Dible and Davie's
PATHOLOGY

An Introduction to Medicine and Surgery

Third Edition

by

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PREFACE TO THE THIRD EDITION

THE first edition of this book was in the press as the war clouds were gathering in 1939. A second edition was brought out in 1945 when the second great war of our times was drawing to its close and now, in the anxieties and uncertainty which face the world threateningly in the autumn of 1950 the writer rather sadly sits to write another brief preface. The torn world has been a difficult place for the ordered progress of medical science and though the stimulus of urgent necessities has, in certain directions, produced great technical advances and increased knowledge, such advances have been in general unbalanced and there has been no time or leisure to take stock of the larger concepts of pathology and its orientation to the whole of medical science ; a relationship which is becoming increasingly functional and must call for a more radical change than is achieved in the present revision of this book.

The call to high administrative office in his old University of the Cape has removed Professor T. B. Davie from active pathological work and deprived the senior author of a collaboration which has been happy and not without success. In consequence the whole burden of revision has fallen upon him. Nevertheless, the book has been thoroughly overhauled and although the format is the same much of the contents has been re-written and large sections extensively altered. The book remains what it has always tried to be, an account written primarily for the medical student of the processes of disease, in which structural change and functional alterations are considered together and effects are related to causes. Its size has not been increased materially, though a few new illustrations have been added.

The author again would express his gratitude to those who have helped him ; especially to Dr. J. V. Dacie who has read over the chapters on hæmatology, discussed them with him and made many valuable suggestions. Sir Cecil Wakeley has allowed the use of his figure of the lymphatic drainage of the breast and Sir Hugh Cairns and his collaborators the diagram on page 806. The little illustration of clubbed fingers is from an article by Mr. R. C. Brock and for all of these thanks are due to the proprietors of the *British Medical Journal*. The author would also like to thank Dr. Cuthbert Dukes for permission to use his diagram on page 646 and for supplying an up-to-date analysis of his cases of carcinoma of the rectum. Finally, Messrs. J. and A. Churchill have remained models of courtesy, helpfulness and consideration.

J. H. D.

PREFACE TO THE FIRST EDITION

THIS book is based upon lectures delivered by us to medical students, chiefly in the Universities of Liverpool, Manchester and Bristol, and in the London School of Medicine for Women. In writing it, and in all our teaching, it has been our object to give expression to the conviction, which we strongly hold, that pathology—" the grammar of medicine and surgery "—must be taught as a living subject and in its relationship to the other aspects of the diseases of which it is the basis. We do not belong to that school which interprets Pathology as synonymous with Morbid Anatomy. This was not the view of Cohnheim, and it is not a view to which we can subscribe.

It has been our endeavour to present pathological changes to the student as a series of *processes* going on in the living body and leading to certain consequences—signs, symptoms, functional changes and morbid anatomical results. This conception involves some consideration of causation and we have, where it has seemed proper, dealt in a simple and concise way with the organisms which cause the conditions under discussion. We believe that the right place for bacteriological teaching in the medical curriculum is in relationship to the diseases which the bacteria cause, and that its divorce from this position tends to make the subject dull and uninteresting to the student of medicine, whereas in another setting it is part of a fascinating study.

In visualizing the processes of disease we have been at more pains to teach how the conditions arise and evolve, than how to recognize them once the morbid anatomical changes have become established. The right places to learn to recognize morbid anatomical conditions are the post-mortem room and the museum, and no amount of text-book teaching can supplant these. By laying emphasis upon the natural history of disease we have hoped to stimulate the student to think in this way, and to question the genesis of the lesions which he may later be called upon to treat. By such a process morbid anatomy leads back to ætiology, and ultimately to preventive medicine—all of which are parts of the whole story of pathology.

In arranging our subject matter we have neither followed the conventional subdivisions into General and Special Pathology, with a systematic description under the latter heading of most of the changes in the different organs, nor have we pursued the seductive method of treating all infective conditions which are due to the same cause together, irrespective of the systems involved. The latter is the more logical method, but its disadvantages are great : it leads, to give a single example, to the separation of the different forms of meningitis and to their treatment in different parts of a book, whereas, from the clinical point of view, they should be kept together in the student's mind. We have, therefore, fallen back upon that characteristically English solution of a difficulty : a compromise.

Where the gross effects of any one agent of disease are closely similar,

we have dealt with them collectively as manifestations of a single infection ; but where different infections result in clinical conditions which anatomically are closely related, we have considered them together under a regional classification. Thus, syphilis, diphtheria and actinomycotic infections are described under these headings, and, if dealt with at all, are only briefly referred to under system diseases ; but, on the other hand, it has been found more convenient to describe pneumonia, phthisis and endocarditis in connection with the organs which they involve, rather than to regard these important and clear-cut clinical conditions as mere examples of pneumococcal, tuberculous or streptococcal infections.

We have omitted all description of animal parasites, for the reason that they illustrate no special principles in pathology and are adequately described in the many excellent monographs upon parasitology. Likewise, we have included no special description of gynæcological conditions, since these, to-day, are usually dealt with quite adequately in the text-books upon this subject and by its teachers. In our choice of illustrations we have similarly omitted many of those which illustrate common conditions which every student should become familiar with in the post-mortem room, or the operating theatre. Their inclusion would serve no really useful purpose and would add unnecessarily to the cost of publication.

In the arrangement of the book a certain system has been followed which we have found convenient in teaching. Inflammation, as the most fundamental process in pathology, has been dealt with first, followed by vascular disturbances, cellular damage and degenerations, disorders of growth, and immunity. These constitute the first section of the book. Then follows a section dealing with special infections, which commences with a discussion at some length of the three diseases : Anthrax, Diphtheria and Actinomycosis. These have been chosen as examples of septicæmic, toxæmic and subacute inflammatory processes. After this the student proceeds to the study of the other common infections and certain examples of virus diseases. The third section of the book is given up to systemic pathology, and in it the more important pathological conditions which have not already been dealt with are discussed.

In most medical schools in this country the student's study of pathology is in advance of his clinical experience, so that he is reading about conditions of which he has no clinical knowledge. We have endeavoured to meet this difficulty, as far as is possible, by postponing the consideration of the respiratory, circulatory and genito-urinary systems and introducing, at an earlier stage, the endocrine system and the diseases of the blood. In the former, a knowledge of the pathological changes is of less importance than an appreciation of functional derangements, and his recent study of the physiology of the endocrine glands will assist the student in appreciating their disturbances in disease. Further, anæmic states are common in both medical and surgical wards and their comprehension does not demand any extended clinical experience. By the time that the study of these systems is completed it is

hoped that the student will have reached a stage at which he is well equipped to apply his pathological knowledge to his clinical teaching.

Since the book is written for students it has been our endeavour to discuss the more important pathological processes at the greatest length: we do not pretend that it is a repository of information upon all and every sort of pathological condition.

We are under, and acknowledge with gratitude, a heavy obligation to the many friends who have assisted us in various ways in the production of the book. Especially we would mention Professor J. Shaw Dunn, to whom we are indebted for various photographs and for the loan of Fig. 328; Professor S. L. Baker for the photograph reproduced in Fig. 39; Professor Bruce Perry for a number of photographs dealing with infective endocarditis; Dr. Paul Wood for Fig. 239; Professor Hewer for the material illustrated by Fig. 169.

Dr. Robert Coope has assisted us greatly by reading manuscripts and proofs, and has aided us with his criticism and suggestions. Dr. John Mills has rendered us very great service in supplying a number of drawings from his own pen and in assisting us, in ways too numerous to acknowledge, by suggestions, criticism and proof reading. We are indebted to Mr. Douglas Kidd for his skill in making drawings and diagrams, and to Messrs. F. Beckwith and C. Wilmott for theirs in photography. To those who have generously lent us the use of material or published illustrations we would offer our grateful acknowledgment, especially to Professor James McIntosh, Professor R. T. Hewlett, Professor C. F. W. Illingworth and Mr. B. M. Dick, Messrs. W. H. C. Romanis and P. H. Mitchiner, Sir Girling Ball and Dr. Geoffrey Evans, Drs. L. E. H. Whitby and C. J. C. Britton, Dr. Janet Vaughan, Dr. E. J. King, Professor M. J. Stewart, Drs. T. W. Eden and C. Lockyer, Dr. Edgar Wallace, Dr. J. Galloway, Dr. E. Wynn Jones and Dr. W. W. Gerrard; also to the publishers of the *Journal of Pathology and Bacteriology*, the *British Journal of Surgery*, the *Journal of Hygiene*, the *Liverpool Medico-Chirurgical Journal*, *Brain*, Messrs. Cassell & Co. and Messrs. Butterworth & Co., Ltd., who have kindly allowed us the use of blocks.

Even in this comprehensive list there are many omitted who, in various ways, have assisted us by their help and by the provision of illustrations, and to these we would express our gratitude.

Finally, we would offer to our publishers our thanks for their ready co-operation, and our admiration for their restraint in refraining from any trace of cynicism in the face of the authors' promises.

J. H. D.
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CHAPTER I

WHAT IS PATHOLOGY?

An introductory lecture to Medical Students commencing its study

PATHOLOGY is the study of the changes produced in the body by disease. Anatomy and physiology have taught you normal structure and function: pathology will teach you the alterations in structure and function which are found in disease.

Derangements in the normal mechanism of the body produce changes of which the patient is aware—*symptoms*—and others which those who examine him are able to detect—the *signs* of disease. The study of these makes up clinical medicine. Trousseau, one of the greatest clinicians of a great clinical period, once said that "to know the natural progress of disease is to know more than half medicine." Pathology is the study of the natural progress of disease. It comprises the anatomy and physiology of disease; the means whereby its changes are brought about and the way in which they develop, are overcome and retrogress. It is the grammar of practical medicine and surgery.

It must never be thought that pathology is an isolated subject which can be learned and subsequently forgotten in the exacting pursuit of clinical experience or in the hurly-burly of professional practice. This it can never be, for the better you are acquainted with the pathology of the clinical conditions which you will see and be called upon to diagnose and treat, the better physicians or surgeons you are likely to become. And for the very obvious reason, that it is only by the complete knowledge of the alterations which underlie the patient's condition that you can attack their cause and follow a rational system of treatment.

Therefore, strive to acquire the habit of thinking in terms of pathology whilst you are students in hospital, and of looking deeply into disease. There is no merit in a mere diagnosis and the prescribing of the text-book remedies. To follow such a superficial method is to walk along the road which leads to En-dor; for it connotes the abandonment of observation and logical inference, and the substitution of a rule-of-thumb automatism in circumstances in which man's highest faculty—his ability to think and reason—should be exercised. Cultivate the habit of looking beneath the surface: collect and consider every symptom and every finding and strive to correlate their anatomy and physiology into one pathological whole. Above all, do not neglect the fact which does not quite fit in. Remember that it must have a basis somewhere, and until you have discovered this basis your knowledge of the disease is incomplete and to this extent your treatment is empirical.

Entia non sunt multiplicanda præter necessitatem: for most diseased conditions there exist a single cause and a simple and connected series of

consequences; although these may be far to seek and the state of our knowledge may not enable us to follow them all. Even so, every effort should be made to find the cause and mechanism of every change which we observe.

One more point and this homily is done. A very great Scottish teacher was wont to say to his students, "Always follow your patient to the post-mortem room": advice which gave scope for misinterpretation but which nevertheless was full of the soundest sense. Go to the post-mortem room whenever the opportunity offers and study the anatomy of disease. Never neglect the opportunity of seeing the last and fullest examination of a case which you have previously seen and observed during life. Here alone can you check your clinical observations by seeing the actual lesions and interpret your clinical findings in terms of morbid anatomy. The opportunities for doing this are abundant to the student, but are far rarer once he has qualified. By following the work of the post-mortem room you will soak up a store of knowledge—perhaps unconsciously—which will be a permanent asset.

But, whilst counselling the study of morbid anatomy, we are far from suggesting that the mere recognition of morbid conditions is an end in itself. In the early days of pathology this was so, and in the early days of the student's training there is a temptation to regard it as such. But this is a very barren conception. The real value of morbid anatomy, apart from its use as a check upon diagnosis, is that it forms the basis of morbid physiology. The study of diseased structure is a necessary complement to the study of diseased function which, in its turn, is the basis of the therapeutic art.

THE TYPES AND CAUSES OF DISEASE

What induces Disease? Disease consists in departures from the normal in the structure and functions of the different organs of the body. Such changes may be brought about by a variety of agencies. They may be *inborn* or *congenital:* due to some error in the developing embryonic body. Organs may be absent, malformed, or so structurally imperfect that normal life is impossible and the result is a state of disease. Such defects may be so extreme, and involve organs so essential to life, that independent existence is impossible, or, if less grave, they may allow of a limited survival. Thus, in certain cases of congenital malformation of the heart, birth may be survived, but the symptoms of circulatory disease show themselves from the earliest years of life. At the other extreme, even after years of apparently healthy maturity, an inborn defect may become manifest and produce disease and death; as for example in the congenital cystic disease of the kidneys. In this connection we may also mention that large group of disorders of growth, the tumours, which includes certain examples in which congenital influences are of unquestionable importance, although less stress is laid to-day upon this aspect of the tumour problem than formerly.

Secondly, disease may be due to *trauma* (injury). This is obvious. Trauma may be physical: a blow may seriously damage tissues and, if the damage implicate a vital organ, it may cause death. Burns are examples of another type of physical injury and the converse condition, frost-bite, is a

third. Such injury may be gross, mechanical and visible, inflicting immediately recognizable damage; or it may act slowly and in a more subtle way, as do β and γ rays. A commonplace example of slow traumatic action is the long-continued pressure and irritation which give rise to the common corn. Examples of more obscure traumatic action, in which both physical effects and chemical products play a part, are seen in the anæmia which results from long exposure to irradiation, or the cancerous growths which may be produced by the long continued action of X-rays, arsenic, and certain other agents.

A third group of diseases, which has only of recent years received full recognition, is that depending upon *alterations of nutrition*, using that term in its widest sense. Many of these are due to a lack of certain essentials to the continued well-being and nutrition of the body. Such substances may be relatively simple chemical substances, such as the iron which is essential for the manufacture of hæmoglobin, or they may be the more complex vitamins, which are for the most part absorbed in the food and a lack of which leads to those conditions known as the *deficiency diseases*. In a different category come the products of certain of the body cells, the ductless glands, in which disturbance, either in the direction of deficiency, excess or alteration of secretion, leads to diseases such as acromegaly, diabetes, or myxœdema; these being the *endocrine disorders*.

Fourthly, and this group is the largest of all, there are those very numerous maladies which are to be attributed to the presence of *poisons* in the body. Certain of these are relatively simple and normally innocuous substances, such as alcohol and tobacco, which produce disease only when taken in excess. Others are more definitely poisonous in small amounts, such as lead and many of the organic solvents used in industry. There are also poisons of an *endogenous* nature, which are believed to result from faulty metabolic processes: gout, arterial disease and certain forms of nephritis are possibly of this nature, but of the genesis of this group we know very little. Finally, we have the important group of diseases due to micro-organisms. These we classify as the *infective diseases*, and here the causal process has been studied with a great deal of success. Partly within and partly outside this group are those conditions which are designated *allergic*, in which the tissues of the body become affected by contact with certain substances, which may be of very diverse types—such as pollens, foreign proteins and bacterial products—but all protein in nature. Such contact or assimilation changes the chemical reactivity of the cells, so that when again stimulated by the same protein they exhibit a condition of disease. Common examples are hay fever, and the urticaria which in certain individuals may be produced by specific articles of diet, such as shellfish.

THE GENERAL FEATURES OF DISEASE

Now, in almost all the different types of disease which we have mentioned, from whatever cause they may arise, there is an infliction of some sort of damage to the body cells, either by the positive action of the influences which

have been named or by the lack of substances which are necessary for the health of the tissues. The effects produced in the individual cell tend to follow a regular sequence; the first evidence of disease is an interference with the cell's functional activity; at a later stage, or with a more severe injury, changes in its appearance take place; and, finally and terminally, the cell dies. The natural course of disease does not, of course, by any means always terminate fatally and we must therefore be prepared to encounter a whole series of opposite changes which take place when the cells recover, together with those which are required for the removal of any units which have been irreparably damaged and for the restitution to normal of the affected part.

INFECTION AND DISEASE

The discovery of micro-organisms was an outcome of the development of the microscope, the early history of which is obscure. It is, however, enough for our purpose to know that round about 1675 a citizen of Delft, the son of a brewer, and chamberlain to the sheriff of Delft, whose official duties appear to have left him ample time for his private scientific investigations, first saw and depicted these lowly forms of life. This was Anthony van Leeuwenhoek, who manufactured lenses of a power surpassing anything which had previously been produced, by the help of which he was able to give a good account of the red corpuscles of the blood and of the capillary circulation. Leeuwenhoek's primitive microscopes have been described by Clifford Dobell, who has also reproduced the letters to the Royal Society of London in which micro-organisms are described and depicted in such substances as impure water and decomposing organic matter.[1] For about two hundred years little interest was taken in these animalcules and the question of their possible relation to disease was barely discussed. In those days it was dangerous to probe too deeply into the mysteries of nature: only some forty years earlier Galileo, to save his head, had been forced by the Holy Inquisition to make a celebrated recantation ("*e pur se muove*") of his teaching that the earth moved round the sun; whilst a little over one hundred years before, Servetus, the discoverer of the pulmonary circulation, had been burnt at the stake for doctrines which conflicted with the religious dogma of the times. The considerations which hedged about scientific enquiry are vividly dealt with by Kipling in "The Eye of Allah."

For two hundred years after Leeuwenhoek's discoveries the theory of the causation of disease remained wrapped up in the wonderful jargon of obscuration which enfolded the old humoral pathology. The body was supposed to be dominated by a "vital fluid," directed by the nerves, and disease to be due to abnormalities in its distribution.

Although speculation outran discovery, and a germ theory of disease was frankly canvassed in certain schools of thought, the first real step towards the demonstration of bacteria as its active agents was taken in 1863,

[1] Antony van Leeuwenhoek and his "Little Animals," by Clifford Dobell, F.R.S. London. John Bale, Sons and Danielsson, 1932.

when Davaine discovered small rod-shaped organisms in the blood of animals which had died of anthrax, or " splenic fever " as it was then called by veterinary surgeons. The reasons which led to these particular organisms being the first to be seen in disease are not far to seek. For not only are the anthrax organisms amongst the largest of the pathogenic bacteria but they occur in greater numbers, and are more widely spread through the body in the disease they produce than any other infecting bacteria.

Fortunately Davaine's discovery came at a time when Pasteur was pursuing his great work upon the causes of fermentation. Led, by the discovery of optical isomeric forms of tartaric acid, into the investigation of the fermentation of alcoholic liquids, which he did much to put upon a scientific basis, Pasteur soon realized a similarity between fermentation and putrefaction and was led to look for the same causes in both. Thus, from the yeasts which cause carbohydrate fermentation, he came to study the bacteria which cause the curdling of milk and the putrefaction of organic substances, and ultimately to look upon disease as an alteration in the living body produced by organisms similar to these. This as we have said was no new conception, for it had been suggested as a philosophical speculation that micro-organisms might cause disease. Pasteur's first great contribution to medical knowledge was to replace these speculations by proven scientific facts. The opposition to his teaching was tremendous, but gradually and inexorably he broke it down until, by continuous and logical experiment and demonstration, he forced the truth of his contentions upon an unwilling generation. Pasteur is the real father of modern medicine and surgery.

The incredulity which Pasteur, and the early workers who followed him in the same field, encountered is not difficult to realize to-day when we remember that the doctrines which they introduced, which to us are commonplace, were unorthodox to a degree and radically opposed to the current conceptions of disease which were linked up with the old humoral pathology. Moreover, Pasteur, the prophet of the new beliefs, was not a medical man and, with that unity which a common prejudice begets, the medical profession combined to oppose his teaching.

The most serious objection advanced against the microbic theory of fermentation and putrefaction, not—be it said in all truth—by the medical world alone, but by the greatest chemical authorities of the time, was based upon the then current doctrine of spontaneous generation. It had long been accepted that in suitable circumstances life could originate in organic matter ; and that when putrefaction took place in meat and organic fluids, or when water became stale, the maggots, infusoria or bacteria which appeared were the result of the decomposition, and had originated in, and drawn their life from, the decomposing material. Moreover, it was accepted doctrine that both fermentation and putrefaction were the results of oxidation, and had nothing to do with animalcules and the activities of life at all. Hence, when Pasteur claimed that these changes of decomposition were due to organisms, those who were prepared to admit the existence of these lowly forms of life declared that they were the products of the changes which were taking place, and were neither the cause of them nor essential to them.

The oxidation theory was a matter of serious difficulty, since the view was not only deeply rooted and consecrated by time, but as great an authority as Liebig obstinately supported it. The reasons for the putrefaction of urine, and the putrefaction of broth and foodstuffs, were so settled and for years had been so satisfactorily explained as due to oxidation, that the statement that these decomposable substances would remain indefinitely in an unaltered condition if organisms were excluded was received with a very natural incredulity. It was not understood that the admission of air also meant the admission of micro-organisms. It was well known that when urine was boiled in a flask, and the neck sealed during the currency of the experiment, it would fail to putrefy. This was an old observation and well established; but when Pasteur explained it on the grounds that the putrefactive organisms were killed by heat, and subsequently their ingress was excluded, the objection was immediately made that air had been driven out of the flask and that it was the lack of oxygen which prevented the decomposition.

Pasteur, and those working in the same field as he, claimed that since living organisms have a certain mass, decomposition must depend upon the entry of particulate materials. They held, therefore, that if all particulate matter were excluded from sterilized materials, oxygen might have free access but putrefaction would not occur. To prove this Pasteur performed a long series of experiments which may be read in his original papers. He boiled putrescible fluids in vessels with long inverted necks, which opened to the air but made it very difficult, in the absence of violent and direct draughts, for particulate matter to enter; he boiled his fluids and, before sealing the flasks, filled them with air which had been passed through a red-hot tube; and in both of these instances the material failed to undergo the decomposition which invariably occurred in other flasks of the same materials not so specially protected. Finally, he performed the experiment of ascending the Jura mountains, armed with a whole series of sealed flasks containing sterilized putrescible material, batches of which were opened to the air at different levels and, after being again sealed, were returned to his laboratory for incubation. It was argued that in the higher and purer air of the mountains particulate matter, and micro-organisms, would be less in numbers than in the dustier plains below. The truth of this was amply substantiated by the results, and it was found that the proportion of flasks undergoing putrefaction became progressively smaller as greater altitudes were reached.

Slowly, and by experiments of this sort spread over a number of years, the doctrine of spontaneous generation became discredited and the immense potency of bacteria in producing alterations in both dead and living matter became realized and accepted.

Whilst these questions were being acutely debated, a young surgeon at the Glasgow Royal Infirmary was struck by the similarity between putrefaction and the hospital gangrene and septic processes in wounds, which caused the odour of putrefaction never to be absent from surgical wards. Accepting Pasteur's work he set about devising means for the exclusion of micro-organisms from wounds. This was our own Lister, and upon these bases he founded antiseptic and aseptic surgery. There is, we have some-

times found, a certain belief that Lister made his discoveries by some sort of happy chance ; or that they were the overwhelming reward of crude methods empirically employed. Nothing is further from the truth. Lister's whole work was, from first to last, logical and based upon Pasteur's discoveries, and that is why it stands to-day. The only direction in which later experience has modified Lister's teaching is that it attributes infection more to the surgeon, his instruments, his assistants and the patient's skin, and less to organisms in the surrounding air, than Lister did, and it has therefore abandoned certain precautions which he made use of for the exclusion of the latter and has substituted physical for chemical methods of sterilization.

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If we have lingered upon and stressed this historical introduction it has been not only because of its great interest but also on account of its practical importance. It has been shown that a fluid in which organisms are capable of developing, once rendered sterile will remain so indefinitely, if proper precautions are taken. From this comes the all-important result, that when we inoculate any such medium with blood, pus, or other material from a case of disease, any organisms which develop therein are those which have been present in our inoculum. This is the basis of the bacteriological investigation of disease. Its success entirely depends on our ability to prepare and preserve sterile culture-media for the growth of the organisms which are present in the diseased tissues. By such means we can cultivate bacteria and, when we have assured ourselves that we have obtained them in a state of purity, we can examine their properties, classify them, and investigate their relationship to the disease in question. The methods of doing this are technical matters which must be learnt practically.

CHAPTER II

INFLAMMATION AND REPAIR

LIVING tissues, as an essential of their living nature, do not remain passive when acted upon by external influences but react more or less swiftly to changes in their surroundings. This phenomenon is characteristic of all living matter and, as we ascend in the animal scale and the functional differentiation and specialization of cells become more and more highly developed, the phenomenon of reaction becomes more and more complex. In all injuries to the animal body, short of those which kill it *in toto*, reaction follows upon injury, and the study of this comprises a most important side of pathology, which as we have said is especially concerned with the changes occurring in diseased, altered, and therefore often injured, tissues.

The Reaction of Living Tissues to Injury is known as Inflammation. It is a phenomenon met with in a vast number of pathological conditions. Hence a thorough understanding of it is necessary as a basis for the study of most of the changes of disease. It is, in fact, rarely that we observe any pathological process in the living, or examine any pathological organ in the dead, without encountering inflammation in one of its phases, or seeing some evidence of one of its many stages.

Since disease is so often a consequence of invasion of the body tissues by micro-organisms, inflammation is very often the outward and visible sign of their presence and activity. Such an inflammatory reaction may be a rapid and florid process, *e.g.*, in erysipelas, osteomyelitis, or cellulitis, in all of which the processes of *acute inflammation* are most obvious. Or it may be of slower and quieter development, as in a tuberculous joint infection, where the inflammatory process is *chronic* in type. From a contrast of the clinical features of such conditions as osteomyelitis and tuberculous disease of a joint, we appreciate that the conditions which we include under the broad heading of inflammation must vary very greatly, both in their anatomical features and in the symptoms which they occasion. And so it is. We find acute and chronic types of inflammation, which present widely different features when examined separately; yet they are really made up of the same processes. But since these processes occur in different proportions and intensities they produce different pictures.

Where organisms gain access to the tissues it is necessary, if they are to be prevented from growing indefinitely and fatally injuring the body, as the pathogenic varieties tend to do, that they shall be destroyed and, further, that any injury which they may have occasioned shall be repaired. Thus the whole story of inflammation is divided into two distinct processes which, however, closely merge: *defensive reaction* and *repair*.