SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, OCTOBER 12, 1906.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE FUTURE OF MEDICINE.[1]

THE future occupations and interests of the medical profession are to be in some respects different from those of the past, and they are to be more various. The ordinary physician has for the last hundred years been almost exclusively a man devoted to the treatment of diseases already developed in human bodies or of injuries already incurred. He made his diagnosis, and then sought remedies and a cure. He was the sympathetic and skilful helper of sick or injured persons. Most of the cases that came under his care were cases considered plain as to symptoms, period and accepted treatment. The minority of cases were obscure, and called for unusual knowledge and skill in discerning the seat of the disorder, or the approximate cause of the bodily disturbance. Hence the special value of the experienced consultant, who was ordinarily a man of some peculiar natural gift of body, mind or temperament, possessing also in high degree the faculty of keen observation, and the habit of eliminating irrelevant considerations, and ultimately finding his way to the accurate, limited inference from the facts before him. Both the ordinary physician and the consultant have already been much helped by the extraordinary progress made in medical science during the last thirty years; but they have been helped chiefly to a surer recognition of diseases established in human

[1] An address delivered by President Charles W. Eliot, on September 26, 1906, at the dedication of the Harvard Medical School.

bodies, and to a better treatment of their patients' diseases when recognized.

The physician or surgeon commonly renders a personal service to an individual, sometimes for a pecuniary recompense, but often without money compensation. He is often a trusted adviser in the most intimate family concerns. Births and deaths alike bring the physician into the home. In rendering these services he must be tender, sympathetic, considerate, pure-minded and judicious. There will always be need, crying need, of the physician and surgeon in this sense, and for these functions; and whatever else the regular education of the physician provides in the future, it must provide all the elements of the best training for the practising physician who is to treat diseased or crippled human bodies, and give advice about the sudden and the chronic ills which afflict humanity. So much will continue to be demanded of all good medical schools; but much more they must do.

The progress of what we call civilization exposes human beings more and more to the ravages of disease. When savages come in contact with men called civilized, they invariably suffer from diseases new to them. When a rural population crowds into cities, it falls a victim of diseases from which in the country it had been exempt. When hundreds of thousands of people huddle into small areas, and create there smoke, dust and noise, they suffer not only from new diseases, but from the exacerbation of diseases not wholly unknown to them in their rural condition. Under such unfavorable conditions of residence and labor the human body degenerates in many respects, and, losing vigor, becomes in some respects less able to resist the attacks of disease.

Against these bodily evils which result from civilization the physician has thus far struggled chiefly by treating more or less successfully the numerous individuals who are attacked by disease. Doubtless the treatment of sick and injured persons has substantially improved; but, nevertheless, the death-rate in our cities diminishes slowly, and the heavy economic losses which result from disease and premature death continue. Moreover, the improvement of treatment in hospitals and private practise has been accompanied by a great increase in the cost of treatment; so that the charges upon the community resulting from sicknesses and injuries have within the last thirty years rapidly mounted, and these heavy charges are, after all, incurred for the palliation of evils already suffered, and not for the prevention of such evils. Again, in different parts of the habitable globe mankind has been exposed for centuries to dangers more or less localized; in one region to the attacks of venomous reptiles, in another, of fierce carnivora, in another, to the ravages of flights of insects which devour every green thing, in another, to the constant presence of formidable diseases. For the most part, the human race has learnt how to exterminate the offending creatures, or at least to limit their ravages; and where grave infectious diseases are always present in greater or smaller degree, or frequently recur, a considerable proportion of the population becomes in some degree immune to them. Mankind is now in face of enemies which are not localized, but which, on the contrary, are carried all over the habitable globe on the ubiquitous routes of travel and commerce. The worst of the new enemies are minute, multitudinous and mysterious in that their relations and connections are unknown; they infest many of the animals with which man is associated, or pass into man from the animals and plants of which he makes use. Untrammelled dissemination of noxious

things has taken the place of centuries-long localization, a localization which sometimes secured checks, antidotes or immunities. Since, then, modern society can not help incurring new risks, it should seek new defenses. These defenses it may reasonably expect medical education to plan, and public and private expenditure to provide.

If civilized society is to endure under its new exposures and dangers, it is clear that the medical profession must take up with new ardor the work of preventing approaching disease in addition to the work of treating disease arrived. The profession must recognize that health is eminently a social product, just as the psychologists have recognized that the mind of a civilized man is a social product.

When we consider what has already been learnt about the production, transmission and prevention of smallpox, cholera, yellow fever, the black death, typhoid fever, diphtheria, anthrax, rabies and tetanus, we can not resist the conclusion that in the future medical science must include the study of causes and sequences which will carry the student through a large portion of the animal and vegetable kingdoms, and particularly into the habits and habitats of their minute parasitic forms. Systematic medical education must, therefore, produce a considerable number of men capable of studying in this region the causes of disease, and the ways of interrupting the means of communication, or breaking the chain of sequences, through which at last the germs of disease get a chance to produce their malignant effects within the human body. Considering the great obscurity of the physiological processes which go on within the body and the dense ignorance of mankind concerning the microscopic animal kingdom, it is a great wonder that medical science in its imperfect state has constructed so many effective defenses against disease within the last thirty years. Indeed, we are now using some efficient defensive methods, the real nature of which we but imperfectly understand, as for instance, the vaccinations against smallpox and hydrophobia. Although we are not yet able absolutely to prevent disease, we are able in many cases to restrict the communication of diseases and to modify their course in the individuals attacked.

The medicine of the future has, therefore to deal much more extensively than in the past with preventive medicine, or in other words, with the causes of disease as it attacks society, the community, or the state, rather than the individual. The object in view will be not only to arrest or modify a malady which has appeared in the body of a patient, but, as in the recent case of yellow fever, to learn how the disease is communicated and how to prevent that communication. The study of mitigations, remedies and cures is to continue; but the study of the causes of disease and the means of prevention is to be greatly developed. The function of the nineteenth-century physician will continue, and indeed will become more effective through a better knowledge of the forces which may be made to act upon his patient both from within and from without; but another sort of physician will be at work in the twentieth century preventing the access of epidemics, limiting them when they arrive, defending society against bad food and drink, and reducing to lowest terms the manifold evils which result from the congestion of population. The explorers and pioneers in medical science must be encouraged to press on their patient work of analyzing all the processes which accompany disease, in order that they may learn their actual sequences. Only through the knowledge of these sequences can real control over disease be certainly gained. And this

work will be endless; for civilization involves constant changes in the environment of the human race; and it is on medical science that the race must depend for protecting it from the new dangers which accompany each novel environment. The medical scientists being provided and furthered, medical education must also train large bodies of men to clear and cultivate the regions through which the pioneers have made trails, or, in plainer words, to apply to millions of men and women in all sorts of climate and environment the discoveries of the scientists. Thus thousands of physicians all over our southern states must for years be teaching the people how to protect themselves from yellow fever. Major Walter Reed and his colleagues proved how yellow fever is communicated, and—what was equally important—how it is not communicated; but thousands of medical men must see to it that intelligent application is made of that precious knowledge.

Recent events have brought into strong light a new function of the medical profession which is sure to be amplified and made more effective in the near future. I mean the function of teaching the whole population how diseases are caused and communicated, and what are the corresponding means of prevention. The recent campaign against tuberculosis is a good illustration of this new function of the profession. To discharge it well requires in medical men the power of interesting exposition, with telling illustration and moving exhortation. Obviously the function calls for disinterestedness and public spirit on the part of the profession; but to this call it is certain that the profession will respond. It also calls for some new adjustments and new functions in medical schools, which should hereafter be careful to provide means of popular exposition concerning water supplies, foods, drinks, drugs, the parasitic causes or consequences of disease in men, plants and animals, and the modes of communication of all communicable diseases. Medical museums should be arranged in part for the instruction of the public, and with some suitable reservations should be statedly open to the public. The medical schools should also habitually provide popular lectures on medical subjects, and these lectures should be given without charge on days and at hours when working people can attend. In other words, selected physicians should become public teachers, as well as private practitioners. America has much to learn from Europe in regard to this public-spirited service on the part of the profession.

In another respect the teaching of medicine must be broadened in the century we have now entered on. Medical study has been in time past far too exclusively the study of man's body by itself. Hereafter the study of medicine must be largely comparative, or in other words, must include man's relations to the animal and vegetable kingdoms. The Harvard Medical School enters into possession of its new buildings with three professorships of comparative medicine already established, the professorships of comparative anatomy, comparative physiology and comparative pathology. This tendency to comparative study has been already well developed in other subjects, as for example, in comparative psychology, legislation and religion. Wherever this study by comparison wins adequate place, it makes the study of the subject broader and more liberalizing, and the results obtained more comprehensive and juster. Medical students should, therefore, have studied zoology and botany before beginning the study of medicine, and should have acquired some skill in the use of the scalpel and the microscope. It is absurd that anybody should begin with the huma

body the practise of dissection or of surgery; and, furthermore, it is wholly irrational that any young man who means to be a physician should not have mastered the elements of biology, chemistry and physics years before he enters a medical school. The mental constitution of the physician is essentially that of the naturalist; and the tastes and capacities of the naturalist reveal themselves, and, indeed, demand satisfaction long before twenty-one years of age, which is a good age for entering a medical school. The Harvard Medical School has derived great advantages from its requirement of a previous degree for admission; but in view of the fact that many young men procure a bachelor's degree without ever having studied any science, the school needs an additional and more specific requirement, namely, a previous knowledge of biology, physics and organic chemistry, and an acquaintance with laboratory methods in all three subjects.

As at the preliminary stages of the medical career, so at its climax there is an increasing need of men who have a working knowledge of several sciences which were formerly treated as distinct, and whose best representatives in medical schools labored apart each in his own field. The most promising medical research of our day makes use of biological, chemical and physical science combined. Physiology advances by making applications of the principles, the methods and the implements of all three sciences. The physiologist listens to the normal or abnormal sounds in the bodies of men and animals with a modified telephone, and may record by electricity almost all the phenomena he studies. Bacteriology and biological chemistry go hand in hand in serving pathology and the public health. A great number of new chemical substances, coming from organic sources, yet as definite and uniform in composition as salt or alum, prove serviceable in pharmacology, and in physiological and pathological research, although they were neither discovered nor manufactured with any such purpose in view. The stainings of bacteriological technique, and the quantitative color tests for characteristic ingredients in the various secretions of the body, ingredients which fluctuate in amount in health or in disease, illustrate the present dependence of medical research on chemistry and physics. For the effective study of the toxins and antitoxins, within and without the body, the bacteriologist and the biological chemist must cooperate. Many of the effects produced by the toxins in the living body are definite chemical changes, such for instance as may be produced by the activation of certain ferments, and the antagonism of toxin and antitoxin is probably a chemical reaction. Many of the great discoveries of the future will come through the cooperation of sympathetic groups of medical scientists representing different modes of attacking the same problem. There will be a like necessity for cooperation between the clinician, the pathological anatomist, the physiological chemist and the bacteriologist.

The world has observed, and will not forget, that some of the greatest contributors to the progress of medicine and surgery during the past thirty years have been, not physicians, but naturalists and chemists. Pasteur was a chemist, Cohn, the teacher of Koch, a botanist, and Metchnikoff a zoologist. Students of disease must, therefore, be competent to utilize in their great task every aid which natural science can furnish. How vastly is the range of medical science and medical education broadened by this plain necessity! The dignity and serviceableness of the medical profession are heightened by every new

demand on the intelligence and devotion of its members.

The recent liberal endowment of the Harvard Medical School by private persons is an indication that the more intelligent and public-spirited portion of the American people is beginning to understand that most diseases would be preventable, if only mankind had acquired the knowledge needed to prevent them. The urgent duty of society to-day is to spend the money needed to get that knowledge. How to spend it we have learned—witness the admirable work of the Massachusetts Board of Health for thirty years past, aggressive work both defensive and offensive; witness also the remarkable results of the medical institutes both in this country and in Europe.

The medical profession of the future will have the satisfaction not only of ameliorating the condition or prolonging the life of the suffering individual, but also of exterminating or closely limiting the preventable diseases. CHARLES W. ELIOT.

THE UNITY OF THE MEDICAL SCIENCES.[1]

THE dedication of the new buildings of the Harvard Medical School is an occasion for rejoicing, not to Harvard University alone, but to all in this country and elsewhere interested in the progress of medical education and of medical science, and in behalf of all such I beg to offer to this university hearty congratulations upon this magnificent addition to its resources for medical teaching and study. Medicine everywhere and especially in America has reason to be profoundly grateful to the generous and public-spirited donors who have made possible the construction of this group of buildings, unsurpassed in the imposing beauty and harmony of their architectural design and in their ample, internal arrangements. This design is adapted from the Greek, and it is peculiarly fitting that the medical sciences should be housed in a style which suggests the spirit of ancient Greece, where first flowed the springs of medical science and art, living springs even to this day. In the singular harmony of the architecture of the group of buildings devoted to the various medical sciences are typified the unity of purpose of these sciences and their combination into the one great science of medicine. What I shall have to say on this occasion is suggested in part by this thought of the 'Unity of Medical Science.'

The good fortune of the Harvard Medical School in coming into possession of the splendid laboratories now formally dedicated is well merited by the leading position which this institution has held in this country since its foundation, by its union with Harvard University and by the assurance that the greatly enlarged opportunities will here be used to the highest advantage. Since the appointment in 1782 of its first professors, John Warren and Benjamin Waterhouse, of enduring fame, this school has had a long line of honored names upon its roll of teachers, lustrous not only for such single stars as Channing and Ware and Holmes and Ellis and Cheever, but especially for its clustered stars, the Warrens, the Jacksons, the Bigelows, the Shattucks, the Wymans, the Bowditchs, the Minots; and it will not be deemed invidious on this occasion to mention of the latter group the names of two members of the present distinguished faculty to whose services this school is so largely indebted for securing the funds for the new buildings, Professor Henry P. Bowditch, the eminent leader of Americ physiologists, and Professor John C

[1] An address delivered by William H. Welch, M.D., LL.D., professor of pathology, Johns Hopkins University, on September 26, 1906, at Harvard University, at the dedication of the new buildings of the Harvard Medical School.