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THE SCIENTIFIC APPROACH TO SURGERY*

BY

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I wish to thank the Senate of the Welsh National School of Medicine for this opportunity of paying homage to the memory of Professor William Sheen. He honoured me with his friendship and we had many discussions about medical education. I believe that what I have to say to you expresses opinions which harmonized with his own.

His career was in may respects similar to that of my own Chief—Professor George Gask, for they were both interested in military surgery and held senior rank in the Army Medical Service; both were strong advocates of the importance of travelling to watch other surgeons at work; both were pioneers in the establishment of whole-time Professorial Clinical Units, and their conviction that there should be more intimate links between Medical School and University showed that they possessed more foresight than the majority of their contemporaries. Sheen's loyalty to the University ideal was rewarded by his appointment as Provost of the Welsh National School of Medicine, which gave full scope to his administrative genius. His devotion to duty cost him his life, for it was by walking three miles through a blizzard to keep an appointment at the School that he contracted the acute heart failure that killed him.

Dawn of the Scientific Era

The reliance of modern surgery upon the basic medical sciences is taken for granted, but I would like to trace very briefly the growth of the influence of science upon surgery from the Renaissance in the sixteenth century, in the days of the men referred to by Kipling as "Our Fathers of Old."

> "Wonderful little, when all is said,
>   Wonderful little our fathers knew.
> Half their remedies cured you dead,
>   Most of their teaching was quite untrue."

Yet Kipling paid tribute to their skill and their courage when "they took their life in their lancet hand." The only science they had to guide them was anatomy, and that in its infancy; the man whom we revere for his leadership and example in these far-off days is Thomas Vicary, who taught more than anatomy, for he laid down ethical rules for the conduct of surgeons which give us a good idea of why he was chosen to be the first Master of the combined Company of Barber Surgeons in 1540.

Somewhat later came Ambroise Paré, whose treatment of wounds was revolutionary in that he condemned the harmful effects of caustics and other forms of maltreatment and believed in the healing power of nature. Even to-day we need to remember to try to aid and never to hinder natural cure.

The dawn of the scientific era coincided with the latter part of the lifetime of John Hunter (1728–93), whose memory will always be honoured because he applied the experimental method to the problems of physiology and pathology. His intellect and his unflagging industry made him pre-eminent, yet he was not the only pioneer in the eighteenth century who used the method of experiment, for James Lind carried out carefully controlled clinical experiments of lasting importance to surgery while serving at sea as a naval surgeon in 1747. It is known that in the treatment of scurvy effective use had been made of citrus fruit by Sir Richard Hawkins (1593), Captain James Lancaster (1605), and James Woodall (1617), but to James Lind must go the credit for the controlled experiment.

He wanted to test the various remedies recommended for the cure of scurvy, and therefore chose 12 patients equally severely affected by the disease; all were nursed in the same sick bay, and all were given the same basic diet. To the diet of two of the men he added two oranges and a lemon daily; two men were given cider; two were given sea-water; two received elixir of vitriol; two were given vinegar; and the remaining two were controls without any addition to the basic diet. By the end of a week of this treatment the first two men had recovered, whereas all the others, with the exception of those on cider, who showed a slight improvement, failed to derive any benefit from their treatment. Though another 150 years were to elapse before vitamin C was described, and still longer before this was identified as ascorbic acid, yet Lind's scientific approach to the problem should not be forgotten—nor should we forget that he made his observations without laboratory aid and in a sailing-ship at sea.

It was not till the mid-nineteenth century, however, that great advances in surgery became possible through the introduction of modern anaesthesia and antiseptics. Thus was surgery made safe for the patient, and as all parts of the body became accessible to the surgeon, so the function of the organs he was handling became even more important than their structure. There is no doubt that surgery thus afforded a powerful stimulus to physiological research; and the elucidation of the problems arising in the course of the correction of the

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disorders of function produced by disease has tended, in Moynihan's words, "to make the patient safe for surgery."

The importance of physiology was driven home to surgeons first by the ill effects of the sudden relief of chronic obstruction in the urinary and biliary tracts leading to renal and hepatic failure, and by the oedema of the brain or of the lung which followed too rapid decompression of these organs. The complications following the short-circuiting of gastric secretion into the small intestine and the after-effects of blood loss and of incompatible blood transfusions followed later. More recently attention has been directed to the importance of water and electrolytes in the body fluids and tissues, including the dangers of over-enthusiastic administration of both water and salt. The urinary tract provides its special problems, including the risk of excessive water absorption during prolonged operations involving irrigation cystoscopy, and the extreme electrolyte upsets which can follow ureteric transplantation. Furthermore, the study of the response of the body to trauma, surgical shock, has shifted beyond the purely physiological explanations based upon vasomotor and nervous responses, and has now reached the province of the biochemist.

Clinical Science

The recognition of the importance of physiology in clinical medicine has led to the development of "clinical science," and we would do well to consider the relationship of this new department of science to the clinician. While we should profit to the full from the researches of the pure scientist we must be careful not to become dazzled by the accuracy of laboratory methods and forget that the ultimate criterion for us as surgeons must be the contribution they make to the care of patients.

The difficulty of applying scientific method to clinical practice is encountered by the undergraduate as he passes from the physiological laboratory to the wards. He finds that it is hard enough to measure even a superficial tumour, and that there aren't any instruments to estimate the hardness of a lump, or, more difficult still, to determine how ill a patient may be. In fact, those of us who believe in the importance of trying to preserve the scientific outlook which the study of physiology should have given them must be painfully aware of the impression they gain from watching their elders and betters at work that inspired guesswork is a better bet than the methods of science.

Trotter pointed out very clearly the conflict that exists between a practical art like surgery, success in which depends upon judgment, intuition, and skill, and the exactitude of science which demands the elimination of human faculty. Yet this conflict must not be made the excuse for failing to make clinical methods as accurate as possible. The clinical scientist has to attempt to resolve the conflict by devising methods of investigation the results of which can be correlated with clinical observation. If he succeeds in this difficult task, and may thus appear to be reducing a scientific study to the level of "clinical experience," it may be necessary to defend him against the attack of the pure scientist who would depose clinical science from the dignity of being included among the true sciences. In this connexion it is well to recall the words of Sir James Paget in an address to the Clinical Society of London in 1869:

"Receiving thankfully all the help that physiology or chemistry or any other sciences more advanced than our own can give us, and pursuing all our own studies with the precision and circumspection that we may learn from them let us still hold that, within our range of study, that alone is true which is proved clinically, and that which is clinically proved needs no other evidence."

We see examples every day of the triumph of experience over pure theory. If we were guided only by the knowledge that thyroxine is the agent which inhibits the production of thyrotrophic hormone we wouldn't dare to remove the thyroid gland for Graves's disease. Furthermore, if we paid too much attention to those who teach that to restore the normal rhythm to a fibrillating heart carries with it the risk of embolism, very many patients with thyrotoxic heart disease would be allowed to die without the benefit of surgery.

Similarly we might decide never to excise sympathetic nerves if we were only to read the numerous articles which lay stress upon the ill effects of removing a vasodilator reflex pathway as well as a vasoconstrictor mechanism, and of rendering denervated organs supersensitive to vasoconstrictor substances, without also having the opportunity of examining patients who have derived permanent benefit from sympathectomy.

Methods of Precision

It is of course essential that the clinician should avail himself of all the precise information he can obtain with the aid of electrocardiography, electroencephalography, and radiography, and with the help of his colleagues in the departments of pathology and bacteriology. But while these methods of precision are good servants they are bad masters, and they can weaken or even abolish an element which is essential to the make-up of a good clinician—his power of decision. Before the days of these elaborate aids to diagnosis the clinician had to rely upon his own senses aided by experience; and if he was competent precision in examination was followed by decision about treatment, and wonderfully few mistakes were made.

At St Bartholomew's up till about 1930 surgical consultations were held every Thursday afternoon, and I remember men like Bowlby and D'Arcy Power, then consulting surgeons, joining the active members of the staff in the discussion of diagnostic and therapeutic problems. These consultations were of great value to younger surgeons and were both instructive and entertaining to students, as the senior men handed on the fruits of experience. In time, however, it became clear that modern methods of investigation were sapping much of the interest of these clinical problems, and consultations faded out. During the same period we have been conscious of a tendency for clinicians to hesitate to commit themselves—they prefer to suggest some further *x*-ray examination or a still more complicated pathological test. They have lost what Kipling in the poem already quoted referred to as "the excellent courage Our Fathers bore," and the final lines are singularly appropriate in a memorial lecture:

"We are afflicted by what we can prove;
We are distracted by what we know—
So—ah so!
Down from your heaven or up from your mould,
Send us the *hearts* of our fathers of old!"

Professorial Clinical Units

As clinical science develops it becomes more difficult and more important and urgent to attempt to reconcile the interests of the scientist with those of the clinician, and one method of harmonizing these interests which is being tried at present is the establishment of professorial clinical units. One of their most important functions is to study recent advances in the preclinical sciences, to consider whether these should be incorporated in clinical teaching and practice, and if so how these changes can best be brought about. It is for this reason that the head of such a unit and a proportion of his staff are freed to some extent from the strain of routine professional work so that they may have leisure to think out and plan the strategy as well as the tactical details of what may amount to major changes in the curriculum, in teaching methods, or even in the practice of surgery.

Everyone knows the chapter in Ecclesiasticus which begins:

" Honour a physician with the honour due unto him for the uses which ye may have of him: for the Lord hath created him For of the Most High cometh healing . . ." At least we know well the first 15 or 20 verses; but most of us are less familiar with the rest of the chapter:

" The wisdom of a learned man cometh by opportunity of leisure: and he that hath little business shall become wise. How can he get wisdom that holdeth the plough, and that glorieth in the goad, that driveth oxen, and is occupied in their labours, and whose talk is of bullocks? He giveth his mind to make furrows; and is diligent to give the kine fodder . . ."

The writer goes on to describe in similar fashion the work of the carpenter, the engraver, the smith, and the potter, all like the surgeon, practical artists, and continues:

" All these trust to their hands: and every one is wise in his work. Without these cannot a city be inhabited . . . they will maintain the state of the world, and all their desire is in the work of their craft." Yet " they shall not be found where parables are spoken."

Let us remember why we try to give the professor leisure; and let us hesitate before putting him on boards and committees *ex officio* either out of respect for his office, or, worse still, to enhance the prestige of the committee.

Pray do not misunderstand me. I do not wish to infer that a clinical professor should be a theorist pure and simple. In my opinion he will fail if he is not a sound practical surgeon (the same applies to physicians, but I will confine myself to my subject) and a teacher who can stimulate undergraduates to interest themselves in clinical surgery. Most part-time consultants on the staffs of teaching hospitals are there because they possess both these attributes of technical skill and teaching ability. The professor should in addition play his part as a link between surgery and science, or, as Dunphy puts it, " the professor of surgery must be able to bridge the gap between the patient and the laboratory." There are many different ways of doing this, but whatever method is adopted the essential element for success, an element which must be fostered by the head of the unit as an example to all its members, is the spirit of collaboration which springs from the mutual respect which one department should have for another, which encourages consultation and bears fruit in the material aid which one can afford to the other.

Biochemistry and Surgery To-day

Whereas in the past clinicians were satisfied with the explanation of disease processes in terms of defects of structure or function in certain organs of the body, attention has gradually become focused upon the activity of cells rather than of organs, and nowadays these cellular activities are reduced to biochemical reactions. One has in mind, for example, the mediation of nerve impulses through chemical mechanisms, and the effect which a change in the *p*H of the blood may have upon renal function. The control of endocrine glands by circulating hormones has been well recognized for a long time; but that there should be similar mechanisms affecting the growth of both normal and neoplastic cells, as a sort of extension or modification of the chemical factors influencing embryological and infantile development, is a concept which we are only gradually accepting, the importance of which we may not be able to assess for some time to come. All people like myself can gather is that some knowledge of biochemical principles is required for an understanding of almost all current surgical research. As an example let me refer to recent work on the process of wound healing.

The Healing of Wounds

Formerly the vascular and cellular invasion of a wound with the formation of granulation tissue was regarded as the first step in healing. Since it is the presence of dead or damaged tissue in the wound that determines the ingrowth of capillary loops a chemical mechanism must underlie this process.

Hadfield (1951) has drawn attention to the similarity between this process of vascularization and that of bone growth at a metaphysis, which is known to be regulated by pituitary growth hormone and can be inhibited by cortisone. The process of epiphysial bone growth is comparable to the healing of a fracture, which can also be inhibited by cortisone (Sissons and Hadfield, 1951).

It therefore seems likely that there are two phases in the formation of granulation tissue—an early phase of vascularization and proliferation controlled by pituitary growth hormone, and a later phase of devascularization and differentiation controlled by cortisone and influenced by ascorbic acid. These considerations may appear to be exaggerating the importance of chemical factors in healing, yet there is much more to come.

Whipple pointed out many years ago that after the infliction of a wound there occurs what he referred to as " the lag period," lasting anything from three to five days, during which nothing appears to be happening between the wound edges. This seemed mysterious enough, but Ravdin's showing that the lag period could be prolonged by protein deficiency suggested that something important must be going on, though only recently have the biochemists discovered what it is. Very shortly after wounding, the few fibroblasts present produce a homogeneous matrix in the wound which contains mucopolysaccharides and soluble protein precursors of collagen (Dunphy and Udupa, 1955). These substances essential for the subsequent formation of collagen are accumulating during the lag period, when there are no histological changes and while there is no tensile strength developed between the wound edges. In view of this intense chemical activity it might be well to abandon the term " lag period " altogether.

Since protein is required for the formation of pre-collagen the significance of Ravdin's work becomes obvious, yet it is remarkable that even when protein is deficient healing will proceed normally if methionine is present. Research of great interest in this respect has been going on for some time at the Royal College of Surgeons under the direction of Professor Slome, and has shown that the ill effects of *x* rays upon wound healing can be overcome by giving cystiamine.

I have quoted the biochemical influences at work in wound healing to indicate the complicated nature of such problems, and I would suggest that if research is to be undertaken along these lines in a clinical unit it is no good entrusting it to a clinician who dabbles in biochemistry. It is necessary to have the appropriate scientist attached to the unit. If he is medically qualified so much the better, partly because he will be more likely to be sympathetic to the clinicians and less likely to be diverted into purely scientific problems without direct application to patients, and partly because if he is given university status in the unit he can also be given an honorary contract with the hospital.

Training of the Young Surgeon

Bearing in mind the impact of science upon surgery, how should the young surgeon be equipped to meet the situation ? Let me say straight away that I think it is a mistake to try to make him into a pseudo-scientist. He should be given the opportunity of acquiring a scientific mode of thought, an attitude of mind, so that faced with a problem in clinical practice he should know how to make accurate and "controlled" observations, if necessary designing a method of investigation appropriate to the problem ; he should know how to collect his results and arrange them for analysis, recognizing the margins of error—that is, their reliability and value ; he should be able to make logical deductions from these results which may lead to some general conclusion, perhaps with a practical application. In this way he may contribute in some degree to the science of surgery, or at any rate to the therapeutic art.

To enable him to acquire this scientific outlook he needs a certain basic knowledge of the preclinical sciences. He may be supposed to have acquired this as an undergraduate, but we all know how little of this knowledge survives even the first clinical year. So as a postgraduate he must experience the discipline of a laboratory for a period of two years—whether in a department of anatomy, physiology, pathology, biochemistry, or pharmacology doesn't much matter—or if he cannot afford the time for this he should have a really thorough revision course of about six months to give him a better appreciation of the subjects, towards which his own clinical experience will have helped him greatly.

The object of the course or of the laboratory experience is not the mere acquisition of knowledge, but rather to learn where and how to obtain what he may need later for working out his own problems. To live for two years in a laboratory gives a man something he can scarcely obtain from a course of study, however well planned it may be, though it need scarcely be added that it must be a course in which the student has a chance of doing things for himself in practical classes and in a dissecting-room, and in which much of the teaching is done by discussion rather than by lectures alone.

Let me repeat that it is a mistake to think that such a course of study is intended to give a man encyclopaedic knowledge. When he finds his clinical problem he will have to delve much more deeply in search of anatomical, biochemical, or pathological details which a course could not possibly be planned to cover. But his contact with scientific method, either in the laboratory or in the postgraduate course, should afford him guidance in clinical research, which may require laboratory methods as adjuvants but not as ends in themselves, thus distinguishing the work of the clinician from that of the pure scientist.

For the objective of the clinician, however scientific his bent, must always be the treatment of a patient ; and it will be only by the results he obtains in the alleviation of suffering and, if possible, in the cure of disease that the success of his labours can be judged.

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ACQUISITION OF A B-LIKE ANTIGEN BY RED BLOOD CELLS

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In the past four years we have tested the blood of seven patients whose red cells undoubtedly possess a B antigen of some kind but whose serum contains an apparently normal β (anti-B). We have gradually come to recognize that the B-like antigen in these people is an acquired and not a genetic character and that it is probably connected with old age or disease, or both.

There have been several reports of peculiar B reactions which are referred to in the discussion below, but only two of them appear to be of the kind we are describing: both were briefly mentioned by Stratton and Renton (1958).