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A NEW OUTLOOK IN CARDIOLOGY.

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INTRODUCTION.

THE following articles illustrate the methods which we use in an investigation at the St. Andrews Institute for Clinical Research. They bring to light certain fundamental principles which are essential to the understanding of the phenomena of disease. While here they are applied to the interpretation of cardiac phenomena, they are also applicable to the discovery and interpretation of phenomena produced by every organ of the body.

The essential matter in connexion with all cardiac affections, so far as they concern the practice of medicine, is heart failure. This is a problem which has hitherto baffled all attempts at solution. The failure to solve such a problem indicates that the methods hitherto employed are inadequate, and that some new concept must be evolved.

At the outset we sought for a method that would enable us to pursue our work in a systematic and logical manner. We recognized the necessity for understanding the laws that govern the production of the phenomena of ill health. A great mass of phenomena of this kind had already been accumulated, but it was so chaotic that it was not possible to make much use of it. To remedy this we saw that it would be necessary to render the phenomena easier of comprehension, and this could only be done by some principle of classification based upon the affinity in nature of the individual phenomenon.

To this end we employed the method of framing hypotheses. An hypothesis outruns the facts, and this constitutes its value in research in that it supplies an object at which to aim and a guide to follow. The object is to find other facts which will support the hypothesis or disprove it. If new phenomena fail to support it, then it must be modified or replaced by another. When at last the hypothesis is found to include all the available phenomena it then ceases to be an hypothesis and becomes a theory or a law.

By reasoning along these lines we came to recognize that most symptoms were produced by disturbances of normal processes, and in this way there was gradually evolved the theory of disturbed reflexes as a cause of symptoms. Having found the theory, the question of its application arose, and after a time the "principle of the reflex arc," as employed in these articles, emerged.

The application of this principle called for the analysis of the elements of which the arc is composed, and the part they play in that harmonious working of the organs which is characteristic of health. Out of this study there came the recognition that symptoms were but the evidences of increased or decreased functional activity of organs. To appreciate this required a better understanding of what was meant by stimulation and inhibition, and this led to the recognition of a law which we have called the "law of fluctuation."

The first steps in the discovery of this law arose from the analysis of stimulation of the skin, when it was found that sensations of heat and cold applied to limited parts varied from minute to minute as set forth in the articles by Professor Waterston.¹ This was followed by the recognition of the variations in the size of the capillaries of the skin that were continually taking place. This led to the recognition of similar variations in activity in other organs.

In the further analysis of the reflex arc it was found that certain symptoms of a particular kind arose when a particular element of the arc was destroyed or ceased to exercise its function. The parts below this element became more excitable, frequently acting in an aimless and ineffective manner. It became manifest that the reflex arc is controlled and regulated in some special manner, and in this way the function "control" became recognized.

We had long known that the stimulus which was adequate to produce pain and other reflex disturbances in the skin was inadequate to produce these phenomena when applied to the organs whose nerve supply was limited to the autonomic system. In the former instance, mechanical stimulation was adequate, whereas in the viscera mechanical stimuli produced no perceptible reaction. We recognized that for the production of reflexes in the viscera some vital processes were necessary. This led to a further inquiry into the activity of cells, and we recognized that while "stimulus production" was a special function of certain cells, others, and probably all active cells, when they exercise their special function, at the same time throw out impulses which are capable of stimulating other organs. In this way we came to recognize how all organs generated impulses by which they were capable of reacting one upon the other.

We have advanced so far that we recognize that there is no possibility of understanding the nature of the phenomena which constitutes ill health, unless the principles involved in these laws and theories are used in research and in the interpretation of clinical phenomena. If this be granted we are now able to realize the reason for the failure of so many enterprises in medicine. These enterprises have been undertaken under the belief that the knowledge for their successful achievement existed when, as a matter of fact, it did not exist.

That there are other laws concerned in the production of the phenomena of disease, of equal or of greater importance than those here described, there can be no doubt. There can be just as little doubt that enterprises will continue to fail until, as a preliminary, steps are taken to acquire a knowledge of such laws.

It is not contended that the problem with which these articles deal are solved, or that our interpretations are correct. The interpretations are those which the present state of our knowledge permits, and are intended to show the line along which we are seeking the solution of medical problems.

THE NEED FOR A NEW OUTLOOK IN CARDIOLOGY.

In a recent article² I pointed out a great field in medicine which had been neglected, but which was essential for the intelligent practice of medicine and for its progress. This field was the nature of ill health. When a person is ill we can rarely tell the conditions which cause him to feel ill,

or the nature of the symptoms which we may detect. Absence of this kind of knowledge, while it hampers practice in general, is particularly hampering in affections of the heart.

When it is recognized that a patient has, or when he is supposed to have, an affection of the heart, the essential question to be answered is, What bearing does the heart's condition have on the patient's future health? In other words, are the signs by which we recognize an affection of the heart indicative of heart failure, or do they foretell its oncoming?

A knowledge of heart failure is thus seen to be essential to intelligent practice. For many years certain gross signs, such as dropsy, breathlessness, and enlargement of the liver, have been recognized as due to heart failure, but these signs only occur when the failure is advanced, and the vast majority of people suffer and die of heart failure without these signs.

During the past hundred years, indeed ever since the introduction of the stethoscope, strenuous endeavours have been made to find out wherein lay the danger of heart affections. In these endeavours many people have taken part. During the war the question arose in an acute form; numerous investigators in different countries, individually and in groups, have carried out lengthy researches to find measures for estimating the efficiency of the heart. In these endeavours mechanical devices have been employed, and opportunities in training camps and special hospitals have been afforded. Tens of thousands of individuals have been examined, yet the results of all this work have thrown no light upon the problem.

If we go back to the time before the introduction of the stethoscope, it will be found that writers a hundred years ago gave as good a description of heart failure as will be found in most of the textbooks of to-day. One reason for this is that modern investigators have thought that each new instrument that has been devised would throw light upon this matter, and, though a mass of phenomena has been revealed, the problem of heart failure is still unsolved.

As one who has been engaged in the attempt to solve this problem for nearly forty years, I have obtained some insight into the reasons for this failure. My own attempts for many years were attended with little success. At last I recognized that the concepts that had governed the investigations were unsuited to the purpose, and that no progress could be made until a new outlook was obtained.

While it was not difficult to recognize the need for a new outlook, it was a matter of great difficulty to obtain it. Gradually it dawned upon me that the mere detection of new phenomena and the introduction of new devices held out little prospect of success. When the reasons for progress in other sciences were considered it was seen that until the laws that governed the production of the phenomena with which they dealt had been discovered little or no progress had been made. It was reasoned that as the manifestations produced in healthy and diseased bodies were natural phenomena, there must be laws underlying their production. This was the guiding idea with which we started our work at St. Andrews. In the search for these laws we discovered a number of principles that were essential to our investigations in general. As each of these principles emerged, additional light was thrown upon the problems of ill health.

We can now see more clearly the reasons for the lack of knowledge of the nature of ill health due to affections of the heart. These reasons can be arranged under three heads. There is, first, an absence of the knowledge of the laws which govern the production of symptoms, or of the phenomena of ill health; second, an inability to assess the value of the symptoms in their relation to the functional efficiency of the heart; and third, a misapprehension of the nature of heart failure and of the symptoms which it produces.

THE LAWS GOVERNING THE PRODUCTION OF SYMPTOMS.

Symptoms are produced in a very simple manner—by an increase or a decrease or the suspension of the functions of organs. All organs have nerves or similar structures which regulate their functions. These regulating processes have

much in common, being composed of structures which convey impulses from remote parts of the body to the organ or from one part of an organ to another part. This process is spoken of as a reflex. The great bulk of symptoms are produced by disturbance of this reflex or regulating process, and we have put forward in the pages of this journal the theory that many symptoms are produced by the disturbance of normal reflexes.^{3 4} In applying this theory in practice we find it throws a new and unexpected light upon many problems of disease. It has also revealed the absence of knowledge of a kind that is necessary for understanding and appreciating the phenomena of ill health.

The advantage of applying what we call the "principle of the reflex arc" to the study of symptoms is that it compels the analysis of the different elements of which the arc is composed. Each element is concerned in regulating the function of the organ which produces the symptom, and is liable to disturbance, so that each may thus be the source of the symptom. By the analysis of the reflex arc it is possible to detect the seat of disturbance which gives rise to symptoms and provokes ill health.

The application of this method of analysis has revealed the need for a much better understanding of the manner in which organs vary in their activity. The activity of organs is regulated by structures specially evolved for the purpose. These structures are composed of active cells, and like all organs so constituted they are subject to the laws that govern cellular activity. To understand how their activity becomes modified as a result of disease it is necessary to have a clear conception of the manner in which the cells carry on their work.

THE CELL.

All the special functions of fully developed cells are to be found in a rudimentary state in the primitive cell, and the principles that govern the activity of the primitive cell govern the activity of every cell, however highly specialized it may be. The functional capacity of a cell depends upon its ability to take in nourishment and to transform it into energy. This energy, when discharged, constitutes the special function of the cell—it may take the form of contraction, secretion, production of impulses, conduction of impulses, perception of sensation, etc.

This discharge takes place only in response to a stimulus reaching it from outside the cell itself—that is to say, no cells are automatic. When it discharges its function it discharges all the energy of which it is at the time possessed. During this discharge, and until some energy is restored, the cell cannot be stimulated, for it has nothing to discharge. As the cell accumulates energy it becomes more susceptible to stimulation, so that a gradually weaker stimulus is able to provoke a response in the shape of a discharge of energy. This is the reason for the law of "all or nothing," and for the refractory and latent periods.

The rate at which the store of energy is renewed can be influenced by different agencies—heat hastens while cold retards the rate. Nerve influences may act in the same way—the sympathetic hastening, and the vagus retarding in some instances. Chemical agents like drugs, and the toxins of disease, have a similar action.

STIMULATION AND INHIBITION.

The simple process of the capacity of the cell to recover slowly or rapidly lies at the root of both stimulation and inhibition. When we analyse these terms we find that "stimulation" is used to indicate the effect of agents that hasten the recovery of the cell, while "inhibition" is applied to the effect of agents that delay the recovery of the cell. While this is easily understood in reference to the individual cell, it becomes complicated when the cells are grouped in organs, for these simple processes can be so varied as to give rise to results difficult to interpret.

While, as we have seen, several agents act in favouring or hindering the process of cell recovery, we will limit for the present the consideration of the subject to the influence of nerves. We recognize that increased activity of the sympathetic results in the favouring of the process of recovery of certain cells, while the vagus has the opposite effect.

When both nerves are supplied to the same organ, the term "reciprocal innervation" is used. The result of this double nerve supply is that in the variation of activity in normal circumstances both nerves are concerned, so that, while the activity of one is increased, the activity of the other is diminished. In normal circumstances both nerves are continually increasing and decreasing their activity, as seen in the constant variations in the size of the pupil, and the rate of the heart, when the eye or the heart is being exercised in the normal activities of life.

When we look more closely into the matter we find that the variation in the heart rate is due to the influence of these nerves exercised only on the cells of the sino-auricular node. When a movement of the body takes place, impulses are generated which are conveyed to these nerves, with the result that the sympathetic influence dominates, and the cells of the sino-auricular node recover more rapidly after they have discharged the impulses which set up the heart beat. As they recover more rapidly, they become susceptible to stimulation earlier, and in this way they discharge their impulses after shorter periods of rest, which is recognized by the result—an increase in the pulse rate.

When, on the other hand, the body is at rest, the pulse rate falls—it may be considerably. Here those impulses which are the result of exertion do not now arise, and the sympathetic influence on the sino-auricular node diminishes while that of the vagus increases, so that the cells of the sino-auricular node recover more slowly after their discharge, and this is shown by the decreased rate of the heart.

We thus see one phase of what is meant by stimulation and inhibition. The conditions which these terms connote are simply the hastening or the delaying of the recovery of the cell after it discharges its function.

FLUCTUATION.

While cells grouped in organs are subject to the same laws, the rate at which they recover after discharging their functions may vary. This variation in recovery is most marked during those periods of quiescence to which all organs are subject. The result of this variability in recovery is that all the cells of an organ do not function at the same time, some cells being active while others are inactive. When those that are active cease to function, the others which were inactive come into action. This variation in recovery becomes organized and instrumental in regulating the activity of organs, so that at any given time of functional activity all the cells are not necessarily in action. Moreover, during periods of quiescence, to which all organs are subject, a greater proportion of the cells are inactive, and during periods of activity more take part. In this way organs are provided with a means by which they can vary their activity. This variation in activity of cells of an organ we have called "fluctuation" and the law of fluctuation is of the greatest importance in understanding the functional efficiency of an organ, and particularly in understanding the functional efficiency of the heart. This law of fluctuation has been the subject of a special inquiry by Professor Herring,⁵ and he has demonstrated the part it plays in the varying functional activity of healthy organs. We find it of equal importance for the interpretation of the symptoms of disease.

THE FUNCTION OF CONTROL.

In addition to the agents which favour or hinder the metabolism of cells and thus affect their excitability, there is another agent which exercises a potent influence upon cells when they are gathered together to form an organ. The system which is concerned in modifying the functional activity of organs has another action which is exerted upon the organ as a whole, through its effect upon the individual cells. In normal circumstances the cells are restrained in a manner so that they only act in response to impulses from the regulating system, and thus act in harmony the one with the other. In addition they are rendered impervious to other influences from outside the regulating system. To this influence the term "control" is given.

This function of control is not the property of all parts of the regulating system, but only of certain elements, and for each organ this element may be different; it is usually

nervous in origin. In some organs, as the heart, it is due to structures of a slightly different nature, as the sino-auricular node.

When this influence is lost, either from cessation of activity of the particular element of the regulating process which is concerned in this function, or when its connexion with the organ is separated, the individual cells of the organ show a remarkable difference. They continue to function, but become susceptible to outside influences and are thereby stimulated to excessive activity, but so disorderly that the whole aspect of the organ becomes altered, in the sense that its activities are aimless and disorderly. Under normal conditions the organs work so harmoniously that the processes which render this harmony possible are not recognized till they are lost. The loss of control is demonstrated to produce remarkable effects in the heart, and it is reasonable to assume that control is present in every organ. This concept of control was applied by Hughlings Jackson to brain processes, and was present in his mind when he laid down the doctrine that "destructive lesions never cause positive effects, but induce a negative condition which permits positive symptoms to appear."

It is assumed that the function of nerves is limited to their more easily demonstrated functions, such as the impulses for contraction conveyed by motor nerves or the stimulating and inhibitory function of the sympathetic and vagus. A more intimate inquiry into the symptoms of disease demonstrates that they exercise an influence of the kind to which we apply this term of control.

THE CELL IMPULSES.

It has long been recognized that the organs of the body are related to one another in that the activity of one organ affects the activity of the others. This may be brought about in different ways, as when the secretion of one organ being conveyed through the blood stream acts on other organs. One organ may affect the others through the nervous system. Although this latter method has been recognized, there is no clear conception of how it is brought about. The following explanation seems to throw a little light upon the matter.

It has already been remarked that the specific functions of highly developed cells are found in a rudimentary form in the primitive cell. Many specialized cells retain in an imperfect form other properties than that of their special function. The special function of certain cells is the formation of impulses, which, when discharged, stimulate other cells. The chief function of the cells of the sino-auricular node is to discharge impulses which stimulate the muscle cells of the auricles to contract. The cells of the cortex of the brain discharge impulses which cause contraction of the voluntary muscles.

By impulses is meant some kind of energy which is capable of exciting or stimulating cells to discharge their function. This property is not limited to cells whose specific function is the formation and discharge of impulses, but seems to be a property possessed by every cell. Such impulses are given out at the time that the other functions of the cells are discharged. The possession of this property can best be demonstrated in muscle cells. The contraction of the heart produces these impulses, and they are capable of affecting delicate electrical instruments, such as the string galvanometer, and are recorded in the electro-cardiogram. It will be shown also that these impulses play an important part in producing the peculiar phenomena found when the auricle is fibrillating, or in a state of flutter. In these conditions the impulses from the contracting muscle fibres stimulate the auriculo-ventricular node to discharge the impulses which cause contraction of the ventricle.

The recognition that muscle fibres discharge impulses capable of stimulating other cells gives a clue to the origin of many symptoms, which arise from hollow muscular organs.

There are good grounds for assuming that the impulses from the contraction of the muscles are the cause of the increased heart rate that follows bodily effort. These impulses reach the sympathetic, which reacts upon the sino-auricular node, or on the auriculo-ventricular node in auricular fibrillation or flutter (see Fig. 1).

THE PRINCIPLE OF THE REFLEX ARC.

It has already been pointed out that the varying activity of an organ is dependent upon the structures which regulate the functional activity of the cells. These structures are

FIG. 1.—Diagram of a simple reflex arc. Impulses are received by the receptor A, are conveyed by the afferent nerve B to the central nervous system C, where they are transferred to the efferent nerve D, which excites the effector organ E.

mainly nervous, and are arranged in a very definite way. They can be represented in a diagram (Fig. 1) of a simple reflex—in which there is an afferent nerve (B) whose receptor (A) at its peripheral extremity is situated in some organ or tissue. From the receptor the afferent nerve conveys impulses into the central nervous system (C), where the nerve is connected, either directly or by means of inter-neuronal neurones, with an efferent nerve (D). This efferent nerve receives the impulses and conveys them to an organ, the effector (E), which responds to the impulses by increasing or decreasing its activity.

Many of these responses pass unperceived, but at times they are either so increased or so decreased that the effector organ shows abnormal activity. This abnormal activity, when perceived, constitutes a symptom of disease. The disturbance which results in a symptom may occur in different parts of this reflex arc, and it is necessary to find out at what part of the arc the disturbance takes place. This is what we mean by analysis of the reflex arc.

FIG. 2.—Diagram to show the parts concerned in regulating the rate and rhythm of the heart. A represents the afferent nerves from the different organs which convey impulses through the spinal cord (S.C.) and medulla (Med.) by neurones which stimulate the sympathetic and vagal nerves. These nerves are distributed in the heart to the sino-auricular node (S.A.N.) and the auriculo-ventricular node (A.V.N.). Impulses are conveyed from the sino-auricular node to the auricle which causes its contraction, and from the auriculo-ventricular node by the bundle of His (B.V.B.) to the ventricle (V).

The structures concerned in regulating the rate and rhythm of the heart are represented in the diagram (Fig. 2).

There are two kinds of structure concerned in these func-

tions, an external and internal. The external consists of the afferent nerves (A) from all parts of the body (including the brain) which convey impulses to the central nervous system, where they act upon the sympathetic in the spinal cord, and upon the vagus in the medulla. These two nerves exercise a peculiar influence upon two structures within the heart itself—the sino-auricular node and the auriculo-ventricular nodes. The sympathetic acts upon the cells of these nodes by hastening the metabolic process which restores the energy expended when they discharged impulses. The vagus has an opposite effect in that it delays this metabolic process. Beyond this effect neither of these nerves has any influence upon the rate and rhythm of the heart. They are in no sense motor nerves to the heart. The afferent part of these nerves has, no doubt, other effects upon the muscle cells, while the efferent part receives impulses which it carries into the central nervous system; but these are not represented in the diagram and are not concerned directly with influencing the rate of the heart.

The internal structures concerned in regulating the rate

FIG. 3.—Tracings of the radial and jugular pulses with the normal rhythm. In the jugular tracing the waves a are due to the auricle and the waves c to the carotid.

FIG. 3A.—A diagram of Fig. 3, showing the part each element of the conducting system plays in the normal heart beat. In this diagram, as in all the other diagrams, the upper space (S.A.N.) represents the sino-auricular node. The shading represents the refractory period after the discharge of the impulse. The shading gradually fades, indicating an increasing susceptibility of the node to stimulation. The discharge of the node causes the contraction of the auricle (waves a in the jugular tracing) represented by the downstrokes in the space As. The impulse passes to the auriculo-ventricular node (space A.V.N.) which passes it on to the ventricle and causes the ventricle to contract. The contraction is represented in the space Vs (corresponding to the c waves in the jugular and the radial pulse).

of the heart and co-ordinating the different parts of the heart into harmonious action are found in what is called the conducting system. The parts which have been so far discovered are the sino-auricular node (S.A.N. Fig. 2), the auriculo-ventricular node (A.V.N.), and bundle with its branches (A.V.B.).

There is much which is still obscure about the conducting system, and in the part of this paper which follows, certain observations are recorded which throw some light upon these obscure functions. The investigation by which this light was revealed has shown a number of other matters with which this paper does not deal.

The diagram (Fig. 2) shows that the sino-auricular and auriculo-ventricular nodes are played upon by the sympathetic and vagus nerves. These two nerves are linked up with afferent nerves from all parts of the body. During their functional activity the cells in the different organs of the body throw out impulses which are adequate to stimulate the receptor ends of these afferent nerves. These impulses are conveyed to the central nervous system and stimulate the cardiac nerves. In this way the heart is played upon by the activity of every organ of the body. This can be demonstrated in a variety of ways.

The brain, for instance, in conditions of mental emotion readily discharges impulses which affect the sympathetic and vagus, and react upon the heart's rate. Contractions of the muscles of the body throw out impulses which also increase the heart's rate, and this is the cause of the increased rate during bodily effort. The movements of respiration act in the same way, probably on account of the impulses thrown out by the muscles engaged in the act of breathing. Other influences, too obscure to be recognized, also cause variation in the activity of the sino-auricular node. This is particularly well seen in the hearts of the young, where the rate of the heart may be continually varying, sometimes with movements of the respiration, and sometimes independent of them.

A diagram, on the principle of the reflex arc, can be constructed, from the records of the jugular and radial pulses, of the part played by each of the elements of the regulating system in the production of the heart beat. Fig. 3 is a tracing of the jugular and radial pulses, in which we recognize the action of the auricles and ventricles. If we represent that tracing in a diagram, as in Fig. 3A, it shows the different elements engaged in the heart beat. The upper space (S.A.N.) in this diagram represents the sino-auricular node. The downstrokes

show the discharge of an impulse which sets up a contraction of the auricle represented by the downstrokes in the space As. The impulse from the auricle stimulates the auriculo-ventricular node (space A.V.N.) which sends an impulse to the ventricle, causing a contraction which is represented in the space Vs. This contraction causes the radial pulse.

The shading in the space S.A.N. represents the degree of excitability of the cells of the sino-auricular node. After the discharge of an impulse there is a darkly shaded portion gradually becoming less dark till it disappears. This represents the refractory period after the discharge of the impulse, and its gradual decrease, or, to put it in another way, to the gradual increase of its store of energy and its susceptibility to stimulation.

The application of the principle of the arc to the interpretation of an irregular pulse is illustrated in Figs. 4 and 4A. Fig. 4 is a tracing of the jugular and radial pulses. The symptom that arrests attention is the irregular pulse.

The different parts concerned in regulating the pulse rate are plotted out and each element of the regulating process is scrutinized. From the facts revealed by records of the radial and jugular pulses a diagram is constructed (Fig. 4A). In it the ventricle (or radial pulse) (downstrokes in space Vs) is shown to be irregular. As the ventricle is dependent on the auriculo-ventricular node, we look at that space and find that it also is irregular. As the auriculo-ventricular node is stimulated by impulses from the auricle we examine and

find that also irregular. As the auricle is dependent upon the sino-auricular node, we examine that and discover that it is irregular as well, and so recognize that the pulse irregularity arises in the sino-auricular node.

This may seem an unnecessary elaboration of an easily recognized interpretation, but it is meant here simply to illustrate a principle whose

application to more complex irregularities gives us a method for recognizing the nature of obscure disturbances of rate and rhythm.

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(To be continued.)

PARATHYROID GLANDS IN RELATION TO SURGERY.

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(With Coloured Plate.)

I PROPOSE to present in this short paper such evidence as I am able which appears to me to establish the hypothesis that parathyroids are glands of which account should be taken at surgical operations. I shall not review literature, for, although it contains an immense body of work of the highest value, I gather that what is desired is personal experience.

It is a fact that tetany occurs in thyroid operations—rarely, I know. It has occurred twice in my practice, in mild but unmistakable degree, and I have personal knowledge of three other cases—one in the practice of each of three of my friends. These were far from being mild. A discussion of the symptoms does not come within the scope of this paper. As the number of my operations on the thyroid gland mounted into many hundreds without tetany happening, I doubted the importance of parathyroids, and wrote my scepticism. Then it occurred!

It is beside the mark to say that tetany occurs in other circumstances. Rare as it may be in thyroid operations, it is out of all proportion to its occurrence in other conditions.

As so many thyroid operations are performed without tetany occurring, it is necessary to ask ourselves whether we damage something unusual on these rare occasions.

Turning to dissection and comparative anatomy, we get some help. Mr. Coyte, late of the Anatomical Department of St. Bartholomew's Hospital, and I have dissected many

necks in the *post-mortem* room. In the beginning we found many bodies which macroscopically appeared to us likely to be parathyroids; but all the earlier ones without exception were proved, on microscopical examination, to be tiny lymphatic glands or pieces of thyroid gland. Every suspected piece of tissue was cut and stained by our dressers, Mr. Brocklehurst and Mr. Sturton, and examined microscopically by Mr. Keynes and myself.

At this stage I began almost to despair of finding the parathyroid glands, and was on the point of visiting anatomists in Europe who alleged that they could always be found with ease. I mention this because in discussion so many surgeons state that they have never seen the parathyroid glands at operations, and therefore they doubt their existence.

Then we found our first parathyroid.

We can now display one pair of parathyroids with precision, guided by their site, which is where the inferior thyroid artery breaks up into its branches, and by their colour, which, in the living body, is a dark terra-cotta.

Microscopically there are seen islands of large polygonal cells with eosinophilous cytoplasm: these are characteristic, being unlike anything seen in the thyroid. Professor Welch¹ has described these bodies very precisely, and Professor Schafer notes them in his well known book on histology, but I find that they are very infrequently shown to