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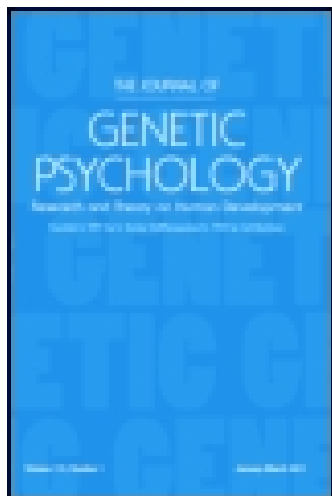
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THE SCIENTIFIC STUDY OF HYGIENE (ABSTRACT)

By WM. H. BURNHAM, PH. D.

The scientific study of hygiene is recent. The popular interest in hygiene is very old. Pettenkofer introduced the scientific study of hygiene into the German university about the middle of the last century. The empirical study of hygiene was begun in ancient Egypt at least as early as 1500 B. C. On account of the recency of the more scientific study of this subject only relatively meagre results have yet been obtained, and so large is the field where we lack definite and well-established knowledge that hygiene is sometimes called the science of the future. On account of the antiquity of the interest on the other hand, a large body of common sense wisdom mingled with a great mass of opinion and of error exists. Thus it has come to pass that hygiene is often sadly misunderstood, on the one hand by those who think it is not yet a science; on the other, by those who deem it largely a collection of whims and fads.

A great advance, however, is marked by the fact that the scientific attitude and scientific method are now brought to this study, and the same ideals obtain in this subject as in other sciences. The aim is to determine significant facts and the relation of natural environment and human development and activity to human health. The methods, as in other scientific subjects, are induction from experience and laboratory study under controlled conditions. Observation, experiment, and verification are as rigorously demanded here as in other university subjects. And the aim is primarily to add something to human knowledge in regard to the conditions of health rather than to meet the demands of the popular interest.

As I have said, however, on account of the recency of scientific research in this field only a relatively small nucleus of well-established truth has yet been collected; and on the other hand, on account of the antiquity of the popular interest, there exists a large mass of opinion, superstition, and error. Perhaps the relations between the scientific study and popular opinions and practices may be of general interest. Some of these I shall try to illustrate.

1. First of all we find that the development of hygiene is largely a story of superstition and of error. Time would fail

me to recount the vagaries and superstitions of the early centuries of the Christian era and of the middle ages. But a few illustrations may be given from modern times. As late as the 16th century, for example, we find preachers who inveighed against the habit of bathing as immoral and physicians who took an attitude of wise suspicion. This was a period of great discoveries and inventions. One of the great inventions of the renaissance was the making of spectacles. In the second half of the 16th century, in the large cities of the Netherlands it became the fashion for boys and girls as well as adults to wear glasses. Since elderly people can see near objects better by means of them, it was argued that children when looking at small things should wear them. It is believed that by this means the eyes were improved.

In fact the whole history of child hygiene is rather pathetic. Children have been denied fruit, meat, drink, perhaps almost everything, by the whims and superstitions of some one. They have been dosed with things vile from tansy to human excretions. In the schools they have suffered at the hands of hygienists even to the use of sulphur and tobacco. As late as the 18th century the lancing of the gums was repeatedly practiced upon infants to ease their teething.

In the field of general hygiene nowhere perhaps have there been so many delusions as in regard to diet. We need not go back to the past; for plenty of them survive to-day. We can find plenty of illustrations in the popular literature. Everywhere there is conflict of opinion. There is scarcely an article upon our tables which has not been condemned by some one in the name of hygiene.

Again, in regard to ventilation numerous errors have prevailed, and scientists themselves have not always avoided them. First it was noted that warm air rises, and then from this modicum of physical knowledge it was argued that in order to ventilate a room, the exhausts for foul air should be at the top, with the results that when warm fresh air was introduced at the bottom much of it passed out at the top without either heating or ventilating the breathing area. Again it was learned that the carbonic dioxide expired from the lungs is heavier than the air, and forthwith it was argued that exhausts for foul air should be placed near the floor. And still others thought that the CO_2 rises at first and then sinks. As a matter of fact the carbon dioxide in an ordinary room is diffused like any other gas throughout the whole mass of the air. And CO_2 is not apparently dangerous anyway in the quantities in which it is found even in the worst ventilated rooms. It is only because it is usually found in bad company that we take it as a gauge of the impurities in the air.

Thus the pathway of development in hygiene is strewn with the fragments of exploded theories. The obvious lesson is that of caution and humility. To the student of hygiene one may be tempted to adapt the words attributed to Averroes, "An honest man may derive pleasure from the theory of the physician's art but his conscience will never allow him to pass on to medical practice, however vast be his knowledge." But there is in this field a considerable body of well-established scientific truth.

The test of truth is merely the old one, namely, the possibility of verification *ad libitum*. For example, the decrease in oxygen and the increase in CO_2 in expired air are facts that anybody can verify who has a sufficient knowledge and suitable apparatus. The presence of a volatile poison organic in expired air, thought to have been demonstrated by the famous experiments of Brown-Sequard and d'Arsonval, is apparently not verifiable at pleasure.

As students of science, we learn to distinguish between facts and opinions, and while we may be sure of our facts we should doubt our interpretation of facts.

The first message of scientific hygiene, then, is to beware not only of fads but of many of the popular doctrines.

A general statement of the prime condition of health may perhaps be formulated somewhat as follows: it is a condition of unhindered functioning of all the organs of the human mechanism. Without normal functioning the normal development of structure is impossible. And more concretely the advantages of functional activity may be illustrated in many ways. Take, for example, the heart and the circulatory system. The functioning of the heart not only is essential for the maintenance of the life of the whole body, but the health of this organ itself depends upon its activity, and cardiac disease is often cured by stimulating its exercise.

Thus the second doctrine of hygiene is the gospel of work.

If the key note of positive hygiene is work, the key note of what may be called negative or prohibitive hygiene is cleanliness. So far as prohibitive hygiene is concerned the word cleanliness is almost synonymous with hygiene. If it were possible to have clean food, pure water, clean air, and cleanly habits, the death rate would be enormously decreased, and sickness would be a relatively rare phenomenon. The studies of the late Dr. Harrington of the Massachusetts Board of Health and of other investigators indicate that the appalling mortality among young children during the months of July and August is due to dirty milk. While unclean food is not as dangerous apparently for older children, it is nevertheless the cause of much illness.

If I should describe in detail the conditions of filth in the streets and public halls and public conveyances of the modern city, you would, I fear, leave this room in disgust. I am sure that the time will come when men will look back to the urban conditions of to-day with much the same horror as we think of the indescribable practices of our ancestors a few generations ago.

If our practices in regard to hygiene are an inheritance from the long distant past, our popular opinions are medieval in their crudeness. The scientific gauge of cleanliness is the number of bacteria present, and by this token the inside of the body should be kept clean as well as the outside; and clean food and clean air are quite as essential as clean clothing, and clean faces.

From the point of view of modern hygiene we see that however clean the food that one takes into the mouth, if the teeth are decayed, or if the soundest teeth are unwashed, then it becomes loaded with bacteria before it enters the stomach. And again when we eat improper food, or too much food, or fail to chew our food, fermentation occurs, and the whole intestinal tract is made foul.

Again clean air is necessary as well as pure water. But while we turn with disgust from dirt that we can see, we are usually tolerant of dirt often quite as filthy and more dangerous that we can only smell, or see with a microscope. From the scientific point of view clean air is only common decency; for it is distinctly practicable. In the best hotels they use the modern method of vacuum cleaning and are able to reduce dust and bacteria to a minimum, and afford their guests comfort as well as increased protection from disease. Even by means of the kerosene oil brush the dust is enormously reduced. If we can trust tests made by the Commissioner of Health in Milwaukee a few years ago in schoolrooms where this brush had been used for a year and in other rooms where it had not been used, other conditions being largely the same, a culture developed an average of 5 bacteria per square foot where the oil brush was used, as against 218 where ordinary sweeping was practiced.

Thus the third doctrine of hygiene is cleanliness.

Enough has been said to illustrate the university attitude toward hygiene and to show some of the relations between the scientific study of this subject and the popular interests and opinions concerning matters pertaining to health. While scientific hygiene is slow and cautious, using the method of induction from experience and experimentation, and while it accepts results only tentatively until subjected to the tests of experiment and verification, when results have been estab-

lished by these methods, it has complete confidence in any ideals based upon them, and believes that the practical realization of such ideals is only a question of time; recall, for example, the ideal of exterminating mosquitoes in order to give protection from yellow fever, or that of supplying clean milk to save children from diarrhea diseases.

In the part of the field with which I am most familiar, namely, in school hygiene, we have good illustrations of this in recent years. At the time of the first summer school held at this University, in 1892, certain ideals based upon scientific study were presented. At that time adjustable seats and desks, tests of the physical condition of school children, school baths, and the idea of complete cleanliness in schoolrooms, were largely vagaries of scientific theorists. One prominent educator complained that we did not want to leave all good things for our grandchildren. But less than twenty years have passed, and now adjustable seats and desks are recognized as essentials in every good school; tests of the senses and of the general physical condition of school children are coming to be required by law; and modern methods of cleaning by vacuum methods have already been introduced into some buildings used for academic purposes, notably in a new public schoolhouse in the city of Rochester. This method actually removes dust and makes possible a degree of cleanliness in the air that is beyond the wildest dreams of the university hygienists of twenty years ago. Thus scientific hygiene is not afraid of ideals when based upon scientific results, and it adopts the words of Dr. Richardson, "Utopia is but another name for time."

Hygiene as a university subject stands in a somewhat unique position because of the popular interest in matters relating to health and because the problems in the practice of hygiene must be solved at once as best they may in the light of what knowledge we have. But in spite of the popular demand for quick results on the one hand and the popular indifference to scientific teachings on the other, the methods of hygiene are the same as those of the other sciences; its ideals are much the same; and it develops the same spirit.