to devolve upon it; and there will be a greater necessity than ever before arose to invoke the cooperation of practical zoologists in the elucidation of problems connected with the administration of the fisheries and the conduct of fishery and aquicultural enterprises. Knowing as I do the limitations that are necessarily imposed on the make-up of our permanent scientific staff, it seems to me to be incontrovertible that our ability to measure up to the situation and meet the needs of the coming years will depend in large part on our success in enlisting for personal service and sympathetic counsel the trained minds in the university zoological laboratories or the trained students sent therefrom.

H. M. Smith

Bureau of Fisheries,
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The most cordial relations have always existed between the zoologists of the country and the Bureau of Fisheries. When the bureau was established, its work was placed in charge of one who was recognized as a scientific authority and who commanded the support of investigators in zoology because of his scientific standing. The same recognition is accorded to the present head of the Bureau of Fisheries and to his able corps of assistants.

The characteristic feature of these relations, however, has been the individuality of the situation. Recognition has been given the individual leader by the individual investigator and that cooperation in the activities of the bureau, which has been referred to so cordially by Dr. Smith, has resulted from individual initiative, for the teacher or investigator has responded to the personal requests of the scientific leaders in the bureau. Now, admirable as these relations have been in many ways, I do not look upon the cooperation as the most effective which can be secured, for it has not been animated and directed by the institutions of the country which concern themselves with the training of investigators and with the encouragement of research.

So far as I know there have been no fixed and formal relations in the past between the government bureau and the public or private colleges and universities. The results which have come from individual initiative are so conspicuously satisfactory, however, that one may confidently look forward to much greater benefits, if more extended and definite relations can be established between the Bureau of Fisheries and the educational research institutions of the country. The next question is naturally the direction, scope and character of such relations as are likely to yield greater results.

The paper of Dr. Smith has justly emphasized the need for greater work on the problems of aquatic resources and their utilization for human welfare. No comment is needed to demonstrate the social significance of the present high prices of food and of the heavy draft on the world's reserve of food stuffs in consequence of the war. To counteract the reduction in food supplies and the increased prices

of food articles no movement offers greater hope than that which draws into the realm of human consumption new foods and thereby lessens the demand on old supplies while at the same time it offers for the dietary of man a greater variety than was included before.

This is precisely the work of the U. S. Bureau of Fisheries. In various ways it contributes to the perpetuation and increase of the supply of well-known and long-utilized varieties of food fishes while at the same time it endeavors to find and utilize unknown or undervalued aquatic products. It has met with marked success in both lines of activity; but to make further progress, especially in the direction of discovering and utilizing new kinds of fish, and perhaps also of other aquatic organisms, research must come in to demonstrate the what and how in the situation. The universities of this nation are already many of them organized for research and others have made partial progress in the achievement of that organization so that they are able to do the research that is needed with less expenditure of money, time and energy than any other agency, especially in comparison with a new organization that must be built from the ground up. Furthermore, the universities have a multitude of young workers eager to find opportunities for a future career, and hence likely to be attentive to the appeals from this new field. To realize all the possibilities of this movement, therefore, there is need of more effective cooperation as well as more extended and more active effort.

There are two real educational problems, or two real points of attack on the one great problem, which are outlined in the presentation of Dr. Smith: (1) Technical training of young men for this work. This involves the introduction of courses of study which shall fit them to carry on the work demanded by the U. S. Bureau of Fisheries and by the corresponding state organizations. (2) Organization of science to permit the exchange of knowledge and formulation of plans, as well as to secure cooperation in solving the problems.

In spite of what has been said by others today I feel sure that the future of research is bound to be different from its work in the past. In the past the dominant note in scientific work has been a high degree of individualism; in the future I believe it will be a pronounced tendency towards correlation in the investigation of significant problems. When the U. S. government brought together chemists in Washington and set them to work on poison gases in warfare, this action broke down the ancient barrier supposed to exist between any control over individual activity and success in research. It assigned men a prescribed problem—and you all know how successfully this was met and solved. Individual action which has been so general in the past will, in my opinion, disappear gradually until men in scientific circles are working not under restraint, but under some general direction in a joint attack on these problems, the solution of which is of evident and most immediate value for the human race.

Training Younger Men for Expert Work of Bureaus.—To furnish scientific training for attacking and solving the problems of existence is a characteristic function of our universities. These institutions have sought, in recent years at least, to keep in touch with applied science, perhaps chiefly along individual lines; but no one of our universities is without some work in applied science, and the various schools of agriculture, engineering and laboratory science have reached a development truly characteristic of those institutions. It is natural that a similar training should be provided for aquiculture. To be sure, there are certain limits to this as the demand in the field is small as compared with that in agriculture and the number of men interested in pursuing such work is limited. Furthermore, the funds in the possession of institutions are limited and it is impossible to enter on the study of all problems. But even after all has been said and done, one must recognize a real demand upon the university to furnish help in this evident and increasing need.

Let me emphasize at this point the fact that in the course of their growth universities must come naturally to the same sort of spe-

cialization that individuals have reached. It has been characteristic of the larger institutions rather generally in this country during the past that whenever any department or line of work was suggested by one institution, every other one has desired at once to introduce a similar department. Now, funds are and in future will be even more lacking for duplication of new departments and our universities must face the problem of teaching subjects for which they are naturally adapted by their location and the funds at their command. It is very likely also that new topics which are taken up by any institution will have in many cases a genetic relation to the history and previous program of the institution as well as to its geographic location and natural advantages. Other limiting and directing influences will readily suggest themselves without further discussion of this point. But however the matter is determined, there is sure to be in future university development a clear recognition of the fact that it is neither possible nor desirable for each institution to cover all fields of developing knowledge. And this principle applies clearly to the special question under consideration.

Courses in aquiculture must be established to train technical workers and those institutions should embark upon the work which are advantageously located to undertake it, all factors being considered. It is also important to note that such work may follow either one of two distinct lines. There will be courses of a general character to train the routine worker, and those of advanced character to train the research worker. There is evident need in both directions in order to prepare men for general purposes and also to carry on research and direct the work of the former group. The general training will naturally be given in special undergraduate courses, whereas the special work must be provided in courses for graduate students.

I should like to emphasize here the necessity of having the specific cooperation of the Bureau of Fisheries in order to make this work successful in either phase. A certain amount of technical practise is inseparable from proper training in this field. It already exists under the control of the bureau, and the proper type of organization will bring these two things together so that the student getting training along theoretical and laboratory lines will be able to secure practical work under the Bureau of Fisheries. This practical training might well be given during the summer months. There are opportunities for this practise in connection with the operation of egg taking and other work of the fish hatchery and with the problems of fish foods to be worked out in the new laboratory of the bureau. There are opportunities of this sort at many points already controlled by the bureau, which might be very appropriately utilized for training men registered in these special courses. The bureau already provides in part for taking in college students, associating them with this work and giving them manual training in those processes essential for work in practical fisheries problems.

May I point out one feature known to the bureau which has proved thus far difficult to handle well and which is conspicuous to the outsider as a weakness in the present organization. The helpers drawn into this summer work are often only casually interested in the problem or concerned merely in getting a pleasant summer vacation. They are not men who are so directly interested in fish culture problems as to desire to make this summer training a part of their general education for service in fisheries work. If these summer positions could be filled first of all by men who are seeking to secure thorough training for work as fishery experts and hence directly interested in the problems of the fisheries, the students would be advantaged in their work and the training given would not be incidental but would form part of a general program that would ultimately serve to advance the work of the bureau and fisheries interests in general.

Organization of Science.—I touch upon this theme with some hesitation. The National Research Council has given intensive study to the problem, and the opinions of an outsider are likely to be premature or to appear of little value in comparison with Dr. Merriam's.

Some work has already been done to bring into closer touch the research worker and the bureau. Many of the men before me have enjoyed from time to time opportunities for carrying out investigations at various laboratories and have gained immensely, not only in their own work but in the possibilities for training younger men to meet the needs of the service. There is a demand for a more definitely organized program, one calculated to bring the university laboratory with its pure science and the bureau with its applied science into definite and intimate contact. Two lines of attack are possible:

First, the end desired might be reached under the direction of the research council or some branch of it through discussion or correspondence. The gain would be very great. I merely suggest one of the evident disadvantages in such a plan. It throws a heavy burden of labor on some central committee. Its success depends upon the existence of a machinery functioning actively enough to carry out all the processes of conveying the information and coordinating the plans. Furthermore, it suffers the disadvantage of being at times subject to the difficulties due to imperfect understanding. Men express themselves so differently that what is found on the written page is sometimes interpreted in a different way than was intended. This may be followed by a further waste of time spent in explanations. Extensive discussions in modern science have arisen from this very cause and the result is evident loss of energy.

The second method, which looks more likely to be successful, is a plan for having a divisional board of ten, fifteen or twenty members, which should be representative of different parts of the country, different institutions, different lines of work, and different regions that come in contact with different phases of existence—a board to have meetings as a general body and able to have personal conferences with representatives of the Bureau of Fisheries. The advantages of personal contact seem to make this a more profitable line of attack than the other, though I am not blind to the difficulties in both suggestions. Personal discussion brings up new points of view and yields keener analyses of any situation; it provides, I believe, means for meeting difficulties more readily than methods of conference by letter.

I want to indicate clearly, however, that if such a plan is to be tried this board must be directly subject to the Bureau of Fisheries. I am confident that the history of the past shows that no undesirable connotation can be attached to the words "subject to." The bureau has responsibility for these problems given it by the people and should have the final authority in such an arrangement. It should have freedom to suggest where in its experience certain plans do not seem to be feasible.

It would be possible for such a body to hold sectional or topical conferences for the discussion of problems important in a particular region or for the solution by joint action of a question of serious import at a particular time. The membership of such conferences could be specifically determined with reference to the special need and the definite questions that demanded experimental investigation or laboratory study to be taken back to the universities for research and report at some later date. Other advantages will evidently accrue from this association of technical experts and scientific investigators in a board which could outline a plan of active and direct procedure with a view to securing the necessary knowledge whether it was already in existence or had to be worked out by investigators properly equipped with library and laboratory facilities.

Such a board would exert a powerful influence outside of that which it might have in developing a program; it would possess power to push those lines of activity which are seen on analysis to be not only right but essential. Important items often appeal to men in legislative halls or to the general public as being quite unnecessary or even foolish. A board representing the public at large would give a weight to its views that could not be imparted to them in any other way.

Of course, one has to consider also another aspect of the question. It is inevitable that

attempts be made from time to time to force the introduction of unwise policies and the modification of well-planned organization; these influences may emanate from political centers and sources that are unfortunate. At best such influences delay the progress of scientific investigation and the application of scientific methods, in this instance to the Bureau of Fisheries; at worst they destroy work built up by laborious efforts in the past. We must be awake to the need not only for building an organization and for securing the best so that it can weather the shifting of political results but also for directing the organization parties and of public opinion in politics.

Henry B. Ward

MEDICINE, A DETERMINING FACTOR IN WAR[1]

The death rate in our Civil War of killed and dying of wounds is given as thirty-three per thousand, the disease death rate as sixty-five. In the Spanish War the death rate from battle is five and the death rate from disease 30.4 per thousand. In the present war, taking the statistics up to March 28, 1919, we find the rate of death from wounds received in action is 14.191 and that of death from disease is 14.797 per thousand. This includes the army on both sides of the ocean. The statistics of the American Expeditionary Forces, with an average strength of 975,716, reveal a rate of death from wounds in action of 31.256 per thousand and a death rate from disease of 11.233. Of those who died of disease, pneumonia claimed 9.146 per thousand.

Studying comparatively the diseases of the American armies during the Civil War, Spanish-American War and the recent war, we find that malaria was one of the chief causes of disability in both the Civil War and the Spanish-American War, though it caused but 6 per cent. of the deaths in the Civil War and but 10 per cent. in the Spanish-American War. But in the recent war malaria has caused such a small number of deaths that it is not given in detail, but is put into the aggregate term of "other diseases." Typhoid fever, with typho-malaria, so called, was one of the chief causes of death from disease in both the Civil War and the Spanish-American War, causing 22.4 per cent. of the deaths of the Civil War, and being the one great uncontrolled epidemic of the Spanish-American War, causing in the fighting period of the latter war 60.5 per cent. of all deaths. But in the recent war only 0.4 per cent. of the deaths are chargeable to this scourge. Pneumonia, on the other hand, causing only 13 per cent. of the deaths during the four years of the Civil War and only 3 per cent. in five months of the Spanish-American War, has become the dreaded epidemic of the recent war, causing in the American army 85 per cent. of all deaths from disease. In the Civil War, meningitis caused 2 per cent. of the deaths, and 2 per cent. of the deaths in the Spanish-American War, and it caused 4 per cent. of the deaths in this war. Smallpox caused 4 per cent. of the deaths in the Civil War; in the Spanish-American War, one man died of this disease; in this war, one man died from smallpox in the United States and five in France. In 1918 and in the first months of 1919, there were 102 patients with smallpox admitted to the hospitals in the United States. These patients came into the various camps from civil life, for the disease developed among the recruits before they could be vaccinated and thus protected, but it has not developed at all among the vaccinated troops in the United States. Dysentery caused 28 per cent. of the deaths in the Civil War, and nearly 30 per cent. (29.3 per cent.) of the 5,600,000 cases of disease reported in that war. In the Spanish-American War it caused 5.6 per cent. of the deaths. But it caused only forty-one deaths out of 48,000 cases, or 0.08 per cent. of the deaths in the recent war. The transmission of yellow fever by mosquitoes does not come into consideration in the recent war, though there were small epidemics of this disease in both the former wars, there being about 1,300 cases in the Civil War and about 1,100 in the Spanish-American War.

There is one achievement by the Medical

[1] From the presidential address of Dr. Alexander Lambert given at the Atlantic City Meeting of the American Medical Association and printed in the *Journal* of the association.