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THE VERTEBRATE ZOOLOGIST AND NATIONAL EFFICIENCY

THE American government having been forced into the war, it is the privilege of American scientific institutions and of the army of American scientific men to adapt themselves at once to the new conditions, and to hold themselves in readiness to serve wherever their contribution is most needed.

At no time in the world's history has the necessity of thoroughgoing scientific preparation been emphasized as it is at present. For some time it has been clear that the war is a war of physics and chemistry. The pressing agricultural and medical problems of to-day make it sharply apparent that the war is no less a war of biology. Other things being equal, those national groups win which are best prepared scientifically.

A moment's consideration of certain problems, chiefly agricultural, which the war has thrown into strong relief serves to demonstrate the essentiality of knowledge of the complicated relations between man and his environment. By furnishing aggressive and intelligent leadership in this province the vertebrate zoologist can make a contribution of supreme and immediate importance to the national efficiency.

We may now proceed to discuss five propositions which stand out predominantly in this connection.

First, the possibility of the development of new resources in food or clothing is indubitable; there is no great hope for the successful elaboration of plans looking to this end, however, without intimate knowledge of the wild stock which it is proposed to domesticate or otherwise develop.

The Biological Survey has on more than one occasion called attention to the vast possibilities in wild game mammals as a source of food. Of interest in connection with the present critical shortage in the food supply of the world are the following words of Lantz[1] written in 1910:

> It is believed that with proper encouragement much of the otherwise waste land in the United States may be made to yield profitable returns from the production of venison, and that this excellent and nutritious meat, instead of being denied to 99 per cent. of the population of the country, may become a common food product.

The Honorable Franklin K. Lane, Secretary of the Interior, as reported by the daily press, recently called attention to the reindeer as a possible source of increased food supply. It has been lately suggested by J. B. Harkin, commissioner of parks for the Dominion of Canada,[2] that the barren-ground caribou, 20,000,000 strong, constitute a valuable potential meat supply. Some years ago Mr. Charles Goodnight, of Goodnight, Texas, conducted some most promising breeding experiments with the buffalo, crossing the animals principally with Polled Angus cattle, and securing fertile hybrids which ate less, put on more flesh with the same amount of food, cut more meat, and were subject to fewer diseases than the steer. Similar experiments have been carried forward by C. J. Jones, of Topeka, Kansas, and Mossom Boyd, of Bobcaygeon, Ontario, Canada, and are now being prosecuted by the Canadian Department of Agriculture. It is hoped that there may be produced an improved range animal, having 100 pounds more meat than the steer, and in addition possessing the valuable robe and rustling ability of the buffalo. The American Breeder's Association has gone on record as appreciative of the possibilities of increasing our national food supply through fuller utilization by domestication of wild birds and mammals. A recent writer in Science (Needham, April 20, 1917) wisely argues that the possibilities of undeveloped economic values in the wild species constitute an important argument for their preservation.

Second, since life is an active process, and new adaptations and adjustments are continually appearing in the complex of living things about us, man must be alert and on guard against new parasites and disease germs of one sort or another, which may be borne and distributed by animal hosts, either to valuable live stock or to man himself.

While the rôle of flies and mosquitoes as bearers of disease is well understood, that of certain mammals is not fully appreciated. In the Old World the rat is chiefly responsible for the spread of bubonic plague through its acting as host to the flea, which is the direct agent of transmission of the disease to the human being. The introduction of plague into the United States has been threatened at least once, in Seattle in 1915, and has actually occurred twice, in San Francisco in 1907–08 and in New Orleans in 1914. The most serious of these introductions took place in San Francisco and vicinity, where a part of the ground squirrel (*Citellus beecheyi*) population became infected from the rats, and threatened to disseminate the plague widely through the state. Attention has already been called to the fact that probably all kinds of rat fleas transmit plague.[3] The susceptibility to the disease of the fleas of ground squirrels suggests the possibility that the fleas of other rodents also may be potential transmitters of plague.

In addition to their plague-bearing proclivities, rats disseminate trichinosis among

[1] Biol. Surv. Bull. 36, p. 59.

[2] *Bull. Amer. Game Prot. Assn.*, May 1, 1917, p. 8.

[3] *Biol. Surv. Bull.* 33, 1909, p. 32.

swine; and a note in *Nature*[4] suggests that the causative organism of epidemic jaundice, which has occurred of late on the western front in Europe, probably has its natural habitat in the rat. Examples of other mammal-borne diseases are found in the Rocky Mountain spotted fever, transmitted through the agency of ticks borne by rodents in Montana and Idaho, and rabies, carried by coyotes and dogs in Nevada and California.

Third, the resources of nature are distinctly limited in amount, and man should know what and where these resources are, that accurate determination may be made of the amount and kind of use which may be permitted as being compatible with a regard for the rights of all the people, and of future generations.

In the matter of conservation of her natural resources America has been perhaps the most backward of all civilized peoples. She has permitted undue exploitation of all of her resources by selfish commercialism. In no province is this more apparent than in that of the wild life, where it is well known that some of the most valuable and interesting mammals and birds have been exterminated, and others dangerously reduced.

Fourth, the perpetuation of interesting and rejuvenating natural objects, including scenery, forests and wild life, demands detailed and accurate knowledge of all the objects to be preserved.

Many signs indicate that the people are coming to realize, as never before, the recreative value of the preservation of nature. The hearty support given the Department of the Interior in its epoch-making work for the national parks and that accorded the Department of Agriculture in its comprehensive forest, bird and game protective activities are full of meaning in this connection.

[4] January 18, 1917, p. 393.

Fifth, a more intensive agriculture brings man into more strenuous competition with certain insect and mammalian pests; for the successful maintenance of farming and horticulture man must know both his friends and enemies in the animal world; he must be prepared to perpetuate beneficial species, and he must be ready to control or exterminate those which are detrimental.

Disturbance of the balance of nature, having to do with increased competition between man and certain pests, is effected in several ways, of which the following are important: Destruction of carnivorous or predatory birds and mammals; reduction in numbers of game birds and mammals; introduction of useful domesticated species of plants and animals; involuntary or mistaken introduction of harmful exotic species of plants and animals; cultivation of the soil and the raising of crops; removal of the natural cover of forest and brush.

Some of these disturbing factors, notably the increase in the supply of rodent food provided by growing crops, and, all too often, the ill-advised destruction of natural checks on rodent increase, such as hawks, owls, badgers, skunks, weasels and other predatory animals, indicate that rodent outbreaks may be expected to occur more frequently in the future than they have in the past, and it is well known that plagues of rodents have harassed mankind at intervals since the dawn of history.

In Nevada in 1907 and 1908 meadow mice of the genus *Microtus* overran four fifths of the cultivated area in the lower Humboldt valley leaving a "dismal scene of destruction," and necessitating the complete replanting of much alfalfa land.[5] Depredations of cotton rats (*Sigmodon*) in certain sections of the middle west, notably southern Kansas and Oklahoma, in the

[5] Piper, Yearbook, U. S. Department of Agriculture for 1908, 1909, p. 302.

spring of 1915–16, were so severe that in some instances no less than three plantings of corn had to be made.[6] A serious outbreak occurred during 1916 in the province of Foggia in Apulia, Italy,[7] where the grain crop is reported to have been almost entirely destroyed by inordinate increase of voles of the genus *Pitymys;* and in the fertile Shenandoah valley, Virginia, where a thriving fruit industry is conducted, mice belonging to the same genus have become so abundant and so troublesome during the spring of 1917 that in some orchards they have girdled and killed seventy-five per cent. of the trees.[7]

That the steady drain upon our agricultural products caused by various noxious rodents over a large part of the country when present in normal numbers is of even greater consequence to our agricultural welfare than the damage from plagues has already been emphasized by Lantz.[8] Some idea of the extent of this damage may be gained from the following figures, gathered recently by the chief of the Biological Survey.

The annual loss to grain crops through the agency of ground squirrels in North Dakota on the basis of present prices is estimated by authorities at the State Experiment Station to aggregate more than $6,000,000.

A. E. Bowman, director of the State Agricultural Extension Service, Wyoming, states that 15 per cent. of the crops within that state are destroyed annually by rodents.

The annual losses from rodents in the state of Kansas are placed at $12,000,000.

The department of biology of the Montana Agricultural College estimates that the crops in that state suffer annual losses through ravages of rodents amounting to $15,000,000 to $20,000,000.

These are isolated reports concerning a situation which is general; a conservative estimate places the probable losses to agriculture from noxious native rodents in the western and Pacific states alone at more than $100,000,000 annually.

In 1909 fire losses and losses to grains and other merchandise due to European rats and mice were estimated to aggregate $59,917,000 annually.[9] Assuming that the amount of damage done by these rodents is approximately the same now as then, it is not improbable, at present prices of grain and other merchandise, that the annual losses will aggregate at least $100,000,000. Suggestions made by Creel[10] and Forbush[11] indicate that even this figure may be far too low. The former estimates that each rat costs one half a cent per day, or $1.82 per year, to feed; and the latter calls attention to the fact that on the basis of Creel's estimate, assuming that the rat population is the same as the human population, the annual cost to the country is $182,000,000; and both these suggestions were made when the price of wheat was less than half what it is at present.

The cogency of these facts is more than ever apparent during the present growing season. Weather conditions have been unfavorable, labor is scarce and the winter wheat crop is reported to be the shortest in years. All practicable steps should be taken, not only to increase acreage, but to guard against local or general plagues of insects or rodents, and to cut down to the minimum the enormous losses which heretofore have occurred continuously. The saving of grain which will be effected through

[6] Reported by Professor D. E. Lantz, Biological Survey.

[7] *Nature,* December 28, 1916, p. 338.

[8] *Biol. Surv. Bull.* 31, 1907, p. 8.

[9] C. Hart Merriam, Rept. Nat. Conservation Commission, Vol. 3, pp. 339–340.

[10] U. S. Public Health Reports, 28, 1913, p. 1405.

[11] Bull. No. 1, Econ. Biol., Mass. Board of Agriculture, 1915, p. 25.

up-to-date and aggressive methods of rodent control will furnish an increased food supply for America and her Allies which will help to guarantee just that margin of advantage in the world struggle which will be necessary to victory.

Essential to action regarding any of the problems discussed in this paper, whether the domestication of and development of new resources from wild stocks, the protection or propagation of those which are beneficial, or the control or destruction of detrimental species, is an intimate and accurate knowledge of nature. And this knowledge can only come, in any comprehensive and authoritative way, through the collection of series of specimens, with the associated study, in field and laboratory, of the distribution, systematic relationships, habits, economic status and ecology of the animals concerned.

The present-day organization of American science delegates this task to the vertebrate zoologist in college or university, museum of natural history, or government laboratory.

It should ever be the obligation of the scientific man to labor for the public good. With a world to help feed, and a war to help win, it now becomes peculiarly the duty and privilege of the American scientific man to make increased practical application of technical information, in short, to furnish a large measure of cooperation and leadership in the struggle to make democracy efficient and so to secure the benefits of government by the people for the nations of to-day and the generations of the future.

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BIOLOGICAL SURVEY

THE STATUS OF THE GRADUATE DEGREE IN MEDICINE[1]

THE University of Minnesota is offering graduate work in the various fields of medicine and surgery in three-year courses open to students who already possess the bachelor's degree, or its equivalent, the doctor's degree in medicine from a Class "A" medical school, and who have had at least one year's internship in a general hospital or a year's service in an approved laboratory of the medical sciences. On the satisfactory completion of such a three-year course, the student is eligible for the degree of Doctor of Science in internal medicine, in surgery, in pathology, or in whatsoever other branch of medicine he may have chosen his major subject.

The status of this new degree of Doctor of Science in a medical specialty has not yet been determined; hence the following analysis and discussion. Since the conditions laid down regarding admission, residence, language requirements, thesis and examinations are those which have long been applied by graduate schools of universities in the approval of candidates for the degrees of Doctor of Philosophy or Doctor of Science, it has been assumed by some that the new degree in medicine scholastically reaches only the level of these older degrees. This assumption would seem to be incorrect, first because of the longer time required to obtain the degree, and, second, because of the scientific ability exhibited by men with only the formal schooling represented by the doctorate in medicine or the baccalaureate in arts or sciences.

In the following diagram is shown the relationship in point of time required for the attainment of the M.D. degree in schools with the "Minnesota standard" and the attainment of the Ph.D. degree in universities in general, as well as the additional time required for the attainment of the new degree of Doctor of Science in a medical specialty.

It will be noted from the diagram that four students, *A*, *B*, *C* and *D*, who have had the necessary high-school or other preparatory training, enter the college of literature, science and the arts of the university at the same time and pursue regularly prescribed courses. At the end of two years in college, during which time he has taken a preponderance of prescribed physical, chemical and biological studies, *A* transfers to the medical school, and

[1] Presented before the Minnesota Academy of Medicine, St. Paul, Minnesota, October 11, 1916.