The Field of Clinical Science

LORD NUFFIELD'S GIFTS TO OXFORD

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MEDICINE as a charity for the sick poor has for hundreds of years been entrusted with the gifts of kindly minded men and women. But the great advances in recent times of medical knowledge, whether directly won or derived from kindred sciences, have shown such promise of abundant help for all, rich and poor alike, that the gifts are now directed with a broader hope upon medicine itself. Such gifts, and they have followed one another in an astonishingly rich profusion since the beginning of this century, do not derive from a purely intellectual interest in science. Their aim is practical, for the welfare of humanity ; they are guided by the sense that medicine itself, the instrument, must be sharpened with a keener power of penetration into the tangled problems of disease. Merely to multiply hospitals is not enough, for there is still substance to justify the indignant comment of Tristram Shandy's father on the physicians' motto, *Ars longa, vita brevis,* "Life is short, and the art of healing tedious ; and who are we to thank for the one and the other but the ignorance of quacks themselves—and the stage loads of chymical nostrums, and peripatetic lumber, with which in all ages they have at first flattered the world, and at last deceived it".

The practical art itself can make little true progress unless medicine is brought closer and still closer to the discipline of scientific thought. But the word 'science' in itself carries no reference to laboratories and their modern uses. It simply connotes exactness of knowledge. Plato in his Republic defined 'opinion' as a faculty wandering between ignorance and knowledge, and too often resting near the former state. It is not the traditional reliance on doctor's opinion, but proof of every clinical rule and determination of the laws co-ordinating the phenomena of disease that are needed if the subject is to take rank as a science.

There are faint-hearted people within medicine who feel that the complications of each individual patient and his disease are so manifold that the clear generalizations of an exact science can never be applicable in practice, and that the latter must always remain at the level of an individual art. Others who are outside of the clinical group believe that discoveries of far-reaching value, the issue of a science that is creative as well as exact, will so rarely have their parentage among clinicians that it is fruitless to attempt to foster their birth in other homes than those of the ancillary sciences, such as physiology, biochemistry, and bacteriology. If both these views were true, clinical medicine might remain a useful art but it could never gain the exactitude and fruitfulness of a science. Good judges have decided otherwise, and laid plans for the embodiment of their views. To the practical English mind it is important to note the origin of these plans and their subsequent vigorous growth.

In 1913 the Royal Commission on University Education in London published its final report. Lord Haldane was chairman, and associated with him were Lord Milner, Sir Robert Morant and others, none of whom held medical qualifications. The great fracture of the War has broken the continuity of memory in many affairs, and it often escapes notice that many of the recent developments in London were foreshadowed in and owed their origin to the arguments of that report. In dealing with the teaching of medicine, Lord Haldane and his colleagues concluded that clinical medicine is capable of being treated scientifically, and that for this purpose the subject should be dealt with by men of the kind spoken of as university professors, who would do for medicine what other men do for physiology or chemistry. In order to enable each of such clinical professors to develop his subject by both teaching and research, it was proposed to equip him with a 'hospital unit' or service of beds, laboratories and assistants, all under his general control.

Soon after the War, in 1919, Sir George Newman announced a grant from the Board of Education for the immediate establishment of a number of such clinical units in certain medical schools of London, and their directors were afterwards given the status and responsibilities of professors in the University. The primary conception owed much to the examples already given by Germany and the United States, and at the outset it was nourished by great gifts from the Rockefeller Board. But time has proved its strength ; and the Regius professorships of medicine in Great Britain, which are among the oldest established of all our university chairs, are now being one by one transformed into posts held by men who do not aim at individual reputation in practice but seek to establish their subjects on a broader basis as an exact science. Lord Nuffield's gift of £2,000,000 to the University of Oxford for a school of advanced teaching and research in the clinical subjects emphasizes both the momentum of this change and the hopes that ride by its side.

Exactness in medicine as a science, whether curative or preventive, has all too short a range of ascertained knowledge. The vastness of the unmapped stretches, where disease must be met and somehow or other dealt with as it arises day by day, makes the science seem so small and the art of medicine almost the only means for ready action. Who can best be entrusted with the duty of riding out to extend the borders of the known? Physiologists and biochemists have claimed the honour, justly pointing to the work they have already done. But to Lord Nuffield and his advisers it seemed right to choose men who belong to a different group, clinicians, and his choice lacks neither precedent nor good argument.

In the same year as that in which the Royal Commission outlined its plan for medical education in Great Britain, research in medicine was suddenly given State recognition and endowment on a great scale by those decisions of Government which created what is now known as the Medical Research Council. Though always devoting the greater part of its resources to laboratory work by bacteriologists, chemists and others not in direct contact with the sick, the Council from the outset resolved to foster research by actual clinicians. It was happy in its first choice of a man to be given full opportunities for such work. Sir Thomas Lewis, with his beds, laboratories, and assistants at University College Hospital, London, has given knowledge of the highest value to medicine by his studies of diseases of the heart and blood vessels. So emphatic a success justified the Council in developing similar posts for clinical research in other medical schools; and with the assurance of such possibilities for work in front of them, even before the advent of Lord Nuffield's endowments for clinical research, some of the ablest of the younger men in hospitals have chosen for their life's work research in that particular field which Sir Thomas Lewis by his recent writings and addresses has sought particularly to identify under the name of clinical science.

Neither the name nor the idea is new. But the steady advocacy and the proof of its importance have created a group of workers who will make of it almost a new science in Britain. Including as it does all exact knowledge concerning human disease, it is in that respect nothing more than the science of medicine, to which so many workers in the past have added from their various points of view. The fresh impress is in the emphasis on the possibility, and the need, of developing a science directly related to medicine and dealing with the clinical phenomena of disease.

The accepted medical sciences, as distinct from clinical science, comprise all those biological studies which contribute to the understanding of disease and which were originally developed by medical men because they felt the need for such ancillary knowledge. Physiology, bacteriology and the rest have shown such vigorous growth that each now prospers with the independence of a pure science. The separation was inevitable; but thereby clinical medicine lost much of its own repute for scientific work, while the ancillary sciences acquired the term of being 'fundamental' because they revealed the main facts and laws of the working of the healthy body through which the disturbances wrought by disease might be analysed. For argument, let it be granted that in the future the deepest discoveries of far-reaching importance will be made by research in these separate studies. Such discoveries cannot be used at once in practical medicine. Some intermediate group of workers, equally trained in exact scientific judgment, must test and prove the way in which they may be applied to the management of human disease. The physiologist has learned that what is true for the frog may be untrue for the cat; and even what is true in healthy man may not be true in disease. If life must be measured in terms of life, then medicine must be measured in terms of medicine. That is the responsibility of clinical science.

The British school of physiology has a world-wide eminence. Its great discoveries regarding the nervous control of the viscera and blood vessels were among its earliest achievements, and little has been added to the details of that analysis in the last thirty years. Time moved on, and still almost nothing was gained from that great store of knowledge until at last clinicians themselves began to test by experiment its applicability to diseased states in man. In this direction clinical science is complementary to the fundamental sciences, and as essential as they are for the progress of practical medicine. But the clinician is the first to be aware of the insistence of a medical problem and to define it: in the end, only he can test the accuracy of the proposed solution. The needed discovery will often be his own, but if it chances to be made by a laboratory worker in other biological sciences, it is plainly to the advantage of the latter in so far as public support of their sciences is concerned that the applicability of such discovery to practical medicine should be proved with the least possible delay. Indeed, those aspects of pure physiology and pathology which require experiments on animals would not be accepted as justifiable if they did not yield knowledge that finally gives help to both man and the animals.

There should, therefore, be no jealousy between clinical science and the sister subjects. Each relies on the other where medicine is concerned. For the fundamental sciences there may be fears that such great gifts as those of Lord Nuffield, opening too wide an irrigation channel over the new fields, may compromise their hopes of support. But the clinical work must be done, and the study of medical patients is costlier in all forms of maintenance than that of any other laboratory work. It cannot be stinted. For clinical science in its newer aspect there is a human need of intellectual sympathy and encouragement. Its work and its own proper discoveries tend to be disregarded in the domains of pure science, unless they happen to contribute facts or laws that are seen to be important also in those fields of work. The science must therefore stand in its own ground if it is to gain adherents and fulfil the responsibilities which are proper to it.

Some events in the history of medical progress more than a hundred years ago may be looked at in this reference. Thomas Young, whose intellect devised a theory of light and colours and went far in deciphering Egyptian hieroglyphics, was a physician. After years of study he wrote a book on consumption of the lungs, and to that subject even his great scientific powers could contribute nothing beyond a device for identifying pus cells in sputum by the coloured rings produced by the uniformly sized globules when the sputum was squeezed into a thin layer between two glass plates. Three years later, Laennec in Paris published his epoch-making observations on the use of the stethoscope and of physical signs for exact analysis, as proved by subsequent necropsy, of diseased states of the lungs. These discoveries were missed even by the inquiring genius of Thomas Young, and yet they were so great as to make all his treatise idle reading. Though demonstrably true, they are barely noticed in the history of scientific thought because they belong only to clinical medicine. They derived nothing from and contributed nothing to other sciences; but they had the exactness of proved knowledge and in that sense became a part of medical science.

Much of the best in medicine is knowledge of this type, gained by direct observation of the phenomena of sickness; but being self-contained and not linked by any clear laws with the generalizations of other sciences, it tends to be judged as falling below that which would entitle it to the rank of a science and being little more than the furnishing of a practical art. The exclusiveness of such a judgment might well be challenged. On the other hand, Young's observation on the sputum, though it added nothing to medical knowledge and only introduced an ingenious device, would by modern custom probably be spoken of as scientific because it was derived from the established body of mathematical and physical knowledge. The present fashion is to assume that there is nothing scientific in medicine unless it has been either derived from or re-affirmed by experimental tests in laboratories of the fundamental sciences.

Certainly in the past, medicine has taken a first but only half-hold of many discoveries, and then let them slip unproved out of her grasp because she lacked the technique of experiment and proof that has been the foundation of the biological sciences. The control of rickets and the whole range of modern progress in nutrition have thus tended to pass to the credit of physiology. But physiologists have their own problems to solve, and it is essential to the advance of a pure science that its quests should not be limited by the narrow horizon of what is visibly capable of practical use. There will be a long and wasteful delay in the progress of both the science and art of medicine unless the means are strengthened for prompt study of clinical questions by every available form of science, and equally for the testing and transference into clinical knowledge of any hopeful new discovery in physiology or the other sciences. Every part of such work will be scientific, while its direct concern with the questions of human disease is stated in its name of clinical science.

Engineering and metallurgy derive the whole of their scientific thought from the fundamental studies of physics, chemistry and mathematics. Geology derives still more widely. Yet in these subjects an independent science exists, and is creative in its own field. Clinical science in England at the moment makes use largely of the physiological approach to medical problems. With such methods clinical workers have made advances that are momentous in their own science, though some of them are of little import to physiology. The analysis of the different forms of irregularity of the heart-beat, their relationship to failure of the heart, and the appropriate therapy by digitalis provide one such instance. The delightful success of American work on the treatment of pernicious anæmia is almost entirely due to clinical research, while it has given to physiology new knowledge about the ripening of red blood cells that includes a process of such fantastic strangeness that no sane physiologist would have allowed himself even so much as to dream of its possibility. Each science learns from and helps the other.

Physiologists have taught all the 40,000 medical men in Great Britain. These practitioners of medicine are busy with their own technical art, and that is neither physiology nor clinical science, though it is inspired by each. Year by year their work grows more effective, thanks to progress in scientific knowledge of disease. Lord Nuffield's gift will augment the number of those aiding this advance by work in clinical science, and still leave them few in comparison with those in the other medical sciences whose work is less directly related, and therefore less immediately applicable, to the treatment and prevention of disease.

Chemical Exploration of the Stratosphere*

By Prof. F. A. Paneth

STUDENTS of the history of astronomy may remember that those of the natural philosophers in old Greece who favoured a geocentric conception pictured the universe as being built up of several spheres surrounding the earth. According to Aristotle, the sub-lunar world consisted of the four elements, each tending to its "natural place"; innermost was the core of the earth, surrounded by layers, first of water, then of air, and fire, wherever found, trying to rise to the top layer. Next came the realm of the "quinta essentia", the substance of the celestial bodies; but these were not supposed to circle in one and the same sphere. In order to explain the movements of the planets, Aristotle saw himself compelled to assume not less than fifty-six spheres in the sky, all concentric with the earth.

It looks somewhat like a revival of these old ideas that to-day science speaks of many concentric layers in the earth, sea and atmosphere. Since the development of modern seismology and geochemistry, it is known that the earth consists of at least four regions: a core of liquid iron in the centre, then a medium shell of, probably, sulphidic ores, covered by two outer shells of rocks of different densities. Fairly recently, in the early part of this century, it was discovered by Teisserenc de Bort that the thermal qualities of the atmosphere show a break when the height of about 11 km. (in our latitudes) is attained. In the lower part, called the 'troposphere', the temperature decreases regularly with increasing altitude until, at the height mentioned, about − 53° C. is reached. From here onwards, however, the temperature remains nearly constant at any height accessible to direct meteorological measurements. We have obviously entered a layer of the atmosphere in which different physical conditions prevail: the 'stratosphere'.

For a while it was assumed that the constant temperature of the stratosphere might extend to the top of the atmosphere. But from 1922 onwards it became clear that the structure of the atmosphere is much more complicated. We now know from indirect evidence, interpreted by Lindemann, Dobson and Whipple, that in regions at present beyond the reach of any thermometer, between 30 km. and 40 km., the temperature of the atmosphere begins markedly to increase again, and that this warmer layer is responsible for the reflection of sound waves; that at about 100 km. and again at 300 km. there exist strata of ionized air which play a role in the reflection of radio waves (Kennelly-Heaviside and Appleton layers); and that in the highest parts of the atmosphere a gaseous mass of about 1,000° C. is to be assumed. However complicated this may sound (even if we add that oceanographers nowadays distinguish between a 'troposphere', the upper layer of the sea in which the temperature decreases with descent, and a 'stratosphere' of fairly constant temperature below) we may still console ourselves by the thought that the modern scientific picture of the onion-like structure of the earth, sea and air is yet much less involved than the speculation of the ancient philosophers, and that its exploration advances quickly, thanks to the co-operation of various sciences.

While the temperature and the electrical state of the stratosphere have been the subject of many investigations, its chemical composition has seldom been studied. But so early as 1912, Tetens pointed out that a chemical investigation of the composition of the stratosphere would be the best, if not the only, means of deciding the question raised right at the beginning by the discovery of the stratosphere: Does the constancy of temperature mean that there is no convective motion of air masses; does it prove the absence of winds?

It is not difficult to see why the chemist should be able to settle this question. If it were possible in a long vertical tube containing a homogeneous

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