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Medical Education.

DURING the last thirty years the feeling has become increasingly insistent, both in this country and in America, that certain radical reforms were needed in the methods of education in medicine. But our American colleagues have been fortunate in having the opportunity and the means for building new schools of medicine to meet the new circumstances and for making drastic changes in their methods of teaching which a variety of circumstances has hitherto prevented us from attempting in Britain. Now that the Rockefeller Foundation, by its magnificent generosity, has made it possible for us to embark upon the difficult sea of reform, it is particularly interesting and instructive to study the policy adopted in the more advanced schools of America during the twenty-seven years since the Johns Hopkins Medical School gave the study of medicine in America a new aim and a higher ideal. Though we are a quarter of a century behind our American colleagues in making a start, our delay has given us the advantage that we can profit by the experiments made on the other side of the Atlantic.

It is not generally recognised here how thoroughly the leaders of medical education in America explored every possible method of education throughout the world, and how much devotion and thought they have expended on experiments to discover, by truly scientific methods, how best to employ the few years that the medical student can devote to the training for his profession. Those who want to understand something of the spirit and the high ideals that have inspired the American leaders in this great reform movement should read the account of their work and aims in the volume "Medical Research and Education," issued by the Science Press in New York in 1913. Briefly expressed, the matters upon which chief insistence is placed are as follows: The absolute necessity of (*a*) an adequate preliminary education and a serious University training in the basal sciences, physics, chemistry, and biology, without which foundation it is impossible for the student really to profit from his training in medical science; and (*b*) a method of practical teaching in all branches of professional work, whereby the student can, so far as possible, investigate for himself the facts and theories of each subject under the direction of men who are themselves engaged in research work, and not rely mainly upon lectures and demonstrations to give him merely the *results* of other people's work. In other words, the aim of the reform is to train the student in scientific methods rather than to "cram" him with traditional lore.

So impressed were certain American teachers with the evils of the lecture system of instruction that the attempt was made to eliminate lectures altogether. On this side of the Atlantic (and in most American schools also) it is recognised that some lectures are essential to give the student guidance and a right perspective in his work, and that demonstrations are an invaluable means of instruction, provided the student can really see the objects and appreciate the significance of the experiments. No impartial observer will, however, refuse to admit that in most British schools an altogether undue amount of the medical student's and his teacher's time is wasted in the attendance upon lectures and demonstrations of a useless or distracting kind. Several circumstances make it difficult to break with this vicious system. The financial arrangements in most of our schools are based upon payments for certain courses of lectures or demonstrations: the requirements of most institutions and examining boards are for attendance at so many lectures: and the method of awarding the Board of Education grants for some time helped still further to stereotype this system. In the American schools the student pays for his instruction, and the teacher is free to decide how best the required instruction is provided; in other words, the method of administration of the department is so arranged that the perpetuation of obsolete and vicious methods is not made compulsory for a teacher who has his own ideas as to how to educate his students to the best advantage.

The other great reform in American medical educational practice has been to bring the methods of teaching and research in the clinical subjects into line with those of the intermediate subjects.

The teachers of medicine, surgery, gynæcology, etc., used to be men practising their profession who gave up a certain amount of time to teaching medical students. Such men could bring to their teaching the ripe experience gained not only in the hospital wards, but also in contact with private patients; and, in addition to teaching the science and practice of medicine, were supposed to be able to convey to the student something of the subtle art popularly known as the "bedside manner," which is sometimes reputed to be more useful to the practitioner than either knowledge or skill. But it has long been felt that such teachers, in the course of their individual careers, would become more and more strongly tempted to neglect teaching and research as the demands of their practices became more insistent, and that it was only the exceptional man who would be sufficiently interested in investigation and teaching to make the financial and social sacrifice which the cultivation of his scientific interests would inevitably entail.

British medicine, both now and in the past, has been extraordinarily fortunate in such "exceptional" physicians and surgeons, who have deliberately set aside part of their time for scientific research and teaching. But for their zeal, this country could not have acquired or maintained its deservedly high reputation for clinical research. Nevertheless, the fact has to be faced that in some of the hospitals attached to our schools of medicine no real research of any kind is being carried on, and the clinical teaching is of the most perfunctory order. The obvious remedy for this disastrous tendency is to appoint selected men to investigate the problems of medicine and surgery and to direct the education of students, who will devote the whole of their time to this work, as the professors of anatomy, physiology, pathology, and pharmacology do at present. Such a development has, in fact, become inevitable, for now that a real science of medicine is beginning to emerge the investigation of its difficult problems and the direction of the students' training demand the whole time and energy of specially selected men with the necessary technical training and self-denying devotion to science to cope with such tasks.

This system has been tried in America with most encouraging results. Acting on the advice of Sir George Newman, the Board of Education last autumn agreed to provide financial help to enable certain medical schools to introduce the system of full-time teachers of medicine and surgery in England. Of the institutions that availed themselves of this offer, the University College Hospital Medical School was the only one which adopted a really whole-time system; and it was this consideration that focussed the interest of the Rockefeller Foundation upon the Gower Street School, for in America the Rockefeller Foundation has played a large part in encouraging the adoption of the whole-time professorships of medicine and surgery. Another factor that played some part in determining its selection was the fact that University College had made provision in its Institutes of Physiology and Pharmacology for the adequate training of students in those subjects, so as to equip them to make the best use of the new facilities for clinical study in the medical school; and further that Prof. Starling had agreed to hand over to the department of anatomy the sub-department of histology, which is vitally important for the full development of teaching and research in anatomy.

The great development in the science of anatomy during the last thirty years has been due mainly to the use of the microscope for the investigation of the structure of the body and for the study of embryology. British anatomy has been hampered by the lack of the facilities for teaching these vital parts of the subject, and has suffered enormously from the lack of stimulating daily contact with them. In other countries, and especially in America, the cultivation of histology and embryology has not only made anatomy one of the most active branches of medical study and research, but also brought the work of the department into close touch with physiology, biochemistry, and pathology, to the mutual benefit of all these subjects, and especially to the student who has to integrate the information acquired in the different departments. It was the radical reforms effected in the teaching of anatomy by the late Prof. Franklin Mall at the Johns Hopkins Medical School in 1893 that played the chief part in starting the great revolution in medical education in America. The stimulating influence of the abolition of the methods of medieval scholasticism in anatomy and the return to the study of Nature and to the use of experiment brought about a closer co-operation with other departments and a general quickening of the students' interest in the real science of medicine.

The effects of these developments spread to other American schools, and the Rockefeller Foundation came to their help and contributed part of the cost of the vital reforms. In 1914 it helped the Washington University at St. Louis to build a new medical school and hospital, with full-time

professors of the clinical subjects, for the endowment of which it gave 250,000*l.*, a quarter of the cost. In 1917 it gave the Chicago University 500,000*l.*, and in ninety days the University collected a further 900,000*l.* to complete the endowment of full-time clinical chairs. In 1918 Yale University raised 650,000*l.* for the same purpose, of which the Rockefeller Foundation contributed one-quarter. In 1919 the Johns Hopkins Hospital established a full-time teaching staff in obstetrics and gynæcology, with an endowment of 250,000*l.*, of which the Rockefeller Foundation gave 100,000*l.* It is rumoured that the same Foundation, which has also given such vast endowments for medical education in Canada and China, is about to excel all its former efforts by a new scheme for further helping medical education in the United States. With such examples of the scale on which these things have to be done, surely England can do more for medical education than she is doing!

The task of the reformer of medical education is vastly more difficult in this country than in America, because on every side there is the hampering influence of cast-iron conventions; but now that the Rockefeller Foundation has helped us to begin the urgent reform there can be no doubt as to the ultimate result.

The Theory and Facts of Colour Vision.

(1) *The Physiology of Vision, with Special Reference to Colour Blindness.* By Dr. F. W. Edridge-Green. Pp. xii+280. (London: G. Bell and Sons, Ltd., 1920.) Price 12*s.* net.

(2) *Card Test for Colour Blindness.* By Dr. F. W. Edridge-Green. 24 cards. (London: G. Bell and Sons, Ltd., n.d.) Price 25*s.* net.

(1) THE great importance of the subject-matter of the volume under notice and of the card-test which supplements it is beyond all question. Interest in it is enhanced by the fact that the subject is admittedly full of difficulties. In every discussion of human sensations and of the organs which serve as the receivers of stimuli, one is impressed by the uncertainty of much which has been put forward as assured truth. It is not long ago that the mechanism of audition was being discussed anew, and even now, in spite of the renewed examination, the functions of various parts of the ear are much in debate. Yet in audition we have to deal with purely mechanical stimuli which we might have expected to have yielded up the secrets of their operation long ago. In the case of light the problem is clearly of a more recondite order, and it is not so surprising that little is actually known with certainty about the functions of various parts of the eye, and that we have therefore to fall back upon surmise.

The theory of vision most espoused by physicists is the three-colour theory of Young and Helmholtz, based upon the facts of colour mixture. It is possible to reproduce any tint whatever by mixing together three selected tints in a suitable proportion. This is accepted now by every school, and it must be taken as the basis of any theory of colour vision. The Young-Helmholtz theory explains the fact by *assuming* that there are three units in the sensitive apparatus of the eye (either three sorts of nerves or rods or cones), each of which responds in a maximum degree to one of the three primary tints, but also to a less degree to all (or most) other tints. Red, green, and blue of selected wave-lengths are taken (for reasons which cannot be given here) as the primary tints. A spectral yellow stimulates both red and green sensations, so does a mixture of red and green lights; hence a certain such mixture will produce the same sensation as does a spectral yellow. In this way the phenomena of colour mixture are explained.

Unfortunately, there are difficulties in accepting this theory. In the first place, there is no histological evidence of the existence of these three units. This objection, taken alone, is not fatal. It is conceivable that anatomical differences exist which are beyond detection with the microscope. But, in addition, there is a vast number of phenomena to be explained besides those of colour mixture, and many of these seem to be directly in opposition to the theory. Dr. Edridge-Green is well known as one who, after prolonged study of the question, was compelled to give up the trichromatic theory. The volume under review summarises the conclusions to which he has come. We can cite only a few of the experimental facts.

In certain cases of defective colour perception the yellow sensation is diminished, and in others lost altogether, although the percipient experiences three definite colour sensations (red, green, and violet). Why do not the red and green make yellow in such cases? If the eye be fatigued with pure spectral yellow light, and be then turned aside to view a spectrum, this will appear to have lost its yellow; and though yellowish-red or yellowish-green will appear less yellow, the terminal red of the spectrum will not be affected. According to the trichromatic theory,