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THE SCOPE OF TEACHING AND RESEARCH IN ANATOMY*

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Anatomy is the science of the form and structure of living organisms. That is to say, it is concerned with the study and interpretation of those factors which determine or modify form and structure, whether they are chemical, physical, physiological, developmental, or phylogenetic, and with the precise relation between structure and function. It is clear, therefore, that the science of anatomy is very comprehensive in the scope of its inquiry. It is necessary to emphasize this for the reason that, in this country at least, anatomy seems to be regarded by many workers in the cognate sciences as rather a limited subject. If this is the case, the fault is to be found not in the science of anatomy itself, but rather in its accredited exponents.

Anatomy as an Experimental Science

In 1628 Harvey's great work on the circulation of the blood was published under the title "An Anatomical Dissertation on the Movement of the Heart and Blood in Animals." This title forms an apt text for a discussion on the scope of teaching and research in anatomy, because it does, by implication, provide a definition of the real meaning of anatomy. The term "anatomy" strictly refers to a *method* of investigation—the study of an organism which involves first opening it up and analysing the component parts of which it is constructed. But the method of anatomy was primarily employed entirely for the purpose of studying functional mechanisms. It was a method developed by the pioneers of biological science, impelled by a curiosity to find out how the body works. These pioneers were certainly not primarily concerned with organs and other structures as pure morphological entities. Harvey was in a large degree responsible for the introduction of the experimental approach to anatomical problems, in particular to problems relating to the functional significance of the various structural systems of the body which are in the first place laid bare by dissection. The experimental approach involved, as an essential elaboration of earlier methods, the "anatomizing" of the living as well as of the dead body. It is important to note that this method of study was primarily regarded as a logical extension of the science of anatomy. Historically, therefore, anatomy was initially concerned with the inquiry into the functional mechanisms of the living body.

It was not until the seventeenth century that there began to develop an apparent separation between the sciences of morphology and physiology. This contrast became very evident in the latter part of the eighteenth

century and in the early part of last century, when pure morphology, as the science of form pure and simple, developed as a separate discipline. The exponents of this science became absorbed in the attempt to define the fundamental unity of plan which served as a theoretical basis for the development of the various types of animals, and to formulate the ideal archetypes of which different organs and anatomical systems might be regarded as modifications in one direction or another. The methods adopted for the prosecution of these inquiries were of a comparative anatomical and embryological nature. The experimental approach to the study of the significance of form and structure was entirely neglected by pure morphologists for the time being. Naturally enough, Darwin's influence on morphological research was immense. Problems of classification, homology, adaptation, etc., became essentially evolutionary problems instead of the philosophical abstractions of the old idealistic morphology. The recognition of the evolutionary principle demanded an intensive and detailed study of the anatomy of diverse animal types in order to provide adequate material for the application of the evolutionary concept to specific problems.

With this wide field of inquiry inviting the attention of anatomists it is not surprising that they continued still further to ignore the original aims of anatomical science—the study of form and structure from the point of view of their functional significance in the living organism. Meanwhile, experimental technique in the study of biological problems was being rapidly developed by physiologists who were primarily interested in the chemistry and physics of living processes. Thus there arose the curious conception that any experimental work on the living body was essentially the province of physiology rather than anatomy, while the latter came to be regarded as dealing exclusively with the dissection of the dead body. This tradition has survived for many years in this country, to the great disadvantage of the science of anatomy. It is interesting to note that in America, where the different branches of modern biological science have crystallized out in a natural and logical way without the hampering distortions of traditional bias, this artificial contrast between anatomy and physiology has never really arisen. American journals of anatomy are almost as richly supplied with records of experimental investigations as are the journals of physiology. Consequently anatomical science in America has until recently been far more progressive and dynamic than in this country. It is of the utmost importance that we, as anatomists, should realize this position. In the realm of pure morphology the vast amount of observational records of human

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and comparative anatomy which have been collected have gone far beyond the morphological and evolutionary theories which can explain them. More extensive research along these lines are unlikely to lead to very profitable results for the time being. It is necessary, meanwhile, that anatomists should turn their attention to more productive fields of research in the scope of their science, and this necessarily involves the extensive employment of the experimental method.

Anatomy and Physiology: Their Spheres of Activity

It may be asked by those who are not conversant with the aims of anatomical science, wherein lies the difference between anatomy and physiology if both use the same technique in their investigations? The answer is that although they are both concerned with the same type of problem—the analysis of the mechanism of living processes—they approach these problems from rather different angles. There is really no difficulty in defining their spheres of activity as natural subdivisions of biological science. The anatomist is primarily interested in the significance of structure and growth and their relation to function, the physiologist is, on the other hand, primarily interested in the physics and chemistry of the living organism and in the detailed analysis of the functional processes which have their basis in anatomical structure. To achieve results both must resort to the experimental method. It has been remarked that, in adopting this method, the anatomist generally aims at disturbing or modifying the normal functions in order to study the ensuing changes in the structural mechanisms which are involved, while the physiologist, in his researches, is concerned with studying function by interfering with or modifying the structural mechanisms which underly it. For example, the anatomist interested in the structure and growth of bone may require to study the structural changes which occur in bone following an experimental disturbance of endocrine functions. The physiologist, in studying the functions of the cerebellum, may find it necessary to interrupt the anatomical paths by which the cerebellum is linked up with other parts of the central nervous system in order to observe the resulting disturbances of muscular action. Their studies are mutually complementary.

Clearly it is undesirable and, indeed, impossible to confine either the anatomist or the physiologist within the strict limits of his science as arbitrarily defined by custom. The physiologist, in the course of his work, will sometimes find it necessary to direct his attention to the structural mechanism itself, although this is properly speaking the province of anatomy. It may sound paradoxical, but it is nevertheless true, that some of the best anatomical research on the nervous system in this country has been carried out by a physiologist, Sir Charles Sherrington, in unravelling the intrinsic anatomy of the brain and spinal cord, defining the topography of motor and sensory tracts, and determining the anatomical composition of the limb plexuses. Conversely, the anatomist, in his study of structural mechanisms, may require to pursue his studies into the realm of pure function in order satisfactorily to understand the full significance of the gross and minute anatomy of these mechanisms. Indeed, in many ways the anatomist is peculiarly well equipped by his training and outlook to appreciate the real nature of functional problems, simply because he views as a whole the experimental animals with which he deals. He has a detailed and intimate knowledge of their entire structure (macroscopical and microscopical), of their embryological development, of their taxonomic position, and of their phylogenetic origin. He deals with functional processes, therefore, not so much as artificial abstractions to be

interpreted in a limited way in terms of chemistry and physics, but as integral components of the complete mechanism of a living and evolving organism.

A Change in Orientation

Experimental anatomy is not only essential for interpreting the functional significance of structure, it also provides the most important technique for the study of anatomical problems of growth, development, and tissue differentiation. It is a matter of common knowledge that the development of tissue culture and experimental embryology has in recent years opened up a vast field of anatomical research which promises to take us far beyond the knowledge which we have been able to gain by the study of fixed and stained sections of normal material. Anatomists in this country are realizing now that if their science is to develop along progressive and active lines they must once more become essentially experimentalists. This change in the orientation of anatomical science has not hitherto been fully recognized by their biological and clinical colleagues, and it is precisely for this reason that I am now emphasizing it. It has been my privilege, as president of the Section of Anatomy, to arrange with my committee the programme of this Section, and I have asked four of my anatomical colleagues to give a short report on the progress in their own particular fields of work in order to illustrate the present trend of anatomical research in this country.

The Teaching of Anatomy

One of the main duties of the teacher of human anatomy is the provision of facilities for the study of the topographical anatomy of the human body by medical students as a very necessary preliminary for clinical practice. No one doubts that, before he can deal successfully with the subjects of medicine and surgery, the medical student must lay the foundation of a sound knowledge of the "geography" of the human body. For this reason it will always remain necessary for him to make a dissection of the whole body (usually in collaboration with his fellow workers), some time during the course of his training in preclinical subjects. But in recent years it has come to be realized generally that he should not be required to learn and commit to memory for examination purposes so vast an amount of topographical detail as is to be found in standard anatomical textbooks. This opinion finds expression in the recent report on the medical curriculum issued by the University of London. In this report, also, it is suggested that the time which has been usually spent by medical students in the dissection of the human body could be appreciably cut down. This can almost certainly be done to some extent if less emphasis is laid by examiners in anatomy on unimportant details which may have to be learnt and re-learned several times if they are to be retained in the memory for the examination. I am heartily in agreement with those who hold that the student may conveniently be tested for a knowledge of the *details* of anatomical topography as he goes through his course of dissection, by informal departmental examinations, while the M.B. examination in anatomy should rather test his knowledge of broad anatomical principles and general topographical relationships.

The teaching of straightforward topographical anatomy is in many ways the least difficult duty of the teacher of human anatomy. I would like to emphasize this because there is sometimes expressed the view that the teaching of pure topographical anatomy requires mental powers of quite an unusual type. This is not really the case, and it is difficult to understand how such an idea should have arisen. It requires no particular intellectual

acuity to learn up the data of topographical anatomy necessary for medical education, nor does it require any mental effort to give out this knowledge in a palatable form which can be easily assimilated by the medical student. I would assert that anyone who has any teaching ability at all would be able to deal adequately with so straightforward a subject. It is necessary to draw attention to this common misconception, for I have the impression that in appointments to anatomical posts it often tends to favour the candidate who has established a reputation as a hack teacher in dissecting-room anatomy, to the disadvantage of the candidate who has distinguished himself by brilliant research. It is a tragic circumstance for the progress of anatomy in this country that this should be so, for my own experience is that the man whose mind is kept alert and active by original research is usually by far the best and most stimulating teacher, whether he is dealing with ordinary topographical anatomy or the more intellectual aspects of his subject. To be able to discuss in lectures to students the bearing of current research on the anatomical problems of development, growth, functional adaptation, etc., does demand very considerable mental ability, together with a wide acquaintance with current anatomical and physiological literature.

It is very important that in the routine teaching of topographical anatomy form and structure should always be correlated with function. Only in this way is it possible to secure in the student's mind a proper co-ordination between the anatomical and physiological aspects of the living body. In dealing with the functions of the kidney the teacher of physiology must necessarily introduce his subject with a brief outline of the gross and minute anatomy of this organ although this is really the province of anatomy. Conversely the teacher of anatomy, in dealing with the details of the macroscopical and microscopical structure of the kidney must necessarily refer, however briefly, to the functional significance of the glomeruli and the various parts of the renal tubules if he is to make his subject really intelligible. It is obvious, therefore, that the efficient teacher of anatomy must cultivate a physiological outlook. I suspect that the lack of this physiological outlook has been in part responsible for a considerable loss of prestige by the science of anatomy in this country.

Histology

One of the most vital parts of anatomical science is histology or microscopical anatomy. To most people it may seem absurd to make an obvious statement that microscopical anatomy is anatomy, but it is necessary to do so because there is still in this country some difference of opinion as to the proper place of microscopical anatomy in the medical curriculum. Kölliker, one of the founders of modern histology, in defining anatomy, states that "Anatomy is and remains the science of the structural parts of the organism and of the laws of their origin and transformation, whether these structural parts are visible to the naked eye or only through the microscope." By an accident of circumstance, however, when anatomy and physiology came to be separated into different teaching departments in British medical schools, the teaching of microscopical anatomy was taken over by the physiologists. This was due in part, no doubt, to the fact that at that time the attention of anatomists was occupied in collecting morphological data for the elucidation of evolutionary processes. Since then this anomalous position of microscopical anatomy has persisted in most medical schools in this country. Exceptions are found in University College, London, Guy's Hospital Medical School, the Universities of Wales, Manchester, and Liverpool, and, partially, in the University of Glasgow. The remarkable

custom of teaching an important section of anatomy in departments of physiology seems to be quite peculiar, for in other European countries, apparently without exception, microscopical anatomy is taught either in institutes of anatomy or in institutes devoted to histology and embryology. From the methodological point of view there can be no doubt but that practical classes in microscopical anatomy should be given in departments of anatomy. The anatomist, in dealing with structure, must of necessity be constantly referring to histological details. The whole anatomical significance of an organ like the liver or the pituitary gland ultimately rests on its minute structure. While, therefore, the anatomist finds it necessary to teach histology in lectures and demonstrations, in most British schools he has no control over the arrangement of practical classes which would enable him to demonstrate practically what he teaches. This illogical state of affairs is quite intolerable. One argument which is frequently raised against the suggestion that practical histology should be handed over to its rightful position in departments of anatomy is that histology is essential for the proper understanding of physiology, and that the two subjects should therefore be taught in the same department. There is really no reason at all for this provided that histology is taught in *some* department concurrently with the course in physiology. Other subjects such as physics, chemistry, and biochemistry are equally essential for a proper understanding of physiology, and yet they are taught in different departments. It might be argued that a knowledge of microscopical anatomy is also essential to a proper understanding of anatomy, were it not that such a statement is absurd in itself. For the fundamental fact is that microscopical anatomy is anatomy.

I would plead with those who control the organization of teaching in medical schools that they should give their assistance to obtaining a fair and logical division of subjects in accordance with the natural content of each branch of science which is taught. Unless the anatomist is allowed to control the teaching of the whole range of his own subject he will find it extremely difficult to give expression to his desire to develop his science along progressive lines.

One very cogent reason why the anatomist should be responsible for the teaching of practical histology is that he is already concerned with teaching embryology. This subject, of course, involves the application of histological technique, and it forms an important part of the curriculum in anatomy for the medical student because of the light which it throws on adult form and structure. It is clearly quite ludicrous that the anatomist should teach the details of histogenesis and organogenesis, while practical instruction in the minute structure of adult tissues and organs is carried out in a separate department altogether.

Conclusion

In this discussion I have confined myself to those aspects of the teaching of anatomy and anatomical research which call for special consideration because they are expressions of a new outlook in what is one of the most venerable of all the sciences. If I have omitted reference to such subjects as neurological anatomy, radiological anatomy, physical anthropology, and the comparative anatomy of the Primates, it is only because the place of these in anatomical teaching and research is already fully recognized. The revivification of anatomy in this country is already apparent in the attention which is now being paid by anatomists to experimental work and cytological technique. It is essential that these aspects of the science should henceforth be fully incorporated in the scope of the activity of recognized departments of anatomy, and that these departments should be equipped with all the facilities necessary for their development.