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THE SCIENCE OF BIOLOGY AND THE FUTURE OF MAN[1]

By Professor ANTON J. CARLSON

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THE title for my discussion is too formidable for me, and, I believe, for every other biologist, that is, if we propose to stick strictly to the known and the probable. However, I think the fundamental issue before us is the significance and the service of the science of biology in man's future biologic, social and economic development. And that raises another fundamental question. I think we are all agreed on this point: that understanding should be a significant factor for to-morrow's man, both for him as an individual and for him as an effective factor in the social environment. The only question is—to what degree is it possible to bring this about? That is primarily a question of development of control by the higher centers of our nervous system, that is, the cerebrum, over the primitive lower center of the brain, the hypo-thalamus. For biology of sub-human species and the history of man to date show that human actions have been determined more by the emotions, and the hypo-thalamus than by understanding, and reason based thereon.

I think at this point we biologists should be more than ready to confess that our science, to-day and more so to-morrow, depends on our sister sciences, chemistry and physics. We advance or fall together. It is perfectly true that the old style descriptive biology, classification of species, etc., can be accomplished with little or no background or understanding of either chemistry or physics; but functional biology, dynamic biology, as it has developed in the last 50 years and as it will further develop to-morrow, is very intimately dependent on parallel developments in the physical sciences. It is functional biology which constitutes and determines the behavior of man. This is the more difficult phase of biology. This is the

[1] Abstract of an address given before the National Association of Biology Teachers on September 16, at the Cleveland meeting of the American Association for the Advancement of Science.

field of biology filled with most of the unknowns, the gaps and the guesses. But we, the teachers in this field, must obviously master the known and somehow present it to our students, children and adults, in such a way, if possible, that the understanding of the human machinery in health and in disease becomes a dynamic factor in human behavior. What I have said so far seems, to me at least, obvious. That we have not achieved this goal up to the present most of you will agree. When it comes to the question of how we can more rapidly approach this goal, there will probably not be an equal unanimity of views and opinions among us.

In a recent national survey of the teaching of biology in the nation's high schools, under the direction of Dr. Oscar Riddle of the Carnegie Institution, the conclusion was reached that a deplorable percentage of the teachers of biology in our high schools were poorly equipped to perform this function in a manner demanded by the needs of man. There are probably not enough of superior teachers to go around either in biology or in any other field of education, knowledge and training. As an excuse for this condition is frequently offered the fact of the over-all low salaries of high-school instructors attracting too few superior men and women into that field. This may be so, but I seriously doubt that those men and women who understand the necessity for and the fundamental role of teaching, those people who would rather do or try to do this kind of service than any other thing, that these people are deflected from such course by a difference in remuneration of a few hundred or a few thousand dollars a year. It is, of course, true that the social status or prestige of any man or woman in our society is, unfortunately, determined so largely by the yard-stick of salary and material wealth. Where this view prevails the high-school teacher becomes an insignificant member of society, indeed. But the conviction that we are performing an essential and significant task should outweigh all other considerations, and ultimately society will recognize our important work.

There can be little doubt that for the fullest realization of the significance of biology for the future of man there must be much more serious consideration given in the high-school curriculum to human biology than is the case at present. And that means that much more fundamental attention must be given to the essentials of human biology in the training of the teachers for high-school positions in this field throughout the land. In a recent study of the impact of all the natural sciences on the college freshman in 16 central states, including Ohio, I found according to the measures used that psychology and chemistry came first, zoology—third and human biology—last or eighth. This relation probably reflects the situation in the high school if not as to time in the curriculum, at least as to the scientific quality of the teaching. I think you will agree that by tradition and regulations, there is a disproportion in the amount of attention given to the "ten thousand more or less useful facts" as against the efforts towards understanding of the fundamentals that may guide man's judgment and actions as to food, health and behavior towards his fellow man.

Before entering on my last topic, I should like to make these two points, as it were, in passing: (1) The teacher of biology in our high school should gain some courage, confidence and ambition from the well-known fact that for two thirds of his pupils the high-school teaching of human biology is all the formal aid to the understanding of human biology that these boys and girls will ever receive. And even those high-school graduates who later enter college may go through the entire liberal arts college course without further exposition to the important fundamentals of human biology in health and disease; (2) the above point which I think nobody can question raises a further problem, namely, that of the urgent need in our country of adult education in the fundamentals of human biology. It is, of course, a fact that education is never completed. New developments in human biology, health and disease go on at an accelerating pace in our times. Many adult fellow citizens never entered or completed even their high-school education. Most of the adult education in human biology now prevailing in our land is through advertising of foods, drinks, vitamins and other remedies by concerns primarily interested in greater sale of these products. Such advertising in the press and over the radio too frequently assumes the form of skilful weaving together of facts and fancies to be artistic lying. Should we not consider the possibility of making every high school in our land the center for well-conceived and well-directed evening courses for adults in fundamental human biology? Such courses could be directed, and I believe would be directed, by our best teachers, even without additional pay. Visual aids to such adult education such as slides, motion pictures, suitable reading materials are available. We should not be discouraged by small registration to begin with, because serious educational efforts are in competition with entertainment in motion pictures and radio and at the start come out second best.

Human biology can no longer be taught effectively solely by aid of the materials in the formalin jar supplemented by the best of books. Such effective teaching requires the aid of experiments, and demonstrations on living tissues, living organs, and living animals under anesthesia. In some States that type of teaching is prohibited or limited by law, in other cases it is limited or prevented by custom or social

pressure. Some people do not yet admit that man is an animal. How are we to remove this handicap, except through more effective adult education in human biology?

So far I have said little about biology in its bearing on the future of man. This phase of my talk will be largely a series of questions:

I. All the present evidence indicates that the human beings now inhabiting the earth are one species, irrespective of their color and form. But this knowledge has not yet succeeded in eliminating the ancient and ever-recurring superstition or belief in this or that "superior race." We admit superior individuals and, for varying times, superior families, but I know of no clear evidence of superior groups within the same species, given the same environment, food and educational opportunities. In many species below man it has been possible to breed, for specific forms, qualities and performance. Even if this was desirable for to-morrow in the case of man, it certainly has not been tried on a scientific basis up to date. So that, apart from the possibility of weakening our race to-morrow by the survival of too many of the inferior or less fit individuals, it is a futile pastime to tarry long with the question as to what extent the growing knowledge and possible control of heredity will benefit our race in the future.

II. Can application of relative justice in national and international relations ever avert the (to me) insane destruction of the best in human lives and the valuable products of human toil which prevail in war? I am well aware that even some men and women who think (including some biologists) have held the view that war aids and improves the human race. There are others who take the opposite view. All we can say is, we have no controls. And that raises the question, assuming we biologists were permitted to teach: What can we teach on this issue?

III. Nearly every activity of man (social, political, industrial) has an impact on and frequently a limiting factor in the dynamic biology of man. Thus:

(a) In many industries we are face to face either with new chemicals injurious to man or with dangerous concentrations of injurious chemicals. I have said earlier and I repeat here that in our so-called civilized countries, through industry and science, man is being exposed to new chemical environments by virtually turning the earth inside out at the rate to which man and other species in the past were seldom, if ever, exposed. The chemical poisons of our industrial civilization—what will they do over the centuries to our air, our soil, our waters and our human frame? Will biologic understanding and increasing medical knowledge cope with this problem to-morrow?

(b) Urbanization and industrialization pose problems of housing and food, work and leisure, not present under the more primitive conditions which governed the greater span of man's evolution. This means that these phases of life become part of human biology to-morrow. Why not start studying them to-day?

(c) Man of the stone age appears to have gained fair control over most of the larger predatory species competing with him for the control of the earth and a place in the sun. But the stone hammer and the flint spear head were poor weapons against the harmful and disease-bearing insects, and perfectly impotent against the myriads of man's microscopic and sub-microscopic enemies. Modern biology, to-day's preventative and corrective medicine, have gained some control over these injurious and deadly hordes. That may spell better health, better mental and physical efficiency and more years of useful life for the man of to-morrow. But we can not be sure of these results because new and injurious factors may sneak in, as it were, through the back door of our civilization. One of these factors may be greater malnutrition, as all species, man included, tend to multiply beyond the limits of available foods for an optimum diet. When the check on over-population by disease is checked by medical science, can and will the man of to-morrow substitute understanding as a check on population increases beyond the conditions for optimum living? Or will he resort to war?

(d) The harder conditions of life in man's past and the virtual absence of scientific control of disease until yesterday unquestionably resulted in the earlier elimination of the weaker and the less fit members of our race. How is that important function for the race to be taken care of by and for the man of to-morrow? We can not answer this question now, for the simple reason that we do not know how soon and to what degree man's action will be governed by understanding and the long view, rather than by the emotions of to-day and the taboos of yesterday.

(e) Assuming increasing control of infectious diseases and a decrease in the prevalence of war and a not too rapid weakening of the human race by the reproduction and survival of the less fit, it seems clear that food will some day be the limiting factor of our numbers, if not of our health and efficiency, no matter how much more understanding we may gain of the interior of the earth, of sub-atomic energy and of the super galaxies in the distant heavens. That means that agriculture and foods are clearly must items in the teaching of human biology to-morrow. But why wait till to-morrow?