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PROGRESS AND TRENDS IN THE SCIENCE OF ANATOMY *

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I well recollect, at the International Anatomical Congress held 20 years ago at Amsterdam, hearing that distinguished anatomist the late Professor C. U. Ariëns Kappers deliver a notable presidential address of welcome. In the course of his address, without any hesitation and with perfect fluency, he changed about from one language to another, speaking as easily in Dutch, French, English, German, and Italian. I fear I am quite unable to emulate such remarkable linguistic ability in welcoming the delegates of the International Anatomical Congress now meeting at Oxford, and I am therefore limited to addressing you in my own language.

Welcome to Oxford

On behalf of the Anatomical Society of Great Britain and Ireland, and of the University of Oxford, I offer you all a sincere welcome. We may not be able to claim for Oxford the tradition of a great teaching school of anatomy which can parallel the glories of the mediaeval Continental schools such as those of Padua, Montpellier, Leiden, and Uppsala, but we can look back with pride on a line of renowned anatomists who lived and worked in this university, leaving their names firmly engraved on the list of the great scientific worthies of Oxford. Such names as Harvey, Willis, Lower, and Highmore need no commentary from me, for they will already mean much to you. We meet here in a building which they, in their time, also frequented; and even now, after so many years, you will be able to capture something of the atmosphere in which they worked as you wander round the old colleges and their beautiful gardens. I like to feel that the meeting of this international congress at Oxford is in some sense a tribute to their honoured memory, as I am also certain that, in our deliberations here, we shall derive inspiration from the thought that long ago they too deliberated on similar matters in the same surroundings.

We are proud to welcome anatomists from so many parts of the world, representing no fewer than 35 different countries, and proud also that (in spite of difficulties of travel) you have come in such numbers. This is the fifth of the International Anatomical Congresses which have so far been held, and it is a striking indication of the continuing vigour of our ancient and venerable science that the delegates outnumber those of any previous congress.

Anatomy has always been recognized as one of the most fundamental of all the biological sciences, and for this

reason it has never ceased to be a lively and active subject. But it appears to me that during the last 10 years or so it has been still further invigorated by the impetus of many new developments. Perhaps one of the most notable of these developments is the application of new technical methods, and particularly experimental methods, to the study of anatomical problems on a much wider and more intensive scale than has hitherto been usual. In many cases these methods demand a high degree of manipulative skill and technical ingenuity, and the opportunities which they offer have drawn into the field of anatomical research numbers of young scientists of exceptional ability who are eager to apply them to fundamental problems of structural organization. Anatomical research has also come to have a closer reference to the actualities of living organs and tissues than has often been the case in the past, so that the anatomist finds himself much more intimately concerned with the functional implications of the structural detail whose analysis is his particular province. In his attempts to correlate as directly as possible structure with function he has inevitably been brought into a closer collaborative association with his physiological colleagues, and this working relationship has without doubt been a most potent factor in some of the outstanding advances in both subjects during recent years. For not only has the anatomist become more and more physiologically minded, the physiologist has also become more and more anatomically minded. Indeed, so much is this the case that in some universities the casual visitor may be forgiven if, on first entering a department, he is undecided whether it is concerned primarily with anatomy or physiology. It seems, indeed, that the artificial boundary between "anatomy" and "physiology" which had developed rather strongly in the early part of this century is now breaking down altogether (both in teaching and in research). This, it should be emphasized, is not really such a new development as it may appear to be; rather it is a reversion to the attitude of many of the older anatomists. Harvey and Hunter, for example, both cultivated assiduously the experimental method in pursuing their studies.

With the application of new technical methods to anatomical research, anatomy departments are becoming far better equipped with laboratories, apparatus, and technical assistance. Accommodation for experimental animals, which at one time was limited to the physiology department of a medical school, is now generally regarded as no less necessary for the anatomy department. Anatomy, it will be agreed, has as its ultimate aim the study of the form

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and structure of the living organism, and it must therefore necessarily concern itself with the investigation of all those factors which determine or modify form and structure, whether chemical, physical, physiological, developmental, or phylogenetic. Hence the anatomist in the pursuit of his inquiries may need to employ technical and experimental methods of great variety borrowed from other fields of science. Yet in doing so he must constantly hold in view his primary duty—the investigation and interpretation of structure.

I should like to emphasize rather strongly what I conceive to be the proper role of the anatomist. Clearly it is undesirable, and also impossible, to confine the anatomist and physiologist to arbitrarily defined limits of their subjects. The physiologist in following his inquiries into function may find it necessary to make a parallel study of the underlying anatomical mechanisms involved, and the anatomist in his study of structural organization may require to pursue his studies into the realm of pure function in order satisfactorily to understand the full significance of anatomical details. This complementary overlap of the interests and activities of anatomists and physiologists, which has become so evident in recent years, can only be of the greatest advantage to both groups of workers, but it would also be a severe handicap to both if, as a result of such a community of interest, the importance of pure morphology should be in any way underestimated or belittled.

One of the main features of the science of anatomy has always been the unusually wide scope of its activities. As I have stated elsewhere, the subject naturally embraces the whole range of organic structure—that is, the organization of the elementary components of living matter into a complete cell, the organization of cells into tissues, of tissues into organs, or organs into systems, and finally of systems into fully integrated living creatures. But, more than this, it is also a historical subject in so far as it is concerned with the genesis and growth of tissues and organs from the germ cell, and with the evolutionary origin and development of all the varied manifestations of structural organization during the dim and distant ages of the geological past. This diversity of interests is well illustrated by the list of contributions to be presented at our congress. A reference to this list provides an opportunity for a brief review of recent progress and current trends in the different branches of anatomical science, and this is perhaps the more appropriate because it is 15 years since an international gathering of anatomists was last held. The expansion of anatomical research now proceeding in so many fields, and the increasing specialization in some of these fields, obviously makes it impossible for any one individual to survey the whole subject in any way adequately. What I have to say, therefore, is based on a personal impression which may not always be well informed and which necessarily has strict limitations.

General and Comparative Anatomy

The term "general anatomy," like the term "general physiology," is not altogether satisfactory. It is taken to include those aspects of anatomical study which do not readily lend themselves to the distinction of a special category. It includes gross and topographical anatomy, subjects in which a great deal of important knowledge has been accumulated (and still continues to be accumulated) by the time-honoured method of skilful dissection with scalpel and forceps. In its application to the needs of clinical diagnosis and treatment the study of gross anatomy is no less important now than it has been for many years in the past. Indeed, in some respects its importance has

been enhanced, particularly as the surgeon develops new technical methods which permit him to deal with regions of the body not previously accessible to his art. Recent progress in intracranial and thoracic surgery, for example, has revealed serious gaps in our knowledge of certain important details of topographical anatomy, and these gaps are now being filled by intensive studies by many anatomists. These studies include the visualization of the gross pattern of vascular trees or duct systems by the use of appropriate injection masses, the preparation of corrosion specimens, the application of stereo-photography, and the use of radiographic methods. With the more refined techniques which have now been developed some anatomists have been able to make preparations which are not only of great practical value but have an impressive beauty of their own. The need for a much more detailed knowledge of the vascularization of muscles and nerves in the treatment of injuries became very apparent in the war, and led to much intensive research which has yielded a great deal of important information for the orthopaedic surgeon. Of particular interest are the investigations of the vascular patterns of various organs (for example, the lung, kidney, liver, and testis); for it is being demonstrated that the nature of these patterns has a more important reference to pathological conditions and operative technique than has been fully appreciated in the past. The anatomical evidence for a vascular "by-pass" mechanism in the kidney has directed attention to the possible importance of similar mechanisms in other organs, and already valuable information is being gathered from studies of the liver, stomach, spleen, etc. Special mention should be made here of the employment of radiographic and micro-radiographic techniques for the study of these vascular arrangements.

The study of muscular action and joint movements in man has received a new impetus from the realization of its importance in what has been termed "ergonomics"—that is, the study of man in relation to his working environment. Many of the statements contained in textbooks of anatomy regarding the mechanism of muscles and joints are, it appears, the result of inferences based on the study of the cadaver, and are found to be not altogether applicable to the living body. These questions are now being investigated more directly in the living human subject by new methods such as electromyography and strain-gauge dynamometry, and already some very significant results are beginning to appear. An interesting field of work is also being opened up by a detailed analysis of the mechanics of joint movement in relation to theories of lubrication, by studies of variations in the viscosity of synovial fluid in joints of different types of movement, and by intensive investigations on the nature and absorptive power of synovial membrane, the innervation and lymphatic drainage of capsular structures, and so forth. The importance of all this work for the proper understanding of arthritic conditions will be quite apparent.

The study of comparative anatomy still has an important part to play in problems of systematics, and as an essential adjunct to the study of comparative physiology. The need for more detailed knowledge in this field is also becoming apparent in connexion with palaeontological studies. For example, the discovery of the skeletal remains of extinct primates (particularly those of the early apes of the Miocene period) has shown that the interpretation of certain of their morphological features can be satisfactorily determined only by a more detailed knowledge of the anatomy of existing forms. There is an obvious need here for the comparative anatomist to work in close collaboration with the palaeontologist.

Neurological Anatomy

The large number of papers on the nervous system to be presented at this congress is a significant commentary on the active state of neuro-anatomy. Progress in the study of the central nervous system has been stimulated by the development of a closer co-operation with neurophysiologists and by the use of more refined technical methods for determining the interconnexions of different parts of the brain and spinal cord. No doubt one of the significant contributions of the anatomist to the study of the central nervous system in the past has been the demonstration of the importance of structural differentiation for problems of functional localization. For example, the cyto-architectural contrasts in the cerebral cortex, the nuclear configurations of subcortical levels of the brain, and the demonstration of different patterns of fibre connexions between them had led to the suggestion that there must be a corresponding degree of functional differentiation and localization.

It is interesting to find that, with the more delicate electro-physiological techniques which have become available, this has now received some degree of confirmation from the physiologists. At the same time, the investigation by the physiologist of patterns of functional activity in the central nervous system has directed the attention of the anatomist to new problems of structural organization. In the investigation of these problems the development of a silver technique which permits the study of early stages of terminal axonal degeneration has been of the greatest importance, for this method enables us to determine fibre connexions with much more certainty and precision than has hitherto been possible. Combined with a more systematic use of the method of retrograde cell degeneration in young animals, and with the technique of "physiological neuronography," it has given a new impetus to the study of the anatomy of the central nervous system. Indeed, it has become clear that many of the current statements regarding fibre connexions, which have been accepted without serious questioning for years, amount to little more than rough approximations. Consequently the anatomist has before him the task of checking all the older descriptive accounts with the more refined methods now at his disposal. Already this has led to new observations which seem to be of considerable importance—as, for example, in the details of the sensory and motor paths of the brain and spinal cord, the connexions of different parts of the cerebellar cortex, and the elucidation of the anatomical basis of cortico-striate and cortico-hypothalamic functions.

Finally, in the consideration of the anatomy of fibre connexions and the relation of the latter to function it has become realized that it is not enough to know simply that there is a fibre connexion leading from one functional centre to another in the nervous system. There is good reason to suppose that sensory discrimination depends largely on patterns of stimulation of receptors (spatial or temporal), while co-ordinated muscular reactions are the result of specific patterns of stimulation of effector mechanisms. It thus becomes a matter of the greatest importance to determine also the pattern of the fibre connexions, in terms of the precise regional distribution of the different components of these connexions, as well as the spectrum of fibre size which makes up each fibre system. These investigations demand considerable technical skill, as well as much patient work, but the results to which they are leading are fully justifying the efforts put into them.

As a necessary corollary of the more intensive study of the interconnexions of different parts of the central nervous

system much more systematic work is now being undertaken on the analysis of cyto-architecture. This applies not only to the more accurate delineation of cortical areas (and their individual and specific variations) but also to that of nuclear patterns in the brain stem and spinal cord. In connexion with these studies several very excellent atlases have been prepared which are of essential importance in their application to experimental investigations, and they mark one of the most fruitful results of the combined anatomical and electro-physiological approach to the investigation of the nervous system.

A development of neurological anatomy which calls for special mention is the application of experimental methods to the study of the organization of the central nervous system in submammalian vertebrates—particularly reptiles and birds. It has always been a matter of peculiar difficulty to equate the various nuclear masses in the brain of these vertebrates with those of mammals, and many of the homologies which have been suggested in the past are evidently based on little more than conjecture. Some of the results of experimental studies have already indicated that in the case of the reptilian brain the organization may be of such a specialized nature that it is perhaps impossible to establish strict homologies between some of the nuclear elements and those of the mammalian brain. Apart from their intrinsic interest, these observations, it is clear, may have important evolutionary implications.

The concentration of attention on patterns of conduction and excitation in the central nervous system has its counterpart in the study of the peripheral nervous system. For here also its importance is becoming increasingly recognized, both on the sensory and on the motor side. In the former case renewed efforts are being made to correlate patterns of innervation of cutaneous receptors with the phenomena of cutaneous sensation, and it is becoming clear that this problem is very much more complicated than has hitherto been supposed. On the efferent side the pattern of distribution of motor end-organs in muscles, as well as the distribution of proprioceptor mechanisms, is being systematically studied in relation to patterns of muscular contraction and co-ordination.

Several papers to be presented on the anatomy of the sympathetic nervous system indicate the important information which is still to be gained in this field, both from macroscopical and from microscopical methods of study. The importance of this type of work in relation to the surgery of the autonomic system is quite apparent.

During and since the war extensive investigations on the regeneration of nerve fibres have added very considerably to our knowledge of the factors which retard or favour this process, even if the fundamental nature of axonal growth remains an unresolved mystery. It is this mystery, no doubt, and also current studies on the biophysical basis of the nerve impulse, which have attracted the attention of anatomists more and more to the micro- and ultra-structure of the nerve fibre and its sheaths and the histochemistry of the nerve cell. These studies involve a consideration of some of the most fundamental properties of living protoplasm, and, since these particular properties have been developed to a high degree in nervous tissue, the latter is especially favourable for their elucidation. Let us hope that these penetrating studies may throw light on some of the basic problems of living protoplasm which so far have remained peculiarly elusive.

Histology

The need for a much more exact knowledge of the structure of the neuraxon and its sheaths is now directing

attention to the possible fallacies of histological methods which have commonly been employed in the past for the study of this problem. Indeed, a critical evaluation of these methods has already suggested that some of the appearances of the axon and its supposed variations (particularly at its termination) may after all be the result of artifacts. The increasing use of phase-contrast microscopy for the examination of living cells and tissues now provides an opportunity for overcoming difficulties of this sort. I remember that when, years ago, I saw the first cinematograph film of a cell undergoing mitosis I marvelled that the whole process seemed to take place so precisely as, a century or so ago, the old masters of microscopical anatomy had inferred from their study of fixed and stained preparations. To-day the phase-contrast microscope has likewise confirmed the essential accuracy of many of the observations on cellular anatomy based on fixed and stained preparations, but at the same time it is serving as a vitally important corrective in regard to some of the previous conceptions of the finer details of protoplasmic structure. Apart from problems of this sort, phase-contrast microscopy obviously provides a means for studying in continuity the sequence of changes which occur in the living cell, in a way which has not previously been possible.

The development of new optical methods generally is perhaps the most outstanding feature in the recent progress of histological research. It is well known that the application of the electron microscope to the study of certain cellular elements and cellular derivatives has already led to remarkable advances in our knowledge of biological structure. By way of example, mention may be made here of electron microscope studies of collagenous fibres, cells from tissue cultures, and retinal receptors. The construction of the reflecting microscope is another notable achievement in this field. The advantage of this instrument, as has been made clear, depends on the special facilities which it offers for absorption spectroscopy. The improvement of spectro-photometric techniques is also likely to make possible much more accurate quantitative studies of cellular constituents. Complementary to such improvements in optical methods are the development of more precise and selective histochemical techniques and the use of autoradiography, and it seems probable that within the next few years advances in these directions will throw a good deal of light on the organization of what the biochemists have called the "cyto-skeleton." The application of histochemical methods to cytological studies (qualitative and quantitative) is leading to important observations on the relation of cell structure to function in such organs as the kidney and liver, and in some cases this type of work is also being pursued with success into the nutritional field.

Lastly, mention must be made of the employment of radioactive substances in tracing out the life history of cellular elements whose origin and determination in the living body are still obscure (particularly mobile elements such as the elusive lymphocyte), and in defining the structural basis of the functional cycles of various tissues.

Embryology

In the study of embryology, like that of some of the other branches of anatomical science, there is an increasing tendency to resort to experimental methods—for example, in attempts to solve some of the problems of histogenesis. Not that the descriptive approach is by any means exhausted, for there is evidently still much important information to be gained from the careful study of the anatomy of various stages in the development of embryos

as it is displayed statically in serial sections. As is well known, considerable advances have been made in the investigation of the embryology of the higher primates—particularly in reference to the earliest changes which occur in the development of the germ layers. These observations are being paralleled by more detailed studies of early human embryos, the material for which is gradually being accumulated in sufficient quantity to allow of the interpretation of quite closely graded sequences and also to permit some idea of the extent of the individual variations which normally occur in development. The application of more varied staining methods (for example, silver impregnation) has thrown new light on some of the details of histogenesis. The whole field of comparative embryology still offers very considerable scope for the interpretation of developmental processes, as well as for the information which it can yield in problems of taxonomy.

The combined anatomical and physiological approach has, again, provided an impetus of much value in the consideration of the functional significance of various embryonic structures, a matter of obvious importance for the elucidation of the factors which determine developmental abnormalities. The problem of placental permeability, and of its variations at different phases of development, has demanded a renewed and more detailed study of placental structure, and the application of histochemical methods provides the embryologist with a particularly interesting field of research in this direction. The experimental embryologist, with the micromanipulative techniques which he has now elaborated, is in a specially favourable position to undertake functional studies in the early embryo (for example, the details of the cardiac cycle in the earliest stages of the formation of the heart), and the results of several such studies will be reported at this congress.

Experimental Morphogenetics

It is now many years since experimental morphogenetics became established as a special branch of anatomy, but it shows no signs of any waning in vitality. The problem of the organization of the unfertilized germ cell and of the developing ovum is being pursued with histochemical and biochemical techniques, and in the further investigation of the morphogenetic fields and gradients which have been previously established by the embryologist the latter is joining forces with his biochemical colleagues or is himself (at least temporarily) assuming the role of a biochemist. Further developments in the subject of morphogenetics have been marked by the improvement of technical methods of experimental work on the mammalian embryo *in utero* and on the chick embryo in the egg. Already these methods have been applied with success to a variety of problems—for example, the study of the developmental mechanics of the fissuration of the cerebral cortex, and the elucidation of the part which cellular migration plays in the development of certain cell masses in the brain stem. In morphogenetic studies relating to problems of growth, repair, or reconstitution during post-embryonic life much new information has accumulated in relation to skeletal structures. For example, the influence of function or muscular activity on skeletal form is being studied more closely, as well as the hormonal and vitamin factors concerned in the morphogenesis of bone. The evidence that ossification may be induced by the injection of appropriate extracts of cartilage or bone into indifferent tissues is of the greatest interest, particularly since it raises anew the question of the specificity of the osteoblast. This problem of the morphological and functional specificity of cellular elements has also been brought to the fore by the suggestion

that even such a highly specialized element as a striated muscle fibre may in conditions of tissue culture revert to a generalized histiocytic type of cell.

Looking as an outsider on the results of recent studies in experimental morphogenetics, I confess that what I find most intriguing about them is their "will-o'-the-wisp" character. Appearing at first sight to reveal important principles of developmental mechanics not previously suspected, they continually open up still deeper mysteries. This has become especially apparent from the more detailed studies which have lately been made of the functional potentialities of experimentally induced abnormalities. For example, it is one thing to demonstrate that a heterotopically grafted amphibian limb becomes completely innervated from unusual segments of the spinal cord; it is quite another thing to find that the muscles of the supernumerary limb actually function in rhythm with the corresponding muscles of the normal limb. This seems to imply an astonishing degree of reorganization of central connexions in the nervous system. Again, it is one thing to demonstrate that transection of the visual tracts in a newt is followed by regeneration of the fibres; it is another thing to find that the fibres, having become (as it seems) hopelessly entangled at the site of the scar, sort themselves out again so as to re-establish their proper connexions with their original sensory centres in an orderly, systematic manner. This "selective patterning of synaptic connexions" opens up new problems of morphogenesis which are clearly of profound importance.

Endocrinological Anatomy

The contribution of anatomists to the study of endocrinology is made very evident by a consideration of the history of this subject during the last twenty years. It was, of course, an anatomist who first discovered the pituitary growth hormone, and it was another anatomist who first demonstrated the influence of the hormone of the corpus luteum on the endometrium. The hormonal control of many of the tissues of the body has provided great opportunities for the investigation of problems of structural growth and differentiation on a wide scale. Advances in endocrinological anatomy during recent years make it clear that the somewhat empirical approach of injecting crude hormonal extracts just to see what happens is being replaced by much more critical investigations based on more delicate cytological and experimental methods, combined with a better appreciation of the specific relation of hormonal substances to certain types of cellular reaction. Of particular importance in this connexion is the isolation in a relatively pure form of the hormones secreted by the anterior lobe of the pituitary gland, for this now makes possible a much more accurate study of their specific influence on the structure and functions of different tissues and organs.

Probably it is true to say that in the last few years the adrenal cortex has come to occupy first place as the most intensely investigated of all endocrine organs. This is evidently in large part related to the demonstration that extracts of adrenal cortex (e.g., cortisone) may provide the means of alleviating such chronic pathological conditions as rheumatoid arthritis, and to the realization of the role of this organ in physiological reactions of the body after long-continued exposure to stress. The intensive studies which have been stimulated by these observations seem to indicate clearly some correlation between the morphological zonation of the adrenal cortex and specific functions, and this interesting conception is being followed up by a variety of experimental and selective histochemical

methods, including studies of the cytogenesis and the mode of vascularization of the different zones. The further demonstration of the close interrelation between the adrenal cortex and the structural organization of other tissues—for example, the lymphoid system—opens up new lines of investigation for the histologist.

In regard to other endocrine organs, reference may be made to the use of radioactive iodine for the study of the metabolic activities of the thyroid gland, and to the application of "alloxan" as a chemical tool for the investigation of the morphology of the islet cells of the pancreas and their relation to function. In the anatomical study of the pituitary body investigations have tended to be concentrated on the details of innervation and vascularization, with particular reference to the hypothalamo-hypophysial interrelationships. The experimental study of the hypophysial portal circulation, involving great technical skill, seems to have settled some of the problems of this interesting vascular connexion which have for many years been the subject of conjecture. Lastly, in the field of endocrinological anatomy an immense amount of work has been completed (and is still being undertaken) on the hormonal control of the development and morphology of the mammary gland—a subject which clearly has most important practical applications.

Physical Anthropology

Physical anthropology, a natural extension of anatomy from the study of the individual to that of the human species as a zoological group, has always occupied a prominent position in anatomical congresses. Much has been done in the past, and is still being done, by physical anthropologists in an attempt to determine the mutual relationships of different racial communities by reference to anthropometrical data, and an enormous quantity of data of this sort has now been accumulated. Further advances in the solution of these problems are to be expected from more detailed studies of the genetic basis of racial differences, from the collection of data on blood groups, and from the application of photogrammetric methods for recording body measurements and physique. The relation of the latter to environmental factors such as nutrition is engaging more attention, and, in connexion with matters of social welfare among native communities, observations are being made on possible racial differences in post-natal growth and development.

Reference may be made to an interesting extension of racial anthropology into the physiological field. There is considerable evidence of a circumstantial kind that some of the more obvious physical differences of race are adaptive in character, but up till recently little attempt has been made to confirm these inferences by experimental tests. Studies in climatic adaptation, which have lately assumed importance in other directions, open an interesting field of investigation in this respect, and already observations are being made in different parts of the world on the relative adaptability of local communities living in varied climatic environments. The importance of more complete anthropometric surveys has also been recognized for practical requirements such as those involved in the design of man-operated machinery, household and school furniture, and so forth. Incidentally, these surveys are likely to provide much useful information for the further analysis of the racial composition of mixed communities in many parts of the world.

The value of anthropometry for the archaeologist is becoming increasingly apparent as the skeletal material of ancient populations accumulates in sufficient quantities for

the application of methods of statistical analysis, and it is clear that as a result much more light is likely to be thrown on the movements of populations in the past. In some cases, it is interesting to note, sufficient remains of ancient communities have been found to permit conclusions regarding the sex and age composition, mortality rate, the expectation of life, and the relation of physique to social grade.

In the field of human and primate palaeontology the past fifteen years have been marked by most remarkable discoveries in many parts of the world—in Europe, South Africa, East Africa, and the Far East. In Europe the discovery of well-authenticated skulls of pre-Mousterian date raises anew the problem of the position in human evolution of Neanderthal man; in South Africa the great quantity of Australopithecine material found in limestone deposits near Johannesburg and elsewhere now provides an opportunity for a correct assessment of the affinities of these extinct ape-like creatures; in East Africa the discovery of an astonishing variety of Early Miocene apes of a generalized type (including a skull and a number of limb bones) has added very considerably to our knowledge of the earlier stages of hominoid evolution; and in the Far East the further discovery in Java of many more remains of *Pithecanthropus* and allied forms of early man (much of it still in course of publication) appears to indicate that the evolutionary radiations of primitive hominids showed a much greater diversity than had previously been suspected.

Considering their novelty, it is not surprising, of course, that such remarkable discoveries should have given rise to a certain amount of controversy, but in general this controversy has been concerned with details of interpretation rather than with main issues. I confess to a considerable amount of sympathy for those energetic field workers who, in remote parts of the world, have shown such initiative in their search for the remains of early man and other fossil primates. For, having by their own strenuous efforts made available for scientific study all this valuable material, they sometimes have patiently to look on while laboratory scientists (like myself) dispute among themselves on the precise value of specimens which they themselves may never even have seen. It is rather like throwing bones into a den of lions and watching the inevitable squabbles which ensue—an entertaining spectacle in some cases, no doubt, but also one which may tend after a time to become a little irksome. As a matter of fact, if the history of palaeo-anthropology is reviewed it is astonishing to find how often the original interpretations of obscure fossil remains turn out to be broadly correct. No anthropologist to-day, I think, gives serious consideration to the criticism that *Pithecanthropus* was nothing more than a giant gibbon, or that the remains of Neanderthal man found at Düsseldorf were only those of an idiot or an acromegalic. Even the original interpretation of Piltdown man has now received unexpectedly strong support from the fluorine analysis of the jaw and skull fragments. Special mention should be made of this method of estimating the comparative antiquity of fossil remains found together in the same deposit. It has already been applied with success to some of the fossils of uncertain date which have been the subject of much debate in the past, and it will certainly be applied as a routine test to similar problems as they arise in the future.

Conclusion

This short review of the progress and trends evident in anatomical science to-day, I should like again to emphasize, is no more than a personal impression. It is not, of course, based on a detailed study of all the relevant litera-

ture; it is simply the casual survey of one individual who, preoccupied with his own particular field of studies, gleans scattered pieces of information here and there from discussions with his colleagues or from all-too-hurried glances at the contents of papers and journals. For this reason, also, it has perhaps tended to make too much use of illustrative examples near at hand. You will therefore find many gaps in the review—some of which you may feel to be rather glaring. But at least it may serve to show how very active are the numerous branches of our science and how many problems of paramount importance are now engaging the attention of anatomists. And, even if I have not made this fully apparent, the programme of communications at this international congress in Oxford can hardly fail to do so.

AMOEBIASIS IN GREAT BRITAIN WITH SPECIAL REFERENCE TO CARRIERS*

BY

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The recent war has left an aftermath of medical problems arising directly from the fact that large bodies of men returning to Great Britain have been exposed to exotic diseases in tropical and subtropical regions. As a result the medical authorities are concerned about the possibility of the introduction and spread of protozoal diseases among the local inhabitants.

I propose to restrict myself to a consideration of infections due to *Entamoeba histolytica* among the population of Great Britain. The problem of amoebiasis in this country is more complicated than that of other protozoal diseases owing to the cosmopolitan distribution of *E. histolytica*, on account of which infection with this parasite can hardly be described as a merely tropical disease.

The medical practitioner is apt to encounter cases of amoebic infection of different types—some with typical clinical symptoms, others with non-characteristic manifestations, and others again without any symptoms whatever. While in cases of overt amoebiasis there can be no doubt about the necessity for specific treatment, opinions regarding the policy to be adopted towards apparently healthy "cyst-passers" are divided. This is due to conflicting views on the aetiology, host-parasite relations, and pathogenesis of amoebiasis. Although much research has been devoted to these questions, the results are inconclusive, and most physicians are influenced in their choice of a practical policy either by personal preference for some particular hypothesis or by expediency. The problem of amoebiasis in this country can be best appreciated from a review of the present state of our knowledge of the subject.

Incidence of Infection

Investigations carried out in the last 35 years have demonstrated that *E. histolytica* has a world-wide distribution and that the incidence of infection with this parasite may be as high in countries with a temperate climate as in those with a tropical climate. It has also been established that the majority of infected persons everywhere are carriers

*Read in opening a discussion in the Section of Tropical Medicine at the Annual Meeting of the British Medical Association, Liverpool, 1950.