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THE PRESENT STATUS AND THE FUTURE OF HYGIENE OR PUBLIC HEALTH IN AMERICA[1]

DURING the past few years an increasing and now insistent demand has been heard in this country for better facilities for the training of public health officials. This demand has come from members of the medical profession, chiefly those engaged in official positions as officers or commissioners of health for cities and states, from sanitary engineers, and from various philanthropic societies whose aim is the betterment of social conditions among the poor in our great cities and in our rural communities. With the last this demand is associated with a demand for more enlightened instruction for the general public in matters affecting their health. At this time when these various desires are but an index of the awakening of interest throughout this country in that branch of science known as hygiene or public health, it becomes a matter of vital necessity for those of us who are working in this field to clearly formulate the underlying principles of this science, its scope and its needs, and present them to the public and especially to those who hold the fate of our great institutions of learning in their grasp and under their direction.

HYGIENE IN GERMANY AND AUSTRIA

Despite the fact that an American-born scientist, Count Rumford, of Munich (Benjamin Thompson of Concord and Boston), was the first to inaugurate and carry out a comprehensive movement for

[1] Read at the May, 1915, meeting of the Association of American Physicians.

the betterment of living conditions among the very poor, during the course of which he made a most accurate and painstaking study of the many factors leading to poverty and ill-health and suggested remedies for them, the modern conception of hygiene was given the continent of Europe by Max von Pettenkofer, the first professor of hygiene in Munich and indeed the first professor of hygiene in any German university. A pupil of Liebig and Voit and a well-trained chemist, Pettenkofer first served as professor of chemistry in Munich, but in 1865 transferred his activities to the science of hygiene, a professorship of which was established for him in this Bavarian institution. More than any other man of his time, Pettenkofer saw clearly the prevailing chaos in the facts and theories relating to the science of health and especially in regard to the infectious diseases. At that time epidemic after epidemic of typhoid fever devasted the population of such cities as Munich and Vienna, Asiatic cholera was always knocking at the doors of central Europe and frequently obtained admission, while other zymotic diseases spread like wildfire from person to person when once started in a community. The laws passed to control these epidemics were ineffective and the mortality from disease extremely high. The single exception to the prevailing helplessness was the Jennerian vaccination which had placed smallpox in the sphere of controllable diseases. Pettenkofer not only realized the inadequacy of the methods employed to limit the spread of disease, but he also saw that the fundamental difficulty lay in the ignorance of the medical profession in regard to the mode of transmission of infections from one individual to another. In this great crisis, for such indeed he felt it to be, Pettenkofer raised a powerful voice and demanded that the various facts relating to disease "en masse" should be thoroughly studied by experts just as the symptoms and pathology of individual cases were being studied by experts, that after the fundamental facts had been observed on a broad basis, theories to explain these facts should be formulated and submitted to the rigid test of experiment, to the end that proper conclusions from fact, theory and experiment might be drawn and measures in accord with these conclusions be carried out. In other words, Pettenkofer demanded that the empiricism of hygiene should be converted into a science. To accomplish this he further insisted that departments of hygiene be established in the various universities, that proper equipment be provided to gather the data and test the theories of hygiene, and that trained scientists be given the opportunity of carrying out this work. The widespread agitation coming from the movement originated by von Pettenkofer resulted in the establishment of a department of hygiene in the University of Munich, the selection of von Pettenkofer as professor and the construction of a hygienic institute. This institute founded in 1865 still stands, I believe, although plans for a new building upon somewhat more modern lines have now been completed.

From this brief résumé it may be seen that Pettenkofer was really the founder of modern hygiene, at least in so far as the German-speaking races were concerned. He occupies indeed the same position in regard to hygiene that Virchow does in pathology.[2] The radical movement in

[2] An interesting analogy is also evident in the domain of therapeutics. In this science Schmiedeberg, a pupil of Bucheim, who founded the first laboratory for the scientific study of drugs in Dorpat, realized the inadequacy of the existing knowledge of the composition and the action of the various remedies employed by the medical profession largely on an empirical basis. He demanded that the medical profession turn from the clinic to the

hygiene fathered by him made a profound impression upon Europe, especially upon Germany and Austria. Professorships were established in the leading medical schools, first in Bavaria and then in other parts of the German empire, thoroughly trained men were put in charge of the administration of sanitary laws and the attempt made to limit the spread of the infectious diseases by scientific methods. The new knowledge acquired by Pettenkofer and his pupils, and the laws promulgated at their suggestion soon began to have a definite influence upon the mortality returns. In the city of Munich, for instance, the sewage system was reconstructed and proper methods established for drawing off human and animal wastes, a new and pure supply of drinking water was obtained, old, ill-constructed houses were pulled down and air and sunshine admitted to the darkest sections of the city. A special corps of sanitary police was instituted, the members of which were given extraordinary powers so that they could visit every quarter of the city, and enter every dwelling to enforce the execution of the new sanitary laws. As a result of these sweeping changes the mortality from zymotic diseases fell rapidly in Munich and typhoid fever practically disappeared. In Vienna also, where Gruber, a pupil of von Pettenkofer, became professor of hygiene in the university, a similar change took place. Here was a city built within narrow walls, the population crowded together in unsanitary quarters with a water supply from surface wells sunk in a sewage-permeated soil. Sweeping reforms were instituted in this old medieval town, a new method of sewage disposal established, a new water supply obtained and in a surprisingly short time the typhoid mortality was cut in two. Whereas in 1874 it had been 15–16 per thousand, by the end of two years it had fallen to 7–8 per thousand and subsequently steadily diminished.

Under the stimulus of von Pettenkofer the new science of hygiene developed rapidly and from his institute in Munich his pupils passed first to one and then to another of the European universities as the chairs of hygiene were founded. Thus Buchner became associated with hygiene in Munich, Gruber went to Vienna, von Fodor to Budapest, Flügge to Göttingen (later to Breslau), Hofman to Leipzig, Lehmann to Würzburg, Rubner to Marburg, Pfeiffer to Rostock and Prausnitz to Gratz. The science of hygiene was established upon a firm basis and it is not too much to say that the movement inaugurated by von Pettenkofer was one of the most important movements in the science of medicine of the nineteenth century.

The Munich school of hygiene was developed in the days before modern bacteriology was dreamed of however, the etiological agents of disease were unknown and much of the work of the great investigators had to be carried out upon a hypothetical basis. This is best shown by the famous *x y z* hypothesis of von Pettenkofer by means of which he attempted to explain the spread of the diseases in which the intestinal tract is involved, typhoid fever, cholera and dysentery, the so-called diseases of the soil or Bodenkrankheiten. The kernel of this hypothesis lay in von Pettenkofer's belief that the unknown etiological agents of these diseases must undergo a process of modification or ripening in the soil before they are in a condition to produce the disease in other individuals. With the rise of the new science of bacteriology as the result of

laboratory, study the chemical composition of drugs, determine their action by animal experimentation and endeavor to explain this action by the facts and theories of physiology. Under the leadership of Schmiedeberg the new science of pharmacology was established to take the place of the older science of therapeutics.

the wonderful and brilliant investigations of Robert Koch and his immediate pupils, especially the discovery of the responsible parasites of anthrax, tuberculosis, Asiatic cholera and typhoid fever, the Munich school of hygiene received a staggering blow. Here were the hypothetical etiological agents of disease capable of demonstration under the microscope and of cultivation in the laboratory. Why waste one's time indeed in arguing about an unknown factor when this factor had been discovered and identified and the facts relating to it could be accurately studied? This was especially the case with Asiatic cholera where methods had been devised for the accurate bacteriological examination of suspected cases by the use of which an almost absolute diagnosis could be made in forty-eight hours and the infected individuals quarantined, the simplest possible method of preventing the introduction of this fearful scourge into any community. But the Munich school of hygiene died hard and in the long and somewhat bitter controversy between the old and the new, between Pettenkofer and his pupils and Koch and his, most important facts bearing upon the etiology of the infectious diseases were established. Gradually, however, the newer and more correct theories of the modern bacteriologists supplanted the older and often incorrect theories of the Pettenkofer school and in 1885 Koch became professor of hygiene and bacteriology in the University of Berlin. This set the pace and within the next few years the various professorships of hygiene as they became vacant were filled by the appointment of men trained in the modern bacteriological technique. Thus Gaffky, the discover of the typhoid bacillus, went to Giessen, Loeffler, the co-discoverer with Klebs of the diphtheria bacillus, to Griefswald, Hueppe to Prague, von Behring to Halle and Marburg, Carl Fraenkel to Marburg and Halle and Gärtner to Jena. At the same time hygienic institutes corresponding somewhat to our municipal health laboratories were founded in many of the larger cities of Germany and Austria to provide for the accurate bacteriological diagnosis of the infectious diseases. The largest and best-equipped of such institutes is probably that of Professor Dunbar in Hamburg, one of the few American-born scientists to make his career in Germany. A more recent institute of the same general character is that of the city of Frankfurt a. M. under the able direction of Professor Neisser. With the single exception of the laboratories of the City of New York there are no institutions in America which are founded upon quite the same broad combination of routine work and advanced research as are these.

As a result of the various factors operating to develop the modern science of hygiene in Europe we find that this subject is now firmly established in all the German and Austrian universities. It is a principal or major subject in every medical school and there is an "ordentlich Professor" of hygiene in every university where medicine is taught. Every student of medicine must pass a rigid examination in hygiene before he can obtain his degree and before he can practise his profession. As was to be expected from the somewhat diverse lines of development hygiene has taken we find men of various tendencies occupying the professorships. On the one hand Flügge and Gruber represent the older or Munich school at Berlin and Munich, both trained in the Pettenkofer methods but both greatly influenced in their thought and work by the newer bacteriology of Koch. In Berlin also before the appointment of Professor Flügge, hygiene was brilliantly represented by another product of the Munich

school, Professor Rubner, now professor of physiology. On the other hand, many other chairs of hygiene in Europe are held by the bacteriologists as by Kruse in Königsberg, by Fischer in Kiehl, by Uhlenhuth in Strassburg, by Kolle in Berne, by Schottelius in Freiburg i. B., and by Neumann in Giessen. At the same time hygiene is taught in Vienna by Shattenfroh and Grassberger who clearly unite the two schools, while in Budapest von Lieberman is associated with von Fodor, and may be said to approach the subject more from the standpoint of the physicist.

Despite the great diversity in training of the various hygienists in Germany and Austria, the subjects they teach and study are much the same in the different universities, approached necessarily however from different viewpoints. The fundamental principles of hygiene as applied to vital statistics, heating, lighting, ventilation, clothing, disinfection, sanitation, water and milk supplies, sewage disposal, nutrition and food values are taught to all medical students while special emphasis is laid upon demonstrations which show the mode of transmission of the infectious diseases. Lecture courses in theoretical hygiene are compulsory, laboratory courses in practical hygiene are attended by the majority and all students who are candidates for degrees in medicine must pass a rigid examination in hygiene before graduation. At the same time special courses in hygiene are offered in all the hygienic institutes. They cover a variety of subjects and include such topics as school hygiene, mental hygiene, the hygiene of inheritance, nutrition and systematic instruction in the principles of infection and immunity. Finally elementary bacteriology is taught the medical students in many of the hygienic institutes which in a few instances provide facilities for the cities where the universities are located for diagnostic work in connection with the infectious diseases. No matter how seemingly diverse the subjects or how varied the interests of the many workers in the field, hygiene is a distinct scientific entity in central Europe to-day, the object of whose teaching is the demonstration of all the available facts and theories relating to disease in bulk as distinguished from individual cases of disease.

HYGIENE OR PUBLIC HEALTH IN GREAT BRITAIN

During the period which saw the establishment of hygiene on a modern basis in Germany and Austria, the same science was being developed in England under the name "public health." In Great Britain the system of local control of public affairs had spread more widely than in any of the continental countries in consequence of which the local authorities were enabled to dictate their own mode of government. Local organizations were formed to control all matters relating to the health of the community and the system of local government boards with their peculiar privileges and responsibilities has resulted. This system represents indeed Great Britain's especial contribution to hygiene in the last century and the years 1847 when medical officers of health were first appointed, 1848 when they were required to be qualified medical practitioners (Public Health Act), 1855 when every vestry and district board in London was required to appoint one or more medical officers of health and 1872 when the new Public Health Act forced every sanitary authority outside of London to appoint a medical officer of health, formed the especial landmarks in this chronological development. Long before 1847, however, English physicians had devoted time, energy and thought to the problems of hygiene and the names

dear to the heart of every Anglo-Saxon are scattered over the pages of English medical history. Thus in 1720 Dr. Richard Mead, the physician to St. Thomas Hospital, published his "Short Discourse Concerning Pestilential Contagion, and the Methods to be Used to Prevent It," a book which went through seven editions in its first year of life. In 1764 appeared Dr. John Pringle's work on "Diseases of the Army" which was destined to revolutionize sanitary conditions in jails and hospitals as well as in military camps, while the same service was rendered the navy by Dr. James Lind's publication entitled "On the Means of Preserving the Health of Seamen," soon followed by a series of essays concerning the health of the Royal Navy, on "Fevers and Infection" and on "Jail Distemper." Dr. Gilbert Blane's "Observations on the Diseases of Seamen" appeared in 1785 and in 1796, when Blane was serving as chief officer of the Naval Medical Board under the admiralty, lemon-juice was added to the diet of the seamen and scurvy ceased to rage. Dr. George Baker, in 1767, elucidated the etiology of "colic and palsy" in Devonshire and by his demonstration that this was lead poisoning pure and simple first put the study of industrial diseases upon a scientific foundation. More important than any other single discovery, however, and more beneficial from the world-wide campaign it inaugurated against smallpox stands of course Jenner's discovery of cowpox vaccination in 1798.

In the century from 1738 to 1838 England saw its great rejuvenation manifest in its acute religious revivals, its political emancipation, the social liberation of its lowest classes and the destruction of class privilege, the extinction of slavery, the improvement of agriculture, the extension of trade and commerce and the organization of its industries on a firm basis. During all this time great movements were usually associated with great men and the names of John and Charles Wesley, George Whitfield, Adam Smith, Jeremy Bentham, John Howard and William Wilberforce, will always be held in affectionate reverence by those who are alive to the ills of mankind and who love their fellowmen. By 1838 England had been thoroughly purged of many of its ills and when ten years later the first systematic efforts to regulate the sanitary affairs of London began, the government found a population no longer hostile to sanitary reform. During most of the subsequent period one figure looms up persistently in public health in the United Kingdom, Sir John Simon, who bears much the same relationship to English hygiene that Pettenkofer does to German, and who was fortunately also spared till close to the end of the last century.

As a result of the Public Health Act of 1872, it became apparent that the supply of men trained in sanitary science to occupy positions as public health officers was inadequate and the University of Cambridge set about the task of remedying the difficulty. For this purpose it established the system of examining qualified medical practitioners in the principles of hygiene and granting diplomas to those who satisfactorily passed the examination. In this work the great hygienist Parkes was the leading spirit. The diploma granted came to be known as the D.P.H. or Diploma of Public Health, the holders of such diplomas having a distinct advantage over their competitors when they applied for the coveted positions with the various local government boards. The great advantage to any community in having its medical officer of health a trained sanitarian was soon apparent and in 1892 an act was passed

which required every medical officer of health to have a diploma of public health in every district of 50,000 inhabitants or to have served as health officer before the passage of the act. Thus a medical officer of health in Great Britain is not only a qualified practitioner of medicine but is a trained sanitarian as well.

The example set by Cambridge in granting the D.P.H. was soon followed by other universities in the United Kingdom and at the present time this or a similar degree with the same general purpose is granted in sixteen of the universities in Great Britain as well as by the Conjoint Board of the Royal Colleges of Physicians and Surgeons in England, in Ireland and in Scotland. At the same time the various universities offer courses of instruction in hygiene or public health which qualify men to pass the examinations. In general the work required of a candidate covers nine calendar months, thus corresponding to a year's postgraduate work in America. During this period the candidate spends four months in studying the principles of sanitary science in their application to public health problems, "air, water, soil, sewage, food, climatology, bacteriology, parasitology and the general pathology of diseases of animals transmissible to man, etc." (See Nuttall.) Following this he receives instruction in sanitary engineering, food inspection, epidemiology, occupational hygiene, vital statistics and public health laws. Finally during six of the nine months the student must study public health administration under a qualified medical officer of health and during three months must attend a hospital for infectious diseases and acquire training in diagnosis and in preventive methods. In addition to the men who expect to enter upon an administrative career in public health in Great Britain and who are now required to obtain this diploma, many medical graduates take the D.P.H. as a post-graduate degree corresponding somewhat to our Master of Arts and a large number of the most eminent scientists in the medical profession there are holders of diplomas in public health. Whatever else may be said of the public health instruction in Great Britain and however true some of the criticisms leveled at it may be, it must be admitted that this system has resulted in an enlightened control of sanitary measures by competent authorities which is not surpassed by any other country in the world. How well this system fits into the general political and governmental systems of Great Britain is shown by a glance at their mortality returns in which a death from typhoid fever is so rare as to be an occasion for comment or in a study of the distribution of rabies which seldom or never appears in the British Isles. The English conception of public health differs essentially from the German conception of hygiene, however, and while differences are difficult to formulate, it may be said in general that in England attention is focused upon the administrative side of the subject, while in Germany the emphasis is laid upon the theoretical or purely scientific aspects of the science. This does not mean that in Great Britain the scientific side of public health has been neglected or that in Germany the practical side of hygiene has been forgotten. It is nevertheles true that the modern conception of public health has been furnished the world by Great Britain just as the modern conception of hygiene has been developed in Germany and Austria and that there are certain differences between the two conceptions.

The English notion of public health prevails in Great Britain's colonies and some years ago the late Wyatt Johnston, of

Montreal, established a systematic course of instruction in this branch in McGill University which was the first institution in America to grant a diploma of public health.

HYGIENE OR PUBLIC HEALTH IN FRANCE

In France also from early times thoughtful medical men and government officials were deeply concerned with the health of the people and alive to the necessity of studying and reforming sanitary conditions. On July 6, 1902, Dubois, prefect of police in the City of Paris, founded the Council of Health or Conseil de Salubrité with four members, Deyeux, Parmentier, Huzard and Cadet-Gassicourt. The organization of this body was modified by subsequent decrees in 1810 and in 1815, and similar bodies were formed in Nantes and Bordeaux in 1815, in Lyon in 1822, in Marseilles in 1825, in Lisle (Lille) in 1828, and in Rouen in 1831. In 1848, the year that saw the first Public Health Act of Great Britain, the Conseil d'Etat passed an ordinance for general health regulation throughout France. Since that time the administration of health laws has been on a firm and scientific basis in France and many medical men of prominence like Thouret, Leroux and Dupuytren have been members of the various councils of health. In general the administration of health or sanitary laws is in the hands of the department of police (law, etc.), the Conseil de Salubrité being entirely a consultative body. Its decisions have the practical force of laws however and are seldom reversed. At irregular intervals voluminous reports are issued, relating to health, salubrity and industry. The regulations under the caption Health relate to food and its adulterations, poisonous substances found in it, kind of vessels used in its manufacture, etc. Under Salubrity is considered the regulation of anatomical theaters, barracks for soldiers, public baths, street fountains, water supplies, factories, prisons, markets and disposal of filth. Finally Industry covers the bituminous trades, manufacture of candles, slaughter houses, powder mills, white lead factories, and all places where poisonous gases are liberated. From time to time the old regulations are modified to meet the needs of modern civilization and new regulations promulgated. The wonderful sewerage system of Paris and the beautiful gardens for sewage disposal on the banks of the Seine a few miles below Paris are lasting monuments to the genius of the French hygienists, and the leading positions which French authorities occupy in the scientific development of quarantine testify to their soundness and versatility. French hygiene or public health, however, has been especially influenced in its later development by Pasteur and the various institutes named after him and has, to a considerable extent, developed the idea of preventive medicine. The Pasteur Institute in Paris, originally designed for the study of rabies and the preparation of anti-rabic inoculations, soon took on the character of a general bacteriological and hygienic institute in which the problems of all the infectious diseases were investigated. The other Pasteur Institutes in France and her colonies have also been modeled on the same general plan. Hygiene likewise is an important part of the medical curriculum and a number of standard publications are devoted to it.

HYGIENE OR PUBLIC HEALTH IN AMERICA

When we now turn to the consideration of hygiene or public health in America, it is at once evident that the greatest confusion of ideas prevails concerning the subject. Authorities are not agreed upon

even the fundamental definition of the science the development of which has been both sporadic and limited. It is high time indeed that we should have some sort of free discussion of the whole matter particularly as to the best lines for the future growth of the beginnings already made. Certain fundamental facts stand out clearly. The most important of these is that municipal and state authorities have for years recognized the needs of safeguarding the public health and have established various institutions for this purpose, especially our city and state departments of health. Thus as far back as 1856 our state boards of health were well organized and held an important conference in Philadelphia to deal with the vexing question of yellow fever which appeared at Bay Ridge the previous year. The national government has lagged far behind other countries in public health matters however and a national department of health, so vital to the interests and happiness of every citizen of the United States, has thus far failed of establishment. The abortive attempt made to bring about this much needed reform, in the early eighties, led to the foundation of such a department, which led a precarious existence of only two years. Fortunately the Marine Hospital Service has gradually been able to take up many of the duties of a national department of health and has now become in fact and in name a Public Health Service.

In our universities and in our medical schools, while hygiene was early recognized as a major subject by many of our leaders in medical education, this feeling was by no means widespread. Nevertheless important beginnings were attempted and in some instances splendid results followed. As early as 1865, the year von Pettenkofer became professor of hygiene in Munich, the medical college of the New York Infirmary for women and children made hygiene and public sanitation a compulsory part of its curriculum. Even before this the Women's Medical College of Pennsylvania had taught hygiene in association with physiology. The University of Michigan when its medical department was founded in 1850 taught the principles of the sanitary analysis of drinking water to its students, in the early seventies lectures on hygiene were given to both medical and literary students by the late Dr. Corydon Ford, and in 1876 a course of lectures was given on this subject by the present professor of hygiene there. In 1887 the state legislature made an appropriation for a hygienic laboratory which was formally opened in the session of 1887–88. In Western Reserve, in Cleveland, state medicine and hygiene were taught as early as 1881 sometimes in association with pathology and again in connection with clinical subjects. In Harvard lectures on hygiene were given in 1876, and the present department of preventive medicine was established later as a department of hygiene with the late Dr. Harrington as director. In 1892 the institute of hygiene of the University of Pennsylvania was established upon a broad foundation with the gifted Dr. Billings in charge and in this institute we see most clearly the influence of the Munich school of hygiene upon medical thought in America. Foundations of hygiene were likewise provided for in many other medical schools such as the University of California and Cooper Medical School in San Francisco. With the exception of Michigan, Pennsylvania and Harvard however the hygiene which was taught in America was presented either by practising physicians or by health officers whose time was largely occupied by administrative duties and who gave brief and in general unscientific lectures upon public health topics to medical students. The excellent

example set by three of our leading medical schools was not followed, the science of hygiene failed to develop generally and in many instances the older foundations of hygiene were abandoned to make room for subjects regarded as of greater necessity in the medical curriculum. Thus the department of hygiene in Cooper Medical School, now Leland Stanford, gave way to a department of bacteriology. Recently however Western Reserve has reorganized its work in hygiene and has appointed a full-time professor in this branch, a similar change has taken place in Yale and the relatively new University of Chicago has also established such a department. With all this hygiene as a major subject, with a trained scientist giving up his entire time to teaching its principles and studying its problems, exists in but six of our thirty-eight medical schools to-day. What a pitiful showing this makes in comparison with Germany and Austro-Hungary where all the twenty-two universities where medicine is taught have their hygienic institutes or with Great Britain where every graduate in medicine must follow courses in public health and pass examinations in it. I do not mean that many of our medical schools are not making a determined effort to develop the subject of hygiene or that instruction in it is entirely lacking. Indeed excellent courses in public health are given in both Minnesota and Indiana. In the three larger medical schools in New York City hygiene or public health has now become compulsory. At Johns Hopkins too the faculty has long recognized the necessity of further development along this line and the beginnings small though they are have now been made. I merely wish to point out and emphasize that the science of hygiene, one of the most important parts of a medical curriculum, has never reached the same development as an independent subject which has long been attained in Europe, and which has already been reached in America by the scientific branches of medicine, anatomy, physiology, chemistry, pathology and pharmacology, or by the clinical, surgery, medicine and gynecology and obstetrics.

In the same way and possibly as the result of the same influences, hygiene plays but an unimportant part in our state examinations for licensing practitioners of medicine. In but a few states is there a separate examination in hygiene and in some the subject is not even mentioned. Yet there is probably no field in which medical men need training more than in hygiene and in no line of work will his efforts be more beneficial or more appreciated by the community than in the prevention of the spread of infectious diseases by the application of the sound principles of sanitation. The medical profession of America is neither indifferent to the great problems of preventive medicine nor ignorant of its principles however. The long and honorable career of the American Public Health Association and the more recent development of the Section of Hygiene and Preventive Medicine of the American Medical Association testify to the contrary. The indifference to hygiene as a science lies in our universities and in our medical schools and the responsibility for the failure of its development rests clearly upon them.

PRESENT NEEDS

The question now rises as to the especial needs of hygiene, and the conditions which must be met in order that it shall develop. We may best consider this under three divisions.

There is first a definite need and even a necessity for the training of medical students in the science of health, whether the science be labeled hygiene, public health or

preventive medicine. Every man who graduates from a medical school should be taught, some time during his course, the underlying principles of hygiene. He should know what the word ventilation means, for instance, something about clothing, the kinds of exercise suitable for different individuals, the values of foods, how a good water supply differs from a poor one, what good milk is, how a city should dispose of its sewage. Especially should he be taught the mode of transmission of the infectious diseases and the methods of their prevention. This knowledge the well-trained physician of the future must have, not merely that he may advise his patients properly and safeguard their health, but that he may play his part in the community where he lives and lift his voice on the right side concerning that branch of city and state government which most concerns him, the department of health, too often alas merely a pawn in the hands of unscrupulous individuals to move as they see fit in the great game of politics. To accomplish this purpose, namely, the education of the physician, every medical school in this country should have its department or institute of hygiene in charge of a full-time man with a corps of trained assistants. It makes little difference whether the head of this department is a chemist, a bacteriologist or a physicist, since the problems of hygiene must be approached from various angles, but in the organization of the department provision must be made for teaching the subject with reference to chemistry, bacteriology and physics. Didactic lectures in hygiene must be combined with laboratory exercises and the student must acquire first-hand knowledge of water and milk analysis, disinfection, sanitation, and especially the bacteriological diagnosis and the prophylaxis of the infectious diseases. In addition special courses should be offered in such topics as school hygiene, serum-therapy, nutrition and food valuations, etc. The research side should also play a large part in any department of hygiene. It is not sufficient to teach what we know at present about hygiene. The bounds of our knowledge must be constantly widened, new facts acquired and new theories tested.

The relationship of the department of hygiene to the medical school should also be made clear. It is essential that hygiene be presented as a distinct and independent science and not as a phase of bacteriology, or of chemistry, or of physics. How far the department of hygiene should engage in teaching the elementary principles of the sciences whose methods it uses is also an important question but chiefly as it affects bacteriology. This after all is a matter of merely academic interest. Bacteriology must always be taught medical students from the standpoint of the pathogenic bacteria. If the pathological laboratory has the facilities for teaching bacteriology and the staff have the training there is no reason why general bacteriology should not be taught with pathology. Nor is there any reason why bacteriology should not exist as a separate department in the medical school if funds are available for this purpose. At the same time there is no reason why general bacteriology should not be taught in the hygienic institute so long as it does not encroach upon the teaching of hygiene and provided the head of the department has received the proper training and understands the fundamental principles of infection and immunity. Above all it must be remembered that hygiene is a medical subject and a part of medicine. Its methods are the methods of medicine and have been developed in the medical departments of the European and American universities.

Hygiene must therefore always be taught medical students from the medical point of view by medical men.

The second great need in this country is for better facilities for the training of public health officers. The awakening of the public conscience to the necessity of removing health questions from the domain of politics has resulted in the reorganization of many of our municipal and state departments of health while the excellent achievements of others have given them greater responsibilities and increased facilities for carrying out their work. The system of "county health officers" in which employees of the state department of health are empowered to assume local duties either in cooperation with the local authorities or superseding them has now been adopted in two states and marks a signal advance in health legislation. This is an example indeed likely to be followed by a number of states as time goes on. This change in health administration has created a distinct demand for specialists in public health and the medical departments of our universities must now see to it that the men who take up public health as a career are given the opportunities of fitting themselves properly in the science of hygiene or public health. This can probably best be accomplished by organizing courses leading up to the Diploma of Public Health or some similar degree, the possession of which will guarantee that the holder has received expert instruction which will qualify him to act intelligently as an officer of health. Already three of our best medical schools have organized such courses and other universities are contemplating similar enterprises. It is not enough that this or that school shall establish departments for the training of health officials. This movement is one which vitally concerns the physicians of this country and is likely to have an important influence upon the development of American medicine. The medical profession must demand that our health officers be properly trained, that the Diploma of Public Health shall not be awarded to any sort of individual regardless of his preliminary training to be used merely as a lever to help him to acquire a position. There must be some sort of standardization of the courses leading up to the degree and particularly must there be some agreement as to their length and the amount of time which must be passed in preparation for the examinations. Above all American physicians must remember that the health officer, be he county, city or state, has a distinct function, the intelligent exercise of which requires a medical training. It is not enough that our garbage be disposed of, that our drinking water be chlorinated or filtered, the bacteria in milk be counted or the births and deaths of a community be registered, important as these activities may be. It is far more important that the unsuspected and unreported case of typhoid fever or septic sore throat be ferreted out, the typhoid or diphtheria carrier be recognized, the first case of smallpox be differentiated from chickenpox and that the correct diagnosis of the obscure cases of meningitis or some of the exanthemata be established. It is after all in the great field of the preventable diseases of infectious nature that the health officers will do the most work and bear the heaviest responsibilities. Thus while an engineer or a half-trained medical man who has specialized in public health may satisfactorily perform the functions of a health officer in certain particulars it is difficult to see how he can perform the most important. This is a particularly grave problem in maritime cities where the danger of bubonic plague is constantly increasing or where a case of yellow fever may slip in almost any time. It is an important ques-

tion therefore whether the American medical profession shall permit to develop unchallenged that movement now grown so powerful in this country whereby non-medical men are elevated to positions of authority and responsibility in public health matters, which after all are medical matters. Without doubt many non-medical men may become expert health officers and discharge their duties to the communities which they serve in an intelligent manner. Can they be trusted in a crisis however and are we willing as physicians that a practise so fraught with danger be continued?

Finally how can we educate the great mass of people in this country who are engaging in all sorts of philanthropic enterprises which verge on medicine or which require some medical advice and assistance if all this work is to be prosecuted intelligently. These individuals are constantly turning to the medical profession for the solutions of knotty, difficult problems and indeed in no time in the history of this country have physicians had greater opportunities of directing broad, comprehensive charitable movements in the proper direction so that great sums of money shall be intelligently used for useful and beneficial objects. This education of the people in matters affecting their health can probably best be given in a museum of hygiene where models of all sorts of apparatus, collections of charts and statistical materials can be made available for study, where public lectures can be given on health topics, where experts in various lines can be consulted, where commissions can be formed for the investigation of special problems of public health. Such a museum would become a great center for education in hygiene and public health and prove of incalculable benefit to the community in which it might happen to be located.

The question as to which of these three needs should first be satisfied is not easy to answer and the answer will also vary according to the individual point of view of those of us who study the problems. They are here presented in what seems to me to be the logical arrangement. If possible let us first educate our medical students, then our officers of health, then the public. Should the order be changed however no great harm will result. Should this country be so fortunate as to see schools of hygiene attached to the medical departments of our universities properly endowed and aiming to satisfy all three needs, then indeed shall we be fortunate beyond the wildest dreams of the most enthusiastic student of the subject.

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MEASUREMENTS OF THE DISTANCES OF THE STARS[1]

FOR the lecture in honor and memory of Edward Halley, which it is my privilege to deliver this year, I have chosen an account of the persistent efforts made by astronomers to measure the distances of the fixed stars. For many generations their attempts were unsuccessful, though some of them led to great and unexpected discoveries. It is less than eighty years ago that the distances of two or three of the nearest stars were determined with any certainty. The number was added to, slowly at first, but afterwards at a greater rate, and now that large

[1] The "Halley Lecture" (slightly abridged), delivered at Oxford on May 20, by Sir F. W. Dyson, F.R.S., Astronomer Royal, and printed in the issue of *Nature* for June 3.