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*WHAT TRAINING IN PHYSIOLOGY AND HYGIENE MAY WE REASONABLY EXPECT OF THE PUBLIC SCHOOLS.**

IN the public schools of to-day various subjects are taught, and for various reasons. Some, like arithmetic or the reading and writing of English, are indispensable tools of modern civilized life; others, like geography and history, impart necessary information or promote general intelligence; still others, like algebra, geometry and Latin, are agents of mental discipline or else afford necessary preparation for subsequent work. Physiology and hygiene, the studies with which we are concerned in the present paper, were introduced into the public schools for the express purpose of affording information concerning the structure and functions of the human body, being expected thereby to contribute to the preservation and promotion of health; and they have kept their place, in spite of serious shortcomings, as a concession to the practical importance of sound ideas concerning health and disease.

The training which may reasonably be expected in the reading and writing of English, in arithmetic, in geography or in Latin, is the subject of frequent discussion in educational gatherings and is doubtless influenced by such discussions; but it is determined chiefly by the exami-

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nation requirements of the upper grades and by the entrance requirements of higher educational institutions. With physiology and hygiene the case is different. Proficiency in these is rarely made a condition of promotion. They are seldom included in the list of requirements for admission to colleges or technical schools, and never in those for medical schools. They are not often much considered in educational congresses. And yet it is doubtful whether any subject in the whole curriculum of the public schools is of greater intrinsic importance as a preparation for life, or is capable of affecting more profoundly the whole mental attitude of men and women toward an enduring and well-organized civilization.

The real importance of physiology and hygiene is unquestionably far greater to-day than it was twenty-five years ago. At that time physiology was a new science. It was still commonly taught in medical schools as an adjunct to anatomy, and the double-headed professorship of anatomy and physiology had not then become extinct. As for hygiene, this was largely a body of precepts based upon *a priori* reasoning, or else of deductions derived jointly from anatomical knowledge, common experience and common sense. Disease was only a little more baffling that health, and the promotion of one poorly understood condition by the prevention of one still less comprehended was not only a most unsatisfactory, but a most unscientific undertaking. Nevertheless, in spite of this difficulty and uncertainty, physiology and hygiene, such as they were, have steadfastly held their place in the curriculum of the public schools, no doubt because of an unconquerable belief that they should somehow furnish to the developing mind and the forming character some real and lasting help in the preparation for life.

And at last this belief seems likely to bear fruit and to justify its long and patient expectation. For to-day physiology has won an established and recognized position as an independent science. It has become entirely separated from anatomy. It has its own professors in our medical schools and universities. We have a strong and active American Physiological Society, composed of expert investigators and teachers, and a flourishing *American Journal of Physiology*, which publishes regularly budgets of important discoveries.

In hygiene the progress has been even more remarkable. Twenty years ago the infectious diseases were as mysterious as ever, but to-day we understand the essentials of their operation and also to a great extent the mechanism of their dissemination and, therefore, in many cases the ways of their prevention. The clouds of mystery which until lately hung about them have been largely cleared away, and a new hygiene, based partly upon experimental physiology and partly upon experimental medicine, has come into being. Meantime an enlightened sanitary engineering is building improved sewers and water-works and dealing with the purification of sewage and water, with the construction of sanitary pavements, with the dust nuisance and with efficient scavenging and garbage destruction. Boards of health are equipped with laboratories for sanitary testing and research. They are supervising the medical inspection of schools. They are isolating cases of infectious disease and securing the disinfection of clothing and of houses. They are enforcing vaccination. They are vacating unwholesome dwellings.

Educators themselves are engaged in hygienic endeavors. They are providing for playgrounds. They are beginning to attend as never before to the ventilation of school buildings. They are interested in the lighting of school-rooms, in the seat-

ing of the pupils, and in their sight and hearing. The home also is receiving the attention of hygienists. Its site, its drainage, its wall papers, its ventilation, its cookery, are undergoing careful investigation.

And, finally, personal hygiene—the care of the individual body, its exercise, its fatigue, its work, its rest, its play, its clothing, its bathing, its hunger and thirst and sleep, its growth and its old age—is being dealt with to-day, not superficially and by tradition or experience alone, as formerly, but also by experiment. Physiology and hygiene have become experimental sciences, and have thus taken on a new and higher value. In view of all these marvelous changes, we may properly ask and undertake to answer the question which forms the subject of this paper.

But first and always we must keep steadfastly in mind the end and object sought for in the training under consideration. This has always been and still is primarily practical and technical, namely, a sound preparation for the right conduct of physical life. For although it is one argument for increasing the efficiency of instruction in these subjects that they give information on matters of great human interest, and that, when rightly taught, they are of high educational value, still the primary purpose of teaching them is not to give information nor mental discipline, but because their subject matter is of immediate and enduring importance in determining and promoting the right conduct of the physical life, and especially the preservation and promotion of health. Their value is special rather than general, practical rather than cultural, technical rather than disciplinary.

We may confess frankly that physiology and hygiene have not always hitherto justified their place in the curriculum by their results. It would be going too far to deny that they have been without influence, or that in exceptional cases they have not been valuable; but they certainly have not, on the whole, accomplished what was originally expected of them. Their results have been disappointing, and it is by no means unusual to hear competent educators express the opinion that it would be better to drop them altogether. Physiology and hygiene are too frequently looked upon by school authorities as an unavoidable necessity, and by teachers and pupils as a bore. And yet we doubt whether any of these superintendents or teachers would care to take the responsibility of banishing them altogether from the curriculum. They may not be a success; but the conviction remains that they ought to be a success, and doubtless the hope, however faint, that some day they will be.

The present unfortunate condition of affairs is due, in our opinion, largely to the fact that the primary purpose of these subjects in the curriculum has been neglected or forgotten. They were perhaps introduced prematurely, as has been suggested above. Fifty years ago anatomy was the one branch of medical science about which definite statements could be made, but little was known about physiology, and the great field of hygiene was largely a matter of either popular tradition or impressions derived from personal or racial experience, often, indeed, surprisingly accurate, but nevertheless lacking in the certainty of experimentally demonstrated fact.

It is only exact knowledge which lends itself to school instruction. We do not teach electricity in our courses in physics by speculating about thunderbolts or the nature of magnetism, but by telling what we know of the production, the conduction or the induction of electrical energy. We leave the region of the indefinite to the investigator. It is easy to see, therefore, how it came

about at the outset that in planning the work in physiology and hygiene in schools the details of gross and minute anatomy should have formed the major part of the whole. Function was treated but sparingly, because very little was known about it; and considerations of health and disease occupied an insignificant place simply because definite statements could not possibly be made about them. The instruction in school physiology and hygiene was chiefly anatomical for the reason that the dissecting room was the sole laboratory of the medical school. It was the one region of real and accurate knowledge of the subject.

We have said above that this condition of hygienic knowledge has been entirely transformed during the last twenty years. The physician is far less mysterious in his manner than formerly, because his fund of knowledge is vastly greater. He often explains his reasons to his patient and discusses the facts of his profession with 'the laity,' where he would not have done so fifty years ago. It was within twenty years that one of our leading pathologists was heard to define malaria by remarking, 'When you don't know what it is, it is malaria.' To-day he would not give that definition, but would delight to describe the wonderful story of those discoveries which within a score of years have led to our present satisfactory understanding of the nature and mode of dissemination of this disease.

The teaching of physiology and hygiene in the public schools has lagged far behind this march of medical and hygienic progress. It is inexcusably behind the times. We now have facts which any one can teach and which should be made known as a preparation for the proper conduct of life; and it is these facts which should form the main part of the teaching. The subject matter should be thoroughly revised, and in no more important particular than in the restriction of anatomy to the minimum amount needed to give a clear conception to the general structure of the body as a mechanism and of the normal working of that mechanism. In a rural school-house on the Maine coast we once saw upon the blackboard, painfully written down by a fisherman's child, a long and learned list of the bones found in the human body. Even for a medical student the list, as such, apart from the physiology and surgery of the bones, would have been of small value; for the children of fishermen, the bones of the cod or haddock or of the domestic animals would probably have been of greater consequence. An arid osteology is a poor introduction to the study of modern hygiene, and one not calculated to arouse a compelling interest in the subject.

Similar considerations hold with regard to the teaching of physiology. The educational value of this science, it is true, is much greater than is that of pure anatomy, for, in the first place, it is more interesting. Not only in childhood, but throughout life, we do not care greatly about the parts of a machine unless we know or can guess their use. From this point of view physiology is a good teaching subject, and all the more so because it deals with a machine in which most of us are naturally interested. The study of the activities of the human body has also the highest philosophic value. It imparts that first and most important lesson for the conduct of life—a lesson which every person leaving the upper grades of the public schools should carry away with him—that the human body has a material basis and is a *mechanism*, a *machine*. We must constantly recall, in order to emphasize, Huxley's saying that 'the distinctive feature of modern as contrasted with ancient physiology' is 'the fundamental conception of the living body as a physical mechan-

ism.' That this fact is not with most people a part of the philosophy of living is shown by the use and abuse of patent medicines and the frequent neglect of the commonest care of the body, such as would be wisely bestowed on a watch or a bicycle.

We have urged that anatomy has no place in the public school curriculum except as it is necessary to the understanding of the problems of physiology and hygiene; and we shall see it cut down to the minimum needed for this purpose without the slightest regret. We should not feel the same if physiology were similarly made strictly subservient to personal hygiene, that is, if, in doing so, its philosophical value were neglected; but, fortunately, this is not necessary. The physiology which is most useful in understanding the problems of personal hygiene is almost exactly the same body of facts which has the greatest philosophic value; and the method of presenting them is the same for the one purpose as for the other. We have not the time to enter into details in this matter, but we are speaking from experience and are sure of our ground. The instruction in physiology should aim at the outlines of the more important functions of muscular contraction, nervous activity, circulation, nutrition, temperature regulation—all of these expressed as far as possible in terms of physics and chemistry. It should endeavor to avoid needless details. For example, the pupil should understand that the heart is a force pump, but it is not necessary that he should understand the exact structure or mechanism of the auriculo-ventricular valves.

Again, physiology should not be made primarily, or even to any large extent, in public schools, a means of laboratory training. Such training can be had more readily and more advantageously in chemistry and physics. To attempt to give the same laboratory training in physiology as in these subjects would inevitably be to consume precious time which is urgently needed for hygiene. The fundamental facts of physiology can be demonstrated and enforced in the laboratory, even in common schools, without much difficulty, and we would not for a moment depreciate the value or the necessity of a certain amount of this kind of instruction; but the use of the laboratory (always time-consuming) must not be allowed to distract attention from the true function of physiology and hygiene or to interfere with its fruitful realization.

A course of moderate length in physiology should suffice to impart enough facts of structure and function to furnish a solid basis for sound training in hygiene, and to give meanwhile an abiding sense of the material composition and mechanical character of the human body and some knowledge of its environment and operation. With so much of preparation it is easy to pass on to a practical consideration of health and disease, the means of promoting the former and of avoiding the latter. Health becomes simply normal, disease abnormal, living. Such terms as 'constitution,' 'strength,' 'weakness,' 'feebleness,' 'robustness,' are easily understood by constant reference to mechanisms, well or poorly made, or to structures, strong or weak. Wounds become interference caused by invasions or damage by extraneous matters—bullets, knives, parasites, clubs, dogs, slivers—which are as obviously out of place in living mechanisms as dirt in the works of watches. Germs are microscopic invaders, microscopic parasites. They enter and wound and kill, not mysteriously, but by damaging or interfering with the human mechanism. Best of all, they can often be kept out by the avoidance of exposure, as truly as bullets can.

Passing on to the strictly hygienic part of the subject, first in logical sequence comes personal hygiene, the proper regulation of the activities of individual life—

muscular work, mental activity, feeding, the protection against colds and other inflammations, the care of the body by bathing and clothing and the like. These should not be touched upon in short paragraphs which, like after-thoughts, conclude the chapters on anatomy or physiology, but should be separately and fully treated for their own sake, and from the standpoint of the organism as a whole rather than from that of special organs. These are subjects about which every one needs real and true information, and sooner or later seeks it. Shall such knowledge be obtained from the public schools, or sought unwisely and in vain in the brazen advertisements of magazine originators of new systems of physical training, or in the rash and not often disinterested advice of advocates of new breakfast foods?

Modern hygiene begins with the individual, but deals also with the hygiene of the family, of the community, of states and of nations. In a rapid review of the place which these branches of the subject should occupy in our preparation for sound private and public life, it must not be forgotten that the great majority of the pupils in our public schools have no opportunity or intention to enter colleges or higher schools, and yet are likely to become householders, housekeepers, heads of families or citizens. The principles underlying household or domestic hygiene and sanitation therefore claim some consideration at their hands. These should include such questions as the proper site of the house, the value of fireplaces as ventilators, the importance of wall papers free from arsenic, the advantages of bare floors, and of simple rugs as compared with carpets difficult to clean, the necessity of a pure and abundant water supply, the desirability of prompt removal of wastes by drainage and by such other devices for rural communities as may be made most sanitary under the circumstances, the dangers of damp cellars with the reasons why cellar dwellings are so peculiarly unwholesome, the dangers of illuminating gas (especially the modern so-called 'water gas'), the need of careful consideration and frequent inspection of gas fixtures to avoid small but dangerous leaks, and other similar matters bearing directly or indirectly upon the welfare and sanitary condition of the home. Here might well be told the truth in regard to the advantages and dangers of cesspools and sewers, and of leaky or otherwise defective plumbing.

Place should also be found, and might easily be made by the sacrifice of some osteology and histology, for a brief consideration of the health of communities, such as thickly settled neighborhoods, growing towns or cities; of the dangers attending impure water supplies and defective sewerage systems; and the importance of methods for the sanitary removal and disposal of garbage, rubbish and the other wastes of life. Something might well be said regarding the need of proper municipal supervision of all these matters as the essential of a rational municipal sanitation and of the sanitary value of good public service. Here also might be taken up the advantages and the right use of municipal parks, playgrounds and gymnasia, of public lavatories, water-closets and washhouses; of smoke abatement and noise suppression; and something said regarding clean streets and the thoughtless scattering of papers, banana skins and the like rubbish, which necessitates a costly scavenging; something regarding pure ice and especially pure milk—problems in the solution of which all classes of the community must eventually take an active interest and participation, if reform is to come.

And, finally, room should be found for a brief explanation of quarantine, its advantages and disadvantages; the isolation of cases of infectious disease and the reason why this is so essential to the public,

though so inconvenient to the individual; the necessity for public hospitals for contagious diseases and for municipal or state sanatoria for tuberculosis; the fundamental problems of international hygiene; public food inspection, such as that conducted by the federal government for trichinosis in pork to be exported to foreign countries; and other problems calling for intelligent cooperation of the citizen in national and international hygiene.

Trained along these lines, the youth of America, whether or not afterwards going to college or technical school, would enter upon their maturer life with some realizing sense of the general structure and operation of the body as a physical mechanism, and the necessity of obedience to physical laws. They would become familiar with the sources of diseases and with some of the more obvious ways of avoiding them. They would have some intimation of their duty, not only to themselves and to any families which they might afterwards have, but also concerning wholesome houses, pure supplies, the safe disposal of wastes, and some of the problems of the municipality, and even of the nation, of which they are units.

We have, of course, to meet the important objection which will be urged against our point of view, that, desirable as all these things may be, the time available is too short for proper dealing with them. This, however, we deny. Time enough to do all these things and to do them well, either is now or lately has been found in the public schools in the various courses for instruction in physiology and hygiene. It will be necessary, it is true, to revise and bring up to date our subject matter and our methods of instruction. We must teach less about bone and sinew, and more about muscle and nerve. We must teach less about anatomy and histology, and more about the germ theory of disease, about polluted water and polluted milk. We must simplify every statement and eliminate the unimportant. We must not seek to make of physiology a training in the precision of measurements, or in scientific method, or in anatomy, or in physiological chemistry. Some experiments must be made by the students, and demonstrations by the teacher must abound; but we must keep steadily in view the practical object for which chiefly school time is, and long has been, dedicated to physiology and hygiene, namely, the rational conduct of physical life.

Above all, we must insist upon relief from the incubus of that 'scientific temperance' instruction, so called, which has too long rested upon the teaching of physiology and hygiene, winding its tentacles about it and, octopus-like, sapping its strength and crushing out its usefulness. On this subject let us have no misunderstanding. The evil effects of the use of alcoholic drinks must be fully and clearly inculcated. The youth of America must be thoroughly informed of the insidious dangers which lurk about strong drink. But, on the other hand, we must never forget that the public schools are no place for any propaganda and that the freedom of teaching must not be surrendered even to reformers.

Whether we are pleased with the fact or not, modern life has become more strenuous. In order to achieve success, the individual must do more in a given time; hence the urgent importance of a personal hygiene which shall really guide him in the proper care of the body. Meantime the care of the public health has become one of the most important functions of government, and it will be increasingly important in the future. Its success in America must largely depend upon an enlightened citizenship to which it can look for support. We now teach history and eco-

nomics and civics with some reference to the future life of the public school pupil as a citizen. Our teaching of hygiene should keep in view the same great end, and if this paper draws attention to the lamentable inadequacy of our present instruction in that subject to this purpose, our object will have been accomplished.

But much more is needed. We need a clear conception of the true place of physiology and hygiene, but we need also the proper teachers to realize that conception. If the subject is as important as we have represented, it should be taught by teachers specially trained. In the higher grades of our schools we often have special teachers of languages, of history and civics, of mathematics, of the natural sciences; but it is rare indeed to find physiology and hygiene in the hands of teachers who have had special training in these subjects. Too frequently they are imposed upon the least experienced member of the staff, whose connection with the school is too recent or whose tenure is too precarious to allow refusal. All this must be changed. The exact method of securing the trained instructor may often be left to local conditions. At times, medical examiners, the demands of whose practice are not distracting, and who are at the same time good teachers, may fill the position; at other times, teachers of the biological sciences should be encouraged to prepare themselves for the work.

A method which especially commends itself to us is to combine this work with that in physical training. The teachers of physical training, of all the instructing staff of the school, stand in closest relation to the work of preservation and promotion of sound health. At present their work is somewhat narrow and suffers from the lack of any direct explanation of the principles of physical training. It would broaden the work of these teachers and make their present efforts more effective, if physiology and hygiene so obviously related to their other work were placed in their hands. True, it would require a broader preparation and an extension of the work of our normal schools of physical training in both time and scope; but this is really an argument in its favor. Normal schools of physical training ought to extend and enrich their courses, especially in view of the fact that so many of their graduates must occupy positions in the higher grades.

There is a widespread feeling that the present training in physiology and hygiene in the public schools is a failure. But signs are not lacking of a strong feeling among prominent educators that these subjects can and should rank in dignity and usefulness with languages, mathematics, physics, chemistry, biology, history and civics. Physiologists have long protested against the domination and excesses of 'temperance physiology.' Educators have complained of the bad pedagogical requirements often placed by law upon the teaching of the subject. We appeal to the members of the American Social Science Association to aid us in bringing about a reform, not as parties to either side of a dispute on questions of scientific fact about alcohol, nor from the standpoint of pedagogic theory and practice, but because the subject is one which profoundly affects social conditions and is closely related to a more intelligent and a more successful conduct of individual and social American life.

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Preliminary Report on the Marine Biological Survey Work Carried on by the Zoological Department of the University of California at San Diego.

The marine biological work of the Department of Zoology of the University of