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CONTRIBUTIONS OF ZOOLOGY TO HUMAN WELFARE[1]

MY colleagues in this symposium have emphasized the important contributions to human welfare which have come from zoological research and the application of the resulting discoveries. On the contrary, I shall tend to stress the contributions which biology, and in particular zoology, may make through education which aims to extend scientific knowledge to everybody. Moreover, my colleagues have chosen to speak concerning the contributions of zoology to human welfare in lines which are directly useful with reference to the physical well-being of the human race. Hence they have emphasized the practical bearings of zoological science in its applications to the production of useful animals and plants and in the relations of certain animals to human health. In short, a strong case has been made for zoology as a science which has immensely important contributions to the economic and hygienic welfare of the human race. With all this emphasis on zoology in its direct material or physical bearings on human life, I most heartily agree. As a matter of education, I believe in "applied zoology" which stresses the science of animals as they economically or hygienically affect mankind; but I regard zoology limited to its direct material usefulness, to its contributions to physical human welfare, as failing to develop the possibilities of the science as it may affect racial welfare and intellectual welfare. Hence, I have devoted my paper to zool-

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ogy (1) as it concerns human intellectual welfare and (2) as it concerns racial welfare.

I. BIOLOGY AND INTELLECTUAL LIFE

One who studies critically the educational essays of the pioneer educator-biologist, Thomas Henry Huxley, must be deeply impressed with the important relations and possible applications of biology to daily life. In Huxley's remarkable address, "The Educational Value of the Natural History Sciences," delivered in 1854, and in those maturer ones, "On the Study of Biology," in 1876, and "Science and Culture," in 1880, Huxley grasped the vast significance of biology in relation to human life at the fullest development of its physical, intellectual, ethical, moral, and esthetic possibilities. Looking, as he always did, at human life and science and education with a far-reaching vision, Huxley needed for his own estimate of the value of science no such a sharp distinction between pure science and applied science as has become common in these later years. To most educated people to-day the terms "applied science" or "practical science" suggest some phase of technology, such as industrial chemistry, or electrical engineering, or scientific housekeeping, or modern agriculture, or hygienic problems; in short, applied science now commonly means the use of science in the material or physical affairs of life. Rarely indeed do we now find educational discussions which consider science as applicable to the intellectual and emotional aspects of the life of educated citizens. No such a limited view of applied science appealed to Huxley. He saw clearly many applications of science, and of biology in particular, to the intellectual and emotional aspects of life in addition to the physical or material welfare to which he often gave appropriate emphasis. I refer especially to his lecture "On the Study of Biology," only one of many lectures in which he showed that to him biology had an applied or practical bearing on our lives through the intellectual or philosophical problems which evolution and other scientific doctrines have forced to the attention of most well-educated people. Huxley illustrated his view of the higher intellectual value of biology as applied science by pointing out the great significance to intelligent people of the evolutionary theory of man's relation to nature. Evidently, this theory has nothing to do with biology applied to the material affairs which affect our physical welfare, for it is of no value in hygiene, agriculture, or other practical applications of biology; but I think that most of us will agree that courses which do not open up for students the great intellectual value of evolution and other biological theories do not deserve to be named either pure biology or applied biology. In fact, I have come to believe that no phase of biology which has a purely physical application to human welfare, such as bacteria and disease, or biology applied to agriculture, is more important for the *average* educated citizen than a general understanding of the evolution theory. Hence, I urge that our conception of applied biology for general education must be large enough to include the intellectual as well as the more directly practical aspects which affect human welfare economically and hygienically.

Summarizing Huxley's views of biology as applied science, biological knowledge is practical, utilitarian and applicable to human welfare (1) in many lines (*e. g.*, agriculture) which are industrial or economic, (2) in hygienic problems aiming at life conservation, (3) in esthetic outlook upon nature in general, and (4) in intellectual or philosophical interpretations of human life in its relations to nature. It is such an ex-

tended outlook upon biology as applied science in the larger sense that we now need for the purposes of general and liberal education. We are living in an age that is eminently industrial, commercial and practical. There are signs that we tend to consider education as productive of results measurable in purely material terms. If we follow closely such tendencies while we are reorganizing biology into applied science, we are likely to interpret the word "applied" as limited to the material and especially the commercial affairs of life, and then we shall leave no place for the intellectual and esthetic values of biological study.

I have thus at some length advocated a larger conception of biology as applied science that functions in our daily life in that it definitely concerns intellectual welfare. This is why I believe in education that present applied biology in the largest sense of the word "applied," namely, biology that sets forth in bold relief the great facts and leading ideas which touch human life in its combined economic, industrial, hygienic, intellectual and esthetic outlook. Applied biology, then, should be understood in the larger sense as meaning a selection from the vast field of biological learning of those facts and ideas which are likely to mean most in the life of the average educated man and woman. Thus, zoology may through education come to make the greatest possible contribution to human welfare.

There has long been a feeling, even among scientific men themselves, that the philosophical applications of biological generalizations are more or less interesting for the purposes of mental gymnastics; but that they have no important bearing on the practical relations of science to human life. How often have we heard the theory of evolution referred to as a strictly pure science generalization without possible application to practical affairs. In all this we seem to have been decidedly in error, for we have overlooked the fact that a philosophical application of a pure-science theory may come to be a guiding force in the material affairs to which science is directly applied. Such is the case in the relation of certain phases of evolutionary philosophy to the Great War.

A striking illustration of the profound bearing of philosophical biology, particularly zoology, on human welfare is found in the German justification of the present world struggle which seems to be opening the way to overwhelming revolutions of our economic, social, political, ethical and even religious systems. It is clear to many American men of science that the German philosophy of the superior state or nation and the superior race or people and the superior qualities of Kultur of the people as a group is at bottom an evolutionary philosophy based on the German zoologist's conception of the Allmacht or all-sufficiency of the Darwinian theory of survival of the fittest in the universal struggle for existence among living things. This biological principle in the extreme interpretation of Neo-Darwinism has been widely adopted by influential German philosophers.

Of course the German doctrine of superiority is not all an application of philosophical biology, for there is obviously an admixture of the peculiar religious state of mind characteristic of many German writers in the universities and in the government. As proof of this we may call to mind the long-standing dual alliance between the Kaiser and his Gott; and judging from many fervently religious phrases in imperial proclamations relating to "glorious" victories in Belgium and Serbia, the mutual understanding between Wilhelm II., and his invisible and silent partner continues to exist. However, we must not allow the religious attitude of those at the center of

the Hohenzollern dynasty to lead us to believe that religion is the determining factor in establishing the prevailing German attitude regarding war as the justifiable method of extending their assumed superiority. The members of the Kaiser's family may sincerely believe, because they have been educated to believe, in their divine rights and affiliations; but it is impossible that traditional religion has played more than a minor part in developing the clearly evolutionary philosophy of German superiority that has spread centrifugally from the universities, especially through the influence of many writers who were not liable to classification as religiously inclined. Perhaps the religion of the people of the masses has led them to accept as a religious idea the doctrine of superiority made by German evolutionary thinkers and spread broadcast by the means of an educational system that with marvelous skill was planned to promulgate and ultimately to put into world-wide practise the clearly evolutionary doctrine of German superiority over the rest of mankind.

In biological philosophy intellectual Germany seems to find good in this war, and indeed in all wars, as a means of expressing force or might of the state, which in the German national philosophy is always right because the fittest win in the struggle.

Of course it matters not, so far as we are inquiring into the possible influence of biological philosophy on human welfare, that numerous German biologists and philosophers have accepted an evolution factor whose Allmacht has long been denied by the great majority of biologists outside of Germany. For our present purposes the fact is that, whether right or wrong, a biological theory has been made to support a national state of mind which is now threatening the very foundations of human welfare. Of course it is beside the point, but to a biologist an interesting question, whether Neo-Darwinism has been widely accepted by the intellectuals of Germany because of scientific facts in its favor or because it fitted in with a previously accepted doctrine of right determined by might. Be that as it may, the one conclusion I wish to draw from the German philosophy of superiority is that we should find an important lesson in the fact that a theory largely zoological in its origin and in its human applications has been brought into conflict with human welfare as we Americans see it with the larger vision.

I have arrived now at my main thesis that only through organized education can the physical and intellectual values of zoology be made to contribute to human welfare in the largest sense. The fact that the German superior state of mind to which we object was developed by national education, and education thus worked against human welfare, is obviously no argument against education, but only against a phase of education limited to the purposes of those in power.

II. ZOOLOGY AND EUGENICS

I come now to the relation of zoology to racial welfare, in other words, the problem of eugenics. It is evident that the application of the laws of heredity or genetics to the breeding of more useful animals is simply another aspect of economic zoology; and one whose total financial value is bound to continue to be greater than that of all other phases of practical zoology combined. We need only compare in cursory survey any of our valuable cultivated or domesticated strains of the animals and plants of agriculture with the most closely related wild forms in order to realize the vast economic significance of man's applications of known and unknown principles of heredity.

On the other hand, the human problem of applied heredity or eugenics is far from being such a simple business problem because the desired results can not be evaluated on a purely economic basis. In short, eugenics, unlike the biologically parallel breeding of animals and plants, is not a phase of economic zoology, except perhaps in the indirectly involved economic problems arising from human defectives and inefficients. Eugenics is at present a biological philosophy and must be developed and promulgated accordingly, namely, through education. As the biologist so well realizes, the production of better human strains involves not only the physical problems of heredity but also the vastly more complicated social, emotional and religious traditions which concern human families as they are organized to-day. Before established biological principles of heredity can be applied to the human race, either by individuals or by nations, a eugenic philosophy must be accepted. This is the next and necessary step in the program of the eugenic movement. More research may bring stronger conviction that the eugenic proposals are scientifically true; but little progress can be made except through an educational movement which distributes widely among intelligent people a eugenic philosophy which deals adequately with the biological, social and other factors involved. Such an educational movement for eugenics must be based on biology, and especially on zoology which more directly illustrates human life and its problems. By education I do not mean schools and colleges only, for I am thinking of the vast possibilities of popular education such as in the past year has been applied by lectures, magazines, newspapers, pamphlets and posters to the great food questions. An energetic and sweeping educational campaign will some day be necessary if the average intelligent citizen is to be made to realize what the eugenic proposition may mean for racial welfare. Here is a possible contribution of zoology to human welfare compared with which all others are of minor importance. As in the case of those philosophical principles of biology which may profoundly influence human thought and action, there is now in sight only one pathway leading towards progress in applying the established biological science to eugenic practise. That pathway is labelled "Education."

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SCIENTIFIC EVENTS

VOLCANOES OF HAWAII

THE entire group of Hawaiian Islands, twenty in number, extending in a chain for hundreds of miles, is of volcanic origin, though some of the islets and reefs are but the wave-battered remnants of volcanoes whose fires died out long ago. The island of Hawaii has been formed by the coalescence of many recently formed volcanoes. The walls of the crater of the active volcano of Kilauea, on this island, are broken down on one side, giving access to its "lake of fire." This volcano has not always been gentle in its ways, but it is now so well behaved that the visitor can stand safely on the edge of its fiery pit and, if the volcano is active, watch the molten rock boiling and spouting 100 to 300 feet below. Sometimes many fountains throw up jets of glowing sulphurous lava and light up with ghastly glare the frowning crags that rim the crater. Then, suddenly and with deafening detonations, the jets rush together and convert the lake into a burning, seething, roaring mass, making a scene to which few others in the world are comparable.

Mauna Loa, on the island of Hawaii, and a neighboring volcanic cone, Mauna Kea, both nearly 14,000 feet above the sea, are among the highest island mountains in the world. On