

# SYMPOSIUM ON SCIENCE AND RECONSTRUCTION

## THE EFFECTS OF THE WAR ON SCIENCE AND THE OPPORTUNITIES AND RESPONSIBILITIES OF SCIENCE UNDER THE NEW ORDER OF THINGS

### ZOOLOGY

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In a sense the effects of the war on the science of zoology are not very different from those it exerted upon other branches of science. In many particulars identical results have followed. The expenses of maintaining work have increased with astonishing rapidity. The number of workers available has been cut down so greatly that many lines of activity have been necessarily suspended if not actually abandoned, and it is hard to see how the pre-war organization can be re-established. In any event it will require considerable increase in endowments and appropriations to finance the work that was under way when the conflict broke on the world. In case new activities are necessitated by the war, as appears to many to be urgently needed, then an even greater increase in financial support will be required. In certain ways the monetary aspect impresses itself most forcibly on those who are in charge of work in institutions for teaching and research.

I do not attach any special significance to the fact that in some such institutions the staff has been depleted in its higher ranks in that men have been called to assume duties in connection with some branch of warfare that demanded the services of an expert zoologist. This has been true, of course, but at the close of the war many such men will return to their old positions and if some have been attracted away from university and college life to what seemed to them to be larger opportunities in other fields, this loss can be made good by advancing those of subordinate grade who have demonstrated their fitness in the meanwhile. The period of pressure during continuance of the war was exceptionally well calculated to test the fitness of men for larger responsibilities and to prepare them rapidly for the assumption of such duties. While in a narrow sense they are lost to our science, yet in the broader influence they are enabled to exert zoology will profit.

To one who examines carefully the entire field both in teaching and in research, the most serious element in the situation seems to be the failure of the stream of recruits to the profession at its sources. Those undergraduates who were in position to be attracted by the opportunities of graduate work in zoology have had their attention diverted to other lines by influences so powerful that in the majority of cases they will not turn back. Those graduate students who were in preparation for the duties of teaching and research have largely been called upon to take up work in other lines and many of them have become so thoroughly entrenched in other fields that they will hesitate to assume the loss incident to the transfer to another line of activity, even if that be the field in which they were interested of old. With the coming of the war the undergraduate body was greatly reduced in numbers, but the enrollment of the graduate schools was affected far more seriously. In zoology at least the enrollment in various institutions fell off from 20 to 90 per cent and those who were left were by no means sufficient to meet even the limited demand for the services of graduate students in this field during war times. The numbers now available will be entirely inadequate to supply the needs for the instructional staff that is sure to be demanded in the period immediately after the war.

Furthermore, the stipends of such positions have always been low, and in comparison with the greatly reduced purchasing power of money, which does not seem likely to be increased in the near future, these positions will not only be much less attractive but are likely to prove impossible for such as previously sought to secure them. While ten years ago or less the stipends furnished were adequate to provide, though scantily, for the actual expenses of the graduate student, now they must be supplemented very considerably to meet even the most modest requirements of such workers. In the face of opportunities on every hand to secure occupations in other lines with generous stipends, the practical disadvantage will deter many from going back to graduate study. They will give up, accordingly, their plans for an academic career and leave the sources of professional assistants seriously depleted. When it is considered that under the requirements for the Ph.D. degree, which in the majority of good institutions has been a condition for entrance to the faculty in

zoology, a student is obligated to spend at least seven years in training beyond the completion of the high-school course and to reach an age of 25 or 26 years before becoming in any degree self-supporting. All must realize that the present salaries paid to members of our teaching staffs are so inadequate as to deter men from entering upon the career unless they are in possession of private means and are moved by an overwhelming desire to devote themselves to this field of work. Once that the supply of trained workers is reduced, it will require considerable time to restore it to proper dimensions because of the time element involved.

During the war period zoology has not experienced the same stimulating effects that have influenced the development of chemistry and physics, for its relation to practical aspects of warfare are not so direct and so striking. It would be wrong, however, to pass over the indirect influence which has been exerted upon it by the general stimulation of war conditions, and the need for efficient workers and dependable work. It is not too much to say that every worker in scientific fields has been impressed with the necessity of pushing his investigations as rapidly as possible and securing the maximum results with the time and energy at his disposal. The drive of the war, which has influenced greatly every phase of human activity, has been to a considerable extent free from the serious effects of pressure under other conditions by reason of the exacting demand for precision and accuracy, and the rigid test to which all the results have been put before they were utilized in a practical way. This increased intensity of effort and emphasis upon the quality of results achieved has, I think, been evident in every field and constitutes a helpful influence for the development of zoological research in the future as well as in the immediate present. The standards necessarily set in war work will serve a good purpose for the development of science in the next period of its activity.

The universal emphasis upon the conservation of natural resources, including human life, and upon the application of discoveries to the elimination of every possible waste and the development of every obtainable advantage in the struggle, has exercised a specific and important influence upon zoology, even though biological work had a less immediate bearing upon the situation than did the work in

some other fields of science. It was what are sometimes denominated as the practical or applied aspects of this science that have been particularly emphasized and developed. Specific examples of this may be taken from various parts of the field.

Thus, the need of conserving and even increasing as largely as possible the food supplies of the nation led to research inquiry into those influences which tend to reduce the numbers of food animals and thus deplete the food supply. A study of the national bill-of-fare, as shown by the statistics of commerce in food articles, indicated at once that the population of the central area of the United States consumed on the average a very much smaller supply of fish as food than was utilized by most other countries in the world. Further inquiry into the situation indicated the presence of numbers of different kinds of fish that were utilized only exceptionally, if at all, as human food. Experimental data furnish in various ways the evidence that among these types of fish which were neglected or scorned were various sorts that possessed qualities of flesh and flavor such as to make them admirable articles of food. It appeared in the examination of the situation that prejudices of one type or another interfered with the use of these fish, and a campaign of publicity which utilized zoological as well as psychological influences resulted in largely increased consumption of types of fish that were previously utilized as well as created a demand for species that had never been included in the human bill-of-fare.

Improvements in methods of catching, preserving, distributing, marketing, and preparing various fish foods were included in this campaign, and the demand for better knowledge of the species of fish, of their distribution and habits made demands upon zoological investigators familiar with this group that could be met in part only by examination and critique of existing data and demanded as well renewed study of the fish and their distribution, food, environment and habits.

It is evident that the same general problem demanded a reconsideration and improvement of the methods which were in vogue for maintaining and increasing the number of fish. As a result hatchery methods, the plans for obtaining supplies of fish eggs and for planting them under favorable conditions, the possibility of finding unutilized

environments for breeding food fishes, and a host of other similar questions came up for attention among those who were previously working on such problems and also forced themselves upon the notice of others who had not before been concerned in the study of applied ichthyology.

As this field of investigation was being brought more fully to the attention of biologists, one factor which had previously been emphasized without having won effective notice attracted general attention as of distinct importance. Pollution of our streams by domestic and industrial wastes had often been pointed out as a source of damage to the fish life and thus, indirectly, to the general public. So long as food was abundant and the loss could be replaced readily by food supplies drawn from other sources, the significance of the draft upon the nation by reason of the pollution of its waters did not seem to demand particular attention. Under the changed circumstances the loss became significant and the situation was still further modified in an unfavorable way by another factor. As necessary adjuncts of war activities, numerous plants for the manufacture of chemicals had sprung into existence. Utilizing processes marked by their efficiency in terms of time rather than by their ultimate effectiveness, they were paying no attention to the by-products that were produced in connection with the main processes, and were dumping into streams enormous quantities of chemical substances that exerted conspicuous and serious effects on the life of the waters. Attention was thus still more forcibly directed to the need of controlling waste products and avoiding the damage produced by them. The opportunity afforded for scientific study was great, but few were free to take up the problems intensively and the desired results are evidently to be looked for in the future rather than immediately. The urgency of war production was in many minds a sufficient answer to the complaint of loss resulting from the situation, and while some record has been made of the losses incurred both in the industries themselves through the wastage of valuable by-products and to the public in general through the destruction of areas adapted to the propagation and growth of food fishes as well as in various other ways that are indirect, though very real, it is only now that conditions are really favorable for investigating the ways in which the loss can be prevented and the pollution cleaned up.

Perhaps the most conspicuous field in which the war influenced the development of zoological science was that dealing with the relations of animals to disease. It became of paramount importance to preserve the health of the soldier. The conditions under which he worked had been in previous wars characterized by a striking increase in the amount of disease, even to the extent of incapacitating armies and defeating well-planned military campaigns. Within rather recent times the investigations of the relations of animals to disease had resulted in disclosing an essential connection between certain types of animal life and specific maladies. It was known that some of the diseases which had threatened the existence of the soldier in previous wars depended absolutely upon specific types of animals for transmission. In other cases where the demonstration had not been made so directly, there was reason to believe that similar relations existed. In the study of the relations of animals to disease, which, was inaugurated and pressed with intensity in connection with the health service of all fighting forces discoveries of striking magnitude were made.

Because of their evident and immediate relation to the welfare of man these discoveries are sure to exert a powerful influence upon the trend of scientific research. They have aroused widespread interest among workers in other fields and have given a significance to work of this type which assures it a permanent place among the research activities in zoology.