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THE anatomy and physiology of man, the doctrine of the structure of the machine and its function, constitute the groundwork upon which the specialized professional education of the medical course is based. We are fortunate at Columbia that in the framing of the four-year curriculum sufficient time has been devoted to the presentation of these subjects in the first two years of the course. The Department of Anatomy has additional grounds for congratulation in the fact that the wise and liberal administration of the University and the generosity of the friends of the College of Physicians and Surgeons have made it possible to construct an anatomical course for medical students in accordance with the demands of modern scientific progress.

Among the special departments of the professional schools in our large universities, the one charged with the teaching of human anatomy to medical undergraduates has felt perhaps more than any other the broadening influences which have resulted from the biological advances of the last decade. Human morphologists, and especially the teachers of human anatomy, have for more than a century occupied a somewhat peculiar position in relation to their subject of study. Able and careful investigators have for generation after generation devoted themselves to the elucidation of the structure of the human body in its minutest details, and the results of their labors make man to-day morphologically the best known vertebrate. Nevertheless a glance at the current anatomical literature will convince that even to-day, with modern methods of investigation and broader generalized views of vertebrate structure and development, our knowledge of man's anatomy is receiving constant and important additions. Revision of the field, however carefully it may appear to be gleaned, results in addition to our morphological knowledge of our own species. To the teacher of human anatomy the best and most productive method of imparting this accrued knowledge becomes a question of vital interest and importance.

At the very outset it becomes asparent that lasting knowledge is only to be acquired by direct personal study and examination of the object itself. Charts, drawings, and models, schematic or natural, and even photographs, however valuable they may be when used as accessory means of illustration, fail absolutely in replacing the actual structure for purposes of study and instruction. In developing the anatomical course at Columbia this cardinal principle of sound anatomical teaching has formed the basis upon which the details of the course have been built. The College of Physicians and Surgeons was the first medical school to abandon, in 1889, the system—universally in vogue at that time—of confining didactic instruction in anatomy to lectures to large audiences, and to substitute teaching by demonstration of the actual object to small sections of the class. In no other way can the systematic instruction be made what it should be—a commentary on and aid to the practical work of the individual student, in the only place in which he actually *learns* his anatomy, the dissecting room. Since that day we have steadily progressed along the lines then laid pown. When we began, the anatomical instruction at the College consisted of three didactic lectures a week, and dissection was voluntary and not regulated. Today twenty-four hours a week are given to section-teaching in addition to the lectures. Through the generosity of the Vanderbilt family, the dissecting room has been enlarged to nearly twice its original size, and affords space for over five hundred students working at the same time. The quantity and quality of the practical work done by each student is carefully supervised and regulated, and the department is enabled to exact the test of a rigid annual practical examination on the cadaver from every candidate for the degree. With this material increase in the time devoted to anatomical instruction, and with the enlarged facilities for thorough practical work, the best method of utilizing these opportunities becomes a question of serious importance.

Early in the constructive period of the present anatomical course the value of employing comparative anatomy as an

aid in the teaching of human anatomy was recognized, and during the past eight years systematic efforts have resulted in the production of an equipment which is increasing in value yearly with the further development of the Museum of Human and Comparative Anatomy. It is not our desire to debate the question whether comparative anatomy should find a place as a permanent and separate study in the medical curriculum, nor can we consider in detail the value of preliminary biological work to the student intending to follow medicine as a profession. We are rather brought face to face with the situation which confronts us at all our great medical centres, where annually a large number of students, differing widely in kind and degree of preliminary training, are brought together and enter at once upon the study of human anatomy. The very wealth of our knowledge here proves a source of embarrassment. The current text-books deal with a superabundance of minute detail, the smallest arterial twig and the most insignificant process of bone receiving the same amount of space and attention as the more important and cardinal structures.

The student is apt to find himself at a loss and overwhelmed, and it is difficult for him to follow the guiding lines in his anatomical studies—lines dealing primarily with the main structural facts of the different systems and capable of subsequent enlargement to include secondary details. The study of anatomy is, after all, the study of a mechanism, complicated and interdependent in its different parts, and adapted to perform certain functions. In teaching these facts comparison with other scientific mechanical studies may be permitted. It would universally be regarded as a faulty system, if a student of mechanical engineering were called upon at the outset of his course to consider the complicated mechanism of a modern locomotive, or the expansion engines of an ocean steamer, before he had become familiar with the simple principles of the cylinder, piston, and boiler in structure and action, or if a course in applied electricity began with the dynamo before considering the properties of the

magnet. And yet, to a certain degree, it is equally faulty to begin at the outset of the medical course with the structure of a highly developed and specialized vertebrate like man. The logical alternative is an introductory study of the simpler morphological conditions presented by the lower vertebrates—in other words, a comparative anatomical course. For this, however, conducted systematically, the time available in the medical curriculum does not suffice. If all our students came to us with a preliminary biological training in the anatomy of the lower vertebrates, the question would be a simple one. As it stands, however, we are forced to adopt a middle course—to utilize to the fullest possible extent the aid which comparative anatomy so clearly affords in explaining the often complicated structural conditions encountered in human anatomy. The question is sometimes asked, by graduates of ten years' standing or more, "What practical use is comparative anatomy to the medical student?" The answer is far more readily given by demonstration than in words, and yet a single example may be cited. The anatomical nightmare, which without doubt every medical graduate vividly recalls, is the human peritoneum or lining membrane of the abdominal cavity. Taken by itself, it is appalling in its detail and complexity. The text-books teem with minute descriptions and representations of it. Its divisions appear, as red and blue lines, in all manner of possible and impossible sections of the body. Its surgical and pathological importance render it a dangerous thing to neglect, but a correct knowledge of its extent and ramifications is difficult to obtain even by the most careful study of the cadaver. And yet, with all its complexity in adult man, the arrangement of the membrane is surprisingly simple and evident in many of the lower vertebrates, presenting permanently in these forms the simpler conditions which characterize the human membrane only during certain of its temporary embryonal stages. An hour's study of the intestinal tract of a carnivore or marsupial, and the comparison of the same with the conditions found in the human subject, will do more towards putting

matters clear in the student's mind than months of work with text-book and cadaver.

It is in this sense that comparative anatomy can be used to the greatest advantage in the teaching of human anatomy. It is teaching by comparison with selected vertebrate types, not instruction in systematic zoölogy, which will produce the best results. For the purposes of the medical student of human anatomy the zoölogical status of the forms which help him to appreciate complicated and difficult structural details is a matter of secondary consideration. He may find what he requires in representatives of any one or of several of the vertebrate classes. In dealing with certain broad subdivisions of the subject, and as an introduction to the study of special systems and organs, such as the circulatory, respiratory and uro-genital tracts, portions of the digestive system and its appendages, etc., it is of distinct value to consider the phylogeny of the structures under discussion in a serial manner, proceeding systematically from the lowest vertebrates to man. In no other satisfactory manner can we demonstrate the position of the organ or complex in the entire animal economy, and the physiological value of the whole and of its parts, revealed so clearly and evidently by the morphological modifications encountered in the various groups.

In this portion of our work we use frequently, with great satisfaction, photographic projections of the actual preparations, when a series of considerable length is to be brought before the class and the individual groups connected in tracing an organ through successive stages to the highest degree of development or reduction. In this manner it is possible to offer a bird's-eye view of the subject, reserving a limited number of selected forms for the subsequent detailed demonstrations. We are exceedingly fortunate at the college in being able to avail ourselves of the services of Dr. Leaming, and the educational departments are greatly indebted to his skillful and scientific management of the department of photography.

The question as to the proper time and place for the in-

troduction of the above outlined instruction is naturally closely associated with the distribution of the topics in a two-year course in Human Anatomy. The opportunities afforded by the new curriculum enabled us to solve the problem in as nearly satisfactory a manner as seems possible. One of the greatest advantages was obtained in the complete pedagogic separation of elementary and advanced students. The first-year student does not attend any lectures in anatomy. During this year the instruction consists in practical demonstrations to small sections of the class, dealing with the entire anatomy of the extremities and with the bones, joints, muscles, and blood-vessels of the head and neck, including also part of the peripheral nervous system of this region. In direct connection with the demonstrations extensive practical work in the dissecting room is required. The first-year student also attends a series of demonstrations constituting the "preliminary visceral course," designed to afford that general information regarding the body cavities and their contents which is requisite to the correct appreciation of the concurrent instruction offered by the departments of physiology and histology.

In the second year, the laboratory work continuing, the student attends demonstrations to sections of the class in the anatomy of the central nervous system, organs of special sense, and cranial nerves. The entire second-year class attends three lectures a week on the anatomy of the body cavities and viscera. The preparations illustrating these lectures are, in the afternoon of the lecture-days, demonstrated again separately to sections of the class, enabling each student to study and inspect the same closely. In this way an opportunity is given to make the anatomical lecture what it should strive to be, not an attempt to teach anatomy at long range to several hundred men at once, but an occasion for presenting the broad morphological principles upon which the animal organs, apparatus, and systems are constructed. Here the significance and importance of the structural peculiarities of man can be accentuated, illustrated, and explained in all their

bearings by contrast with the corresponding structures of the lower vertebrates.

A series designed to teach the evolution of a complicated human organ, through successive stages, from the simple and rudimentary form found in the lower vertebrates, attracts the student's attention and interest from the outset. He is offered actual facts and preparations, not dry statements or schematic drawings; and the knowledge cannot fail to be more readily acquired and more thoroughly assimilated. "Seeing is believing," in anatomy perhaps more than elsewhere. Conversely, many structures appear obscure and ill-defined in human anatomy on account of regressional modification or degeneration during evolution. Their significance and the reason for their existence can be made clear only by direct reference to and comparison with the corresponding parts in forms in which they are fully developed and physiologically active. The nomenclature of anthropotomy contains many terms which the student accepts, without ever clearly recognizing the reasons for the distinctions which they imply, unless the corresponding structures in other forms are brought before him, in which at a glance the correctness and significance of the names used appears. A "globus major" and "minor" with an intermediate "body" might readily be considered almost uncalled for divisions of the human epididymis, and yet certain important structural features of the organ relate to the distinction thus made. A moment's study, on the other hand, of the corresponding parts in a marsupial will place the entire arrangement of the duct in an absolutely clear light, and will abundantly justify the descriptive terminology of human anatomy.

Again, the whole subject of variation from the accepted normal type in human anatomy depends for its rational explanation upon comparative and developmental illustration. Nothing is more difficult or unsatisfactory than the acquisition of knowledge in the form of dry statistics, and considered by themselves the variations in anatomy are little else. On the other hand, a flood of light is shed on these conditions and

a live interest imparted to them, if they can be made to demonstrate man's relationship to other vertebrates, to accentuate facts in human evolution, and to illustrate the unity of plan in vertebrate structure.

But beyond the direct and practical connection between the study of human and comparative anatomy, a broader purpose is achieved by combining them in the medical course. Only a few years ago many facts in comparative anatomy, evolution, and heredity were the scientific property of only a limited number of special investigators. To-day the biological advances of the last ten years have extended to include a much wider circle. The educational influence of universities and scientific institutions, by well planned museum exhibitions, by public lecture courses, and in many other ways, has reached beyond the immediate group of special students. In his relation to the community at large the physician is still preëminently the man of science. He should, as a matter of liberal scientific education, possess a general knowledge, founded on his university course, of the more important structural relations of man to the remaining vertebrates, such as will enable him to express an intelligent opinion on questions of general morphology.

It is quite evident that the institution must command the requisite material for illustration in order to carry out the system above outlined. The progress of the last eight years in this respect has been gratifying. The morphological museum began its development in 1890 in one of the small rooms in the cellar of the south wing. Columbia to-day possesses an equipment which, while it still falls far short of the ultimate design, yet is unequalled in the beauty and clearness of the preparations, and in the complete character of the series most extensively used in the courses of instruction. The first and second floors of the new anatomical building are designed to be the permanent home of the museum, and provide ample floor and gallery space. It is the confident hope of the department that here the future growth of the collection will be as rapid and healthy as it has been in the past under less

favorable surroundings. Unfortunately, however, it was found necessary at the time the anatomical building was erected to leave out the equipment, and the department is to-day in urgent need of cases for the two floors. The old cases inherited from the pathological museum are overcrowded and have to be used merely for storage. The museum loses one of its most important educational features in not being accessible for purposes of serious study in its present condition. It is not possible to carry out the systematic serial exhibition which is the fundamental principle in the application of the collection to the instruction of the student. Moreover, even for the simple purposes of storage the available shelf room has been exhausted, and large numbers of very valuable preparations are of necessity left entirely unprotected, subject to unavoidable deterioration by dust and breakage. The department earnestly hopes that this necessary portion of the equipment may soon be completed.

With all the advances in extent and methods of anatomical instruction which the last few years have brought to us, there still remain projected improvements which we trust the future will realize. It is very true that a state of complete satisfaction with results already achieved is an unhealthy symptom; there will always be motion in some direction, either in advance or retrograde. A notable requisite to the rounding out of the morphological instruction of the curriculum is a systematic course in practical vertebrate embryology, equally important in the purely scientific and in the practical respect. The growing importance of the subject cannot be overlooked. A thorough knowledge of the development of the human body is not only an immense advantage in the study of the normal adult anatomy and physiology of man, but embryology is connected closely and in a practical sense with nearly all the great clinical departments of instruction; midwifery, pathology, surgery, and medicine all deal with the normal processes of development and with the results of abnormal deviations from the usual course. It is unquestionably of great importance to afford our students

the opportunity of obtaining systematic instruction in this branch, to combine the scattered and fragmentary teaching of the different departments in a regulated course.

The course should be designed with especial reference to the requirements of the medical student, and combine from the outset the study of the processes of development in the vertebrate embryo with the consideration of the clinical results of the arrest of development at different stages in man. In this respect the Museum of Human and Comparative Anatomy and the Pathological Museum offer invaluable opportunities for increasing the scope and pertinence of the instruction. Laboratory work in practical embryology should be associated with the study of serial preparations of the lower vertebrates, presenting permanently conditions which are temporary embryonal stages in the higher forms. Combined with this should be the study of the congenital malformations and of the pathological conditions exhibited in man as a result of arrest of development or deviation from the normal type. In like manner, the clinical aspects of pregnancy, parturition, and involution should receive most important elucidation through the opportunities which the course would offer to study practically the normal and abnormal morphological conditions of uterus and placenta during and after gestation. The value of such a course would be great, both in the general scientific education of the medical student and for the acquisition of sound and detailed knowledge of important practical facts.

When we look back over the material advances which the medical school has made as part of a great university system, fostered by a broad and liberal adminstration, and favored by the public-spirited generosity to which we owe our present magnificent equipment, it cannot be doubted that the near future will see our projected improvements accomplished facts.

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