Symptoms and their interpretation / by James Mackenzie.

SYMPTOMS
AND THEIR
INTERPRETATION

Herbert T. Young.
Aug 7th 1912.

SYMPTOMS

AND THEIR INTERPRETATION

TO THE

MEMORY OF MY TEACHER

PROFESSOR W. R. SANDERS.

SYMPTOMS

AND

THEIR INTERPRETATION.

BY

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PREFACE

TO THE SECOND EDITION.

THE exhaustion of the first edition of this work and its translation into other languages has shown an appreciation which I did not anticipate. It has been gratifying to find so much interest evoked by the method of examination described in this book. Numerous members of the profession have testified to me the real help they have obtained in examining patients on the lines here laid down.

Several writers have criticised the view of visceral pain set forth in this book, but it is evident that some of them have not grasped my meaning, nor sought in individual instances for the phenomena which are necessary for the determination of the question. Some physiologists have imagined that they have demonstrated the sensitivity of the viscera, when evident distress has been caused in an animal

by injury to a viscus. In making such a claim, they only prove that with an adequate stimulus suffering may be caused, but, of necessity, they cannot from an animal acquire the knowledge of the phenomena which determine the mechanism by which the animal became conscious of its suffering, for such phenomena, as the spread of pain and hyperalgesia, are incapable of recognition in the dumb animal.

Other adverse critics who have studied the subject clinically have practically ignored the essential phenomena associated with visceral pain. In many cases it is not possible to prove or disprove this view in the absence of these confirmatory evidences, but by the careful and continuous observation of cases with visceral pain, unquestionable evidence will be forthcoming.

In preparing this edition, I gratefully acknowledge the help and criticism given me by Professor David Waterston.

133, Harley Street,
London,
1912.

PREFACE.

IN the following pages I draw attention to the valuable aid to diagnosis afforded by the careful study of pain, and the nervous phenomena which accompany it. The recognition of these nervous phenomena provides the means for ascertaining how many of the symptoms of disease are produced. Although much has been done to elicit the more obscure symptoms that arise from disordered functions of diseased viscera, comparatively little attention has been paid to the more obvious symptoms. While I am far from decrying the importance of the advances that have been made in what may be called the laboratory methods of clinical diagnosis, yet the practical value of these methods to the general practitioner is very small compared to the information to be gained by the recognition of the symptoms arising from reflex stimulation of the nervous system. It is only in a small proportion of the cases which the general practitioner sees that the more intricate methods of examination are of use, or are available, while in the great majority of cases the reflex symptoms lie ready to his hand, and it is on these alone he has offen to rely for diagnosis and treatment. It must be borne in mind that the general practitioner sees a vast number of cases which are never met with in hospital wards. Text-books are too often written from

the standpoint of an experience gained in the hospital or consulting room; their authors necessarily see the more advanced cases, and do not realise sufficiently the class of patient which the general practitioner has daily to treat. The early stages of disease are, therefore, not fully appreciated, and can never be fully appreciated till the general practitioner takes his position as an investigator. I hope to show in the following pages that there is not only a wide field open to him for exploration that can be accomplished by simple practical methods, but that the results that await his investigation are equal in importance to those acquired by the more recondite methods used in well-equipped hospital wards or laboratories. No one has such opportunities for the observance of the early symptoms in disease, and no one can so readily follow the changes that occur in the advance of disease. The nature of the early symptoms and the prognosis of disease are amongst the least understood matters in medicine.

The views put forth here are the outcome of an inquiry that has extended over twenty years. I have endeavoured to utilise the opportunities of a general practitioner to study the earliest symptoms of disease and the bearing of the disease upon the patient's future life in times of suffering and of stress, as when affected by other illnesses, by pregnancy, or by hard bodily labour. A great deal of preparatory work had to be done to find out what symptoms were serviceable, and to understand the meaning and mechanism of these symptoms. In this work symptoms that had been overlooked or ignored have received special attention, and the

study of some of them has given a clearer conception of the nature of many phenomena.

In dealing with the reflex phenomena of disease, as a basis on which to found a rational principle of diagnosis, I have limited myself chiefly to explaining the nature of these reflex phenomena, passing over more cursorily the symptoms that arise from changes in function or in the structure of organs as revealed by physical signs, since these are dealt with more or less fully in every book on diagnosis. I mention this lest it might be inferred from the scant reference to these symptoms that I held them of small importance.

After setting forth the principles on which diagnosis should be based, I give illustrative examples in the application of this doctrine to diseases of certain viscera. The description of the symptoms present in the affection of any organ does not profess to be complete—it would have led me too far afield to have attempted a complete description—and an outline only is given of the manner in which the symptoms arise, and the nature of these symptoms. I have been able to work out the symptoms to detail in only a few organs, as the heart and stomach, and even all the symptoms in these are not fully comprehended. The symptoms in heart affections afford good opportunities for detecting the real nature of the reflex phenomena, on account of the peculiar field in which the symptoms appear, and the ease with which the heart's action can be studied. As the production of the reflex phenomena are fundamentally the same in all viscera, I have frequently used the symptoms in heart affections to illustrate the principles underlying the symptoms in disease of other organs.

It is hoped that not only the general practitioner, but also the surgeon and physician, will find the methods here described of use. Our present diagnostic powers, in regard to abdominal affections for instance, stand sadly in need of strengthening. It is a matter of common experience to find skilled surgeons, who are daily operating on abdominal organs, giving widely divergent opinions as to the nature of the complaint in some single individual. In a measure the ease and supposed safety with which an abdominal exploration can be performed has thrown back the need of a careful and painstaking examination into the nature of the symptoms, so that much confusion exists in regard to the nature and origin of many easily recognised phenomena. This confusion is, in a great measure, due to the fact that the reflex phenomena of visceral disease have not been sufficiently appreciated. The description given in this book is not a solution, but an attempt to bring forward the means of arriving at a solution.

It may be said that I have not sufficiently recognised the work done by other observers in this field. While I have in the main followed my own line of observation, I acknowledge the many valuable suggestions I have obtained from the writings of Hilton, Ross, Head, Maylard, Moynihan, Keay, Lennander, Ramström, and others. I have also to express my indebtedness for advice and help from my friends Sir Clifford Allbutt, Professor Cushny, Dr. Purves Stewart, and Dr. John Muir.

J. M.

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1. Medicine a Science.—Medicine has not attained that position in science which ought of right to belong to her. Instead of leading in scientific development, and giving guides and indications to allied branches, she is too often content languidly to follow in their wake, or to pursue some erratic course of her own. The observations made in her name are frequently made more to support some vague speculation or far-fetched theory than to realise the actual condition of the observed phenomena. The sister sciences in place of seeking for assistance from medicine look askance at the wild speculations put forth in the name of medical science, and at the loose thinking and play of the imagination which many medical writers deem legitimate in dealing with the phenomena of disease. To emancipate medicine from this position of inferiority, and to secure for it that

status which it ought to possess, an effort must be made, as far as possible, to free it from the habiliments that have hampered it in the past, and if this appears an unattainable goal at present, its votaries may at least aim at greater precision in thought and in observation. Although this doctrine may seem the commonest of platitudes, and teachers and writers of text-books are unwearied in inculcating it, nevertheless precision in thinking and in observation are among the rarest qualities.

2. Accuracy of Observation.—The power of accurate observation and precise thinking is so seldom acquired because methods have become stereotyped, that many observers do not realise that they are fettered in the bonds of tradition. Even in the writings of those who claim to be exponents of exact observation and logical reasoning, loose methods of thinking and observing too often appear, even when the scientist imagines himself supreme, for traditional teaching influences their minds and gives a bias to their deductions. What are called observations are often but a mixture of imperfect observation and unwarranted assumption. While a fact is supposed to be recorded, an opinion is at the same time expressed. As an illustration let us observe how the symptoms of a patient with an enlarged liver are often investigated. The position of the liver having been ascertained, pressure over it is found to elicit pain. The surgeon or physician proceeds to record the "fact" that the "liver is painful on pressure," and such a description is universally accepted as truthful. Yet, if the matter be carefully analysed, the statement will appear not to be a fact at all. Had the statement been that the

patient felt pain when pressure was made over the liver, then a plain fact might have been recorded, if the patient's testimony was reliable. But to say that the "liver was painful" is to make an assertion that may or may not be true, but which is not warranted by the evidence, seeing that pressure was being exerted on the sensitive structures of the external body wall, and no attempt was made to eliminate the possibility of the painful sensation being produced by their stimulation. This tendency to embody warranted or unwarranted assertions in the record of a fact is a fault common among medical investigators, and impedes the progress of medicine. An inquirer should keep his mind free from bias and ready to review his most cherished beliefs. What is to-day accepted as axiomatic, may be shown to-morrow to be but a part of the truth. The tendency to be led by tradition is very powerful, and it is difficult to free the mind from beliefs that have been inculcated with the acquiring of knowledge. In consequence of this many observations are fundamentally untrue, and only covered by a veneer of science. I shall have occasion to enter into some detail concerning the relation of pain to the viscera, and this inquiry will reveal that the conception universally prevalent with regard to the symptom is based on tradition and imperfect observation. So much has been taken for granted that the very first step in the examination is often a wrong one. "What do you complain of?" asks the physician. "Pain in my stomach," replies the patient, and the physician too often accepts the statement and records that the patient's pain is in the stomach. The patient having some notion of the situation of the stomach, and finding the pain is in

this neighbourhood, assumes the stomach to be the seat of the pain, and thus, at the very beginning, an erroneous notion is obtained which may pervert the further steps of the examination. The unproved assumption that the mechanism by which visceral pain is produced is similar to that producing pain in the external body wall has led astray physiologists as well as clinical observers. It is assumed that stimuli which produce pain when applied to the external body wall, will likewise produce pain when applied to the viscera. It is recognised that certain nerves running from the skin to the central nervous system convey sensation, and are therefore called "sensory." From this it has been assumed that nerves proceeding from the viscera to the spinal cord have the same function. They are, therefore, also called "sensory," whereas, as a matter of fact, there is not a single observation or experiment justifying such an assumption. Though this is the interpretation usually attached to the term "sensory" physiologists do not now consider that a "sensory" nerve necessarily evokes sensation when stimulated, but use the term to imply an "afferent" nerve whatever its function may be.

When making an observation upon any symptom care should be taken to record nothing beyond what, strictly speaking, the facts warrant. If our knowledge tells us that an organ is situated in the neighbourhood of the area in which a pain is felt, we should not assert the connection between the pain and the organ until we have sufficient evidence of the nature of such connection. The search for such relations will reveal things unsuspected. I may here cite an experience which occurred to me many years

ago. A colleague was demonstrating to me the symptoms in a case of gastric ulcer. The pain was located in a small area in the epigastrium, which, the patient said, could be covered with the point of a finger. My friend, commenting on this exact reference to a limited area, asserted that the pain was felt in the ulcer, and were he to push a long pin through this painful site it would inevitably penetrate the ulcer. I demurred to this, remarking that the evidence did not warrant such a conclusion, that though the pain might be due to the ulcer, the assumption that the pain was felt in the ulcer, and that it could be so definitely localised, was not justified. To demonstrate this I asked the patient to expire deeply, then to draw a deep inspiration. By this procedure the stomach and its ulcer executed an excursion of a considerable extent. But, though the stomach and ulcer moved, the site of the pain remained stationary. From this observation it could be concluded that the relation between the ulcer and the pain was not of the kind usually assumed. The inquiry into the nature of their relations has revealed some very instructive features, which will be dealt with in speaking of the mechanism of pain and the symptoms evoked by gastric ulcer. The necessity for this warning is illustrated by the remarks of observers who have lately been testing the sensibility of the alimentary canal. Where they have succeeded in provoking a sensation by stimulating some portion of the digestive tract, they have neglected some essential features, such as the exact situation of the region in which the sensation was felt, or the manner in which it has spread, and have hastily assumed that the part stimulated possesses the sensation which has been

evoked. How this assumption misleads will be shown when I deal with the mechanism by which sensations are produced.

3. Method of Observation.—If the nature of any symptom is not apparent, all the attendant circumstances and accompanying phenomena should be the more carefully considered. The nature of many a striking phenomenon may remain inexplicable until its association with some remote, or trivial, or transient, but better understood symptom reveals its true nature. This method is in frequent use, as for instance when a severe headache or retinal hæmorrhage directs our attention to the state of the kidneys or a pain at the knee leads us to inquire into the condition of the hip joint. The recognition of the relations of symptoms so widely separated has been acquired by the observation of a sufficiently large number of instances of this continual association. The occurrence of one symptom of a group now leads to the inquiry for the other symptoms that may be associated with it, and from the experience thus acquired a better view is obtained of the diagnostic significance of particular symptoms. When I come to deal with the reflex symptoms of visceral disease it will be shown that, in many cases, phenomena appearing at a distance from the causative lesion give the best clue to the seat of the disease; while the inquiry into the nature of the symptoms throws a flood of light upon the physiological relation of different organs.

4. The Value of a Hypothesis.—An inquirer into the symptoms of disease will in course of time accumulate a large number of more or less isolated facts. Though these may be provisionally employed

in the diagnosis of disease, the observer may have no clear idea of their significance, nor of the process by which they are produced. Accordingly, we often find the symptoms of some given disease presented in the form of more or less detached pieces of evidence. The value of such indicative symptoms will be greatly enhanced if in all cases an attempt be made to detect the mechanism of their production, and to correlate them with the diseased process and with one another. To this end it is necessary to construct a provisional hypothesis.

Symptoms, in respect of concepts, are like the materials used in the construction of an edifice. We may know that detached they can be used to build a house, but their relative values and uses are realised only as we find we can work them into the edifice. It is when the symptoms are logically included in a hypothesis that we clearly ascertain their origin and relative values. But the construction of a hypothesis serves a useful purpose in many ways beyond giving an approximate conception of the disease. It stimulates the search for proofs, and gives a line to follow in the search. The progress of clinical medicine is comparatively slow, in great measure because no attempt is made to give a clear conception of the mechanism of disease. This has largely come about because the observer does not trouble himself to reason out the relations of the symptoms to one another, and to the morbid process as a whole, relations which can alone be ascertained by forming a hypothesis in regard to their association. In the attempt to substantiate the hypothesis definite lines for investigation will arise. The value of a working hypothesis is that it affords a guide and a line of

observation. Defective, or false, or useless, as eventually it may prove to be, yet, even as a step, it is of advantage in directing our attention to the relation of symptoms, and the need for a better interpretation of them. The facts that belie a hypothesis have been appropriately used in building a better one. The atomic theory is now found insufficient to explain the newer revelations of science, but its adoption has proved of immense service in giving a definite line for the prosecution of investigations and in the discovery of those new facts that have led to its modification. In matters more closely concerning the subject in hand we have plenty of illustrations. When Ross drew attention to the nature of sensory disorders in visceral disease he propounded the hypothesis that visceral pain was of two kinds, one he called splanchnic, because he assumed that it was referred by the brain to the site of the lesion in the organ, the other he called somatic, because it was referred to definite areas in the external body wall. This hypothesis is the one held to-day by practically all those who have given attention to the matter; and it has been of no little use in diagnosis. In my own work it influenced me very considerably. At the time Ross propounded this opinion I was inquiring into the sensory phenomena of visceral disease, but was like a ship at sea without compass, I had no definite guide to follow. Then, with this hypothesis before me, I proceeded to inquire into the facts concerning a "splanchnic" pain. The question of the sensitiveness of the viscera arose, of the function of the nerves supplying them, and of the relation of the site of the pain to the lesion. This inquiry brought to light

many other important symptoms, which either had not been recognised, or whose significance had not been appreciated, such as the accompanying hyperalgesia of the tissues of the external body wall, and the contractions of muscles, all having a definite relationship to the viscera affected by means of their nervous connection. These results, though demonstrating that Ross' hypothesis was no longer tenable, were brought to light by means of his hypothesis. Thus, by suggesting a line of inquiry a hypothesis may bring many obscure symptoms to light. In investigating the manner in which sensation is produced by the viscera, I found that to a great extent they were not susceptible to stimuli in the same manner as is the skin. Thus, under certain circumstances, the ingestion of cold water into the stomach is followed by a sensation of cold felt in the abdomen, descending as low as the umbilicus. We usually explain this by saying that the stomach is sensitive to a cold stimulus. Recognising that it was strange that cold should be a sensation of which the stomach was capable, I made a series of observations that showed the cold sensation was in all probability due to a contraction of the cutaneous blood vessels, and was associated with the goose-skin eruption. Further, the evidence pointed to the fact that the so-called goose-skin sensation was coincident with a constriction of the cutaneous blood vessels, and this constriction might possibly be the cause of this sensation. I do not quote this observation as if it settled the question of the sensibility of the stomach to cold, but rather to show the complexity of results from a single experiment. Hertz, in his Goulstonian Lectures on the sensibility of the alimentary canal, contests this

observation, and reckons to disprove it, but while I am far from believing that my explanation is beyond question,I do not accept Hertz's contradiction,for the reason that he has not considered the peculiar nature of the "cold" sensation, and has ignored the very instructive manner in which the sensation spreads.

Whether this explanation be the correct one or not, the attempt to prove the hypothesis led to the discovery of other facts hitherto unsuspected, which, trivial as they may appear, point nevertheless to some fundamental relation between the viscera and the external body wall whose significance cannot yet be fully understood.

A hypothesis based on clinical evidence may serve as a guide to physiological inquiry. The hard contracted muscles present in certain abdominal affections have never received the attention they merit. This contraction, as will be shown later, is of a peculiar kind, and may occur over a small portion of the muscle. I had called this contraction the "viscero-motor reflex" on the hypothesis that the nerve supply to certain portions of the muscles bore a definite relation to the nerve supply of certain viscera, so that the stimulation from a viscus would produce contraction of a definite portion of the abdominal musculature. To test this hypothesis Professor Sherrington cut and stimulated the central ends of certain nerves passing to the viscera, and, in response to such stimulation, found the abdominal muscles contract in a definite manner. The importance of this observation will be appreciated later when we deal with the viscero-motor reflex. This was, moreover, the first physiological demonstration of the function of afferent sympathetic nerves.

The hypothesis formed by clinical observation may anticipate the result of physiological experiment. In 1891, as the result of the study of certain common irregularities of the heart, I formed the hypothesis that the ventricle contracted at times before, and independently of, the auricular contraction. Subsequently this was demonstrated experimentally by Engelmann in the frog's heart, and later by Cushny in the mammalian heart. A hypothesis drawn from clinical experience, though ultimately proved wrong, may stimulate a search which may lead to very important results. Thus in the research just alluded to I found a large and important group of patients in whom all evidences of the auricular systole had disappeared, and I speculated for years as to the cause of this disappearance, and built up one hypothesis after another to explain it. When I found for instance at the post-mortem examination that the auricle in these cases was greatly distended and thin-walled, I put forth the view that the auricle was paralysed. Further investigations to prove this showed that the auricles in some cases were hypertrophied, and I was forced to change my view, for it was evident that if the auricles were hypertrophied, they must have contracted. The cause of the disappearance of the auricular activity was the object of research by several investigators, and Lewis finally showed it to be due to fibrillation of the auricle, a condition in which the individual fibres of the auricular wall no longer contract together at regular intervals, but are in incessant movement, so that the auricle stands still. The recognition of this clinical condition and its cause is one of the most important discoveries in the clinical pathology of the heart.

5. The Parsimony of Hypotheses.—In seeking in any given case for the causation of a group of symptoms, however far apart they may be in situation, and however diverse in character, it is far more probable that the nexus will be found, not in a diversity of causes producing the symptoms severally, but in some condition capable of producing the group. The application of this method, called by logicians "the law of the parsimony of hypotheses," should be rigidly applied in all cases; and, although it may not always be successful, the search for a connection between the several phenomena will reveal many facts previously overlooked or neglected, and give a guide to further evidence. A good illustration of the application of this law is seen in the examination of cases with a focal lesion in the brain or spinal cord. Certain lesions of small extent may produce symptoms widely separated, such as paralysis in one part of the body, and sensory disturbances in another, while disturbed functions may be detected in certain viscera. When the nerve supply of these different parts is considered, it will be found that at some point the different tracts lie close together, so that it becomes fairly certain the lesion will be found at this place. The value of this method will be appreciated in dealing with visceral disease, where it is shown that a diseased viscus, besides affording evidences of impaired function and change in form, may also produce a focal irritation of the spinal cord, resembling in many respects a focal lesion, and inducing widespread symptoms of great diversity. The application of this law becomes a matter of considerable difficulty when the more prominent symptoms are due immediately to one or more organs,

while the remoter causes lie hidden in the depraved function of some other less obvious part. Thus, headache and convulsions may be the symptoms to arrest attention, but diseased kidneys may be the cause of offence. Though, in this instance, it is not possible for us to trace directly the connection between the symptoms and the organ primarily at fault, nevertheless, by the frequent association of these phenomena with kidney disease we have discovered at least the nexus. In the same way hypertrophy of the heart, high blood pressure, arterial degeneration, have been found so frequently associated with kidney disease that the primary cause of these affections may be attributable to the reaction of the depraved kidney function, or, again, to some remoter cause lying behind them all. Thus it will be seen that in many instances while the direct relationship of the remoter cause to the symptoms may not be capable of demonstration, the frequent association of symptoms in certain parts with a pre-existing primary lesion in some other part, affords sufficient ground for the hypothesis that this pre-existing lesion is an antecedent of the distant consequences.

6. Nomenclature.—In the employment of medical terms there is no system or method. In dealing with the nomenclature of disease, names are devised anyhow. In certain instances, as peritonitis, endocarditis, gall-stones disease, disease of the mitral valves, the seat of the disease is indicated. In other instances a particular symptom or a group of symptoms is used, such as tachycardia, exophthalmic goitre, angina pectoris; while in other instances again a name derived from an observer who described

the symptoms, such as Bright's disease, Cheyne-Stokes respiration, Brown-Séquard's paralysis. While such names as these do, perhaps, convey a more or less definite idea of a particular disease, other names are used which may, indeed, designate some fairly definite lesion, but more often cover large numbers of cases supposed to be akin, but of whose nature we are ignorant, such as neurasthenia, rheumatism, neuralgia, gout. On the face of it the ambiguity of these terms is unsatisfactory, but it is difficult to see how it can be altered; partly because some names by long usage have become fixed; partly because provisional names must be adopted for groups of symptoms of whose nature we are meanwhile imperfectly informed. Even when precision is supposed to be attained, and a name given to the lesion, as endocarditis, peritonitis, neuritis, it may yet happen that the symptoms are not really the outcome of the lesion whose name is employed. Such symptoms as dilatation of the heart, rapid or irregular action, so often attributed to an endocarditis, are not evidences of an endocarditis, but of a myocardial affection. In the same way lesions of the myocardium are often ignored if there is a murmur produced at some orifice of the heart. Almost invariably the diagnosis is then based on the noise the heart happens to make, so that we find cases recorded as "mitral disease" when in reality the accompanying heart failure is due to other conditions. A painful and hard abdominal wall is often taken as evidence of a peritonitis, when no peritonitis exists; or, again, a persistent pain along the supposed course of a nerve with tenderness on pressure, often attributed to neuritis, is not infrequently not

due to neuritis, but is the reflex phenomenon arising from some diseased viscus.

The employment of symptomatic names for diseases may find justification in some instances, but may cause confusion in those larval cases which do not happen to present the characteristic symptoms, as, for instance, in the early stage of exophthalmic goitre. But, if justifiable in a few cases, the employment of a symptomatic name, unless very vague, as epilepsy, is very misleading. Although a name ought to be restricted to the one particular ailment, it is too often used loosely to cover the outcome of several widely distinct causes, as gastralgia, tachycardia, embryocardia, neuralgia, albuminuria The results of these incoherent methods of nomenclature are detrimental in several ways. Diseases of very diverse nature are included under one name. On account of the frailty of the human mind, a certain satisfaction is given when a name of some sonorousness is applied to a malady. Mental effort is hard work, and painstaking inquiry into the nature of symptoms may be shirked by the use of some fine name that seems to embrace the case under consideration. Hence it is that the symptoms present in affections like angina pectoris are not generally analysed, while an all-embracing name like neurasthenia, being turned from a specific to any convenient meaning, serves for the designation of many heterogeneous and undefined cases.

There seems to be no logical way of revising our names until the science of diagnosis is farther developed, so that we must fain be content with such names as are at hand. We should, however, recognise and duly appreciate our limits in respect of this

imperfect and disorderly nomenclature, and continually endeavour to explain the meaning we attach to doubtful names so as to make the use of names as precise as possible, in order that like diseases may be brought together from those unlike, and our classification be based no longer on superficial and accidental resemblances but on deep affinities.

Chapter II.

CLASSIFICATION OF THE SYMPTOMS OF DISEASE.

7. *Reflex Symptoms.*
8. *Purpose of Reflex Symptoms.*
9. *Functional Symptoms.*
10. *Structural Symptoms revealed by Physical Signs.*
11. *The Relative Importance of Symptoms.*

Disease is manifested by the presence of symptoms, and these can be classified, according to the mechanism of their production, into three groups :—

Reflex Symptoms.
Functional Symptoms.
Structural Symptoms as revealed by physical signs.

7. Reflex Symptoms.—In the development of the body, organs are adapted for special purposes, some for the nourishment and maintenance of the economy, others for its protection. The functions of separate organs are peculiar to them, and one organ cannot take on the function of another. It is necessary to keep this distinction in mind in order to appreciate the meaning and mechanism of symptoms. What is called health is the harmonious action of all the organs. Ill health, or disease, is the discordant action of one or more organs. There is a certain sense of "well-being" present in every

healthy individual. Until the health is impaired one is barely conscious of having possessed it, and its impairment is the first sign conveyed to the individual that all is not well with him. This first sign is some disagreeable sensation arising from no apparent cause, or brought on by some event that hitherto had caused no discomfort. The disagreeable sensation may vary from pain of a severe type to a slight impairment of the sense of well-being. It may vary also in character, as pain in its various forms and degrees, breathlessness, vomiting, exhaustion, mental depression and muscular contraction. It will be seen that the production of these symptoms is due to the implication of the nervous system, and although the possession of consciousness is necessary for the perception of subjective sensations, yet the occurrence of these phenomena implies the participation of the nervous system in a particular manner. The sensation of pain implies the consciousness to perceive pain as well as the involvement of the special nervous mechanism by which it is produced. This involvement of the nervous system in the production of symptoms requires special consideration if we desire to understand the true significance and diagnostic importance of symptoms. It is comparatively rarely that the changes in the function of an organ, or in its size, shape and position, lead to the detection of disease in the first instance, whereas the presence of symptoms due to involvement of the nervous system are the earliest evidences and are nearly always present. As a matter of fact the layman knows so little of his anatomy that even a serious anatomical change would often not suggest a consultation with a physician, unless it was

accompanied by nerve symptoms. While the functional disturbance of an organ may interfere with the nutrition of the nervous system and produce nervous symptoms directly, in the vast majority of cases the symptoms are produced by reflex stimulation. Organs that are not themselves sensitive to painful stimuli have provided in them a mechanism by which they can call into play the parts of the economy that subserve the function of pain, and, therefore, of protection. Thus the bowels themselves are insensitive to pain, but they can cause pain by stimulating the nerves that are distributed to sensitive structures. This is brought about by the reflex stimulation in the central nervous system of nerves supplying other tissues. Other reflexes, as muscular contraction and vomiting, have also a protective purpose.

8. Purpose of Reflex Symptoms.—To gain a clear idea of the mechanism of these reflexes, their purpose and meaning should be understood. To do this I put forward the following hypothesis, which seems to account adequately for their manner of origin, and has much to recommend it from a developmental standpoint. In the early development of animal life a digestive cavity is first evolved, then, later, a rudimentary circulatory system appears. To this is added a rudimentary respiratory system. To co-ordinate these different systems a nervous communication is developed. The various organs are protected first by an insensitive, and it may be a somewhat unyielding outer covering. As development proceeds this outer covering becomes modified in such a manner as to provide for both protection and movement, hence arises the sensori-muscular

system. Protection is secured in a twofold manner, first, by rendering the outer covering sensitive and uniting it with muscles by means of a reflex nervous system. Painful stimuli excite consciousness and the muscles are stimulated to contract, so that the organism is removed from the offending neighbourhood, or there is interposed between the viscera and the offending agent a hard resistant muscle. Second, by uniting the nerves from the viscera with sensory and motor nerves of the cerebro-spinal system, so that the muscles of the external body wall react to a stimulus from the viscera. From this point of view the primitive nervous system corresponds with the sympathetic, while the more recently developed sensori-motor corresponds with the cerebro-spinal nervous system. This finds support in view of the fact that pain is elicited only by stimulation of structures supplied by the cerebro-spinal nervous system, while such stimuli as produce pain and other sensations in the skin and structures of the external body wall are inadequate to produce these sensations when applied to tissues supplied by the sympathetic nerves (*see* page 28). When pain does arise from the viscera it does so by calling into play the cerebro-spinal system of sensory nerves, and the pain is then referred to regions supplied by the cerebro-spinal system of nerves.

From this point of view it will be found that the most striking symptoms in disease are produced by reflexes, sensory, motor and organic.

9. Functional Symptoms.—The economy is so arranged that the function of each organ is necessary to the due action of the whole. When, therefore, an organ is not acting efficiently the work of

all is impaired. As disease modifies the functions of individual organs these modifications become signs or symptoms of disease, hence it is necessary to understand the function of each organ, and the manner in which derangement of function affects the economy as a whole, or its individual parts. It happens not infrequently that the symptoms which direct attention to disease are caused not directly by the organ at fault, but by the effects of its impaired function on parts remote from the offending organ. From this it will be seen that a series of phenomena may arise from disordered functions of an organ. hence the class of "functional symptoms."

10. Structural Symptoms revealed by Physical Signs.—All the separate organs of the body have a size and situation which experience tells us are normal, and any departure therefrom is presumed to be an evidence of disease, hence a class of symptoms may arise due to alteration in the size, shape, consistency, or position of an organ.

11. The Relative Importance of Symptoms.—The involvement of the nervous system in the production of symptoms requires special consideration if we would seek to understand the true significance and diagnostic importance of signs or symptoms. Although I have divided symptoms into reflex, functional and structural, the last two play a very secondary part in the symptomatology of disease. It is only in comparatively few organs that the symptoms arising from changes in the structure of the organ itself are available. Nor are the functional signs or symptoms of very frequent use. Even when we detect the presence of abnormal functions, it is but rarely that this evidence of derangement is

the actual cause of the symptoms. In kidney disease it is not the presence of albumen, or the escape of albumen into the urine that is really the serious fault of the function. Albuminuria is merely an abnormal condition which is often associated with functional changes of such obscurity that we know little about them, but of such potency that we are justified in attributing widespread effects to their presence. In functional derangement of the stomach, though we may detect certain abnormalities in the secretion as an increase in the hydrochloric acid, it is not the acid itself that is the chief symptom, but the pain associated with its presence. It is very doubtful if the secretion of an excess of hydrochloric acid is the real functional derangement, for it may be, like the albumen, only one result of a complicated process.

From this standpoint the most important class of symptoms arise from the involvement of the nervous system, where a stimulus arising in some viscus passes to the central nervous system, and there acts on the nerves supplying other organs, exciting the function peculiar to them. Thus it is that we find pain, muscular contraction and vomiting excited by an organ remote from these evidences of nervous stimulation. These reactions are not the outcome of accidental purposeless stimulation, but are reflexes arising in a very definite manner and with a definite purpose. It is necessary to recognise the purpose of these reflexes as their intelligent appreciation leads to the recognition of their cause, whereas to look upon them merely as purposeless evils, and as an indication for something to relieve suffering and discomfort, tends to

hamper an opportunity of diagnosis and rational treatment.

The predominance of the reflex symptoms has never been properly realised, with the result that in the description of physical signs of disease little attention has been paid to these manifestations, and no clear conception has been made of the nature of the symptoms. The small part played by functional and structural signs or symptoms compared with those of a reflex origin will be appreciated if, as an instance, the phenomena of gastric affections be considered. Long before any change can be detected in the function or structure of the organ, the reflex symptoms have been in evidence. It is these symptoms that really call attention to the fact that the stomach is diseased, and the patient may go on for years and ultimately die of the stomach complaint, and none but the reflex symptoms have been capable of recognition. To a great extent it is towards the relief of the reflex symptoms that every endeavour at treatment is directed.

In rare cases a physical sign of grave significance may be detected in the absence of distinctive reflex symptoms.

Chapter III.

PAIN.

12. *Definition of Pain.*
13. *Constitution of the Nervous System.*
14. *The Sensitiveness of Tissues to Painful Stimuli.*
15. *Mechanism by which Pain is produced.*
16. *Radiation of Pain.*
17. *Effects of Chloroform on Pain.*

12. Definition of Pain.—The due recognition of the factors concerned in the production of pain is of the first importance in the study of disease. Not only is Pain the most important of complaints, but it is the most instructive diagnostic sign, for the study of its mechanism gives often the key to the best means for attaining relief. The term "pain" used here is easy to understand though difficult to define. It is beside my purpose to enter into abstruse metaphysical considerations regarding the consciousness of pain and its mental affinities. Nor do I include other disagreeable sensations, which are sometimes spoken of as of pain, as when a brilliant light or a piercing noise unpleasantly affects the sense of sight or hearing. The term is limited to that very definite form of disagreeable sensation which everyone has experienced, and we all recognise. The meaning attached to the term pain in the book may be summarised shortly as follows :—

Pain is a disagreeable sensation due to stimulation of some portion of the cerebro-spinal nervous system and referred to the peripheral distribution of cerebro-spinal sensory nerves in the external body wall.

13. Constitution of the Nervous System.—The nervous system consists of two great divisions, which are distinctly separated in their functions,viz., the cerebro-spinal and the sympathetic or autonomic. The former of these divisions consists of the brain and spinal cord, and the peripheral nerves which are distributed to the external body wall and subserve the functions of sensation and muscular contraction. Incorporated within the cerebro-spinal system is the other division, the sympathetic or autonomic nervous system, which includes the origin of such nerves as the vagus and the sympathetic. The position and distribution of the efferent fibres of the autonomic system is shown in Langley's diagram (Fig. 1, page 27). It will be seen that this system presides over the functions peculiar to the different organs. While much experimental work has been done to establish the distribution and functions of the nerves that pass from the centres to the periphery (efferent nerves) little has been done to examine the nerves that pass from the viscera to the central nervous system (afferent nerves). The reason for this is that the nerves passing from the organs to the nerve centres afford little direct evidence of their function, and it has not yet been understood in what way these afferent nerves react. In the scheme put forth here for the production of visceral pain it is suggested that under certain circumstances these afferent nerves of the autonomic system act by stimulating the cerebro-spinal nerves, and

stimulate them, so that certain phenomena as pain, hyperalgesia, and muscular contraction in the external body wall are the evidences of stimulation by the afferent autonomic nerves.

It is a justifiable inference from clinical evidence that the centres of these sympathetic and cerebro-spinal nerves are in close association. From this association it has been possible to show that the afferent autonomic nerves have a close resemblance in their distribution to the efferent fibres represented in Fig. 1.

14. The Sensitiveness of Tissues to Painful Stimuli.—To appreciate the distinction between these two divisions of the nervous system, and to understand the mechanism by which pain arises in areas supplied by the cerebro-spinal nerves, and by the autonomic system (visceral pain) it will be advisable to consider the sensibility of the tissues of the human body.

A great difference will be found in the susceptibility of different structures. The sensibility to pain varies widely in different parts of the cutaneous surface. The deeper tissues of the external body wall are also sensitive to pain, and generally in a less degree than that of the skin, but the relative sensitiveness of parts is not well understood. When we consider the viscera we meet a totally different state of affairs, for in them the tissues are insensitive to stimuli that produce pain in the external body wall. To bring this clearly forward, let the reaction of the tissues to some definite form of stimulation, as pinching or pricking with a pin, be considered. There will be found, on a systematic examination, tissues where there is a sense of pain evoked by

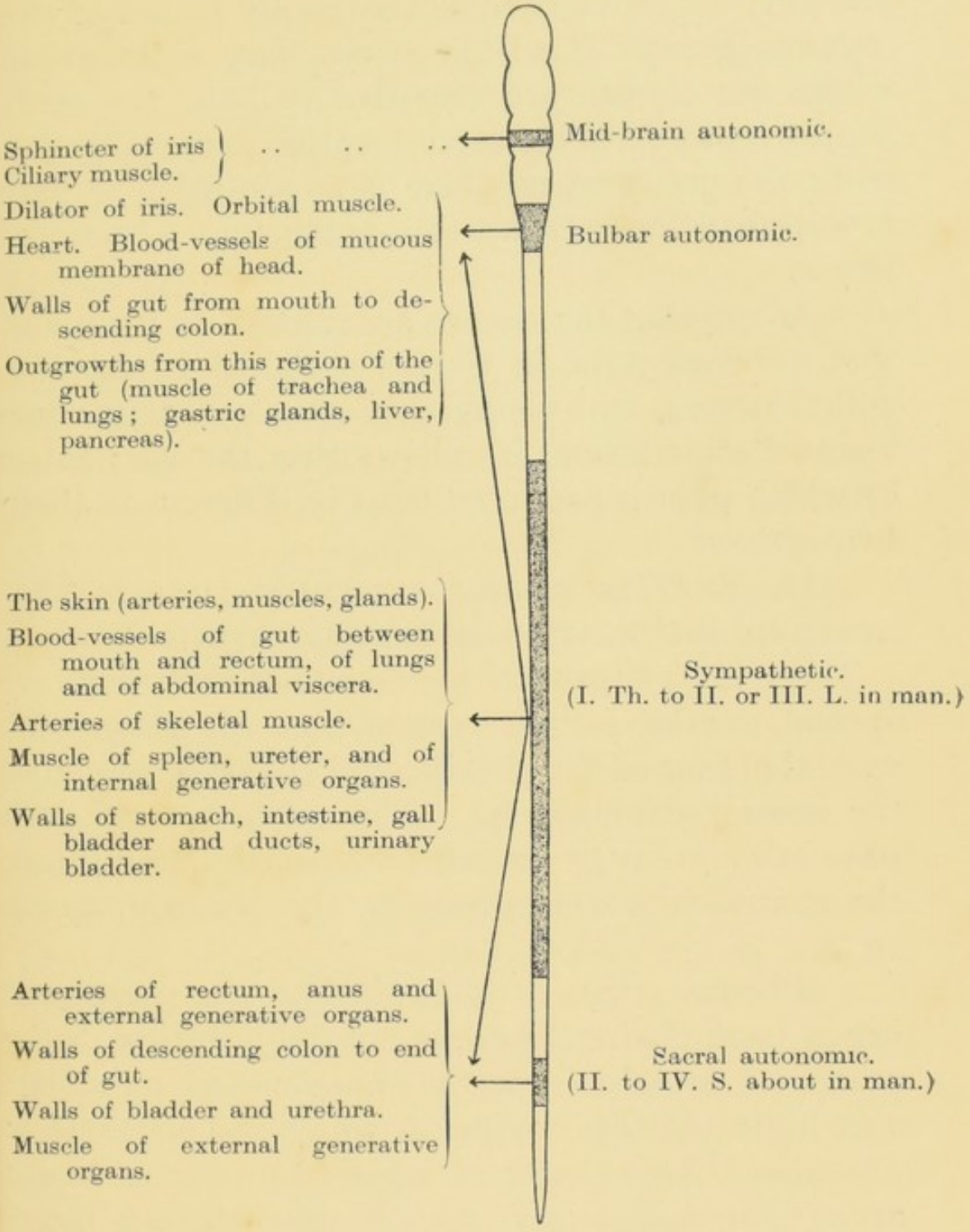


FIG. 1.

Diagram to show the general origin and distribution of efferent autonomic fibres. By "muscle" is, of course, meant unstriated muscle only. By the "walls" of a structure are meant all the unstriated muscle in it. The innervation in some cases is still a matter of controversy (gastric glands, liver, and pancreas; vessels of lungs; small arteries of skeletal muscles, and arteries of the central nervous system.) (LANGLEY.)

pinching or pricking, and tissues where no sensation is felt. When these tissues are placed in two separate groups, it will be found that in the group where the tissues are sensitive to pain the nerve supply comes from the cerebro-spinal nervous system, while the group where there is no sensation of pain is supplied entirely by the autonomic system of nerves.

Seeing that the viscera are insensitive to stimuli that produce pain in tissues supplied by cerebro-spinal nerves, and seeing that pain can arise from visceral stimulation, it follows that the mechanism by which pain is produced must be different in these two systems.

15. The Mechanism by which Pain is produced on stimulation of Cerebro-spinal Nerves. —There is good ground for assuming that there are special nerves for the conduction of pain, with special organs at the pheriphery capable of receiving the special stimulation. The conduction of such pain stimulus is by the afferent nerves passing into the central nervous system by the posterior nerve roots.

When a stimulus is applied to the peripheral organ in the skin, the nerve not only conveys to the centre of consciousness the sensation of pain, but also indicated the locality in which the stimulus is produced. This power of localisation varies in its exactitude, but pain is always referred to a point somewhere in the neighbourhood of the stimulation.

In the course of its passage from the skin to the brain the nerve may be subjected to stimulation, and if the stimulation be sufficient to provoke a response, pain will be felt, and it will be localised at

the peripheral end of the nerve. The pressure of a growth on the trunk of a nerve, or disease affecting the posterior root ganglia, as occurs in herpes zoster, or lesions in the spinal cord, as in locomotor ataxia, or irritation in the brain itself, all give rise to pain when a pain nerve is stimulated, and the pain is referred to the peripheral distribution of the nerve in each case.

The reason for this pain being referred to a part remote from the seat of the irritation is due to the fact that when stimulated to activity every nerve gives rise to its peculiar function. If it be the optic nerve then it gives rise to a sensation of light; if it be the auditory nerve then to the sensation of sound; if it be a pain nerve then to the sensation of pain referred to the peripheral distribution of the nerve.

16. Radiation of Pain.—The consideration of the localisation of pain and the manner in which it spreads throws a great deal of light upon the mechanism of pain. It often happens that when there is severe pain due to any cause, such as from a whitlow, or a small abscess by the side of a finger nail, that the pain is felt to spread up the finger to the hand, and it may be to the arm. Not only so, but the skin and deeper tissues in the neighbourhood of the disease are often very tender on pressure. It might seem, and it is usually accepted, that this is due to the irritation of the nerve ends in the neighbourhood of the lesion by some obscure process. But this is not the explanation. The real nature of the disturbance can be inferred when the nerves stimulated by the disease process are in close association in the brain or spinal

cord with nerve fibres supplying structures at some distance. To take the most common instance, the fifth cranial nerve supplies the teeth and also the skin of the cheek. In toothache there may not only be the pain referred to, and great sensitiveness of, one tooth, but the pain may be felt along the jaw and in the cheek. Not only may the pain be felt in the cheek, but the skin of the cheek may become extremely tender to touch, so that to gently brush the hair causes a definite sensation of pain. A still more striking instance is recorded by Professor Sherrington. He states that "by applying a mustard leaf over the front of the upper part of the sternum, I can produce in myself the sensation of a patch of unpleasantly tingling character referred to the inner side of each upper arm, just above the inner condyle."

Neither in this case nor in that of the toothache could continuity of the peripheral structures be the cause. The same stimulation produced the pain in widely separated parts. If we inquire into the nerve supply the matter becomes clear. The second thoracic nerve supplies the skin of the upper part of the chest and of the inner side of the upper arm. While the peripheral ends of the nerves supplying the upper part of the chest and the inner side of the upper arm are widely apart their centres in the spinal cord are intimately associated, so that when a violent stimulus from the periphery reaches the spinal cord it affects the nerve cells in its neighbourhood, which in this case happen to be those supplying the upper arm, and they react according to their nature, and give rise to pain referred to their peripheral distribution. In the same manner the nerves

supplying the teeth and the skin of the cheek meet in the centre of origin of the fifth cranial nerve, and the stimulation of the fibres from the teeth affect the fibres supplying the cheek.

In the diagnosis of symptoms it is of the highest importance to appreciate both the nerve supply of the part in which the pain is felt, and the relation of these nerves to others in the central nervous system. The manner in which the pain spreads and the appearance of other phenomena due to central stimulation provide the clue.

17. Effects of Chloroform on Pain.—An interesting observation which has been made by several observers is that when pain radiates from some part where it starts, the first effect of chloroform is to cause the radiating pains to disappear, while the original pain remains fixed. This applies to the radiation of pain in visceral disease as well as that in affection of the cerebro-spinal nerves. Thus in toothache, with pain in the cheek as well as in the tooth, the cheek pain first disappears while the toothache proper remains till total anæthesia is produced. Dr. J. H. Keay, in his work on the "Medical Treatment of Gall Stones," refers to this observation, and gives his own experience with chloroform during an attack of gall-stone colic. "Give a whiff of chloroform, not enough to produce unconsciousness, and the distant or referred pains disappear, their mode of disappearance being very interesting to anyone cool enough to observe it, and there remains only a subdued pain in the region of the right hypochondrium, a spot so small that one could cover it with the tips of one or two fingers."

CHAPTER IV.

VISCERAL PAIN.

18. *Insensitiveness of the Viscera to stimulation.*
19. *Sensitive Tissues of the External body Wall.*
20. *Testicular Pain.*
21. *Artificial Production of Visceral Pain.*
22. *Relationship of the site of pain to the site of the lesion.*
23. *Mechanism by which pain is produced in Visceral Disease.*
24. *Referred Pain.*
25. *Radiation of Visceral Pain.*
26. *Pain the only Sensory Reflex in Visceral Disease*
27. *Lennander's Observations.*

Bearing in mind the view that the effective stimulation of any part of a nerve fibre from the periphery to the brain will result in the evidence of its peculiar function, the cause of pain in visceral disease becomes easy to understand. In the normal processes of life a succession of stimuli is continually passing from the viscera by the afferent nerves to the spinal cord, and reacting upon the nerves, supplying muscles, blood vessels and other structures. These processes are so conducted that they normally give rise to no appreciable sensation.

If, however, on account of a morbid process in any viscus an increased stimulus passes by the afferent nerves to the spinal cord this stimulus may be of a kind that affects neighbouring nerve cells, and

these nerve cells react according to their functions; a sensory cell by producing pain, a motor cell by contraction of certain muscles, a secretory nerve by increased flow of its peculiar secretion, and so forth. When such stimulation affects a sensory nerve, pain arises, which is referred to the peripheral distribution of the nerve so stimulated.

18. Insensitiveness of the Viscera to ordinary stimulation.—I have already pointed out that the viscera are insensitive to those methods of stimulation that produce pain in the external body wall. Haller demonstrated that in animals the viscera could be cut and burnt while the animal unconcernedly ate its food. Harvey described the insensitiveness of the heart, and a great number of observers have testified to the fact that other viscera are totally insensitive to stimulation. Personally I have stimulated nearly every organ of the body, and have failed to elicit pain, by procedures which elicited pain when applied to the external body wall. It is only in rare instances that the opportunity is afforded of demonstrating the insensitiveness of the viscera, by their direct stimulation in the conscious subject. As, however, it is often attempted to demonstrate the tenderness of organs by stimulating them through the external body wall, it is necessary to comprehend the sensitiveness of the structures so stimulated, for it often happens that the pain produced by stimulation of one structure is referred to another.

19. Sensitive Tissues of the External Body Wall.—If we take the abdominal wall we find three great layers endowed with exquisite sensibility to pain. The first of these, the skin, I need not dwell

upon, save to point out how its sensibility frequently becomes increased in visceral disease, and how this increased sensitiveness is united to an exalted muscular reflex. The second of these sensitive layers is the voluntary muscular system best seen in the flat muscles of the abdomen. It is the sensitiveness of this muscular layer which is most commonly exalted in visceral disease, its sensibility being very readily increased. Muscular hyperalgesia is such a striking phenomenon, is so frequently present and plays such an important part in the protective mechanism, that it is astonishing to find it almost universally overlooked. One can read elaborate treatises devoted to special organs, in which this symptom is the most striking and the most instructive feature, but its presence is nevertheless overlooked or misinterpreted. In an ordinary case of stomach ulcer, appendicitis, gall-stone, renal colic, or enlarged liver, if one notes the tenderness of the abdominal wall, and observes how this deep tenderness extends far beyond the site of the organ affected, one can appreciate the nature and significance of this sensitive layer. With a little care one will be able to distinguish these symptoms from cutaneous hyperalgesia and from hyperalgesia of the deeper tissues. The third sensitive layer is one of which anatomists and physiologists were quite ignorant till recently, though it has long been suspected from clinical observations. It is the layer of loose connective tissue lying immediately outside the peritoneum. I suspected its presence for a long time as I could frequently get exquisite tenderness in pushing my fingers between the recti muscles, for instance, in cases of gastric ulcer, the stomach not being affected

by the pressure. Its existence can be shown in an operation for the radical cure of hernia under cocaine anæsthesia. The skin and muscles can be cut through, and the patient experiences no pain. When the loose connective tissue outside the peritoneum is gently torn through the patient may experience most exquisite pain. After the peritoneum is exposed it can be incised and afterwards stitched, and the patient feels no pain. I have verified this observation on several occasions. Recently Ramström made a careful histological examination of the abdominal wall of man and other mammals, and showed that this region was richly endowed with nerves and nerve endings, the nerves being derived from those which supply the muscles of the belly wall. This observation may probably afford a clue to the confused statements that exist in regard to the sensitiveness of the peritoneum. I can only say this, that I have on numerous occasions in the course of operations scratched and cut the serous surface of the peritoneum on conscious subjects without any analgesic, local or general, and have never known the slightest sensation elicited. One can understand, however, that the inflamed peritoneum and adhesions might readily affect this remarkable nervous layer. Peritonitis, however, so readily produces muscular hyperalgesia and tonic muscular contractions (viscero-motor reflex), that the pain and tenderness are demonstrably, in the majority of cases, of spinal origin (*see* Chapter XVIII.).

With the recognition of these sensitive structures—frequently rendered exquisitely sensitive to painful stimuli in visceral disease—it will be understood how impossible it is to judge of the sensitiveness

of the viscera from external exploration. When, therefore, we find the surgeon or physician demonstrating the sensitiveness of any viscus, it will be realised that he is in reality stimulating, in his examination, those extremely sensitive structures of the external abdominal wall, and referring the pain he elicits to an organ that is totally insensitive to any such stimulation.

20. Testicular Pain.—On the other hand, one cannot always be sure of the source of pain, as when pressure is applied over a movable kidney or readily palpated abdominal tumour. That pain arises on pressure on a viscus is undoubted, but the pain does not seem to arise from the direct stimulation but by reflex stimulation of a sensory cerebro-spinal nerve. This can be demonstrated in the case of the testicle. In ordinary cases when the cord is short the pains felt on applying pressure to the testicle are not readily differentiated. If, however, an individual with a long cord where the testicle hangs down a long way from the groin, be examined, the pains resulting from pressure on the testicle can be separately recognised. In such an instance a pain is felt at once readily localised over the point of pressure. A few seconds later another pain is felt gradually increasing in intensity, and gradually passing away and referred to the groin. Accompanying the pain there is sometimes a sensation of faintness, very slight with light pressure, but evidently of the same nature as the intense depression following on a blow on the testicle. This depression and pain are similar to those which are evoked by pressure on the kidney and ovary. Concerning the first of these pains when it is felt at

once and referred to the place of stimulation, a curious question arises bearing on the sensibility of serous membranes. As I have already pointed out, I have scratched the serous surfaces of both visceral and parietal peritoneum and pleura, and elicited no sensation of pain, but exquisite pain may be elicited by scratching the tunica vaginalis. In certain cases, in tapping a hydrocele, if the testicle be gently held with one hand and the surface of the tunica vaginalis lightly scratched with the canula, the patient at once experiences pain and refers the pain unerringly to the region scratched. However lightly the stimulus is made no sensation is experienced beyond that of pain, resembling in this respect the sensibility of the cornea. As demonstrating the difference between the sensibility of the tunica vaginalis and the peritoneum, I cite the following experience. A patient consulted me with his scrotum greatly enlarged and full of fluid, which I took to be a hydrocele. I tapped him and tested the sensibility of the testicle. I found the patient did not feel pain when I scratched what I took to be his tunica vaginalis. I scratched rather roughly, yet no painful sensation was experienced. Finding I could not reduce the whole of the swelling I concluded that the case was not one of hydrocele, and on operating I found the case was one of omental hernia with the sac distended by peritoneal fluid. What I had been scratching was the peritoneum.

As the tunica vaginalis and the peritoneum have the same origin it appeared strange that there should be this difference in sensation, until on inquiry I found that a cerebro-spinal nerve is distributed to the tunica vaginalis, viz., a twig of the

genital branch of the genito-crural nerve. The tunica vaginalis is the only sensitive serous membrane covering an organ that I have detected, and it is the only one to which a branch of a cerebro-spinal nerve has been traced.

In certain cases the tunica vaginalis becomes hyperalgesic (*see* page 183). Professor Waterston tells me that the visceral layer of the tunica vaginalis is not of the same origin as the parietal, but is looked on as a persistence of the germinal epithelium. This may have some bearing on the sensibility of the testicle, and my suggestion as to the nature of the testicular sensitiveness is therefore provisional.

21. Artificial Production of Visceral Pain. —It is a curious fact that although the belief is so universally held that the viscera are endowed with "sensory" nerves, and that physiologists refer to afferent sympathetic nerves as "sensory" in function, not a single authentic observation has been rendered to show that the viscera have a direct sensibility of their own, *i.e.*, a sensibility derived from the possession of nerves which when stimulated produce a sensation. Of course, a great deal depends on what is considered evidence, many people being perfectly satisfied if they elicit pain by pressing over an organ. Physiologists have interpreted certain movements as an expression of pain after stimulating afferent sympathetic nerves. But this does not prove that pain was evoked nor does it prove that the pain was a direct pain, nor does it show in what situation the pain was felt, for the location of the pain is the key to the problem. It is therefore necessary in investigating this matter to be sure of

the tissue stimulated, and the region in which the resultant pain is felt. It is because of the absence of the specification of the locus of the pain that many otherwise important observations are rendered of little value in respect to this investigation.

That pain can be produced by visceral stimulation is easily demonstrated if one employs an adequate stimulus. It is now many years since I pointed out that the most violent pains of which we are conscious are associated with hollow muscular organs, and that by producing violent contraction of a hollow viscus pain can be elicited. The easiest way to do this is to give a distending enema of warm water, and to retain the enema until painful peristalsis results. That the pain is really due to the contraction of the muscle wall of the bowel is evident from the fact that with the relaxation of the sphincter during the pain the contents of the bowel are expelled with considerable force, and the pain at the same time subsides. Here it is evident that a considerable portion of the descending colon and rectum must have contracted, but the pain is not felt along the position occupied by these structures, but, in the majority of people, it is referred across the middle line immediately above the pubis.

The following observation demonstrates an exactly similar series of facts :—

I had occasion to resect a small portion of the small intestine in a conscious subject, for umbilical fistula, whose abdominal cavity I laid open. He refused to take an anæsthetic, and no analgesic, local or general, was administered. There were numerous peritoneal adhesions, and while I cut and tore these the patient was unconscious of any sensation. I cut

and stitched the serous surfaces of parietal and visceral peritoneum, I tore adhesions from the liver, I cut and sutured the bowel and mesentery, and no sensation was felt. After preparing the upper part of the bowel it was wrapped in a warm cloth and laid on one side. During the subsequent steps the patient frequently moaned. I asked him if he felt pain, and he replied that he did. I asked him where he felt the pain, and he indicated with his hand that it was across the middle line at the level of the umbilicus. I at first felt that it might be due to the part that I was manipulating, but the pain was intermittent. Chancing to look at the prepared upper part of the bowel that lay on the left side of the abdomen, I observed that every few minutes a peristaltic wave passed over the lower portion of it, and when this occurred the patient moaned in pain. I made certain that the pain was connected with the peristaltic wave, and I produced the peristalsis several times by lightly pinching the bowel. I also made sure the patient had no doubt as to the place in which it was felt, with the result that here before my eyes was the cause of the pain which the patient felt, and yet the patient referred the site of the pain with precision to an area ten inches or twelve inches away from the contracting bowel.

An objection has been taken by Hertz to the explanation of this observation. He contends that the reference of the pain to the middle line was due to the brain referring the sensation of its "average position." The average localisation theory is but an attempt to explain obscure symptoms without taking the trouble to inquire into all the evidence.

22. The Relationship of the site of the Pain to the site of the Lesion.—For many years I have kept notes of the position in which pain was felt in a great variety of diseases, and in course of time I have been able to identify the exact site of the lesion in cases that come to operation, or to post-mortem examination. The conclusion arrived at from the consideration of these cases was that the situation of the pain did not as a rule directly afford any clue to the situation of the lesion, but when the situation of the pain was immediately over the lesion, other evidences showed that the pain was not felt in the organ, but referred to the sensory nerves in the external body wall. I shall quote the proofs of this conclusion presently, but here I will describe the theory which explains the peculiar nature of visceral pain.

23. The Mechanism by which Pain is produced in Visceral Disease.—When a nerve that terminates in a sense organ is stimulated in any part of its course from the periphery to the brain, a stimulation is given to the brain of a kind similar to what would have happened if the peripheral end-organ had been stimulated. Thus the stimulation of any part of the optic nerve or auditory nerve gives rise to the sensation of light or of sound. In the same manner if a sensory nerve be stimulated in any part of its course through the brain, spinal cord, or trunk of the nerve, the resultant sensation is referred to the peripheral distribution of the nerve in the external body wall. As already remarked, in the normal processes of life, a succession of stimuli is continually passing by the afferent nerves to the spinal cord, and continuously playing upon the efferent

nerves that run to muscles, blood vessels, and so forth, maintaining what we call "tone" in muscles and blood vessels. These processes are conducted so that they give rise to no appreciable sensation. If however, a morbid process in a viscus gives rise to an increased stimulus of the nerves passing from the viscus to the spinal cord, this increased stimulation affects neighbouring centres, and so stimulates sensory, motor, and other nerves that issue from this part of the cord. Such stimulation of a sensory nerve will result in the production of pain referred to the peripheral distribution of the nerve, whose spinal centre is stimulated, so that visceral pain is really a viscero-sensory reflex. If the increased stimulus affects a motor centre, then a contraction of the skeletal muscle results, and thus is produced the viscero-motor reflex (see *diagram*, Fig. 4, page 87).

The two following cases illustrate these points : A female, aged 36. For a couple of years the patient had suffered from violent attacks of abdominal pain. I never saw her during an attack, but the following was the condition found after a severe attack. The abdominal wall over the right iliac fossa was hard and rigid, due to the contraction of the muscles. When the skin was lightly pinched there was no increased tenderness but pressure on the rigid muscle was very painful. The right thigh was slightly bent upon the abdomen, and could be extended only with difficulty, owing to a tonic contraction of the psoas muscle. On walking a short distance the patient developed a stoop, due to the increased contraction of this muscle. When the erector spinæ muscles on both sides were lightly grasped in the lumbar region those of the right side

were found very painful. There were frequent calls to micturition, the quantity passed at each time being small, and containing no abnormal constituents.

This description of the symptoms was confirmed by Mr. Caird, who operated on the patient. The following conditions were found at the operation: —When the abdominal cavity was opened nothing abnormal could be detected. The parietal peritoneum was perfectly healthy, and only healthy coils of intestine were exposed to view. On separating these coils the appendix was found red and inflamed, adherent by soft red bands to the cæcum, and separated from the bladder by coils of uninflamed intestine. The appendix was removed, and the patient made a good recovery, though it was a couple of months before all the symptoms quite disappeared —the last symptom to go being the slight contraction of the psoas muscle, which became more contracted on walking a short distance.

Grouping the reflex phenomena in this case we recognise (1) A viscero-motor reflex in the muscular contraction of the transversalis abdominis, the oblique and psoas muscles; (2) a viscero-sensory reflex in the increased sensitiveness of the sensory nerves supplying the muscles over the right iliac fossa and the erector spinæ; and (3) an irritability of the bladder resulting in frequent micturition.

It is manifest from the condition found at the operation that these very definite symptoms could not have been caused by the implication of the structures in the inflammation which affected the appendix. If, on the other hand, we look into the origin of the nerves, motor and sensory, that supply these muscles

and the sympathetic supplying the bladder, we find that they all arise from a limited area in or near the twelfth thoracic and first or second lumbar spinal segments. It becomes, then, a justifiable inference that the stimulus that produced these symptoms arose in the appendix, and that this stimulus was conveyed from the appendix by its sympathetic nerve supply to the spinal cord, and therefore that the appendix is supplied by a sympathetic nerve that joins the cord at the segments mentioned. Further, as the bladder nerve supply leaves the spinal cord at two places (*see* Fig. 1, page 27)—namely, with the sympathetic nerves from the upper lumbar region and with the visceral sacral nerves—it follows that the afferent fibres of the bladder reach the spinal cord at the upper lumbar region.

In the following observation a description is given of the effects produced by a stimulation of the cord as definite as any physiological experiment.

Renal Colic.—A man, aged 30, had suffered for a year from occasional attacks of renal colic, and one attack had been followed by hæmaturia. He was a very intelligent man, and I told him to note every particular during an attack. The following is a summary of his statement—the original statement being illustrated by the patient placing his hand over the regions mentioned: The pain suddenly seizes him with great severity in the right lumbar region, then after a few minutes it strikes into the front of the abdomen over the iliac fossa. Then the belly becomes hard and rigid. The pain then strikes down into the internal part of the groin, the testicle is felt to be drawn up, and the pain then shoots into the testicle. The facts here described were

corroborated by him in a few subsequent attacks, each attack invariably pursuing the same sequence. My notes made after an attack describe an indefinite area of cutaneous hyperalgesia over the iliac fossa, hardness and rigidity of the abdominal muscles over the right iliac fossa, with great tenderness on pressing over the muscles and great tenderness on pressing the testicle and the right erector spinæ muscles in the lumbar region. Here the symptoms pointed to a localised stimulation of the spinal cord at the origin of the sensory nerves supplying the skin over the right iliac region, the testicle and the abdominal and erector spinæ muscles, and at the origin of the motor nerves supplying these abdominal muscles and the cremaster muscle. These nerves issue from the spinal cord by the twelfth thoracic and first lumbar roots. The area stimulated in the cord, it will be observed, is not confined to one segment, but passes along a path which affects only a limited portion of several segments—a curious feature to which I shall revert in dealing with the radiation of pain.

In regard to the immediate cause of the symptoms, I reasoned that there was a calculus lodged somewhere about the pelvis of the kidney, and that its presence acted like a foreign body, sending a wave of strong peristalsis down the ureter, the gradual passage of the peristalsis sending strong stimuli to a descending region of the spinal cord. The fact that the pain always started at the same place indicated that the stone remained fixed in its position, a view confirmed by the fact that there was never any evidence of the calculus having reached the bladder. The reasons I had for the assumption that the stone remained in the pelvis will be gathered as

I develop my argument. An X-ray photograph failed to reveal the stone. Such being my opinion I sent the patient to Mr. Wright, who, agreeing with my diagnosis, operated in 1903, and found a small calculus about the size of a pin's head adherent to the wall of a calyx, opposite the junction of the middle and lower third of the kidney. This was removed, and the patient made a good recovery, and has remained quite free from all symptoms.

24. Referred Pain.—The reason why the pain is referred to portions of the body so far apart is because in the course of development the tissues that in a low scale of life immediately covered the organ had been displaced. Thus, the pain felt in the testicle in renal colic is due to the fact that in its journey down to the scrotum the coverings of the testicle receive a twig from the first lumbar nerve, and when the centre of this nerve in the spinal cord is stimulated, as in renal colic, the pain radiates to the testicle. In renal colic one never finds the skin of the scrotum hyperalgesic, but always the deep covering of the testicle, because the scrotum is supplied by the sacral nerves, while the ureter and testicle are supplied by lumbar nerves.

This view is the one adopted by practically all to account for what is called "referred pain." Ross described visceral pains as of two sorts, "splanchnic" pain in the organ, and "somatic" pain referred to some part of the body wall remote from the organ. But when the so-called "splanchnic" pains are critically examined they will be found to be of the same nature as somatic pain.

25. Radiation of Visceral Pain.—Perhaps the best evidence as to the true nature of visceral pain

is found in the manner in which pain spreads. No attempt has been made by writers to appreciate the meaning and significance of the spreading of pain. Thus, in gall-stones, a "hypersensitive" gall-bladder and a "tender liver" is described, and the pain of an inflamed gall-bladder is "diffused over a large area along and below the margin of the liver." In what tissues was this widely diffused pain felt? If the pain were in the gall bladder, how comes it that it was felt in a region more extensive than that occupied by the gall bladder?

The diffusion of pain over a wider area than that occupied by the organ in which the stimulus producing the pain originates, can be proved in many ways to be due to an extension of the irritation affecting the central ends of sensory nerves in the spinal cord as has been described. Thus the extension of the painful area is frequently associated with hyperalgesia of the tissues of the external body wall. The pain is often found to radiate along peculiar areas, inexplicable unless we recognise the relationship in the spinal cord of the nerves supplying these areas, as, for instance, when the pain of angina pectoris passes from the front of the chest into the axilla and down the arm—that is to say, into areas supplied by contiguous nerve roots (third, second, and first thoracic nerves); or the pain may appear at a distance from the affected organ and gradually approach it till it is felt in the tissues covering the organ, as when in angina pectoris the pain may at first be confined to the arm, but with increasing severity radiates to the front of the chest.

An excellent illustration of the referred pain is seen in cases where the lesion is in the tissues

supplied by the phrenic nerve. The phrenic nerve passes out of the spinal cord with the fourth cervical nerve, receiving sometimes small branches from the third and fifth cervical nerves. It is distributed to the diaphragm, the liver, and the gall ducts. The sensory nerves from the fourth and fifth cervical nerves are distributed to the skin, over the top of the shoulder and down the outside of the arm. In a few cases of diaphragmatic pleurisy (sometimes with basal pneumonia) the patient has felt severe pain over the top of the shoulder on the affected side. On rare occasions I have found a patch of cutaneous hyperalgesia on the shoulder (*see* Fig. 15, page 216). In gall-stone disease, shoulder pain is a not infrequent complaint, and the pain may extend from the top of the shoulder, and down the outside of the upper arm. It may persist here with such severity that the causal condition may be overlooked, and the case looked upon as one of "neuritis." The expulsion of a gall-stone may be followed by instant and permanent relief. In many instances pain of real severity may be experienced and the pain may be in some part near the organ causing the pain, and no hyperalgesia may be detected. Such instances cannot claim to settle the question whether the pain is direct or referred. If, however, a careful search is made in all cases, some will be found which exhibit this hyperalgesia.

26. Pain the only Sensory Reflex in Visceral Disease.—There is one peculiar and puzzling feature about the reflex stimulation set up by a visceral affection, namely, that pain is practically the only sensation evoked. I shall show later that the stimulus from the organ on reaching the spinal

cord, if of an adequate strength, will pass on to neighbouring nerve cells, and stimulate motor and secretory nerves, as well as the pain nerves. But it is not clear why the stimulation should not affect the nerves that subserve other forms of sensation as touch, heat, and cold. The ingestion of cold into the stomach does, under certain circumstances, give rise to a sensation of cold, and I have tried to explain that by another hypothesis, but apart from this the stimulus from any viscus does not produce cold or any sensation but that of pain. The only explanation I can suggest is that for other sensations, apart from pain, a special receptor organ is necessary, for we know that in the skin there are special spots which are alone susceptible to heat or cold, and unless the stimulation reached the central nervous system by the special organ at the periphery for receiving these sensations, the stimulation of these nerves at higher levels gives no response. On the other hand, in disease of the central nervous system other sensations may arise, such as formication, which are supposed to be due to stimulation of particular nerve fibres.

27. Lennander's Observations.—The observations of Lennander are in agreement with those I have made, and I quote here a typical illustration from Barker's translation of Lennander's book. It will be seen that pain is sometimes produced from stimulation of the viscera, as in pulling on the gall-bladder, but such methods of stimulation do not give a clear idea of the tissues that gave rise to the pain, whether, for instance, the pulling affected the sensitive outer layer of the peritoneum; nor is there any indication of the locality to which the pain was referred.

Hast and Meltzer object to the conclusions drawn by Lennander from his observations, because Lennander had used injections of cocaine, which, they say, induced a certain degree of anæsthesia, and diminished the sensibility of the viscera. I do not think this objection valid, for my results agree with Lennander's, and most of my patients had no anæsthetic of any kind.

'Parietal Peritoneum; Gall-bladder; Adhesions between Abdominal Viscera.—We learn, from the following case and others, that the parietal peritoneum derives its sensibility from the intercostal nerves in the subserosa. If such a nerve be divided, the parietal peritoneum on the distal side becomes insensitive over an area corresponding to the distribution of its twigs, which is not, however, large. This depends upon the fact that the areas of distribution of different twigs are common to both. In case . . . it will be seen that a gall-bladder which was adherent to the omentum and transverse colon and whose mucous membrane showed marked catarrh—it contained a gall-stone as large as a plum—was entirely without sensation. The patient had no feeling either of pain or touch during all the manipulations of the operation necessary for a cholecystotomy with so-called "water-tight drainage."

'As it seemed desirable to produce adhesions between the anterior surface of the liver and the abdominal wall in the neighbourhood of the gall-bladder, the serosa of the former was destroyed over a considerable area by various means, such as silver nitrate, thermo-cautery, scratches with a needle, etc. The surface of the liver proved to be destitute of all

sensation either of pain or touch. It was the same when the anterior border of the liver was pinched between the finger and thumb. The adhesions also between the gall-bladder, the omentum and mesocolon were insensitive, as also were the two last structures.

'F., aged 64, admitted December 3rd, 1900. Biliary colic, with tedious fever for fifteen months. Great weakness and diffuse bronchitis in both lungs. In the urine both albumen and granular casts. General anæsthesia contra-indicated. December 3rd, $\frac{3}{4}$ cgr. morphia and Schleich's infiltration. Notes: "The gall-bladder was adherent to the transverse mesocolon, and moderately full of dark green bile. The mucous membrane was red and swollen, but without ulcers; one calculus, the size of a plum, lying in the entrance of the cystic duct."

'Microscopically and bacteriologically the bile showed *B. coli com.*, and another rod-like organism which reacted to Gram's stain, but could not be further differentiated.

'During the whole operation the patient remained perfectly quiet, and to each question in regard to pain gave a clear and intelligent answer.

'Notes specially directed to the question of pain during cholecystotomy with "water-tight drainage" of the gall-bladder. The omentum was stitched to the latter. Iodoform gauze packing between liver and abdominal wall. The first incision was parallel to the right rectus, and at its outer border. Division of the aponeuroses of the oblique produced pain. How far the pain was present at every point or only where small nerve-twigs were divided is uncertain. Nevertheless the pain which follows division

of the aponeurosis may clearly be severe. After infiltration between the aponeurosis of the external oblique and between the internus and transversalis muscles, these structures can be divided without any expression of pain on the part of the patient, but only those parts involved in the artificial œdema. The same holds for the transversalis muscle both before and after infiltration after Schleich.

'On division of a nerve in the abdominal wall a momentary pain was felt.

'In the area supplied by the divided nerve no pain was felt in the parietal serosa, either when incised or pinched with artery forceps, etc., but outside of this area severe pain was produced by the same stimuli. After infiltration of the extraperitoneal areolar tissue the p. parietale became insensitive over the rather limited area efficiently charged by the fluid. In the other parts not reached by the anæsthetic the pain on manipulation of the p. parietale was always severe.

'Stretching of the abdominal wound with rounded hooks produced severe pain.

'When the peritoneum had been opened the mesial part of the same was found to be insensitive (the nerves supplying it had been gradually divided), but the outer part of the peritoneum was still very sensitive to pain.'

Palpation within the belly—of the gall-bladder and its neighbourhood	Pain.
Gall bladder—gentle palpation of the fundus so that the walls of the sac were pressed together without stretching or contact with the abdominal wall ..	No sensation.
Drawing forward of the gall-bladder	Pain.
Three artery forceps were applied to the serosa of the organ	No sensation.
Silver nitrate to the serosa of the organ..	No sensation.
Drying of the serosa with gauze	No sensation.

Burning of the serosa of gall-bladder with the thermo-cautery	No sensation.
Powerful compression of the gall-bladder between the fingers	No sensation.
Drying of the surface of the liver with gauze	No sensation.
Cauterisation of the surface of the liver with silver nit. thermo-cautery, and scratching with needles ..	No sensation.
Drawing forward of gall-bladder and division of adhesions with thermo-cautery	Pain.
Division of adhesions between the gall-bladder and omentum with thermo-cautery	No sensation.
Division or cauterisation of adhesions between the trans. m. colon and gall-bladder behind	No sensation.
P. Peritoneum drawn with hooks on midline of the wound	No sensation.
On outer side of the same	Severe pain.
Introduction and removal of gauze between p. parietale and omentum	Pain.
Opening the abdominal wound in order to introduce gauze packing	Severe pain.
Grasping the whole thickness of the gall-bladder with Pean's forceps	No sensation.
Puncture and aspiration of the gall-bladder	No sensation.
Incision of gall-bladder with thermo-cautery	No sensation.
Palpation of its interior with the finger	No sensation.
Compression of gall-bladder upon the large calculus behind	Pain.
Extraction of the stone with a large spoon introduced with the finger	No sensation.
Plugging of the gall-bladder with iodoform gauze as far as cystic duct	No sensation.
" Tobacco-pouch " suture round the opening in the viscus with a large needle for " water-tight " drainage ..	No sensation.
Introduction of a drain tube and closure of the above suture, lasting a minute	No sensation.
Removal of tampons between omentum and transverse colon	No sensation.
Introduction and removal of gauze tampons between liver and parietal peritoneum	Severe pain.
Suture of omentum round gall-bladder	No sensation.
Ligature of vessel in wall of gall-bladder	No sensation.
Compression of transversi colon between fingers ..	No sensation.
Application and knotting of sutures between the gall-bladder and p. parietale of the medium side of wound	Little if any pain.
On the outer side	Severe pain
Plugging on the inner side of the wound	Slight pain.
On the outer side	Severe pain.
Application of Pean's forceps on either side of the wound showed the same results.	

CHAPTER V.

VISCERAL PAIN—*continued.*

28. *Objections to the referred nature of Visceral Pain.*

28. OBJECTIONS TO THE REFERRED NATURE OF VISCERAL PAIN.—In putting forward the view that the pains arising from the viscera are not felt in the organ, but are referred to the peripheral distribution of cerebro-spinal nerves in the external body wall, I had opposed to me the opinion of practically all people, whether they had studied the subject or not. It is, therefore, necessary to consider the reasons why such unanimous opinion should have been held, and to show the grounds on which I based a contrary view.

It is now recognised that pains arising from an organ may be referred, but it is even now held that there are pains felt in the organ itself, and that the organ can become sensitive, *i.e.*, the organs give rise to a "somatic" or referred pain, and to a "splanchnic" or pain felt in the organ.

The evidence for this splanchnic pain is supposed to be found in the fact that the organ, though insensitive in its normal state, may, under certain circumstances, become sensitive. The evidence for this is supposed to be found in the fact that pressure over the organ causes pain. Thus, the stomach is

said to be tender in gastric ulcer, because pressure applied over the epigastrium is very painful. In the same way pressure over an enlarged liver or inflamed pleura causes pain. As this method of investigation ignores the heightened sensibility (hyperalgesia) of the tissues covering the external body wall (as the skin and muscles), it is no argument in favour of the sensibility of the organ. This matter is dealt with more fully in Chapter VI., where I describe in detail the hyperalgesia of the skin and of the muscles. While in the vast majority of cases the pain arising from pressure applied to an organ through the external body wall will be found to be due to stimulation of the structures of the external body wall, there are exceptional cases where the pain cannot be attributed to such structures. It has been shown in the case of the testicle, that the pain is felt not in the organ but in the groin, *i.e.*, it is a referred pain, the pressure being an adequate stimulus to produce this form of pain. In rare and exceptional cases, as in a movable kidney, or an abdominal tumour, I have not been able to satisfy myself as to the real nature of the pain elicited by pressure, and this matter requires further investigation, if possible, when the organ or tumour is exposed.

Another reason for assuming that the pain is in the organ, is the fact that a pain is felt in the position where our knowledge tells us the organ is situated, and other evidences abundantly justify the view that the pain did arise from this organ. This seems to most people to be conclusive evidence of the sensibility of the organ, but there has to be exercised a very cautious discretion before accepting

such a view. The assurance in all cases is not forthcoming that the organ, though diseased, and though causing the pain, is situated exactly where the pain is felt. I have already referred to the fact that if the organ be moved the pain does not shift, as in gastric ulcer, for though the stomach may be made to move up and down by deep respiratory movements, the pain remains stationary. Another reason against assuming the pain to be in the organ, is that the pain may extend to regions beyond the limit of the organ. This fact, though observed, has never received the consideration it merits in connection with the locating of the pain. Thus, a pain may be described as being felt in an organ and extending in various directions beyond the limits of the organ. I have endeavoured to explain why it does this by pointing out how it is caused by an extension of the stimulus in the spinal cord to the nerve supply of regions adjacent to the nerves supplying the offending viscus (page 47). In certain cases this extension to regions beyond the site of the organ has been recognised. Thus in angina pectoris the pain may start in the chest and radiate to the left arm. This is spoken of as a pain starting in the heart and shooting into the arm—the pain in the heart being of the nature of a localised pain in the organ, while the pain in the arm is a referred pain. To such an argument as this one cannot always bring direct and demonstrable objections, but if all the evidence present in certain cases be considered it will be found that the reasonable conclusion to draw is that the pain in the chest and the pain in the arm arise in the same manner. On page 94 I show that the nerves supplying the chest-wall are in close association in

the spinal cord with those supplying the arm, and that both sets of nerves are thus closely associated with the origin of the sympathetic nerves supplying the heart. The question naturally arises,is the pain in the arm not merely an extension of that felt in the chest, and due to an extension of the stimulation in the spinal cord? When all the facts in certain cases are considered then an affirmative answer to such a question can be reasonably given. Thus the pain may be felt with greater intensity in the arm than in the chest. I have witnessed attacks of angina pectoris where the pain was felt in one case in the left upper arm, and in the other in the left lower arm. In both cases the pain started in the chest and radiated to the arm, and the patients nursed the arm across the chest, rocking backwards and forwards in agony. In other cases the pain has been equally severe in arm and in chest, and on careful inquiry the patients could find no difference either in the character or severity of the pain in the two places. Finally, after an attack, or after a series of attacks, of angina pectoris the skin and sub-cutaneous tissues in the region of the chest and arm where the pain was felt became hyperalgesic, and it is reasonable to conclude that there is a direct relation between the pain and the hyperalgesia, and that these phenomena were due to the stimulation of the same nerves. As these nerves are the cerebro-spinal nerves supplying the chest wall and the arm, the pain in the chest has the same kind of origin as the pain in the arms, *i.e.*, the pain in angina pectoris is a referred pain.

A similar series of phenomena can be seen in affections of other organs, where the contiguous nerve centres in the spinal cord

supply parts widely separated. Thus, in renal colic the pain is described as being felt in the ureter, then shooting into the testicle. On page 46 I point out the meaning of this distribution of the pain, and that observation clearly shows the mechanism by which the pain and other reflex phenomena are produced.

Another argument employed to indicate that pain may be felt in the organ is that the pain is felt not only in the situation where it is known that the organ is situated, but that it is felt deeper than the skin. Thus, the pain in angina pectoris is variously described as being under the breast bone, and some physicians describe it as being in the aorta, and as actually travelling along the arch of the aorta. This idea also seems to receive support when, in addition, some agency directly affecting the organ seems to give rise to the pain, as in gastric ulcer on taking food; or in the case of pain arising from the œsophagus on drinking hot fluids.

Before determining the nature of the pain in such cases it is necessary to realise certain peculiarities in the character of visceral pain. It is not possible to describe visceral pain by any features peculiar to it, for, although many varieties might be described, there is nothing in any of them to distinguish them from the pain resulting from stimulation of a cerebro-spinal nerve itself, either in its peripheral distribution, or in some part of its course in the trunk of the nerve or in the central nervous system. It is for this reason that one frequently finds patients suffering from pain due to a visceral lesion treated for neuritis, neuralgia, rheumatism, or some affection peculiar to a cerebro-spinal nerve. In many cases of visceral pain, though the suffering

may be very great, the pain itself is of so vague and ill-defined a character that its exact situation is not easily ascertained unless attention is paid to this point while the pain is actually present. Because of this vagueness in locality it is sometimes assumed that this vagueness is an evidence of its presence in an organ, as it is notorious that the viscera are deficient in the nervous mechanism subserving the function of localisation. This interpretion of the seat of pain would seem to be strengthened by the fact that patients will often say that the pain is felt deeper than the skin, as if it were in their insides. If, however, we examine those patients in whom the pain is found to radiate some distance away from the offending organ, it will be found that the same kind of sensations—the vagueness, and the depth of the pain, are also present in what is undoubtedly referred pain. It is in cases of heart pain that this can also best be studied. It frequently happens that the patient will describe the region in which the pain is felt in such general terms that no clear conception can be acquired of the situation of his pain. He may say he feels it in his arm, but be uncertain in which arm he feels it. Or, if he describes it as appearing in the left arm, he can give no clear idea of the particular part of the arm. If, however, he be interrogated while he is actually suffering from the pain, he will describe with accuracy the parts in which the pain is felt. It is my custom in these cases to ask the patient to note accurately the situation in which the pain is felt, and the manner in which it spreads. In the next examination the patient, if he has suffered in the meantime from a recurrence of the pain, can usually give a very clear account of the

pain and its radiation, and will indicate with precision the distribution of contiguous nerves in the chest and arm, as shown in such figures as Fig. 6, p. 95, and Fig. 18, p. 238, whereas in the first account no such definite description could be obtained.

The situation of the pain in regard to its depth is the same in referred pain in the arm as in the chest. In angina pectoris the patient will describe his pain as deep in the arm; "in the flesh" is a description not infrequent. If in such cases it be asked if the pain here differs from that felt in the chest—differs, that is to say, from the pain supposed to be felt "in the heart"—the answer will be that they are identical in character, the only difference being that sometimes the chest pain is the more severe, and in other cases that the arm pain is the more severe. This peculiarity in the sensation of depth of pain, or, when it is on the trunk, the attributing of pain to some internal organ, is seen also in such a characteristic affection of the cerebro-spinal nerves as herpes zoster. It has been established by Head and Campbell that this complaint is due to an inflammation of the ganglia of the root of the posterior spinal nerves. In places where no eruption appears, or long after the eruption has healed, pains of a most excruciating character may be experienced. In their description of these pains the patients will state that they feel deep in the belly, and not infrequently the patient attributes these to his bowels and consults his doctor lest a cancer or some other painful disease has affected his bowels. These pains of herpes zoster are also often somewhat vague and difficult to localise with

precision, though they are always felt within an area of definite limits. The same features are present when the pain due to herpes is in the arm, and in one case the pain occurred in paroxysms so like an attack of angina pectoris that at first I felt inclined to attribute the pain to an attack of that affection. The appearance of a herpetic eruption on the chest and arm revealed the true cause (compare the shaded areas in Fig. 6, p. 95, and Fig. 7, p. 97.) This feeling of pain deep in the body is, therefore, no reason for assuming the pain to be in the organ. The pain resulting from drinking hot fluids, due in all likelihood to stimulation of the œsophagus, cannot be felt in the œsophagus. The pain itself is felt so distinctly in the middle line of the front of the chest, while the œsophagus does not lie altogether in the middle line. Furthermore, the œsophagus is situated actually nearer the skin of the back, yet the pain is never, or rarely, felt in this position. It seems more reasonable that the œsophageal pain follows the laws that regulate the mechanism of pain in the other portions of the digestive tube as described in Chapter XII. (*see also* Fig. 8, p. 117).

Another explanation for the pain being felt at a distance from the offending organ is sometimes put forward when it is said that the individual refers the pain to the place usually occupied by the viscera, according to a law of "average localisation." This so-called law is a pure assumption and neglects or ignores the essential facts, and is indeed merely a means to avoid a difficulty. When cases of "average localisation" are carefully examined, other phenomena may be found, which shed light upon the

distribution of the pain. When no evidence can be found to explain satisfactorily the region in which pain is felt, it is far better to acknowledge our ignorance and strive to remedy it, than to stultify one's position by giving some plausible explanation, incapable of proof.

CHAPTER VI.

INCREASED SENSIBILITY OF THE EXTERNAL BODY WALL.

29. *Hyperalgesia.*
30. *Cutaneous Hyperalgesia.*
31. *Muscular Hyperalgesia.*
32. *Hyperalgesia of other structures.*
33. *Effect of exercise on Hyperalgesic Muscles.*
34. *The areas of Cutaneous Hyperalgesia.*
35. *The areas of Muscular Hyperalgesia.*
36. *Tender Vertebræ.*

29. HYPERALGESIA.—In the older writings tenderness of the tissues in visceral disease sometimes receives a passing reference. Morgagni mentions it, and John Hunter, after an attack of angina pectoris, speaks of his left arm being very sore, so that he could not bear it to be touched. In 1891, a patient I had been attending for an attack of gall-stone colic called upon me, and as he entered my room I observed he was holding his right arm stiffly away from his side. On inquiring why he did this, he told me that the skin was so tender he could not bear the slightest pressure. On stripping him, I found a large field of skin extremely tender to touch, covering the upper part of the abdomen and lower part of the chest wall on the right side. This caused me to look for cutaneous tenderness in other cases, and I found it fairly frequently, and I published an account of these observations in 1892, when I called

attention to the fact that there was a distinct relationship between the viscera and certain defined areas of skin. This method of examination was also taken up by Head, who had previously been making researches on the origin of pain in visceral disease, and he mapped out the areas of cutaneous hyperalgesia in visceral disease that corresponded to the areas of eruption in herpes zoster. I pursued the subject further, and found that not only did the surface of the skin become occasionally hyperalgesic, but the deeper layers and the muscles also, while glands, like the mammæ and testicles, become also very tender. This tenderness of the muscles was invariably coupled with an extremely sensitive and powerful reflex contraction, so that on the lightest palpation they often became violently contracted. In addition the muscles sometimes became continuously contracted for long periods. As these muscular phenomena are of considerable importance, I shall deal with them in the next chapter.

30. Cutaneous Hyperalgesia. — Cutaneous hyperalgesia due to visceral disease exists in two forms, superficial and deep. The former is recognised by an extreme sensitiveness of the skin when lightly stroked by a pin head, or by moving hairs, and the latter when pressure between finger and thumb is made to the whole thickness of the skin. The superficial form is comparatively rare, and the deeper form is always present with it. The area in which the superficial occurs is less than, and included within, the deeper. The borders are in both cases ill-defined and inconstant; at one moment the patient will say the skin is tender, and on returning to this part a few minutes after, the patient may

not feel it tender. The result is that the hyperalgesic area is ill-defined, and I have been unable to verify any exact limitation of fields such as Head describes.

31. Muscular Hyperalgesia.—Hyperalgesia of the muscles is far more common than hyperalgesia of the skin, but can only be recognised with certainty when the skin sensibility is unaltered, as hyperalgesia cannot be accurately recognised in deeper structures if the skin covering them is tender. Before testing for deeper hyperalgesia the condition of the cutaneous sensibility should first be ascertained.

The same method—grasping between the finger and thumb — is the best also for eliciting the hyperalgesia of such structures as the muscles. Many of the muscles, as the sterno-mastoid, upper border of the trapezius, pectoralis major, erector spinæ, can be grasped, and the sensibility compared with the corresponding muscles of the opposite side. It is not easy to do this always with the flat muscles of the abdominal wall, particularly when they are contracted. By such devices as pushing the finger into the umbilicus the recti can be hooked up and compressed. By light pressure on the contracted muscles one can feel fairly certain of the hyperalgesic structures. Sometimes, to decide the matter, pressure has to be applied to the origin of the muscles at the ribs, when, with a little dexterity, the pressure can be exercised on the muscle against the ribs. These devices have to be resorted to when the muscles overlying a diseased organ are tender, as otherwise the pain is often referred to the organ. As a rule the tissues that are painful can be differentiated by

observing that the hyperalgesic area extends beyond the organ. Thus, in enlargement of the liver tenderness over the organ may be found, but it may be difficult to tell whether the pain is in the organ or external body wall. On mapping out the size of the organ and the area of hyperalgesia, it will be found that they do not correspond.

32. Hyperalgesia of other structures (extra peritoneal tissue, mammæ, testicle).—I have referred to the layer of tissue outside the peritoneum in which numerous fine nerve fibrils ramify. I am inclined to think that this part can become very tender, as I have found pain complained of when pressure was made between the recti. It is very difficult, however, to distinguish the tenderness of this tissue from that of the skin and muscles. Glands, such as the mammæ and the testicles, may be very tender on pressure. This can be shown by gentle pressure, first making sure that there is no cutaneous hyperalgesia. The reason for the pain on pressing the testicle is explained on p. 36.

33. Effect of exercise on Hyperalgesic Muscles.—The exercise of muscles affected with this hyperalgesia usually results in increasing the hyperalgesia, inducing pain and contraction of the muscles. The hard, tender belly, and "dragging" pains found in various visceral affections, as gall-stones, renal calculus, appendicitis, are always associated with, if not due to, this muscular hyperalgesia. In such cases walking induces pain, and the contraction of the muscles may compel the patient to stoop.

After exercising the muscle, or after the testing for muscular hyperalgesia, the patient may suffer from aching in the muscles which may last for hours.

34. The areas of Cutaneous Hyperalgesia.—Sherrington has demonstrated that the spinal nerves, after they leave the spinal cord, are distributed to the skin in fairly definite areas around the body. Somewhat similar areas are found in herpes zoster, which Head and Campbell have shown to be due to destructive inflammation of the ganglia of the posterior nerve roots. These areas are spoken of as "segments," and the spinal cord is supposed to be "segmentally" arranged. The question arises, is the hyperalgesia of visceral disease segmental in its distribution? If by this is meant that when hyperalgesia appears it first extends to the whole of one segment before affecting the next, the answer is in the negative. When hyperalgesia appears it extends very definitely along portions of neighbouring nerve areas, and from my observation is never limited to the full extent of one "segment." The spread is from one definite portion of a nerve area to another, without completely affecting the whole of one "segmental" area. In widespread hyperalgesia the whole of a series of nerve areas may be affected, as when one half of the trunk is hyperalgesic. The manner of spread is well seen in certain cases of angina pectoris, when it may begin in a patch affecting portions of the distribution of the third and fourth thoracic nerves, and extend into the arms affecting portions of the second and first thoracic nerve areas. Although appearing in the region of distribution of four nerves the hyperalgesia does not affect the whole of the distribution of any one. Cutaneous hyperalgesia will usually be found in an ill-defined patch occupying portions of the field of distribution

of one or more spinal nerve roots. The centres of these nerves in the cord will be found to be in close association with the sympathetic nerves from the offending viscus.

35. The areas of Muscular Hyperalgesia.—There is great difficulty in delimiting the areas of muscular hyperalgesia, as frequently only portions of the muscle are demonstrably hyperalgesic. In such muscles certain spots may be more tender than the rest. Here a small nerve-trunk may be pressed upon, and this nerve may be distributed to other tissues than the muscle (as in McBurney's point). I am disposed to consider that the sensory nerve supply of a muscle is from the same region of the cord as the motor. As the motor supply is more accurately known than the sensory we may by this means more accurately ascertain the centre of stimulation in the cord.

It has been long known that there is an afferent nerve supply to muscles, leaving the cord in the anterior nerve roots with the motor nerves. Head describes a form of pain elicited by compressing muscles which is conveyed by these nerves. Whether these are the nerves that show tenderness in muscular hyperalgesia I cannot say, but, if so, their centres in the spinal cord must be in close proximity to the nerve that conducts pain from the skin.

36. Tender Vertebræ.—In many cases of visceral disease pressure over the spines of certain vertebræ elicits pain, sometimes of a very acute character. I have not been able to account satisfactorily for the manner in which this arises. These tender vertebræ are usually associated with areas of

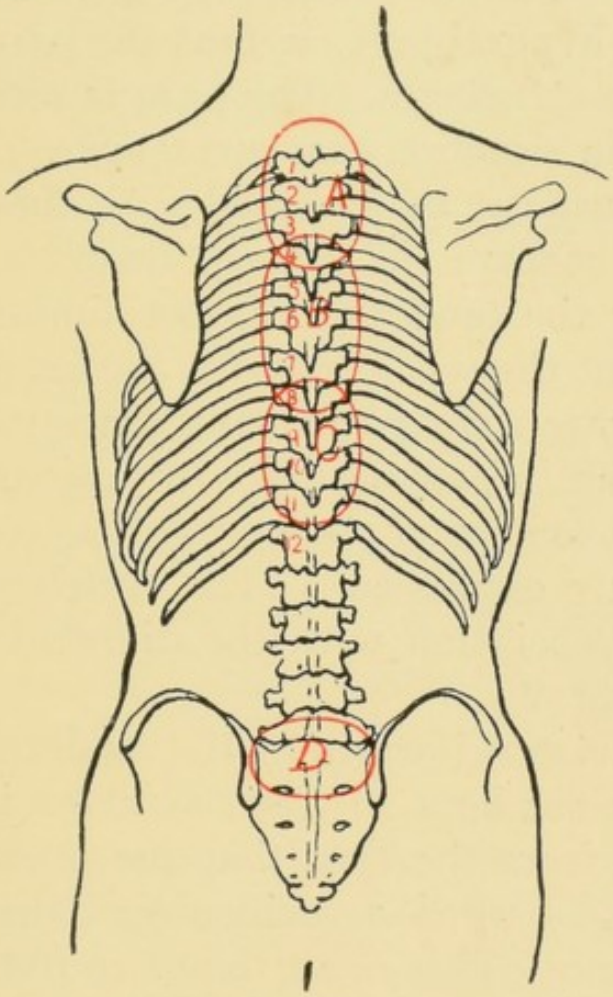


FIG. 2.

Areas in which pain is sometimes felt in affections of heart (A); of the stomach (B); of the liver (C); of the rectum and uterus (D). The numbers refer to the dorsal vertebræ, and those included in each area are sometimes tender in diseases of the organ to which the letters refer.

hyperalgesia in the skin and muscles of certain definite areas, at some distance from the spinal column. Such hyperalgesic areas are supplied by the nerves that issue from the cord at the level of the tender vertebræ. The skin over the vertebræ may not be hyperalgesic, so that the pain is elicited from deeper structures. The pain is referred to the region of the vertebræ that are tender. These tender vertebræ must not be confused with the spinal tenderness so common in certain neurotic cases. In these latter the tenderness is not limited to a few vertebræ, but the whole spine is tender on pressure. In 1892 I gave a figure showing the vertebræ that I found tender in association with lesions of certain organs, and continued observation has confirmed the opinion there expressed. The vertebræ that are tender in association with the different organs are shown in Fig. 2.

If the visceral origin of the tenderness of these vertebræ be not kept in view, an error in diagnosis may result from the fact that the tender vertebræ may be looked upon as evidence of disease of the spinal column. This is all the more likely to be the case if there is well-marked evidence of cutaneous hyperalgesia. I have seen a patient encased in a plaster of Paris jacket on the recommendation of a distinguished neurologist, because of an extreme tenderness of the sixth and seventh dorsal vertebræ, and a band of marked hyperalgesia of the skin around the left half of the upper part of the abdomen. At the post-mortem examination no disease of the spinal column could be detected, but there was a cancer at the cardiac end of the stomach.

CHAPTER VII.

THE VISCERO-MOTOR REFLEX.

37. DEFINITION. — By the term viscero-motor reflex I mean the contraction of voluntary muscles in the external body wall in response to a stimulus arising from a viscus, as distinct from the normal superficial reflex where the muscle gives a brief contraction in response to a stimulus from the skin (as the plantar reflex). Everyone is familiar with the viscero-motor reflex, which is best seen in the board-like hardness of the abdominal wall in certain visceral diseases. A similar reflex is found in the muscles of a limb when an adequate stimulus arises from an inflamed joint. A shoulder joint may be absolutely immobile on account of the strong tonic contractions of the surrounding muscles. If the

patient is put deeply under chloroform the muscles relax, and the joint can be freely moved, and while being moved a grating may be detected. As the patient recovers from the general anæsthetic, the muscles again become firmly contracted and fix the joint.

38. Effects of the stimulation of Motor Nerves on Limb Muscles and on Abdominal Muscles.—It is in the muscles forming the abdominal wall that this reflex can best be studied. Some years ago I pointed out that these muscles could be demonstrated to possess the power of contracting in small sections in response to visceral stimulation. Later I found that Sherrington had described a difference in the reaction to nerve stimulation between these flat muscles and the muscles of the limbs. The fibres that constitute the nerve supply of any given muscle leave the spinal cord in separate bundles. If one of these bundles be stimulated the whole length of a limb muscle like the sartorius will contract. On the other hand, if one of the bundles that constitute the nerve supply of one of the abdominal muscles be stimulated, only a portion of the fibres of the muscle will contract.

The contraction of a small portion of the abdominal muscle, in response to a visceral stimulus, may remain for an indefinite period. The limited hardness thus arising gives to the palpating hand the impression of an underlying tumour, and not only does it give the impression, but it is often mistaken for a tumour. I have, on several occasions, seen experienced surgeons and physicians make this mistake, and at the subsequent operation no tumour was found. This hard contracted portion of a muscle

is often hyperalgesic, and its tenderness is readily mistaken for an evidence of the sensitiveness of the supposed "abdominal tumour."

The extent of this contraction of the abdominal muscle is variable. In appendicitis it may be limited to a few strands of muscle, which may be mistaken for the appendix itself. It may be more extensive and resemble a rounded tumour, and this, in appendicitis, is often mistaken for swelling in and around an appendix (the perityphlitis of olden days). On the other hand, the whole of the right side of the abdomen, and even a portion of the left, may be found hard and board-like.

39. The character of the Viscero-motor Contraction.—There are features in these contracted muscles that have not been appreciated, and which open up some new points in the physiology of contracted muscle. As a rule the contraction is long continued, lasting it may be for days or weeks—or it may be months—as long as the visceral lesion keeps up an adequate stimulus. As a rule it begins as a slight increase in the tonicity of the muscles, and is detected through one side of the abdomen or one portion of a muscle being a little more resistant than other parts. At this stage it is readily provoked to a strong and firm contraction by palpation. If, as often happens, the skin or the muscle itself is hyperalgesic its reflex contraction is very readily induced, but after the contraction it remains for a time strongly contracted. Thus, in palpating the epigastrium in cases of gastric ulcer, if the part is not explored with gentleness the muscles immediately become violently contracted, and remain strongly contracted. On the other hand, if very

gently palpated, all that can be detected is a resistance slightly greater than normal, and with the slightest increase of pressure an increase in the hardness of the muscle is produced.

When this contracted muscle is examined under chloroform certain characteristic features are found. It is, as a rule, the last portion of the muscular system to yield to the influence of the anæsthetic, remaining hard and contracted when all the other muscles are limp and flaccid. The chloroform has often to be pushed, and even in deep anæsthesia no relaxation may take place. I have sometimes observed that the muscles yield after an attack of sickness. In many cases the contraction persists, however deep the anæsthesia, and however long it may be pushed. In such instances, when the muscle is cut during an operation the fibres remain stiff and unyielding, and one is much hampered in forcing an opening through the cut muscle. Thus, in one case of appendicitis the muscle was rigid and hard, and gave the impression of an underlying tumour. When cut the fibres would not yield, and I had much difficulty in getting my finger in to explore the abdomen. There was no underlying tumour, and the peritoneum and bowel in the neighbourhood were perfectly healthy. Deep down an inflamed and suppurating appendix was found.

The contraction may come on suddenly with the sudden onset of some visceral trouble. Thus, in a case of renal calculus, cited on page 44, the onset of pain was immediately succeeded by the contraction of the abdominal muscles, and the patient was also conscious of the contraction of the cremaster muscle by the pulling up of the testicle. In angina pectoris

the sudden onset of the powerful contraction of the intercostal muscles is recognised by the feeling of compression of the chest, which is so great at times that the patient states that he feels as if his breast-bone would break.

40. Conditions causing the Viscero-motor Reflex.—There are many conditions which produce this reflex. Peritonitis causes it, and as the muscle is usually also tender, these symptoms of hardness and tenderness of the abdominal wall have come to be looked upon as undoubted evidence of peritonitis. But these symptoms may be, and often are, present with absolutely no peritonitis. Thus, I have found tenderness with firm contraction of the lower part of the left rectus abdominis muscle in a case of stone in the bladder without peritonitis. Hardness and tenderness of the recti over the epigastrium is common in gastric ulcer, and I have found these symptoms without any peritonitis. I have also found hardness over a limited area in the left lumbar region due to a tuberculous ulcer in the posterior wall of the descending colon, and there was no peritonitis underlying the hard and tender muscle. In like manner widespread tenderness of the abdominal wall with hard contraction of the whole abdominal muscles may occur without any peritonitis. As illustrating the extensive muscular contraction due to visceral stimulation I cite the following case : I was summoned to operate upon a fellow practitioner for obstruction of the bowels. The symptoms were, no movement of the bowels for two days, nor had any flatus been passed; some vomiting, but not fæcal; considerable abdominal distension, with great hardness of the whole abdominal wall, and pain on

the slightest pressure. Some difficulty was experienced in passing the finger into the bowel on account of the strong contraction of the sphincters. The patient had severe attacks of pain every few moments. The pain began in the left lumbar region, passing forwards and downwards towards the pubes. Pain was felt on light pressure on the left testicle. From the situation of the pain, and the tenderness on pressing the left testicle, I had no hesitation in recognising the condition as one of renal calculus. In my experience the pain in obstruction of the bowel is never so distinctly one-sided. The inability to have the bowels moved was simply due to the violent contraction of the sphincters, such contraction, with the contraction of the abdominal muscles, being due to the renal calculus. The diagnosis was confirmed by the passage of a calculus next day with immediate disappearance of all the symptoms. This patient had two subsequent attacks with a repetition of all the foregoing symptoms. The contraction of the muscles was undoubtedly due to a violent stimulation passing from the affected organ to the spinal cord. There the irritation spread, affecting not only the centres of the sensory nerves, but also the centres of the motor nerves. These stimulated gave rise to violent muscular contractions—the viscero-motor reflex.

41. Experimental production of the Viscero-motor Reflex.—Professor Sherrington has recently been making an investigation into the effects produced in the abdominal muscles by stimulating the sympathetic nerves. He dissects out and divides a branch of the solar plexus going to the bowel, and stimulates the central end. There is an immediate

response in the broad muscles of the abdomen, which contract over an extensive area. By dividing one after another the anterior roots of those spinal nerves that supply this extensive area, the extent of the contraction becomes greatly limited until when there is but one posterior root left intact the contraction becomes limited to a few fibres of the muscle.

This investigation is not yet completed, Professor Sherrington having given me this verbal description; but it is not necessary here to insist further upon the matter than to point out that the recognition of the visceral nerve that is capable of producing a given contraction of a limited portion of the muscle will prove an invaluable aid in diagnosis.

CHAPTER VIII.

ORGANIC REFLEXES.

42. *Vomiting.*
43. *Dyspnœa.*
44. *Secretory Reflexes.*
45. *Cardiac Reflexes.*
46. *Vaso-motor and Pilo-motor Reflexes.*

There are a number of reflex acts, apart from the viscero-sensory and viscero-motor reflexes, produced by the stimulation of centres in the spinal cord and medulla from a viscus. These acts may be very complicated, bringing into play a large number of subsidiary centres as in the reflex act of vomiting, or they may result in the stimulation of some gland as the salivary or the kidney. Many of these reflex acts are obscure, as the vaso-motor, and there are probably others we have not yet attained the means of detecting.

42. VOMITING.—Vomiting is due to the stimulation of a centre in the medulla, and this may be played upon from a great many sources, as from irritation of the stomach, from disturbances in the brain, impressions made on the senses of smell and sight. It is frequently set up reflexly from stimulation of the viscera of the abdominal cavity as in affections of the liver or bile ducts, kidney, ureter,

uterus, ovaries, testicle. Its occurrence with contraction of non-striped muscle is a curious feature. In labour an attack of vomiting may be induced at the same time as a uterine contraction. Colic due to renal calculus and gall-stone—the pain arising from contraction of the ureter or gall duct — is often accompanied with vomiting. This association of vomiting with the contraction of hollow muscles, so common in abdominal organs, never occurs in affections of the heart or lungs, nor in affections limited to the bladder or rectum. I do not remember ever seeing vomiting arise as a reflex in heart affections, nor for that matter from a lung affection. One may get vomiting from the stress of coughing, as in phthisis or whooping cough, but it is doubtful if it arises as a reflex from stimulation of the lungs or pleura. In acute febrile conditions vomiting may arise, as in kidney disease, from some general poisoning effect.

43. Dyspnœa. — The centre for respiration is also in the medulla, quite close to the vomiting centre. Dyspnœa may arise directly from the prevention of the entrance of air into the lungs, or because the blood does not take up a sufficient amount of oxygen. It may be excited reflexly also, as seen on the application of a peripheral stimulus (immersion in cold water causing a deep inspiration). In affections of the lung, as pneumonia, pulmonary apoplexy or infarcts, intense dyspnœa may arise, far greater than the mere occlusion of the air cells would account for, and it is generally assumed that this breathlessness is due to a reflex stimulation of the respiratory centre. Thus I have seen a patient seized with an attack of pulmonary apoplexy of

small extent, and breathlessness of great severity supervene. After lasting a few hours the dyspnœa would suddenly cease, and the patient breathe comfortably. Some forms of asthma are undoubtedly reflex. Dyspnœa may arise in heart affections as a pure reflex, altogether apart from the amount of blood that is supplied to the lungs. This is best seen in cardiac asthma, and can be demonstrated in some cases where there is enlargement of the liver. Gentle pressure on the liver with both hands will fill the right heart and distend the veins in the neck, and the patient will at once experience a feeling of dyspnœa. The sense of breathlessness is of great importance in the examination of cases of heart failure.

The possibility of a reflex spasm of the bronchial muscles should be kept in mind, in view of the fact that all non-striped muscles are liable to be played upon, and a prolonged contraction produced.

44. Secretory Reflexes.—When the stimulus from a viscus reaches a part of the spinal cord where arise nerves supplying glands, increased flow of secretion occurs. This is best seen in the kidney and salivary glands. In a number of cases of angina pectoris the pain may extend to the jaws, and the saliva may dribble from the mouth. A similar reflex affects the kidney. Some individuals, after an attack of severe pain, as angina pectoris or headache, or after some stimulation of an organ, such as paroxysmal tachycardia or mental excitement, have a desire to micturate and pass a large quantity of pale urine of low specific gravity. These two reflexes are due to stimulation of centres in the medulla. Wherever the nerve centres supplying separate organs are in

close approximation, the stimulation of one viscus may affect another. In many cases of sub-acute appendicitis, for instance, there is frequent micturition though the appendix may be situated at some distance from the bladder.

From the consideration of these organic reflexes it is clear that there must be some special connection from such remote organs as the testicle and ureter (severe vomiting may occur in orchitis and in renal colic) and the medullary centres, probably by some special path in the spinal cord. In certain cases the stimulus may reach the medulla by the afferent fibres of the vagus.

45. Cardiac Reflexes.—Of all viscera the heart is the most sensitive to stimulation, and the result of stimulation is most readily recognised. This readiness to respond to stimulation is necessary to the demands of the economy, for it is on this account that effort can be undertaken with ease and comfort, the heart rate increasing with the demand made by effort. The heart is so readily susceptible to so many influences that it is often impossible to determine the mechanism by which its changes in action are brought about. Mental impressions have so powerful an effect that reactions playing first upon the mind may secondarily affect the heart, and it is difficult in many cases to tell whether the heart's stimulation is direct or secondary to the mental stimulation. Temperature has also a very marked influence on the heart apart from the toxins which cause the rise of temperature. Toxins may at the same time have an influence on the heart, so that it is impossible in many cases to tell how much of the heart's reaction is due to the rise in temperature,

and how much to the infection. Experimentally it is known that by such means as pinching the stomach wall, reflex stimulation of the heart takes place through vagus excitation, and even the act of swallowing in man can sometimes be shown to affect the heart. Hence it is often assumed that many abnormalities in rate and rhythm of the heart are of visceral origin, and this may be so, as one sometimes finds certain irregularities increased by stomach disorders. Nevertheless one has to be very careful before accepting such conclusions, as a very great many abnormalities in the heart's action are attributed to reflex stimulation when the real cause is in the heart itself.

46. Vaso-motor and Pilo-motor Reflexes.—The peripheral circulation is also susceptible to reflex stimulation through the influence of the vaso-motor nerves. Except in such cases as flushing and the redness or heat of the ears or of the cheek in pulmonary affections, vaso-dilator reflexes are not often recognised. Vaso-constrictor effects are more common though they have not been sufficiently investigated. As they are often accompanied by the pilo-motor reflexes they are often assumed to be due to the pilo-motor reflex. Thus the sensation accompanying the appearance of "goose-skin" is usually put down as a goose-skin sensation. Goose-skin is due to the contraction of the muscles attached to the hair roots, and, doubtless, their contraction does give rise to a sensation as when one feels the hair rise on the scalp. But the curious chilly sensation is due to a vaso-constrictor effect, for it can be felt in regions where there are no pilar muscles, as on the ulnar border of the hand. The explanation I suggest

is that the stimulation which causes the pilar contraction causes also a vaso-constriction, for the pilar and vaso-constrictor nerves both belong to the autonomic system, and are associated in their origin and distribution. This association is well brought out in the following experiment. If in a suitable case the skin under the nipple be given a smart rub with a piece of flannel, the goose-skin will be seen to arise over the part rubbed, then to spread up the chest to near the clavicle, and on to the inner side of the upper arm and forearm. At the same time the individual may feel the curious chilly sensation passing from his chest into his arm and to the ulnar border of the hand. The reason for this distribution is that the stimulus produced by the rubbing has reached in the spinal cord the centres of origin of the pilo-motor and vaso-constrictor nerves, and passed up this region for some little distance. That this is so can be inferred from the fact that the pupil will be seen to dilate at the same time. The dilator pupillæ nerve, according to Langley, leaves the cord at the place where this stimulation has taken place—that is to say, by the upper thoracic nerves. In one instance, a patient described always a chilly sensation in his cheek when I tried this experiment on him, and Sherrington says that in stimulating the sympathetic fibres issuing with the third thoracic nerve in the monkey, he produced elevation of the hair of the cheek.

CHAPTER IX.

LAWS DETERMINING THE NATURE OF THE REFLEX SYMPTOMS.

In this chapter I give a *résumé* of the foregoing observations in order to bring clearly forward the mechanism of the production of the reflex symptoms.

47. MECHANISM OF THE PRODUCTION OF "DIRECT PAIN" AND "REFERRED PAIN."—From what has been said in regard to the production and recognition of pain it will be realised that from the practical and clinical point of view pain can arise from peripheral stimulation in two ways, what may be called "direct pain" and "referred pain." Leaving out of consideration the pain arising from direct implication of the nervous system by disease (as affections in the nerve-trunks and in the central nervous system), and considering only the pains arising from stimulation

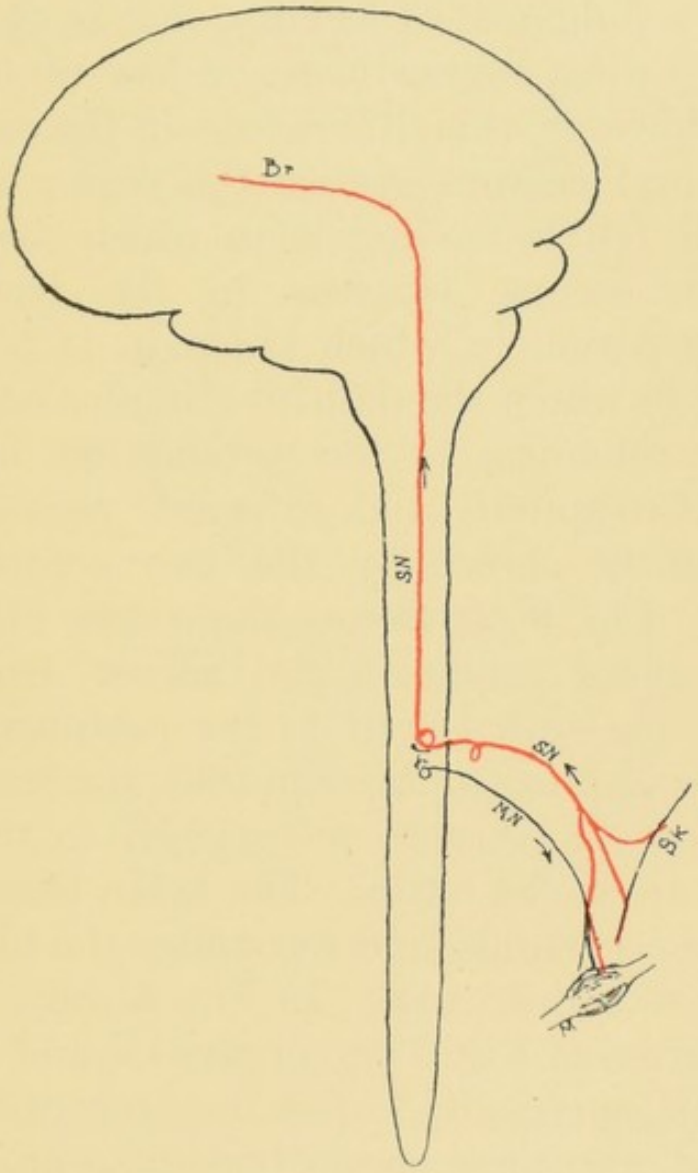


FIG. 3.

Diagram to represent the mechanism of pain and the superficial or skin reflex arising from stimulation of a sensory cerebro-spinal nerve (SN). An adequate stimulus applied to the skin (Sk) or to any part of the sensory nerve (SN) in the external body wall, spinal cord or brain is perceived by the brain (Br), and referred to the peripheral distribution of the nerve in the external body wall (Sk, M). The stimulus from the skin may in the spinal cord pass to the cell of a motor nerve (MN) and stimulating it cause a contraction of a muscle (M).

of the peripheral distribution of the cerebro-spinal and of the sympathetic nerves, we recognise that pain induced in either case is always accompanied by a judgment of locality, that is, the pain is referred to some region more or less well defined. There is, however, this difference—in the case of the cerebro-spinal nervous system the region in which the pain is felt is the region in which the painful stimulation occurs, whereas in the sympathetic system the region in which the pain is felt is *not* the region in which the painful stimulus occurs.

The mechanism of the production of direct pain (cerebro-spinal) and referred pain (sympathetic) can be shown by the two accompanying diagrams. Fig. 3 represents the course of the sensory and motor cerebro-spinal nerves from their centres in the spinal cord to the periphery. If a stimulus be applied to the skin (Sk), the sensation is conveyed by the sensory nerve (S N) to the spinal cord, and up to the brain. The brain becomes conscious of the stimulus, and recognises the place from which the stimulus arose. In Fig. 4 there is added to the diagram of Fig. 3 two organs (V and V′) with sympathetic nerves (SyN) passing from them to the spinal cord, and these nerves terminate in cells near to the motor and sensory cells connected with the motor and sensory nerves (M N, S N).

A stimulus, adequate to produce pain, arising in the organ V passes to the spinal cord, extends beyond its own nerve cell and affects neighbouring cells. These cells being thus stimulated respond according to their function, so that when the sensory cell is stimulated pain arises and the brain recognising this pain forms, at the same time, a judgment

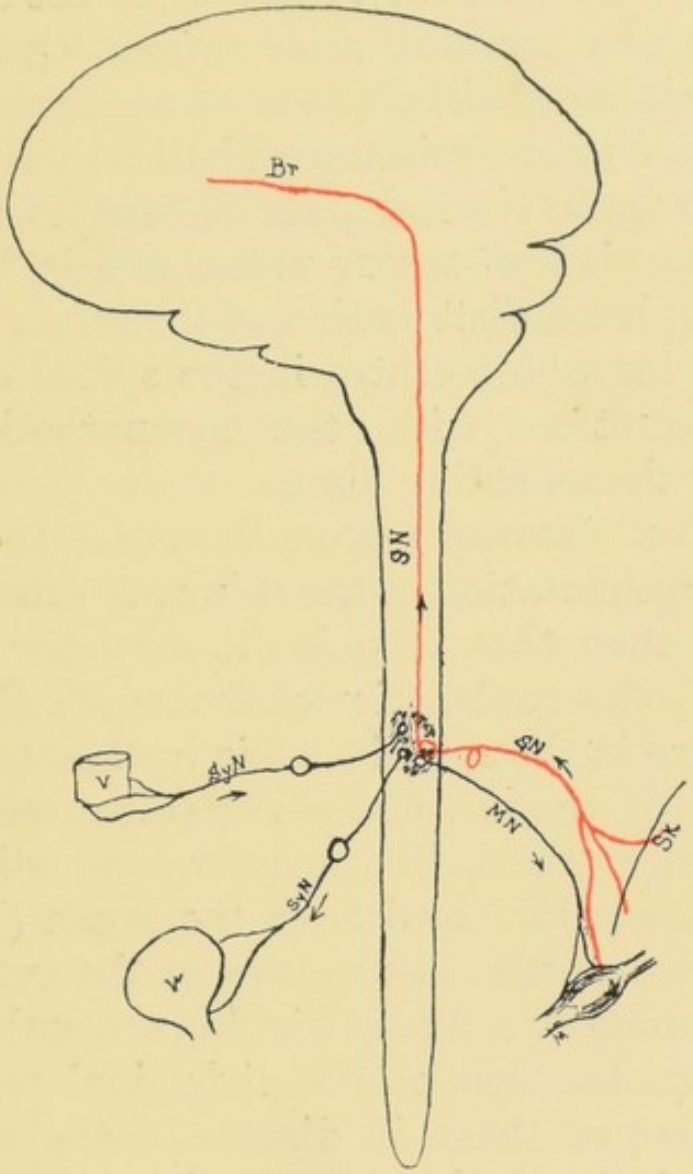


FIG. 4.

Diagram to represent the mechanism of visceral pain, cutaneous and muscular hyperalgesia (viscero-sensory reflex), the viscero-motor reflex, and the organic reflex. An adequate stimulus proceeding from the organ, V, by the sympathetic nerve, SyN, to its centre in the spinal cord extends to the cells of nerves in its neighbourhood, and stimulates them to activity, when the function peculiar to each nerve is exhibited. Thus the stimulus affecting the cells of a pain nerve, SN, results in the perception of pain which is referred by the brain to the peripheral distribution of the nerve in the external body wall (Sk,M); affecting the cell of a motor nerve, MN, causes a contraction of the muscle, M, supplied by the motor nerve; affecting the cells supplying other viscera (as V') stimulates them to their peculiar function (contraction of a hollow muscular viscus, increased secretion of a secretory organ). If the stimulus be of sufficient strength it may leave an irritable focus in the spinal cord (shaded area) as shown by a persistent hyperalgesia of skin and muscle (Sk,M) and by a persistent contraction of the muscle (M).

of locality. That locality, however, is not the region where the pain stimulus arose (organ V), but at Sk in the peripheral distribution of the sensory nerve whose centre in the spinal cord had been stimulated. For this reason visceral pain is seen to be of the nature of a viscero-sensory reflex, and is "referred" to the peripheral distribution of the sensory cerebro-spinal nerves whose centre in the spinal cord is in close association with the sympathetic centre supplying the offending viscus.

48. The Viscero-motor Reflex.—In diagram Fig. 3, the stimulation of the skin may produce other symptoms than that of pain; it may, for instance, produce a reflex contraction of the muscle (M), whose nerve centre in the spinal cord is in close association with that of the sensory nerve (the superficial or skin reflex). In a like manner the stimulation reaching the spinal cord from the organ (V Fig. 4) may produce a reflex contraction of the same muscle (the viscero-motor reflex). It is this reflex that causes the hard contraction of the abdominal muscles, or some portion of them, in disease of the abdominal viscera and the mechanism of their production is shown in Fig. 4.

49. The Organic Reflexes.—In Fig. 4 there is also shown in the spinal cord the close association of the nerve centres from the viscus V, with that of the viscus V′. It has already been pointed out that a stimulus reaching the spinal cord may, if of adequate strength, stimulate other nerve cells in its neighbourhood, and these respond according to the nature of their functions, producing pain and muscular contraction as we have seen. If the nerve supply of another organ be stimulated then that organ will

respond according to its peculiar function, so that in the affection of one viscus we may get reflex stimulation of other viscera, as in the frequent micturition from stimulation of the bladder centre in appendicitis, or increased flow of urine or saliva in angina pectoris. Our knowledge of the exact relationship of nerve centres does not permit of the real mechanism being always ascertained, but the clinical facts point to a relationship as in the production of vomiting from organs so remote as the testicle and uterus.

50. Irritable Foci in the Spinal Cord.—If the symptoms arising in cases of visceral disease be analysed after the manner in which a focal lesion in the brain or spinal cord is analysed, then the true nature of the symptoms present will be appreciated. This manner of looking at the subject will demonstrate that in many cases of visceral disease nearly the whole of the symptoms present are really due to a stimulation of a limited portion of the central nervous system. Thus, the shaded portion of the spinal cord in Fig. 4 may be looked upon as being rendered abnormally excitable in consequence of a violent stimulation from the organ V. All the centres in this region become abnormally sensitive to stimulation, and this is recognised by the exalted functions of organs supplied from this region (hyperalgesia, muscular contraction, and undue activity of other organs).

The stimulus that has had so marked an effect upon the spinal cord not only produced the characteristic reflexes just described, but has rendered the sensory centre abnormally sensitive so that the area stimulated is left in a condition of excessive

irritability. Thus, the hyperalgesia of skin and muscle that is often so marked a feature in visceral disease is due to the fact that a stimulus, which would normally produce no painful sensation on reaching the spinal cord, excites an abnormally sensitive centre, with the result that the sensation of pain is felt. That this is the explanation is shown by the further fact that a stimulus reaching this excitable area in the cord from other sources also produces pain which is referred to the hyperalgesic tissues (skin or muscle). Thus, in a case of gall-stone colic, accompanied by jaundice, there was also extreme hyperalgesia of the skin of the upper part of the abdomen, especially marked in the epigastrium. This persisted for some days after the stone had passed and had been found in the stool. During the time the hyperalgesia persisted, food taken into the stomach produced severe pain referred to the epigastrium. With the disappearance of the hyperalgesia of the skin the pain, on taking food, ceased. Here there seems little doubt that the stimulation set up by the ingestion of food, which normally passes to the spinal cord unperceived by the brain, reached that portion of the cord which had been abnormally excited by the gall-stone colic. The irritable focus thus produced in the cord had extended to the centres of the cutaneous nerves for pain which supply the epigastric region, so that the brain now perceived the stimulation as pain and referred it to the peripheral distribution of the nerves thus stimulated.

I have lately been observing another remarkable manner in which these abnormally sensitive foci in the cord may be stimulated. My attention was

directed to this aspect of the question by the following experience: A lady who suffered from endometritis experienced pain in her back across the top of the sacrum, with tenderness and stiffness of the muscles of the back in the lumbar region. She told me that if she were startled, as by the banging of a door, a pain would suddenly shoot into this tender region of the back.

I have made inquiries of a number of other patients, and have found abundant corroboration of this experience; so much so that many people in whom there is a hyperalgesic area (cutaneous or deeper) experience a sudden pain in that region when startled. Thus, one patient, who suffers from a gastric ulcer, was frightened, on her way to consult me, by being accosted by a drunken man, and she felt a severe pain in the epigastrium at the same time. In her case there was a great tenderness of the skin and muscles of the epigastrium on light pressure. Another patient, with a dilated heart and great tenderness of the left side of the chest, described how some one unexpectedly laid a hand upon her shoulder, so that she started, and at the same time a severe pain struck into her left breast. The explanation I give for the occurrence of these pains is that, when startled, a stimulus passes down certain tracts of the spinal cord, affecting normally the centres of the muscular nerve supply, as evidenced by the sudden contraction of nearly all the muscles of the body. The stimulus is not of sufficient strength to affect the sensory nerves in a healthy cord, but when there are abnormally irritable foci the stimulus, passing through these, affects the excitable sensory nerve centres, and the pain so arising is

referred to the peripheral distribution of the nerve stimulated. It may be that the pain is produced by a stronger and painful contraction of the excitable and hyperalgesic muscles.

A somewhat similar result follows on extra stimulation of motor nerves whose centres are excited by visceral stimulation. When there is an exalted viscero-motor reflex, the muscles are in a permanently more contracted condition than that which the normal tonicity maintains, as evidenced in the flat muscles of the abdomen by the greater or less hardness with which we are all familiar. This is due to their being exercised in their function as part of the protective mechanism. If now they be exercised in their other functions by assisting in the movements of the body the combined result of these two stimuli is to produce a continuous shortening of the muscle. This was remarked in the case of appendicitis, cited on page 42, where the psoas muscle caused the patient to stoop when she walked a short distance. In another patient, who suffered from renal colic, after an attack had passed there always persisted for a few days a slight tenderness and rigidity of the lower part of the right rectus muscle. When he went about the whole of the muscle became so contracted after a few hours that he could not straighten himself, but walked with his body slightly bent. After a short rest the contracted muscle would slightly relax. A similar condition is found in those cases of "lumbago" where the pain and stiffness of the muscles arise from some pelvic trouble—endometritis, hæmorrhoids, etc.

51. Exaggerated Reflexes due to Irritable Foci in the Cord.—In all these hyperalgesic areas

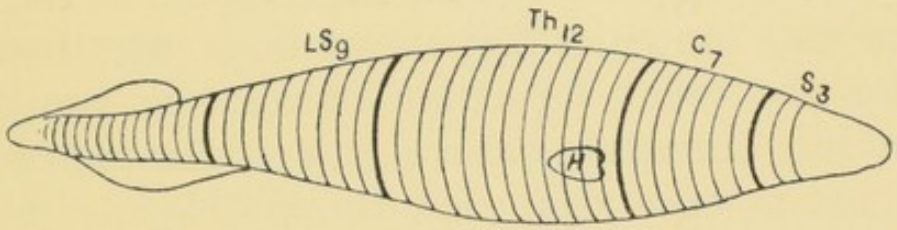


FIG. 5.

Diagrammatic representation of a primitive vertebrate animal—the Amphioxus—divided for convenience into three segments for the head, seven for the neck, twelve for the thorax, nine for the lumbo-sacral region, and an indefinite number for the coccygeal region. For clearness of comparison the heart (H) is represented as occupying the same position as in man, so that an adequate stimulus from the heart would cause pain in the distribution of the four upper thoracic nerves covering and protecting the heart. Compare distribution of thoracic nerves with Fig. 6. (*After Ross*).

due to a focal irritation of the spinal cord the ordinary cutaneous reflex is more easily excited and the muscular response more vigorous and often more prolonged than normal. I need not labour this point as the fact is so readily demonstrated, and every one is familiar with the hardening of the abdominal wall when any tender part is palpated with even very gentle pressure. This springing up of the hardened muscle serves as an efficient protection of the underlying viscera, and the purpose of the cutaneous and muscular hyperalgesia is manifestly to render the reflex muscular contraction rapid and powerful. In severe cases this muscular contraction does not at once relax, but the muscle may remain contracted for long periods, and even under deep anæsthesia.

52. Relationship of Visceral Lesion to Site of Reflex.—Recognising the fact that the pain and other sensory phenomena are to be found in the peripheral distribution of some cerebro-spinal sensory nerve, it is necessary for the detection of the offending viscus to know the relationship between the distribution of the cerebro-spinal nerves in the external body wall and the individual organs. In the primitive vertebrate, before the development of the limbs, each spinal nerve is distributed round the body. The sympathetic nerves supplying the viscera issue from the cord with the cerebro-spinal nerve and supply the viscera at the same level, so that the nerve supply of the organ and the nerve supply to the covering external wall arise from the same region of the spinal cord.

In Fig. 5 there is a diagram showing the position of the heart in a primitive vertebrate. From the

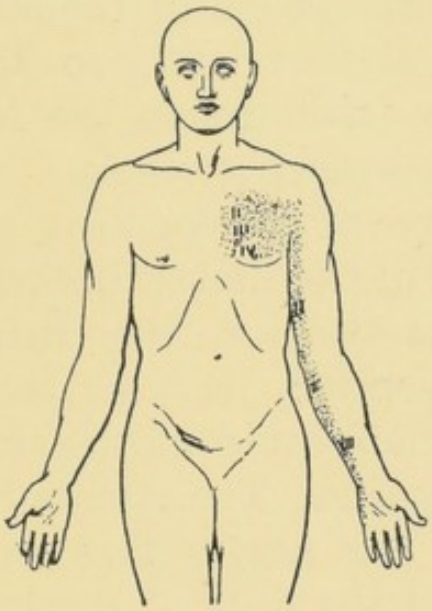


FIG. 6.

The shaded area shows the distribution of the pain and cutaneous hyperalgesia in a typical case of angina pectoris. The roman numbers refer to the nerves implicated, viz., I, II, III, and IV, thoracic nerves, and VIII, cervical nerve. Compare the nerve distribution with Fig. 5, and the shaded area with the position of the herpetic eruption in Fig. 7.

spinal cord the nerves pass to be distributed around the body wall. In addition to these, a branch is given off which runs to the sympathetic ganglia to be distributed to the heart (H). When a stimulus of adequate strength passes from the heart through the sympathetic to the spinal cord the result is shown in the stimulation of the sensory and motor nerves arising at that level, so that these reflex phenomena are exhibited in the immediate neighbourhood of the suffering viscus.

In the course of development, particularly with the appearance of the limbs, this relationship of the situation of the viscus to the distribution of the allied cerebro-spinal nerves becomes modified, although the relationship of the spinal and sympathetic nerve remains. The viscera become displaced backward, and the nerves that were wont to run traversely round the body at the level of their exit from the cord become distributed in an apparently irregular fashion. Thus, the lower cervical and upper thoracic nerves are distributed mainly in the arm, so that the nerves supplying the skin over the clavicle, and as low as the second rib, come from the fourth cervical, while the adjacent skin lower down on the chest is supplied from the second thoracic nerve—the intervening nerves being distributed in the arm. The sympathetic fibres supplying the heart arise from the spinal cord at the level of the upper thoracic nerves, so that the pain in affections of the heart is felt in the distribution of these nerves. In the case of the primitive vertebrate represented in Fig. 5, the pain would be over the heart, whereas in man the pain is felt not only over the heart, but in the arm, where the upper thoracic

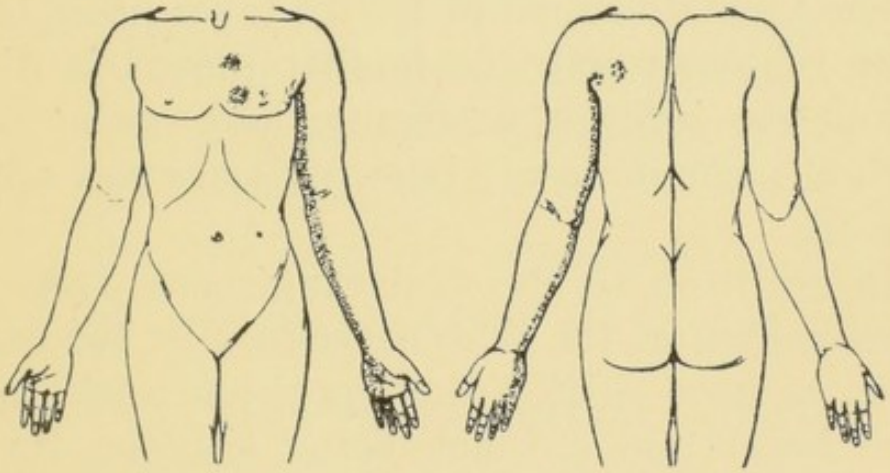


FIG. 7.

The shaded areas show the distribution of the eruption in a case of herpes zoster affecting the upper thoracic nerves. (Compare with the area of hyperalgesia in Figs. 6 and 18).

nerves are distributed, and this accounts for the characteristic distribution of the pain in angina pectoris (Fig. 6).

In herpes zoster there is an inflammation of the ganglia on the posterior roots of the spinal nerves, and when the ganglia on the upper thoracic nerves are affected, the eruption has a distribution closely resembling the hyperæsthetic area in angina pectoris (compare Fig. 7 with Fig. 6).

The same diversion of nerves takes place in the lumbar region, where the lumbar plexus is distributed to the inferior extremity, and, as a consequence, the symptoms of visceral disease may appear in the leg.

In addition to the disarrangement from the primitive plan of the limb nerve-supply, the organs themselves have shifted their position, such organs as the heart and stomach being situated further back, while the testicles migrate far away from their embryonic position.

It is in consequence of this diversion of nerves and displacement of organs that the symptoms arising from a viscus may be exhibited at some considerable distance from the situation of the viscus.

CHAPTER X.

PRELIMINARY EXAMINATION OF THE PATIENT.

53. THE PATIENT'S APPEARANCE.—Before entering upon the physical examination of the patient, the physician ought to obtain a clear and comprehensive appreciation of the patient's own sensations. I therefore wish to insist upon the importance of the preliminary examination, which may be of more value in arriving at a correct estimation of the patient's condition than the most elaborate methods of physical examination. The attempt to appreciate the patient's condition should begin when first he presents himself. On his appearance in the consulting room, his bearing, his gait, the condition of his respiration, the colour of his face, any nervous peculiarity in his manner of speech and behaviour, and so forth, should be noted. If he is in bed, note the position he assumes, and any change in his colour or respiration in response to such exertions as talking or turning over. By habit one unconsciously

notices these things, and as the examination proceeds, first one trivial matter, then another, may arise, which helps materially in guiding the examination, and in forming the final opinion.

54. The Patient's Sensations. — After ascertaining the patient's name, age, and occupation, ask him to describe briefly his chief symptoms. After this inquire into the history of any previous illnesses or circumstances that may have a bearing on his present condition, as the nature of his work, condition of worry, bygone adventures, and hereditary pre-disposition. The data thus elicited will serve as a guide to a further inquiry into the symptoms of which the patient complains. This should be undertaken with the greatest minuteness, and the answers should be precise and definite. When the patient refers to his sensations, get him to indicate the location by placing his hand over the region, and on no account be content with his assertion that his sensation has been felt in some viscus, as the stomach, heart, bladder. When any disagreeable sensation as pain is complained of, get a clear knowledge of the very earliest circumstances under which it was produced, the situation in which it was first felt, and the areas into which it spread. In the same way, if it is breathlessness, the first sign of its appearance and the circumstances that induced it. In putting the questions the doctor should have a definite purpose in view, based on the statements made, but the questions must not be put in such a manner that the patient will divine the drift. It may be necessary, however, to ask leading questions, when it is suspected that other symptoms may have been present which the patient has overlooked.

For instance, I have found patients dwell upon symptoms referable to the epigastric region and assumed to be gastric in origin; further inquiry as to whether there had been any pain in the shoulder has frequently brought forth the answer that severe pain had been felt on the top of the right shoulder, but it was thought to be rheumatic or neuralgic. The recognition of this pain then leads to the suggestion that all the symptoms may be due to gall-stones. In the same way, in obscure cases of pain in the lower part of the abdomen, the question whether the testicle was ever sore and tender has sometimes brought out the answer that the breeches seemed at times too tight, and were supposed to be the cause of the testicular pain. The presence of this testicular pain in such cases is often suggestive of renal calculus.

It will be frequently found that the symptom, such as pain even of the most severe type, is described so vaguely that no definite idea can be obtained in regard to its manner of onset, site, or radiation. In such cases, if the patient be asked to note these particulars next time the suffering arises, he will often be able to give a very clear and instructive account of his symptoms.

I have said that a patient's answer that pain, or any other sensation, was felt in an organ should never be taken. I may add a warning to the doctor not to make a note of the sensation by attributing it to any viscus; thus, a pain should not be noted as felt in the heart, stomach, liver, or lungs, but only in the region indicated by the patient's hand, for it will probably be found, on later examination, that the disease was not in the supposed viscus. In other

words, he should make no notes that might prejudge the nature of any symptom until he has all the evidence before him. The results of this inquiry will be a guide in the physical examination of the patient, when corroborative evidence may be found in areas of hyperalgesia of the skin and muscles, in contracted muscles, or in functional or structural symptoms in certain of the viscera.

55. Facial Aspect.—The first glance may at once dispel the consideration of a large group of complaints, as when a face is healthy-looking and well-nourished there is no need to fear the presence of any malignant or exhausting complaint. When there is an absence of this healthy tinge the recognition of faint and subtle changes is useful. A slight duskiness of the cheeks or lips indicates imperfect aeration of the blood, and leads first to the consideration of the pulmonary or cardiac condition. A faint tinge of yellow in the duskiness raises the suggestion of liver engorgement. This faint yellow tinge is present in many conditions, as in pernicious anæmia, malarial cachexia, and the cachexia of malignant disease. A mere suspicion of jaundice of the skin and conjunctiva, as in certain cases of gall-stone disease, may give to the face the suspicious look of a malignant cachexia, and so also will certain forms of heart failure, particularly that form which is often accompanied with wasting. In the latter case the evident heart trouble gives a key to the nature of the enlarged liver, which is usually present. A dirty greyish aspect is sometimes seen in aortic disease.

Pallor is a common feature, and while it may indicate an anæmia (as chlorosis), yet it is natural

to many families, and one not infrequently sees such people undergoing treatment for "anæmia." In elderly people the pallor may indeed be associated with various complaints, and it is often difficult to tell what importance should be attached to the symptom. I think on the whole the presence of a sallow tinge is the most constant sign of malignancy—bearing in mind what I have just said of the presence of a slight jaundice in heart affections and gall-stone. When people past the middle age suddenly develop a pallor, the sign is one of grave significance, and may be the first clue to the beginning of some malignant affection (pernicious anæmia). Other conditions should be recognised, as the flushed turgid countenance of Graves' disease. Staring eyes, while manifestly indicating the nature of the complaint, may not be very distinctive, but a slight prominence, which may momentarily increase while the patient is being questioned, may be detected.

It is not possible here to detail the many other instructive signs which the facial aspect presents, but I quote the foregoing as being the most common, and would insist on the routine study of the face all the time the patient is being questioned. As a disease progresses the facial aspect should be watched. In some, particularly in children, a sunken expression may appear in the course of an attack of diarrhœa or pneumonia, due to a shrinking of the contents of the orbit and of the cheeks—often heralding a fatal issue. In the course of a typhoid fever the dull look of indifference may gradually be seen to creep over the face. A gradual change in colour may be imperceptible to the doctor who sees the patient day by day, but

is marked at once by one who sees the patient for the first time, and this change—a slight pallor, or a slight yellow tinge—may be the earliest sign of a malignant disease (pernicious anæmia, cancer).

56. The General Condition.—It is undoubtedly a misfortune that the study of what is called "temperaments" has fallen into disuse. My own experience tells that the neglect of this basis of observation is continually leading physicians and surgeons astray. This is particularly the case with those who devote themselves to some speciality. The possession of certain temperaments, particularly the neurotic, leads to exaggeration of the reflex symptoms, and a trifling complaint is thus often mistaken for something more serious. We find such patients passing from one specialist to another, each one attributing the complaint to the fault of some organ which came under his special purview.

Although it may not be possible to differentiate exactly the six temperaments of Laycock (nervous, sanguine, phlegmatic, bilious, lymphatic, and melancholic), yet the consideration of each individual's temperament should help us to estimate at its due value the patient's symptoms and the account of his or her sufferings. While we may not be able to classify temperaments with accuracy, yet in every case the mental attitude of the patient to his complaints should be borne in mind. Although, in a general way, each individual is so constituted that his temperament is a matter of inheritance, yet it can be modified by circumstances. This is particularly seen in people who become "neurotic" in consequence of mental worry or long continuous bodily suffering.

The characteristics of a patient's temperament come out generally in the course of the preliminary examination, in the manner, movements, and description of the complaints.

57. A Review of all the Organs. — In the examination of patients the need for a thorough inquiry may demand that all organs should be inquired into. It is, however, not feasible or even necessary in the great majority of cases to make a systematic examination into the condition of each organ.

In an obscure case, and in cases where there is some complication, and when there is time and opportunity, no examination can be too careful or too thorough. But the great majority of cases with which the general practitioner has to deal do not present such complicated features, and the preliminary inquiry into the patient's symptoms gives a clue to the organ chiefly at fault, so that it is unnecessary that all the other organs should be submitted to a detailed physical examination. It is difficult to be certain when such thorough examination may be considered unnecessary, since, through its neglect, many ailments may be overlooked. To guard against this, many general practitioners have devised for themselves methods which serve to guide them in the detection of affections of organs other than that of which complaint is made.

In the logical and thorough cross-examination to which the patient is first submitted, a fair idea can generally be obtained of the organ or region in which there is trouble. Before examining more specially that part, inquiry should be made into the functions of other organs. These may be at fault,

and may in reality be the real seat of the trouble, and the patient, in describing the more prominent features of his complaint, may have ignored some to him, trivial sign, which the systematic interrogations may bring out. This inquiry need not be time-robbing if the physician makes his questions clear and distinct, and insists that the patient's replies should be precise and to the point. In his inquiries the physician should have some system in his own mind, so that each question bears upon the symptoms of a single organ and has a definite significance. Thus, after having exhausted the information of the particular complaint, and having observed in the course of his inquiry the general aspect of the patient, as already described, he should then carefully inquire into the condition of other organs, beginning as a rule with those related by position or function to the complaint of the patient. Step by step each organ is considered, and any that may show evidence of derangement are reserved for fuller investigation. To do this the essential symptoms of derangement of any organ must be kept in view. Thus, an inquiry is made into the condition of the heart and circulation by asking if the breath is as vigorous as ever, or if he has palpitation or breathlessness on running up stairs, beyond that which one would expect from his age and habits; into the lung condition by the presence of a cough, or of trouble in the breathing; into the digestive system by the presence of discomfort at any time before or after meals, and by the movement of the bowel; into the urinary system by the frequency of micturition, and particularly as to whether the patient has to get up in the night to pass urine. By following such lines

as these, being often guided by some incident in the patient's history or appearance, it will usually be found that no essential sign is overlooked. In all cases the patient's replies must be as direct and to the point as the question asked. The tendency to prolixity, which many patients show, must be firmly repressed; a clear reply should be obtained to each question, and no question allowed to pass until the answer is obtained. The patient may be so full of his own view as to his condition that there may be some difficulty in restricting him to the subject the physician has in his mind, but if the physician will but be persistent in his method—having a clear conception in his own mind as to what he requires—the patient can usually be induced to give clear and coherent replies. According to the tenor of the replies the subsequent physical examination will be guided. In drawing conclusions from the results of the examination it is necessary to consider the bearing of any abnormality, or supposed abnormality, on the sufferings of the patient. It often happens that the complaint from which the patient suffers is obscure, and the cause difficult or impossible to determine. Should some other abnormality be present, which is easily recognisable, then there is a great tendency to attribute the symptoms to this demonstrable abnormality.

A patient of mine, suffering from some obscure abdominal complaint, consulted a gynecologist, who, finding an ovary which he considered too large, put all the trouble and suffering down to this, and removed it. Obtaining no relief, the patient sought the opinion of a surgeon, who, finding a slight dilatation of the stomach, put all the symptoms down

to that, and performed a gastro-enterostomy, also without relief to the patient. In youth and in old age certain forms of irregularity of the heart are present in so many people that they may almost be looked upon as normal, and have no important bearing upon the patient's condition, yet when these patients are found suffering from any obscure condition, as weakness, fainting, or even epilepsy, the diagnosis is often based upon this irregularity, though its nature is not understood. To many minds it is satisfying to detect an abnormal sign, even though it has no connection with the complaint from which the patient suffers. This tendency to be misled by the detection of an abnormal sign is seen very frequently in patients who may have a cardiac murmur. All sorts of symptoms can be referred back to this, and treatment for an innocent murmur is often undertaken with unnecessary energy to the neglect of the essential cause of the patient's suffering (*see* Chapter XXI.).

CHAPTER XI.

SYMPTOMS OF AFFECTIONS IN THE REGION OF DISTRIBUTION OF CEREBRO-SPINAL NERVES.

58. *Headache.*
59. *Sensory and Motor Symptoms.*
60. *Differential Diagnosis.*

The functional and organic symptoms of affections of the external body wall and the limbs are usually so manifest that it is not necessary to deal with them. Here certain phenomena are discussed, connected more particularly with the reflex sensory symptoms.

There are many phenomena resulting directly from stimulation of some part of the external body wall and limbs, which, at first sight, are not easily understood, and often simulate the symptoms of visceral disease. It is necessary to allude briefly to the more important of these.

58. HEADACHE. — There is much obscurity in regard to the mechanism by which the pain of headache is produced. I have made a number of observations in all kinds of headache, and must confess that I see no clear explanation. The conditions inducing the headache, or associated with it, are so varied that all sorts of theories can point to some circumstances for their support.

Certain forms of headache stand out very distinctly, and are of considerable diagnostic value, such as the headache associated with cerebral tumour, kidney disease, migraine. Others may arise reflexly from some peripheral irritation, as eye-strain, but I am somewhat doubtful of these cases said to arise reflexly from more distant organs, as from the abdominal viscera. A stomach headache is the most common, but as absorption of toxins takes place so readily from the digestive tract, I am not clear as to the real nature of headache of this class.

The real confusion arises because of our inability to identify the structures in which the pain is felt; whether, for instance, it is in the scalp or in the membranes of the brain, or whether the real seat may be in the central nervous system, and the pain referred to the periphery. Whether the membranes of the brain are sensitive or not still seems to be a matter of some doubt, and personally, I have not had sufficient opportunity of testing these membranes. Even if it were the scalp in which the pain was felt, we would have to question and consider what part of the nerves is stimulated, whether, for instance, their peripheral distribution, or some deeper part. The variations of pain in the head, as felt by individuals, would seem to point to the stimulation arising in different places, and it is probably for this reason that so many theories can be found to explain headache.

59. Sensory and Motor Symptoms.—The view here expressed that pain is a function peculiar to certain nerves of the cerebro-spinal system, necessitates the consideration whether any given pain is referred (*i.e.*, originates reflexly from some viscus),

whether it is due to some lesion of the tissues supplied by the sensory nerve, or whether it arises from some affection of the nerve itself. In considering this subject it must be remembered that pain stimuli originating in the external body wall may be referred to other parts, and may be accompanied by muscular contractions — symptoms of the same nature and mechanism as the viscero-sensory and viscero-motor reflexes. This is notably the case in joint affections, where the pain is not infrequently referred to areas at some distance from the joint. The best instance is the pain felt on the inner side of the knee in disease of the hip joint. As a matter of fact the pains caused by joint affections are nearly all felt at some distance from the joint. Thus, pain in affections of the shoulder joint may be felt down the arm as low as the elbow, and the pain from the knee joint may be referred over the head of the tibia. In many joint affections the contractions of the muscles that move the joint may be so strong as to lead to the idea that the joint is ankylosed. This is particularly the case with some affections of the shoulder joint. The joint may be immobile until the patient is deeply under chloroform, when it will be found freely movable. There can be little doubt that the pain and the muscular contraction are due, not to a local stimulation of the peripheral nerve, but to a central stimulation. Hilton had called attention to the resemblance of the symptoms in joint affections to those of affections of serous cavities like the abdomen, and there can be little, if any, doubt that he was right. The knee pain is usually put down to a stimulation of a peripheral nerve that supplies the skin on the inside of the knee, but though the pain is

felt in the distribution of this nerve, the real explanation is that there has passed from the hip joint into the spinal cord a stimulus which has excited the cord at the level from which the obturator nerve arises. At this level there also pass out the nerves supplying the muscles around the hip joint, so that in addition to the pain there is the stiffness and contraction of these muscles. This stiffness is comparable to the slight hardening or increase in tone of the flat abdominal muscles in visceral disease, while the permanent contraction is like the hardened abdominal muscles in visceral disease, and the conditions are really due to an irritable focus in the spinal cord at the level of the third or fourth lumbar segment produced by the lesion in the hip joint.

This view of the cause of symptoms opens up the question of the nerve-supply of joints and the sensitiveness of the synovial membrane. I lean to the idea that the synovial membrane, like the peritoneal, is insensitive to direct stimulation, and that the pain arising from its stimulation is referred. This may, perhaps, mean that the nerve-supply of the joint arises not from the cerebro-spinal nervous system, but from the autonomic. Pain may arise from the contraction of muscles due to an increased sensibility of the muscle, as well as from irritability of the nerve-centres, as in reflex hyperalgesia. In certain forms of rheumatism muscular contraction may be present, giving rise to the "stiffness" in the joints, best observed after a long rest. With gradual exercise of the muscles the stiffness passes off.

Pain may arise from violent spasmodic contraction of the muscles, as in cramp. The pain in what

is called muscular rheumatism is often due to contraction of voluntary muscles, as in lumbago, stiff-neck, pleurodynia.

While these contractions are usually due to some temporary affection of the muscles, similar contractions may arise from irritation of the motor nerves by some disease process as spinal caries.

60. Differential Diagnosis.—On account of the fact that pain originating in any part of a nerve in its course from the brain to its periphery is referred to its peripheral distribution, there is often a difficulty in determining the source of the pain stimuli. The differential diagnosis must, therefore, depend on a knowledge of how the pain arises, the relationship of the nerve-supply of different regions of the body to the central nerve-supply, and its connection with the visceral nerve-supply. In the absence of any demonstrable cause of stimulation at the periphery it is necessary to consider the possibility of stimulation at more central parts. The symptoms that may arise from an irritation of a nerve-trunk, as from pressure, neuritis, or herpes zoster, resemble in a great many respects those that arise from visceral disease. So great, indeed, is this resemblance that even the most experienced may be led astray. Thus, the pain and hyperalgesia of a stomach affection may simulate the symptoms produced by caries of the spine (*see* page 70), and the shoulder-pain of gall-stone disease may be mistaken for a neuritis.

It might have been supposed that pain due to the stimulation of a nerve at its periphery, or at its trunk, would have had a distribution peculiar to the peripheral distribution of the nerve branch so

stimulated. If the region of the pain had been limited to the part of the periphery stimulated, or to the distribution of the nerve trunk, such a limitation of the field of pain and hyperalgesia might have given the desired indication, but, as has already been shown (page 29), the stimulation of the periphery of a sensory nerve, or of its trunk, causes a spreading of the pain by reason of a central radiation. It follows that a local irritation may produce such widespread phenomena as to simulate central irritation. It is for this reason that the various forms of "neuritis" so closely resemble the pains of visceral disease, pains due to pressure on the trunk of the nerve, or herpes zoster.

For the purpose of differential diagnosis it is necessary to know how the pains of visceral disease arise and spread. This knowledge can only be acquired by careful study of individual cases, for though certain general laws underlie the production of these symptoms,there are differences in individual cases. In doubtful cases the knowledge that in visceral disease certain associated phenomena can arise may often help to clear up a doubtful case. So far as I can I deal with the characteristics of the symptoms in the organs I have been able to study. This description is far from complete, and does not take into consideration symptoms that arise from certain viscera (as the pancreas or spleen), because I have had no opportunity of studying the symptoms in these cases with sufficient precision, and the descriptions usually given are too indeterminate to be of real value.

Before deciding that any given case is a neuritis or a neuralgia, the possibility of visceral disease should be carefully considered.

Chapter XII.

AFFECTIONS OF THE DIGESTIVE ORGANS.

61. *The Nerve Supply of the Digestive Tract.*
62. *Distribution of Sensory Symptoms in affections of the Digestive Tract.*
63. *Appetite.*
64. *Hunger.*
65. *Nausea.*
66. *Mouth and Fauces.*
67. *Tongue.*
68. *Swallowing.*
69. *Œsophagus.*

61. The Nerve Supply of the Digestive Tract.—The nerve supply of the digestive tract is derived partly from the autonomic and partly from the cerebro-spinal system. If one glances at Langley's diagram it will be seen that the autonomic supply is derived from three regions: (1) from the bulbar autonomic division by the vagus, distributed to the walls of the gut from mouth to descending colon; (2) from the sympathetic division by the splanchnics, which supply the stomach, small intestine, and greater part of the great intestine; and (3) from the sacral autonomic division, which supplies the descending colon and rectum.

The cerebro-spinal nerve supply is limited to the oral and anal orifices. The sensations at the

oral end are divided into those of common and special sensations. The sensory nerves are derived from the fifth cranial and glosso-pharyngeal, and supply the mouth, fauces, and a small portion of the upper end of the œsophagus; the exact extent has not been accurately defined. The mouth differs from the skin in sensibility, touch being less acute and less perfectly localised, though temperature, and pain senses are well developed. The nerves of special sensibility (taste) in the tongue are derived from the glosso-pharyngeal, fifth, and chorda tympani nerves. The olfactory nerve, too, must be considered as an accessory nerve of digestion, for it has remarkable effects in stimulating reflexly the salivary and gastric glands, and also in the appreciation of flavour. It has also, at times, a powerful effect in inducing attacks of vomiting.

The distribution of the cerebro-spinal system of nerves to the anal end of the gut is of very small extent, being limited to little more than the inner side of the external sphincter. So far as I have been able to make out, the mucous membrane covering the internal sphincter is devoid of direct sensation.

62. Distribution of Sensory Symptoms in affections of the Digestive Tract.—The nature of the nerve supply explains the character of the sensory symptoms evoked by affections of the digestive tract. Limiting the study at present to the subject of pain, it will be found that from the top of the œsophagus to the anus there is, in the great majority of instances, a limitation of the distribution of the pain to an area extending down the centre of the body from about the middle of the

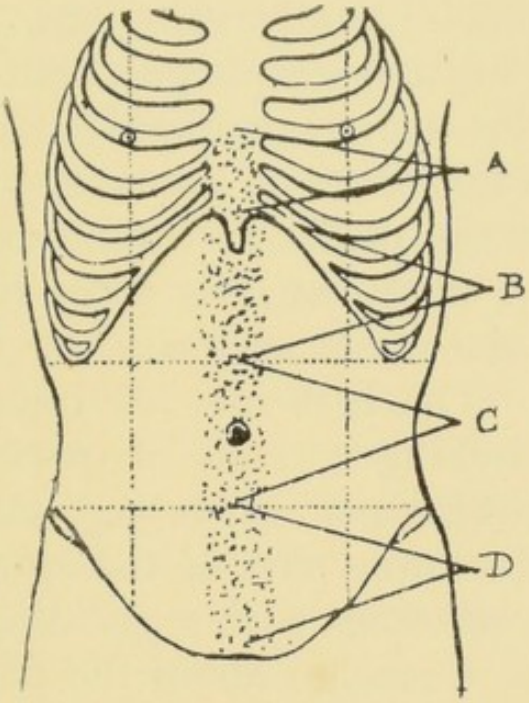


FIG. 8.

The shaded parts show the areas in which pain is felt in affections of the digestive tube. Peristalsis passing through the whole digestive tube may give rise to pain felt descending in the shaded area.

A. Area in which pain is felt in affections of the œsophagus.

B. Area in which pain is felt in affections of the stomach.

C. Area in which pain is felt in affections of the small intestine.

D. Area in which pain is felt in affections of the large intestine.

sternum to the symphysis pubis (shaded area in Fig. 8).

If pain be produced by stimulating the œsophagus as, for instance, by a hot drink, the pain is always referred to the region over the lower part of the sternum. Usually this pain is supposed to be perceived "in the œsophagus," but if this sensation were in the œsophagus there is no reason why it should not be felt better in the back, for the œsophagus is nearer the posterior cutaneous surface than the anterior. Pain arising from the stomach is limited, in the vast majority of cases, to the epigastrium. The best idea of intestinal pain is found in watching a case of peristalsis of the bowel. A painful peristalsis may start with pain referred to the lower part of the epigastric region, then it slowly descends with a grinding intermitting severity until it reaches above the pubes, when the call to defecate becomes urgent, and relief is at once found with the expulsion of a loose motion. In such an instance the fluid has traversed the whole intestinal tract, and the peristaltic waves have passed into all quarters of the abdominal cavity, yet the pain has descended in an even and unvarying direction down the centre of the abdominal wall.

It is well to remember this feature of pain due to peristaltic contraction of the gut, for it will be found of frequent diagnostic importance in solving the source of severe colic-like pains. As already remarked, contraction of non-striped muscles is the most frequent cause of violent visceral pain, and, as a rule, when the pain is violent, it can be very accurately localised. This limitation of the pain to the middle line of the body is characteristic also of

the pain of other hollow viscera, as the gall-ducts, uterus, and bladder, while the pain of renal colic (contraction of the ureter and pelvis of the kidney) is distinctly unilateral.

63. Appetite.—All actions that are performed periodically or intermittently, in which volition participates, are accompanied by sensations which make known the time when the act has to be performed. These sensations are in themselves not unpleasant at first, but are accompanied by a desire to perform voluntarily an act which will gratify that desire. Thus, if the breath be held the desire to breathe is not painful, but there is a longing for the sensation of full inspiration. So, in regard to the call for micturition and defecation, the sensation is one calling for the gratification of a sense of relief. To this category belongs the desire for nourishment, liquid or solid—the appetite.

Appetite itself is a sensation so vague that no definite description of its mechanism can be given, though it is probably dependent on the digestive glands in the mouth and the stomach. The consciousness of appetite is accompanied by increased secretion of these glands—so much so, that even the contemplation of a satisfying meal may cause the "mouth to water." The appetite or desire for food may be increased by the sight or odour, of tempting viands, or even by the mental contemplation of them, and an abundant flow of the gastric juices may result from such stimulation.

The appearance of a normal appetite follows the efficient absorption of food and its expenditure in the production of energy. Thus it is seen at its best in those who work in the open air. The

gratification of an appetite being amongst the most elemental of pleasures, the presence of appetite is a rough indication of health. Man's environment so often prevents its display that means are taken to excite an appetite by providing food in a manner that will supply the craving.

These artificial aids, used to create appetite, diminish the value of this sensation as a diagnostic aid. The loss of appetite, as seen in animals (horses, cattle), is the most important sign of impaired health, and its return is an indication of restoration to health. In man also it has significance, but, as man resorts to all sorts of artificial aids, this significance is often diminished. Still the question of loss and return of appetite affords valuable aid in diagnosis. When an individual loses his appetite it may be taken as an indication that all is not well. The loss of appetite may, with reasonable probability, be referred to a diminished excitability of the secretory glands or their nerves. The secretory reflexes which are associated with appetite may be played upon in a great variety of ways, as by mental excitement, impaired metabolism (as in enforced rest), increased temperature and the agents inducing it, affections of the digestive tube and other organs. The symptom of anorexia, loss of appetite, merely indicates, therefore, that there is something wrong in the economy. Further examination may reveal the cause, and the behaviour of the appetite may often prove a safe guide as to the progress or retrogression of the ailment.

Certain results follow the loss of appetite; the tongue becomes furred, the mouth unpleasant from the lack of the mechanical friction of the tongue

against the palate and the absence of juices from the inactive glands, abdominal discomfort arises from the accumulation of flatus, and the bowels are inactive from absence of stimulus.

An increased desire or craving for food (boulimia) may arise during convalesence from a long illness, such as typhoid fever. The craving is probably due to the tissues losing the poisoned fluids, returning to their normal state, and requiring suitable nourishment of which they were deprived during the illness. An abnormal appetite may be one of a group of symptoms, referable either to the nervous system, as in hysteria, or to conditions in which there is no sign of mental defect, as in chlorosis, diabetes mellitus, intestinal worms. Enormous quantities of food may be taken by those who are thus affected.

Craving for certain forms of food is a frequent sign, but there is often a craving for things that are not food, and that are not digestible. This perverted appetite may arise as a matter of habit, for the custom of eating earth (geophagy) is prevalent among natives of widely separated countries. In some cases the earth may contain nutritious properties, but in many cases it is used, not for its nutritive value, but merely for the gratification of a perverted taste, or to satisfy the craving in the absence of proper food. Perversion of appetite is common amongst the insane, but it is also present as a bad habit amongst others, as children, chlorotic females, pregnant women, and others who have no particular ailment. The objects eaten or swallowed are of the greatest variety, as chalk, coal, earth, plaster, ashes, pebbles, etc.

64. Hunger.—While the anticipation preceding the performance of a periodic act may be pleasant from the prospect of gratification, the undue delay of performance results invariably in the sensation becoming one of distress. Abstinence from food may convert the sensation of appetite into one of hunger, and hunger implies distress, and when pushed to extreme is probably the most clamant of all desires. Hunger becomes more than a mere excess of appetite. Appetite is probably, as already stated, the outcome of the active stimulation of certain digestive glands, while hunger is the craving of the whole body for nourishment, and the digestive tract, with its limited sensations, is the vehicle for the sustenance of the whole economy. This is seen by the fact that hunger may exist when the stomach is full, the appetite gratified, but the food prevented from reaching the tissues in consequence of an intestinal fistula. Apart from hunger due to starvation, an increased craving can be induced by measures taken to stimulate the appetite, by cooking, and the various means of providing "tempting bits," and this may be carried so far as to become a perverted habit. Perverted tastes may arise, however, from custom, or as a symptom of disease.

65. Nausea. — The unpleasant sensation, nausea, is often associated with loss of appetite and certain affections of the stomach. Though it often comes on at an early stage in the act of vomiting, it may arise without vomiting, just as vomiting may occur without any previous feeling of nausea. It is associated with the digestive function, and its appearance is accompanied by a stimulation of some digestive glands, as shown by profuse flow of saliva.

In certain affections of the stomach, as in the gastric catarrh of alcoholics, it is the most distressful symptom, occurring usually after a long fast, as in the morning before food is taken. It may arise suddenly from some reflex cause, as from a bad odour, an offensive sight, or the appearance of unattractive food. In addition to the disagreeable sensation there is often some spasmodic contraction of certain muscles, as the diaphragm with closure of the glottis, as in the preliminary stage of vomiting. Accompanying the nausea there is often a feeling of faintness, the pulse becomes soft, weak, and rapid, and the face blanched, due in all probability to the action of the vagus diminishing the force of the heart beat, and producing a vaso-motor depression.

66. Mouth and Fauces.—The pain complained of in affections of the mouth and fauces may be local or referred, or both. Local pain in the mouth may be present in inflammatory affections of the mucous membrane. In toothache it may be felt not only in the affected tooth, but in neighbouring teeth, and the jaw may become painful and tender. The pain may be felt so severely in places apart from the offending tooth that it requires some care to detect which tooth is at fault. The pain may be referred to parts outside the mouth, in the cheek, or in some portion of the head, and the skin may become very hyperalgesic. It is necessary in any case of "neuralgia" of the face and the head to carefully examine the condition of every tooth.

The fifth cranial nerve is particularly liable to stimulation from affections other than those arising from the mouth, and the presence of pain in the distribution of the fifth nerve may be due to a variety

of causes. The most striking of these conditions is when there is some distinct affection of the nerve itself or the nerve ganglion, in the disease called trigeminal neuralgia or tic douloureux. Before the full character of this complaint is revealed in all its terrible characteristics, there is a period in which it resembles so closely the characters of a toothache, that at first it is almost invariably mistaken for this complaint, and one decayed tooth after another is removed. The pain continuing to recur, the dentist next attacks the sound teeth, and not infrequently every tooth is removed, yet pain continues to recur in the edentulous jaw. Relief may be found after the removal of one or more teeth, but, as with the operation for nerve stretching, it is but temporary. It is not possible in the early stages to distinguish between a case of true tic and a toothache. In both the pains may recur at intervals, and, when there is hyperalgesia of the skin of the cheek in toothache, the resemblance between the two conditions is very complete. Thus, stroking of the hair may be exquisitely painful, and may bring on a spasm of pain. When one decayed tooth after another is removed with no lasting benefit, then the true nature of the complaint may be suspected, but as one is loth to come to the conclusion that the case is one of true tic douloureux, the teeth extraction continues.

Another instructive form of pain occurs in certain forms of angina pectoris, where the pain is not only present in the chest and arms, but may be felt in the lower jaw and throat. The pain of angina pectoris may even start here, and be limited almost entirely to this region. The feeling is described as a sense of intense soreness along the lower jaw, akin to

what is felt in some forms of toothache. The nerves supplying the fauces, and the voluntary muscles engaged in swallowing, may also be hypersensitive, so that the patient has a good deal of pain in swallowing. In rare cases, after a severe attack of angina pectoris, the patient may complain of pain in swallowing for weeks after the attack has passed off. Doubtless, in such cases, the violent stimulation has reached the medulla and upper part of the cord by the vagus, and the stimulation has affected the sensory cells in the neighbourhood and left an irritable focus, as witnessed by the hyperalgesia of the muscles and mucous membrane shown in the act of swallowing.

Inflammatory affections in the fauces often cause great pain in the act of swallowing. When the tonsils are acutely inflamed the increased secretion of mucus continuously excites the act of swallowing and causes great distress. The pain is felt not only in the inflamed parts, but extends into the sides of the neck, and up into the ear. The skin of the neck behind the jaw may become hyperalgesic, and frequently there can be detected enlarged and tender glands behind the jaw.

A number of patients may complain of pain on swallowing, and when careful investigation is made it will be found to be due to a form of infection very common amongst those who use false teeth where the utmost cleanliness is not observed. The patient frequently complains of a sore throat, and if the fauces be inspected a slight redness of the pillars can be detected. If the patient wears a plate on the roof of the mouth, and this be removed, the underlying mucous membrane will be found swollen and red, and

from this place to the fauces there can be detected an extension of the inflammation in the form of small red dots. Sometimes the surface of the mucous membrane, under the plate, may be covered with patches of thrush, and an infective process may extend to the parotid and sub-lingual glands, causing severe inflammation and swelling of these glands. Inspection of the mouth may reveal other abnormalities, as ulcers.

A very interesting instance of referred sensation is seen in passing a bougie into the eustachian tube. When a catheter is passed into the eustachian tube for the purpose of insuflation, the sensation produced by the catheter is referred to the back of the nose. If a bougie be passed along the catheter into the eustachian tube, the sensation is at first referred to some place between the back of the nose and the ear. If the bougie be pushed further in, a part is reached where the sensation is suddenly referred to the neck behind the jaw. This transference of the sensation is doubtless due to the parts being supplied by nerve fibres from different sources — the exact nature of the supply I am unable to determine.

67. Tongue. — In health the tongue should be evenly and steadily protruded, moist, and of a slightly translucent pale red colour. A tremulous tongue should lead to an inquiry into the alcoholic habits, and an unevenly protruded tongue to the question of paralysis.

The principal cause of a furred tongue is absence of friction, usually due to deficiency of saliva and insufficient mastication. Too much stress has been laid upon the supposed association of the furred tongue with certain "catarrhal" conditions

of the stomach and bowels. A person with no appetite has a furred tongue because he does not masticate. A person who bolts his food, or who washes his food into his stomach by drinking while eating, or who lives on "slops," has a furred tongue from the same cause. The posterior third of the tongue in some is always furred, and in these it will be found that the palate is high and arched, so that the tongue does not come into contact with the roof of the mouth. Mouth breathers also have a tendency to a furred tongue, for the playing backwards and forwards of the air over the tongue dries it, and favours the formation of the fur. This is especially the case in fevers where the hot air passing over the tongue dries it. This tendency is further increased by the absence of mastication—the patient being so often fed on slops. In fever a fur may appear in spite of all precautions. A very striking prognostic sign may be found in carefully watching the tongue in febrile states, for the earliest symptom that the fever is about to yield, may be the appearance of a small clean spot on the tongue.

68. Swallowing.—The act of swallowing, so far as it is carried out within the region of distribution of cerebro-spinal nerves, is a voluntary and conscious act; but as soon as the bolus passes beyond into the region supplied by the autonomic nervous system, it becomes involuntary and unconscious. During the act the respiration is inhibited and the levator palati raises the palate and shuts off the nasal cavities. Bilateral paralysis of this muscle, as after diphtheria, leads to fluids regurgitating down the nose during the act of swallowing.

Pain accompanying the act of swallowing is due

most frequently to some inflammatory infection of the tonsils or fauces. It is generally referred to the neck behind the jaw, or up into the ear. Inspection of the fauces will generally reveal the cause. In rare cases, as already cited, there may be a hyperalgesia of the mucous membrane, and of the muscles with a good deal of pain on swallowing.

There is sometimes shown a curious relationship between the tonsils and the nerve supply of the external ear. In a number of cases I have found during a tonsilitis an attack of herpes zoster occur; the eruption appearing on the lobe and pinna of the ear. This has occurred so frequently that the association is more than casual, and I suspect some intimate central relationship between the nerve supply of these parts. Herpes zoster has been shown by Head and Campbell to be due to a destructive inflammation of the ganglia of the sensory root, and it is difficult to explain the definite relationship of the tonsilitis and the herpes on the ear, but the fact is one worthy of consideration in the investigation of the relationship of the viscera to the cerebro-spinal nerves.

69. The Œsophagus.—The nerve supply of the œsophagus being derived entirely from the autonomic system, we get no direct response to stimulation. Pain arises rather easily from stimulation, especially, as every one has experienced, on the drinking of hot fluids. The pain thus excited is referred distinctly to the front of the chest, and although the heart and lungs are interposed between the site of pain and the œsophagus, and although the œsophagus itself is nearer the back of the chest than the front, everyone unhesitatingly refers the pain as

being felt in the œsophagus. Nevertheless, after a good many observations, I have come to the conclusion that the laws governing the sensibility of the œsophagus are the same as those governing the sensibility of the other portions of the digestive tube, and that the œsophageal pain is a referred pain and not direct. That its sensibility is different from that of the stomach is, I think, undoubted. The pain in swallowing hot fluids, for instance, is more readily induced by the œsophagus than by the stomach. Also the stomach contents, though giving rise to no sensation when in the stomach, may cause great discomfort when they regurgitate into the œsophagus, and it is for this reason that I assign the disagreeable sensation of heartburn to the acrid stomach contents escaping into the œsophagus (*see* p. 141.)

Some recent observations by Hertz, Cook, and Schlesinger, lead them to the conclusion that the sensation of heat and cold on swallowing fluids is actually felt at the lower end of the œsophagus, but their observations do not disprove, as they seem to think, the referred character of the sensation. The view I hold that the sensations of heat and cold are really due to a reflex stimulation of the peripheral vaso-motor nerves is not disproved because in some cases the sensation is felt "deeper" than the skin; and, although I am far from asserting that the hypothesis I put forward is absolutely correct, the matter is not the simple one these observers seem to imagine.

In some cases, particularly in females of a neurotic habit, the moment a hard piece of food, as a small crust of bread, or even a soft bolus or fluid, touches the upper part of the œsophagus, the

œsophagus at once contracts with such violence and persistence that no food can be taken for some time. Sometimes a small portion of food may be grasped in the spasm, when the spasm may last for hours, and the patient be in great suffering on account of the difficulty in breathing and the excessive flow of saliva that cannot be swallowed. The forcible passage of a bougie or probang at once gives relief. In a large number of cases I have found the systematic passage of a bougie the best means of treatment. In some rare cases the seat of the spasm may be lower down.

In stricture of the œsophagus, if the stricture be high up the food is rejected at once, if low down it may be delayed for some time. Sometimes the œsophagus wall contracts strongly, and, as in obstruction of the bowel, pain may arise from the peristalsis, and is always referred to the front of the chest, at a level near that of the stricture. Great care should be taken in all cases in the passage of an exploratory bougie, lest injury be done to the walls.

CHAPTER XIII.

AFFECTIONS OF THE DIGESTIVE ORGANS. THE STOMACH.

70. THE NATURE OF THE SYMPTOMS. — The stomach being an organ that daily makes itself known by sensations of pleasure or discomfort, forces its symptoms upon all. Considering its highly complex organisation it is a wonderfully long-suffering organ, for it not only digests food suitable for the whole organism, but it has to submit to improper food, to the gratification of gluttonous desires, and to the caprices of perverted tastes. It cannot be

wondered at that it should so often become deranged in structure and function, and that these derangements should be of various kinds.

Its accessibility has permitted many observations to be made on its functions in health and disease, and has afforded scope for the ingenuity of the physiologist, the chemist, and the clinician. Although continual progress is being made in the discovery of its properties, it must be admitted that little of practical importance has been evolved for the purpose of diagnosis and treatment of the great majority of patients. So far as the physiologist is concerned he cannot acquire the necessary information, because symptoms of disordered digestion are usually the outcome of years of improper feeding. Food unsuitable for the digestive powers of the stomach deranges the functions of its secretory glands and the structures of its walls, and it must be confessed, we are ignorant of the nature of these changes. It is for this reason that so little advance has been made in diagnosis and treatment, apart from the progress of surgical methods, and of the examination of the stomach contents. Some light may be thrown on obscure diseases by the observation of the progress through the alimentary canal of a bismuth meal by the X-rays. These methods, however, apply to but a very small proportion of sufferers from stomach affections.

Attempts are continually being made to classify affections of the stomach, and the lack of agreement in these classifications is merely due to the fact that attempts are made to differentiate what cannot be differentiated. This will be realised when the nature of stomach symptoms is considered. Apart from

some characteristic vomits (blood, mucus), and certain changes indicated in the position of the organ (and these refer only to a very small proportion of the cases), all the symptoms are of a reflex nature, pain, cutaneous and muscular hyperalgesia, muscular contraction, vomiting, air suction. As any adequate stimulus may suffice to produce these symptoms, and as this adequate stimulus may arise from the most varied causes, trivial or severe, it follows that there is a great similarity in the symptoms in diseases of the most varied kinds. Hence it is impossible in many cases to tell the nature of the affection; for instance, a passing simple "indigestion" arising from one indiscreet meal may present the symptoms of "gastritis" or ulceration. For this reason it often happens that no satisfactory diagnosis can be made in the early stages of a chronic stomach complaint. To ascertain the true nature of many stomach affections it is necessary to wait and observe the results of treatment and the progress of the disease. When patients come in a late stage of the complaint the peculiar features of any given disease may have become so evident that an accurate diagnosis can be made; but these form but a small proportion of the chronic cases that the practitioner has to treat.

I have already pointed out that in visceral disease certain areas in the spinal cord may become for a time so irritable that stimuli from the periphery give rise to an exaggerated response, as when the skin becomes hyperalgesic and the recti muscles contracted. This irritable focus in the cord is of great frequency in stomach affections. Not only does slight stimulation of the skin produce pain, but a stimulus reaching the irritable focus from any

source may produce pain, and it is for this reason that the ingestion of food is so frequently accompanied by pain. When pain occurs after food it must not be assumed that there is an inflammation of the mucous membrane, or that the stomach is itself hypersensitive. The ingestion of food under normal circumstances is accompanied by reflex processes which are not perceived, and pain merely indicates that there is an irritable focus in the cord through which these reflex processes pass. The lesion inducing the irritable focus in the cord may not necessarily be a stomach lesion at all, but may arise from a neighbouring organ whose reflex centre in the spinal cord is in close proximity to that of the stomach. In gall-stone colic the pain may be so violent as to invade the stomach area in the cord, and an illustration of the pain arising on the ingestion of food in a case of hyperalgesia due to gall-stone disease is given on page 90.

In true lesions of the stomach this irritable focus in the cord is readily produced, and its presence is demonstrated by the ease with which pain is induced in certain stages of digestion by the hyperalgesia of the skin and muscles of the epigastrium, and by the hardened epigastric muscles.

71. The Nerve Supply of the Stomach.—The stomach is supplied by nerves from the dorsal sympathetic and from the vagus. The origin of the sympathetic has not been exactly determined, as the experimental attempts to find the efferent fibres that supply the stomach have not been very successful, so that the place of origin in the spinal cord is best inferred from clinical observations of the area in which the pain and hyperalgesia arise.

The epigastric region is essentially the place to which the sensory symptoms are referred, and it is the upper part of the left rectus muscle which contracts first in response to stimulation from the stomach. The nerve supply to the skin of this region comes from the sixth and seventh thoracic nerves, and the upper portion of the rectus is supplied by the sixth. When the pain is severe, and tends to radiate, it generally goes to the left of the epigastrium, but may invade the regions of the front of the chest supplied by the fifth and fourth thoracic nerves. I have seen the symptoms in rare cases resemble attacks of angina pectoris, and it has seemed to me that the cause of the pain in such cases was violent peristalsis of the cardiac end of the stomach.

The burning pain of heart-burn is generally felt over the lower part of the sternum, in the region of distribution of the fifth thoracic nerve in the chest. It has seemed to me that the immediate cause of this pain is the regurgitation into the œsophagus of the acrid contents of the stomach. The frequency with which in these cases some of the stomach contents regurgitate into the mouth confirms this view.

The result of vagus stimulation is difficult to determine in stomach cases. Pain may be felt in the neck and jaw in severe gastric colic, very like that felt in some cases of angina pectoris, and this, I can only conclude, is a stimulus reaching the fifth cranial and upper cervical nerve centres, by means of the vagus. The brow pain felt in swallowing ice is often spoken of as a vagal reflex, but this pain arises not from the stomach, but from the back of the mouth. This can be demonstrated, in suitable cases,

by keeping the ice against the soft palate, when the pain will be evoked.

In rare cases vagal stimulation, excited by swallowing or by the ingestion of food into the stomach, can produce irregular action of the heart, of the nature of heart block, or of extra-systoles.

72. The Site of the Pain in Affections of the Stomach.—In 1892 I published a paper, in which I gave the results of a careful inquiry into the site of pain in 320 cases of affections of the stomach. In the analysis I found that 95 per cent. referred their pain to the epigastrium. Since that time I have kept records of some thousands of cases, with the same results. Whatever the nature of the lesion the pain is referred with great certainty to the epigastrium (B. Fig. 8, page 117). It may radiate from here up into the chest, or to the left. It is not infrequently accompanied by a pain in the back, and the patient sometimes states that the pain strikes from the front through to the back. It might be inferred from the situation of the pain that the pain itself was actually in the stomach, but one can demonstrate that it is really referred to the peripheral distribution of the cerebro-spinal nerves in the abdominal walls. Thus, in many cases, the skin and muscles in the area in which the pain is felt are hyperalgesic, and it is but reasonable to infer that the pain felt by the patient is referred to a region where the sensory nerves are so demonstrably affected. The movements of the stomach do not cause a displacement of the pain and when the stomach itself is shifted, as by deep inspiration and expiration, there is no accompanying shifting of the pain. In localised affections of the stomach (as ulcer), however varied the situation may

be from cardiac to pyloric end, the pain in the great majority of cases is referred by the patient to some part of the epigastric region (*see* p. 148).

73. The Character of the Pain and its Relation to the Ingestion of Food.—Although the stomach is a hollow muscular viscus, severe cramp-like pain from violent peristalsis is of rare occurrence. It will usually be found, in the long run, that the so-called "cramp of the stomach," in which there is pain of great severity referred to the epigastrium, is due to gall-stone colic. I have watched many patients for years who suffered from these severe attacks, and found that they all turned out to be cases of gall-stone disease. In later years I have had little difficulty in recognising their origin, because of the peculiar distribution of the reflex phenomena in gall-stone disease (*see* p. 159). Violent cramp-like pain may rarely arise in stomach affections, but the pain tends to radiate higher into the chest, and may be into the jaw (vagus stimulation). More frequently the pain of stomach affections is of a dull prolonged boring character. Its position being so definitely situated in a region remote from the seat of the lesion (as in gastric ulcer) shows that it is the outcome of a stimulation of an irritable focus in the spinal cord. The pain is therefore more prolonged, and varies little in intensity. Such a distinction of the character of the pain can usually be made, and seems to account for the persistent boring pains in gastric ulcer and in other conditions.

The relation of the pain to the ingestion of food is very variable. In some the introduction of food into the stomach causes immediate pain, or the pain

may come on at variable intervals after food. When it comes on two or three hours after food, relief may sometimes be obtained from taking more food. No very certain conclusions can be drawn from this relation of pain to the ingestion of food. Attempts have been made to diagnose the position of an ulcer from this relationship, but there is no ground for such a deduction. As a matter of experience the pain in gastric ulcer may come on at any period whatever its situation. This will be appreciated when it is recognised that the ingestion of food or some stage of its digestion acts as a stimulant to an irritable focus in the spinal cord (*see* page 87). The occurrence of the pain one or two hours after the food, with symptoms of peristalsis (as recognised by the wavy character of the pain) and with acrid regurgitations into the œsophagus, is fairly characteristic of one form of dyspepsia, sometimes spoken of as "hyperchlorhydria," in which the trouble is supposed to be due to an excessive secretion of hydrochloric acid. This form of indigestion often yields readily to suitable treatment, but it is not infrequently associated with gastric ulcer and gall-stone disease, and this association should be kept in mind.

74. Hyperalgesia.--In addition to the pain other sensory phenomena may arise, the chief of which is hyperalgesia of the skin and deeper structures. The area which becomes hyperalgesic is the epigastric. It may be limited to a small area in the middle, but it is usually diffuse with indefinite borders, extending sometimes as an irregular band round the left side to the spine.

The hyperalgesia may not be present in the skin, but in the muscles, or in the sensitive layer

outside the peritoneum. This can be shown by first testing the skin and finding the sensibility normal, then pressing so that the muscle is stimulated; or by pushing the finger between the recti when the peritoneal layer may be found sensitive. Of course, in the latter case, one cannot assert that the pain is elicited from this layer alone, for the pressure may affect other structures, but in view of the observations of Ramström this conclusion is justifiable (*see* page 35).

75. Reflexes.—Associated with this hyperalgesia there is invariably an increase of the reflexes, superficial and viscero-motor. The superficial is demonstrated by the liveliness of the response when the skin is stimulated, the upper part of the right rectus contracting rapidly and powerfully. Not only is the increased reflex activity shown in the response to the stimulation of the skin in the epigastrium, but it is also shown by the greatly extended cutaneous field from which it can be elicited. Normally the reflex of the upper portion of the rectus muscle is obtained from an area limited to the epigastrium, but with an irritable focus in the cord the cutaneous area, stimulation of which will cause a reflex contraction of the upper portion of the rectus, may extend as high as the axilla. The extension of this area follows some peculiar law, as responses cannot be elicited from the whole of the left chest, but only from an area extending in an irregularly shaped band up the side to the axilla.

76. Viscero-motor Reflexes. — The viscero-motor reflex is recognised by a permanent rigidity of the upper division of the left rectus muscle. This may be so slight as to be evident as an increase in the

tone of the muscle and detected only on comparison with the other parts of the muscular wall of the abdomen, or it may be hard and resistant. In seeking for this reflex gentle exploration is needed to avoid the production of the superficial reflex.

77. Vomiting. — Vomiting as a symptom of stomach affection is somewhat infrequent and of very variable significance, and the most persistent vomiting may arise reflexly from other organs, as in the persistent vomiting of catarrhal jaundice, pregnancy and brain affections. As a symptom of stomach affections the frequency of the vomiting and the nature of the material vomited constitute the best evidence. An occasional attack of vomiting may arise from a great many causes. In persistent vomiting, if reflex vomiting from other organs can be excluded, some inflammatory affection may be recognised, and the possibility of gastric ulcer considered. The response to treatment is an important factor in diagnosis.

Certain characteristics at the time of vomiting give information. The morning sickness of pregnancy and of the alcoholic is very characteristic. The vomiting, once a day, or every day or two, of large quantities is suggestive of the dilated stomach secondary to pyloric stenosis. The character of the material vomited is also of importance. If the contents of the stomach contain the food that has been taken many hours before, some obstruction to its passage is suggested. The thick viscid mucus vomited is characteristic of a somewhat violent gastritis. The presence of blood (coffee-ground vomit), is characteristic of ulceration. Inquiries should always be made for the presence of "tarry"

stools. The vomiting of large quantities, sometimes with brown froth, is characteristic of dilatation of the stomach. Vomiting with a fæcal odour usually indicates obstruction of the bowel. The absence of hydrochloric acid in the vomit suggests the possibility of cancer.

78. Pyrosis and Heart-burn.—The food may regurgitate back into the œsophagus. Sometimes this is normal (merycism), and is of the nature of the return of the cud in ruminants. It certain cases, when the stomach contents become abnormally sour and acrid, strong peristalsis may produce pain with regurgitation of some of the contents into the œsophagus, and thus give rise to the painful burning sensation described as "heart-burn." This may be accompanied by the return into the mouth of some of the contents of the stomach, sometimes insipid to the taste, sometimes sour and acrid (pyrosis, water-brash). One form of this condition has received the name of hyperchlorhydria, because an excess of hydrochloric acid is present in the stomach contents, and because it can be relieved by alkalies. But this increase in hydrochloric acid is but one of the abnormal manifestations, and excess in its secretion is not necessarily the disease, nor the cause of the symptoms, for the administration of hydrochloric acid relieves the symptoms, and the presence of hydrochloric acid in the œsophagus does not cause heart-burn. There are other acrid substances of unknown nature present which evidently excite the peristalsis of the stomach.

79. Air Suction.—Flatulence is a common complaint with dyspeptics, but true flatulence, *i.e.*, flatulence due to evolution of gases in the stomach,

is relatively rare. The vast number of people who suffer from "attacks of wind," and who appear to expel large quantities with a loud noise, owe their attacks to air spasmodically sucked into the œsophagus or into the stomach. These may start with a slight feeling of distension after meals, when the patient endeavours to obtain relief by expelling wind. In this attempt air is unconsciously sucked into the œsophagus, and its noisy expulsion is supposed to be an evidence of air being expelled from the stomach. Sometimes the air is sucked into the stomach, and its expulsion is accompanied by some flatulence that was present in the stomach, and in consequence considerable relief is obtained. Some people when suffering from pain get a measure of relief by sucking air voluntarily into the stomach and then expelling it.

This air suction occurs most frequently in people of a neurotic temperament, and the attacks may come on when they are put out, worried, or suffering from affections of other organs. When a patient complains of attacks of flatulence coming on suddenly as during sleep, it will often be found that the patient is an air-sucker. It might seem that an uncontrollable reflex would cause the air suction, for patients during an attack of angina pectoris may hold themselves in such a manner that air is unconsciously sucked in, and its expulsion is often accompanied by such relief that the origin of the suffering is put down to a stomach affection. Attacks of air suction may be stopped at once by the mouth being kept wide open by a gag. Wyllie's article in the Edinburgh Hospital Report (Vol. I.) throws a great deal of light on the subject.

80. Functional Symptoms. — The symptoms that arise from changes in function are available in relatively few cases. Those due to alteration in the secretion are mainly limited to the recognition of an excess of mucus, or an increase or diminution of the amount of free hydrochloric acid in the stomach contents, obtained either from the vomit or by the stomach tube. There are so many individual variations in the amount of gastric juice secreted and in the relative proportion of hydrochloric acid present, that deductions drawn from an examination of the stomach contents must be applied with the greatest caution.

Increase in the amount of hydrochloric acid is indicative of no definite lesion, and the absence of free hydrochloric acid, though suggesting the possibility of cancer, is by no means diagnostic, as it may be absent in a variety of conditions. Save that its absence necessitates the consideration of the question of cancer, it is doubtful if the symptom is of any special importance. Functional derangement of the digestive fluid may be detected by the delay of digestion. This delay is recognised by the retention by the stomach of portions of undigested food, and by observing the time taken to digest a test meal, and by the observation of the passage of a bismuth meal through the stomach by the X-rays.

Dilatation of the stomach is an evidence of a loss of the function of tonicity in the muscular wall, and can be detected by careful percussion, or by the presence of splashing when the stomach is shaken by succussion, or by tapping over the stomach. The extent of the dilatation can often be made out by distending the stomach with carbonic acid gas. The

simplest method is to give the acid part of a seidlitz powder in solution first, followed by the alkaline. The evolution of the carbonic acid gas causes a visible swelling in the abdomen due to the distension of the stomach.

The use of the X-rays in the examination of the digestive tract has been of the greatest service. By giving a meal containing a large quantity of bismuth the movements of the food can be detected. Observation by this means has shed an unexpected light upon the position and shape of the normal stomach, and shows that the description usually given is quite wrong. In quite healthy people the stomach may be as low as the umbilicus. In fact so variable is the shape and position of the stomach in presumably healthy people that no certain standard is yet recognised. In consequence of this the recognition of abnormal conditions of the stomach by the X-rays is mostly limited to cases of very great increase in size.

The retention of portions of food in the stomach for a considerable time affords evidence of the inefficiency of the peristaltic contractions to empty the stomach of its contents. Although dilatation is seen in its most characteristic form in emaciated people with pyloric stenosis, yet it may be of considerable extent where there is no obstruction; and there may be difficulty in deciding whether the dilatation is secondary to the pyloric stenosis. A long history of stomach trouble with pain, particularly if referred to the lower part of the epigastrium, suggests pyloric stenosis. In rare cases a history of vomiting blood, or of huge liquid vomits at intervals, is also suggestive of pyloric stenosis. Apart from

pyloric stenosis dilatation of the stomach is a very common condition, and may be present when there is no symptom pointing to digestive insufficiency. At other times dilatation may be found associated with all kinds of symptoms.

The cause of dilatation is, as I have said, a lack of tonicity in the muscular wall. It is impossible to account for its appearance, and although it may be spoken of as a symptom of "atonic dyspepsia" yet it may be present with no dyspepsia.

81. Structural Symptoms. — Apart from the evidences of dilatation which have been alluded to, the symptoms produced by changes in the organ itself are limited to the detection of tumours in the stomach wall. In the early stages they are impossible to recognise, partly because of the manner in which they occur as a somewhat diffuse thickening of the stomach wall, and partly because of the unyielding contraction of the overlying muscles. It is only when the tumour is in the anterior wall, or has increased to a considerable size, that it can be detected. By that time the patient's condition, if the tumour is malignant, will have suggested the serious nature of the complaint.

Constriction of the stomach, however, may arise as a result of contraction of gastric ulcers (hour-glass contraction). The detection of this condition is a matter of some difficulty, but it may be suspected when in washing out the stomach a portion of the fluid poured in cannot be drawn off.

82. The Diagnosis of Stomach Affections.— From the foregoing discussion it will be seen that in the vast majority of stomach affections there are few signs that may be considered distinctive of any

one complaint. When a diagnosis can at once be made in any given case, the patient has been suffering for a considerable time. As the general practitioner is usually consulted long before a definite physical sign, as a tumour, blood-vomit, or dilatation is apparent, and as the symptoms of ailments from the simplest to the most serious are at first identical, it is necessary to adopt other methods in order to arrive at a diagnosis, such as watching the progress of the affection, its response to treatment, and the general condition of the patient.

As diets are so varied, the personal predilection of the doctor may lead him to assume that the patient's trouble at first is due to some dietetic error. In this he may be right, and it is always best in any given case to start the observation by ordering the patient the simplest and most easily digested form of food. My own practice, in all doubtful cases, is to attend to decayed and deficient teeth, to prescribe a diet in which the food is given in small amounts, the solids dry so as to ensure efficient and thorough mastication, and the fluid mostly in the form of milk, also small in quantity. With people who have to follow their daily work (which is the case with the majority of patients who consult the general practitioner), the food should be taken every two hours. When at work this may be limited to a dry crust, to be thoroughly and slowly masticated. At other times meat or fish with dry bread or toast may be given, if the patient is able to digest it with comfort. The quantity must be regulated at all times by the suffering of the patient. By this simple process the majority of cases of indigestion, due to error in diet, will be relieved. Speedy relief after such a change

of diet, or from some simple remedy, must not be taken as an evidence that the stomach is free from any serious lesion—all that has been done has been to remove the stimulus that was adequate to produce the reflex symptom (pain, hyperalgesia). This is a point on which it is necessary to insist, for many cases of severe stomach disease may be thus temporarily relieved. In such cases the history must be inquired into, and the presence of other symptoms sought for. Persistence of suffering and of hyperalgesia of the epigastric skin and muscle, with contracted recti, are signs usually indicative of ulceration. When these dietetic changes are followed by no improvement, rest in bed is the next step, and the patient may have to lie many months before improvement sets in. When there is dilatation, washing out the stomach and examination of the contents is of use.

The appearance of symptoms of indigestion in persons over the age of forty years, with wasting, should at once arouse the suspicion of malignant disease. In all cases the appearance of the patient should be studied, and in case of blanching the question of hæmorrhage should be carefully inquired into.

The possibility of gall-stone disease should always be borne in mind in chronic forms of indigestion. In severe suffering the temperament of the patient may aggravate the symptoms, for the reaction of a slight stomach lesion in a neurotic subject may cause widespread sensory phenomena.

83. Pain in Gastric Ulcer.—As gastric ulcer can frequently be definitely localised, the comparison of the site of the ulcer with the site of pain sheds a light upon the mechanism of visceral pain, and

illustrates the practical value of the method of examination, where the reflex symptoms are carefully observed. I have watched patients with gastric ulcer continuously for a great number of years, and have had the opportunity of verifying the diagnosis post mortem, or at operation, in a good number. The result of these observations has been to show that, though the actual site of the ulcer had no direct relation to the place where the pain was felt, there was a fairly definite relation explicable by the nervous connection of the parts. In many cases the patient can localise the pain with great definiteness in some limited region, and the skin and deeper tissues may there be hyperalgesic. In such cases I have found that when the ulcer was situated near the cardiac end of the stomach the site of pain and hyperalgesia was in the upper part of the epigastrium, when the ulcer was in the middle of the stomach the site of pain and hyperalgesia was in the mid-epigastrium, and when the ulcer was at the pylorus the pain was felt at the lowest portion of the epigastrium.

To illustrate, not only the justification of this view, but, more important, its practical utility, I will cite some typical instances. I was called into consultation to see a young woman twenty hours after perforation of the stomach had taken place. The patient had suffered for many months from pain after food. She located the site of this pain with great certainty in the upper part of the epigastrium, over the xiphisternum. I reasoned from this that the perforated ulcer would be near the cardiac end of the stomach. The incision opening the abdominal cavity was, therefore, made as far to the left as

possible. On opening the abdomen there was found a large quantity of fluid, and a considerable quantity of flaky lymph covered most of the exposed organs. The stomach was carefully searched, and we found it rather firmly adherent at the cardiac end to the posterior wall of the abdomen. We inspected the whole of the stomach except the adherent part, and there can be no doubt that the adhesions surrounded the ulcer. We resolved not to break down these adhesions, as it would have been impossible to drag this portion of the organ sufficiently far out to enable us to stitch it. The abdomen was very efficiently flushed, the wound stitched up, and the patient made a good recovery.

Another patient I saw in consultation suffered from peritonitis, resulting from perforation of a gastric ulcer. She was a servant girl, twenty years of age. For three years she had suffered at varying times from severe indigestion, and, a year previous to my examination of her, she had vomited a quantity of blood. The pain from which she suffered was situated in the upper part of the epigastrium, just over the xiphoid cartilage (in the shaded area of Fig. 9), and was felt through to the back. When admitted to the hospital, the abdomen was hard and tense, the pulse very soft and 160 per minute. The abdomen was extremely tender to the touch; but on closer examination this tenderness was found to be purely cutaneous, the hyperæsthesia extending beyond the limits of the abdomen—over the lower part of the thorax and down over the thighs. In a few days the hyperæsthesia disappeared, except in a diffuse, ill-defined area about the epigastrium; the greatest tenderness always being

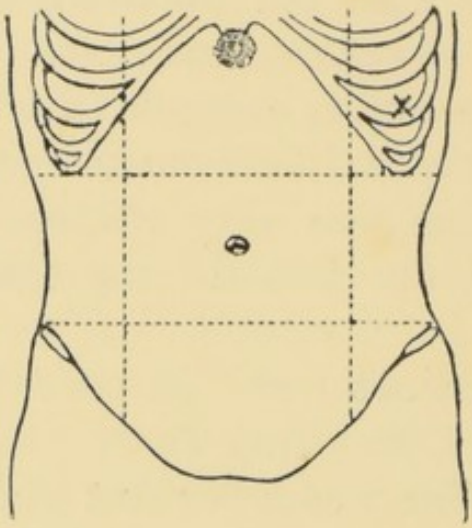


FIG. 9.

The shaded area shows site of pain, × corresponds to the position of the ulcer in the stomach as found at the post-mortem examination.

over the upper part of the epigastrium. The patient sunk and died. At the post-mortem examination there was found much matting of the stomach, bowels, and liver in the upper part of the abdomen by recent soft peritonitic adhesions. The stomach was found perforated by a large ulcer near the cardiac end, its position *in situ* being nearly as far out

as the mid-axillary line (indicated by ×, Fig. 9). There were two other superficial ulcers in the immediate neighbourhood, but they were nearer the œsophageal opening than the perforation.

A girl, aged fourteen years, who had had pain after food for many months, referred the situation of the pain with great precision to a spot in the middle of the epigastric region (Fig. 10). She was suddenly seized with collapse and severe pain over the upper part of the abdomen. There could be no doubt that it was a case of perforation of the stomach. Within eight hours we opened the abdomen, and as I had noted the situation of the pain previous to the rupture, I suggested that the ulcer would probably be found in the middle of the stomach. The incision was therefore made well to the left of the middle line. The perforation was readily met with in the middle of the stomach on the lesser curvature, in a position corresponding to the + in Fig. 10, it was stitched up, and the patient made an excellent recovery.

A female, aged 32 years, for ten years had frequently vomited large quantities of blood, and suffered from severe pain in the epigastrium. The pain was always felt with the greatest intensity at the lower part of the epigastrium, corresponding to the area shaded in Fig. 11. From this region the pain would frequently strike round the left side, and be felt severely over the sixth and seventh dorsal vertebræ. The painful area in the epigastrium was often extremely sensitive to the touch, and the cutaneous hyperæsthesia sometimes extended as a broad band round the left side. The last note I made about the patient was on 1st April, 1897, to the effect that the

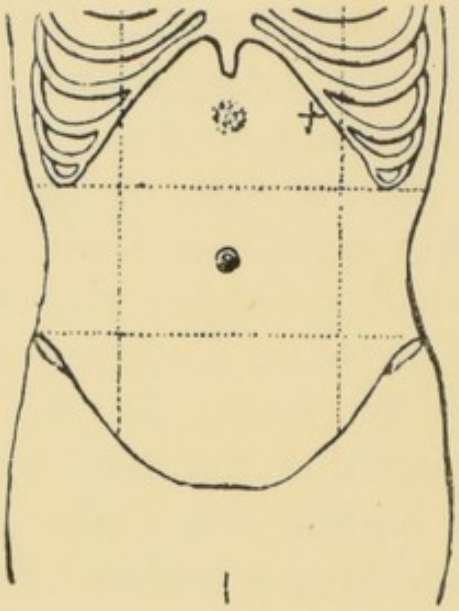


Fig. 10.

The shaded area shows the site of pain, and the + the position of the gastric ulcer as found at the operation.

patient "vomited a large quantity of blood yesterday. The pain is felt very severely midway between the xiphoid sternum and the umbilicus, striking round towards the left side"; and then follows a diagram noting the area, as marked in Fig. 11.

In treating this patient, at an early date, a blister the size of a florin had been applied over the painful area in the epigastrium. So much relief was obtained when the cutaneous surface was raw, that savin ointment was used to keep the wound from healing, until all symptoms of pain had disappeared. During the last five years of her life (she died of phthisis) the patient had been in the habit, from time to time, of applying the blister herself whenever there was a recurrence of the pain. At the post-mortem examination the effects of a recent blister were still evident, as a superficial erosion, occupying the lower part of the epigastrium, corresponding exactly with the area shaded in Fig. 11.

The patient died suddenly on 7th July. At the post-mortem examination held next day, an ulcer, 1 in. in diameter, with slightly thickened edges, was found situated partly in the stomach and partly in the pylorus. I requested my colleague, Dr. Brown, to note exactly what position the ulcer occupied in relation to the external body wall, and he, carefully noting the situation, indicated an area corresponding to × in Fig. 11.

Another case had been under my care for ten years for repeated attacks of epigastric pain. The pain in this case was very constant, unless during three pregnancies when she was quite free. She consulted an eminent surgeon who wrote to me stating that the patient had an ulcer in the middle of the stomach and on the posterior wall, and he recommended an operation for her relief. I re-examined the patient and made the following note in my diary : that, inasmuch as the pain is situated at the lowest part of the epigastric region, and as there is also

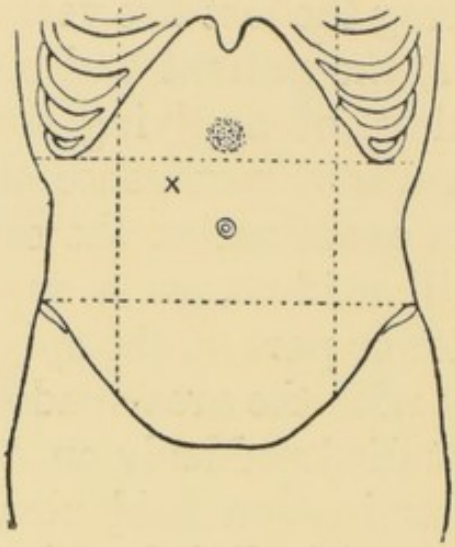


FIG. 11.

The shaded area shows the site of pain, × the site occupied by the ulcer at the pyloric orifice of the stomach as found at the post-mortem examination.

here a limited area of tenderness of the skin, the ulcer should be found at the pyloric orifice. This latter view was verified at the operation subsequently performed.

A patient, whom I had attended for twelve years with mitral stenosis, and who died in 1907, aged thirty-six, suffered severely from gastric ulcer

in 1899, so that she had to be kept in bed for two months, and be fed with the greatest care. The pain gradually abated, but kept recurring at intervals. It was always referred to the epigastrium, but radiated widely. Thus I made this note on May 13th, 1903 : " Has severe pain starting at the shaded area (as in Fig. 11) and passes round to the left side. There is no tenderness of the skin or muscles, and no vomiting. Stomach resonance as low as the umbilicus." She died in February, 1907, from her heart affection, and at the post-mortem examination an ulcer was found at the pyloric end of the stomach —at some distance from the epigastrium. The relative positions of the site of pain and of the ulcer were the same as shown in Fig. 11.

CHAPTER XIV.

THE LIVER, GALL BLADDER AND DUCTS.

84. NERVE SUPPLY.—The symptoms associated with the liver, gall-bladder, and ducts, in many cases resemble those of the stomach so closely that there is often a difficulty in differentiating the one from the other. This will be understood when it is borne in mind that developmentally the liver and its appendages are an outgrowth of the digestive tube immediately below the stomach. The region in the cord from which the nerve supply passes is at, and immediately below, the region of the stomach supply, from the seventh to the ninth thoracic; so that with severe stimulation the irritable focus in the cord invades the nerve supply of the stomach. As in stomach

affections the reflex phenomena appear in the epigastrium, but in gall-bladder affections the hyperalgesia is most common on the right side, and the upper part of the right rectus muscle becomes contracted. The symptoms also tend to spread to the right side and lower down in the abdominal wall. In addition to the thoracic nerve supply the liver and gall-bladder and ducts are also supplied by the phrenic nerve (third, fourth and fifth cervical) and by the vagus.

85. Reflex Symptoms in Gall-stone disease. —The reflex symptoms in affections of the liver itself are often not very distinctive, while those of the gall-bladder and ducts are frequently violent and very characteristic. This difference is due to the fact that the former is a glandular structure, while the latter contain non-striped muscular fibres which, we have seen, may provoke the most violent sensory phenomena.

The pain in gall-stone disease varies much in severity. It may begin with a sense of uneasiness in the epigastrium, or over the lower ribs on the right side. A small area of cutaneous or muscular hyperalgesia may be detected somewhere in the region in which the pain is felt, and also in the upper portion of the right rectus. This muscle may be more or less contracted. These symptoms may be slight and variable, and continue for months or years, or the patient may be seized suddenly with violent pain, with or without these preliminary symptoms. The pain in the majority of cases of gall-stone colic is situated in the middle line, about the lower part of the epigastrium. It may come on gradually and remain for an indefinite period, sometimes varying slightly in intensity. From this place it tends to

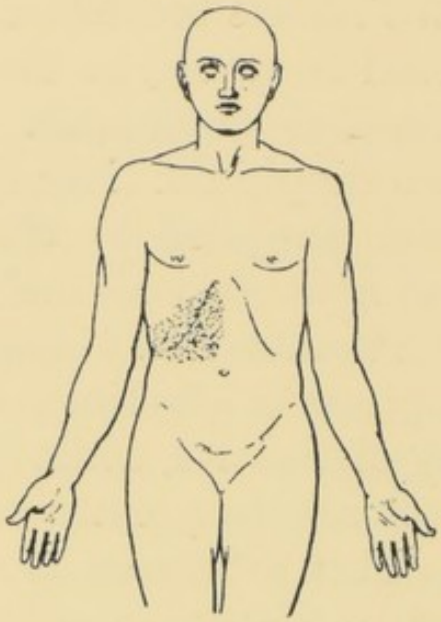


FIG. 12.

The shaded area shows the region of cutaneous hyperalgesia after an attack of gall-stone colic. The + is the position of a tender point in many cases in gall-stone disease, and is over the place where a twig of the ninth thoracic nerve passes out of the rectus abdominis muscle.

spread to the right side, and may be felt with great severity below the edges of the ribs. Sometimes it may extend round to the back, and be felt most severely over the ninth and tenth ribs. In rare cases the pain may only be felt in the back.

The pain, intermitting slightly, may remain for many hours, unless relieved by a sedative. Frequently after the subsidence of the pain the skin and muscles of the upper part of the right side of the abdomen

become very tender to touch, and the muscles hard and contracted. In Fig. 12 the area of cutaneous hyperalgesia is shown in the patient in whom I first discovered the presence of hyperalgesia in 1891.

In a great many cases, after the subsidence of the attack, the hyperalgesia may persist for several weeks, and, during this period, severe attacks of pain are very liable to be provoked, so that the patient is scarcely able to move about.

In a small percentage of cases pain, sometimes of great severity, is felt on the top of the right shoulder, striking down the outside of the arm. It is very necessary to recognise the relationship between pain in this region and gall-stones. I have known patients in whom there was this pain in the shoulder and in the arm treated for years for "neuritis," and the passage of a gall-stone has been followed at once by relief. In many cases this shoulder pain is not very severe, and the patient may not refer to it. If, however, inquiry be made, the patients frequently declare they they have had pain in the right shoulder, which they thought was "rheumatic." When this shoulder pain is severe and the chief complaint, if due to gall-stone disease a careful search will reveal evidences in the upper part of the abdomen, in the hyperalgesia of the skin, in the contraction of the muscles, and in the history of the patient which leaves little doubt as to the cause of the shoulder pain.

86. Gastric Symptoms in Gall-stone disease. —In persistent "dyspepsia" and heart-burn, the question of gall-stones should always be considered. I have already referred to the association of pain on the ingestion of food into the stomach with

gall-stone disease. One frequently sees patients with a history of "acute gastritis" of which the symptoms are described as attacks of severe pain in "the pit of the stomach," or "cramp of the stomach," followed by a period when ingestion of food causes pain. Such a history will, in the majority of cases, be found really to have been due to gall-stone colic, with the subsequent condition of hyperalgesia associated with an irritable focus in the cord.

Nausea and vomiting are frequent accompaniments of gall-stone colic, and their occurrence with the pain in the "pit of the stomach" might seem to confirm the conclusion that the case is one of "gastritis," or "cramp of the stomach."

87. The result of Reflex Symptoms.—When we come to consider the effect of this hyperalgesia, contracted muscles and exalted reflexes, we get a picture that is often very misleading. After the attacks of severe pain have subsided the patient may be unable to breathe freely, each inspiration being checked, as it is in pleurisy, by spasm of the intercostal muscles, and severe pain may be felt over the lower ribs on the right side. Such symptoms are sometimes mistaken for pleurisy. If a careful examination be made, it can be demonstrated that there is an extensive field of hyperalgesia, extending up into the chest and implicating the intercostal muscles. The exercise of hyperalgesic muscles is always limited on account of their increased tone, and the tonic contraction tends to increase with their continued action. It is for this reason that patients with gall-stone and persistent hyperalgesia of the abdominal muscles are comparatively at ease when at rest. On moving about there gradually comes on

a feeling of pain and dragging round the abdomen, and the patient is unable to "stretch" himself freely This is simply due to the fact that the exercise of the hyperalgesic muscles has increased their tonic contraction and their sensitiveness, so that their exercise is painful and the extent of their movement becomes greatly limited.

88. Functional Symptoms in Gall-stone disease.—It is in only a small proportion of cases that jaundice is present in gall-stone disease. If the stone is situated in the common duct, or can cause pressure on the common duct, so as to obstruct the channel, then jaundice arises. When the jaundice is so slight that it is difficult to determine whether it may not be due to a sallow complexion, a careful inspection of the sclerotic may reveal a faint tinge. It may be necessary in cases of doubt to examine the urine or blood for minute traces of bile pigment.

89. Structural Symptoms in Gall-stone disease.—It is only in very rare cases that gall-stones can be detected in the gall-bladder. It can only be done when the stones are so numerous as to cause a tumour, or when the stones cause the gall-bladder to become distended with fluid. This can only happen at a late stage in the disease, and when all the associated reflex phenomena have disappeared, for the presence of hyperalgesia means also the presence of a lively muscular reflex,which effectually prevents the hand reaching the gall-bladder. When the abdominal muscles are lax the distended gall-bladder may be felt as a tumour, and, in rare instances, the stones have been palpated. The liver is sometimes said to "enlarge and become tender."

As, however, the writers who describe this have not appreciated the association of this so-called "tender liver" with contracted muscles, this observation needs to be verified. For my part I have never been able to satisfy myself as to a slight liver enlargement when there is hyperalgesia and contracted muscles. The muscles are so tender on pressure and contract so firmly that it is impossible to palpate the liver; the percussion note also becomes altered with a contracted muscle.

90.—Fever in Gall-stone disease. — In the great majority of cases of gall-stone disease there is no fever, except it may be a slight rise at the time of an attack of colic. In some cases there is an associated inflammation of the gall-ducts, and, as a consequence, febrile attacks may occur of a very characteristic type. These are generally very sudden in their onset and in their subsidence. The patient begins to feel chilly and shivery, and when his temperature is taken it will be found to be considerably raised—101-104°. He may have rigors. In the course of one to three days the temperature returns to normal.

In more advanced stages of cholangitis the temperature may remain continuously above normal with frequent exacerbations. With the formation of pus the temperature usually remains continuously high.

In all obscure cases of intermittent temperature the possibility of gall-stones should be considered. Except malaria there is no disease which gives such characteristic febrile attacks. In many cases a slight jaundice can be detected.

91. Nature of Reflex Symptoms in affections of the Liver.—I have dealt fully with the reflex symptoms in gall-stone disease, because in this complaint they are seen in their most striking form. In disease of the liver the same areas may be affected though the symptoms are less violent. As I have pointed out, it is doubtful if the affections of the parenchyma of an organ ever give rise to pain, unless the fibrous covering is affected or stretched. As a rule in liver affections there is little pain, unless this hyperalgesia of the external body wall and the tender structures are stimulated, as in exercise of the muscles, when pain will be felt in the muscles so exercised. This is well seen in cases of rapid increase in the size of the liver from heart failure, when the capsule is stretched, and when, if the patient moves about, there is considerable pain felt in the muscles over the liver, in front and round to the back. The enlargement of the liver due to heart failure offers an excellent opportunity for the study of the reflex symptoms of liver affections. These symptoms are seen most strikingly when the heart failure sets in with some rapidity, as in certain cases of paroxysmal tachycardia, especially when the tachycardia is due to auricular fibrillation, or where heart failure sets in as a consequence of the permanent establishment of auricular fibrillation. In certain cases this abnormal rhythm is suddenly developed, and in the course of a few hours the heart dilates and the liver becomes very considerably enlarged. If the patient keeps at his work, feeling weak and breathless, severe pain is suffered from across the back and round in front over the liver. If he be examined a patch of cutaneous hyperalgesia

may be found embracing a considerable portion of the upper part of the right side of the abdomen. The muscles below the ribs in front will be found hyperalgesic and contracted, and the erector spinæ muscles at the level of the eighth to twelfth ribs will also be found hyperalgesic (*see* Fig. 16, page 234). If the heart should suddenly return to the normal, the liver enlargement subsides in a few hours, and the hyperalgesia disappears. If, however, the abnormal rhythm persists, then with rest in bed the hyperalgesia gradually diminishes until one can palpate the liver through the abdominal wall, and even take tracings from the enlarged and pulsating liver.

In enlargement of the liver due to other causes, as hypertrophic cirrhosis, cancer, chronic and subacute abscess, the reflex symptoms are of the same nature but less acute. I have no experience of acute inflammatory affections of the liver, so cannot tell the nature of the symptoms present.

Severe and persistent vomiting may arise in liver affections. In the early stages of "catarrhal jaundice," before the jaundice appears, the patient may suffer from the most violent and persistent attacks of vomiting, and the cause may remain unsuspected till the jaundice appears.

92. Functional Symptoms in affections of the Liver.—Jaundice is, of course, the most striking, and needs no further description. In all cases of sallow or dirty gray complexion, the liver should be carefully examined. When chronic liver affections produce jaundice, or alter the complexion, there is generally present also a considerable degree of wasting. This wasting, with an enlarged liver and a faint jaundice tinge, is very suggestive of malignancy.

In some cases of chronic heart failure there may be wasting, enlarged liver, jaundice, slight or severe, which simulate malignancy so closely that a mistaken diagnosis is not uncommon. If the heart be examined the evidences of heart disease are always so marked that no difficulty should be met in recognising the real nature of the liver trouble.

93. Structural Symptoms in affections of the Liver.—Normally the upper margin of the liver dullness corresponds to a transverse line drawn at the level of the junction of the sternum and the xiphi-sternum. The lower edge corresponds in the nipple line to the right costal margin.

Organic symptoms may be recognised as an enlargement of the organ, or a diminution of its size. When there is much muscular hyperalgesia it is often difficult to define the limits of the organ. In the absence of this, little difficulty is found in detecting the extent of the liver enlargement. This is better done by palpation than by percussion, as a distended bowel may communicate a resonant note, particularly with enlargement of the left lobe. In enlargement of the organ from heart failure the organ can sometimes be felt to pulsate. This is perceived by putting the left hand behind and pressing forward the liver, while the right hand is laid over the liver, which will be found to heave gently with each cardiac contraction. The extent to which the liver may enlarge is very great, and its lower margin may extend as low as the brim of the pelvis.

The surface of the enlarged liver may be nodular, as in cancer and cirrhosis. In the great majority of cases the enlargement of the liver is downwards, but in hydatids of the liver, the cyst being on the

upper margin, the liver dullness may extend upwards to the third rib. Percussion gives rise to the characteristic thrill due to vibration set up in the fluid contents of the cyst.

The liver may be pushed down by abnormal conditions in the chest, as in emphysema or pleural effusions, or it may be displaced downwards on account of laxity of its ligaments and of the abdominal muscles (hepatoptosis).

It may be dragged up into the chest, as in the retraction that follows the absorption of a long-standing pleuritic effusion.

Diminution of the size of the liver may occur, as in atrophic cirrhosis, when it is the lower border that recedes.

CHAPTER XV.

THE GREAT AND SMALL INTESTINE.

94. DIFFICULTIES IN DIAGNOSIS.—The difficulties in diagnosis of affections of the bowels are very great. The great length of the tube, with its coils confusedly mixed so that there is no safe guide to the locality of many portions, the continual shifting of each portion with the peristalsis of the gut, and our very imperfect knowledge of many of its functions, all combine to render diagnosis of bowel affections a matter of great uncertainty. There is a misconception, almost universal, as to the position and form of the great intestine, many pictures of this portion of the gut showing it as passing in swelling folds up the right side, across the upper part of the abdomen, and down the left side from the splenic flexure to the rectum. It is further stated that the position of this gut can be made out by percussion. With the exception of the cæcum, which is more or less fixed in its place, and usually distended with gas, no part of the gut can be accurately mapped out. To begin with, it is doubtful if

the descending colon is ever distended in the manner shown in the pictures. When empty of fæces it lies behind coils of small intestine, a contracted narrow tube. The study of the movements of the bowel after bismuth meals, shows that the transverse colon varies extraordinarily in its position in different people. The ready distension of any portion of the small intestine renders attempts to differentiate the particular portion distended a matter of the greatest uncertainty.

A similar confusion exists in regard to the localisation of pain. The sensation of pain is frequently so diffuse and generalised that no clear indication can be obtained in many cases in regard to its exact site. When severe pain arises from peristalsis the situation can often be localised with a certain amount of precision, but here the recollections of the patient are extremely unreliable. I have frequently been struck by the discrepancy between the patient's account of the position of the pain described from memory, and the actual position to which he refers the pain when asked to locate it while suffering from an attack of pain. For this reason the account given by the patient must be taken with great reserve.

To a certain extent the confusion also depends on the shifting of the site of pain. The cause of pain in the intestine is often due to strong peristalsis, and in disease the peristalsis often does not appear at the site of the lesion, but at some distance above it, whence it gradually descends, and as the wave passes over coil after coil the position of the pain shifts likewise. Peristalsis may be stimulated below the disease, as, for instance, when the irritating

secretion from an inflamed portion of the gut causes painful peristalsis as it is conveyed along the bowel.

On account of these and other reasons the diagnosis of bowel conditions is often extremely unsatisfactory, though the recognition of the difficulties should lead to a more careful scrutiny of the symptoms in each individual case. In the matter of pain, the patient should, if possible, be interrogated at the time he is suffering, and the position of the pain localised as he feels it. If this is impossible, then he should be asked to pay strict attention when it recurs to note the exact site of the onset and the subsequent radiation of the pain.

95. PAIN.—I have already pointed out that the pain from peristalsis of the bowel is usually limited to the middle areas of the body. In order to recognise the area in which the pain from any given portion of the bowel may arise, I have taken careful observations in cases of obstruction of the bowel as one was frequently able to demonstrate the site of the lesion by operation or post-mortem examination. It is well known that the bowel below the obstruction ceases to contract and lies inert. On the other hand, the bowel above the point of obstruction is usually stimulated to violent peristalsis in the attempt to overcome the obstruction. In consequence of this violent peristalsis severe colic-like pains are set up. Careful observation of the patient during an attack will reveal the fact that the pain starts high up in the abdomen, passes gradually lower and lower, till it reaches a climax at some definite part; then it ceases and does not descend lower. If when the pain stops this part be noted, the situation of the obstruction can be localised within certain limits.

Unfortunately the limits are still wide; nevertheless, the information is extremely useful. If we take the usual divisions of the areas of the abdomen as in Fig. 8, page 117, it will be found that the peristalsis of the small intestine gives rise to pain limited to the umbilical region, never descending below that area. The cases in which I have specially studied the pains due to obstruction of the small intestine have been strangulated hernias, and I have had abundant opportunities in operating to verify the situation of the obstruction. This localisation of the pain in the umbilical region is supported by the experience acquired in the case of peristalsis, with the intestine exposed, cited on page 40. An attempt has been made to find out whether the localisation might not be more exact, by noting the level of the pain, but the sensation is evidently too diffuse to permit of such exact localisation. One would naturally expect to find a distinct relationship between the level of the pain and the position of the obstruction, but owing to this diffusion I failed to satisfy myself in any given case of the exact limits of the pain. The pain, when very severe just at the lowest limits, also extends widely across the abdomen at the same level. In many cases a diffuse area of hyperalgesia of the skin and muscles may be detected, but it has been of such a vague character that I have not found it of much value as a diagnostic factor.

In obstruction of the large intestine the pain due to the peristalsis descends to the hypogastric region (Fig. 8, page 117), and here certain limited deductions can be drawn from the level at which the pain stops. The cases I have studied have been

patients with obstruction at the splenic flexure, or at the sigmoid flexure, and cases of hard masses of fæces retained in the rectum. In the obstruction at the splenic flexure the pain did not descend below the middle of the hypogastric area, while the pain due to peristalsis below the splenic flexure was felt about, and below, the middle of the hypogastric area. I have observed a number of cases with fæcal masses in the rectum, too large and hard for their expulsion by the anus. In these cases the situation of the pain and straining efforts seemed identical with the pains and straining during labour. This agrees with what has already been said about the situation of pain in diarrhœa and with distending enemata immediately before the expulsion of the fluid contents of the rectum.

In many people scybalous masses may lie in different parts of the bowel, and their presence may set up, after a time, violent peristalsis, in some cases accompanied by diarrhœa. Once the violent peristalsis begins it does not subside until the scybalæ are shifted. The people in whom I have observed this most frequently have been young women who have neglected their bowels. The pains are very severe, and the motions will often contain grayish hard lumps. After the bowels have been voided a large area of hyperalgesia and muscular contraction over the abdominal wall is left. This tenderness and hardness and the history of colic-like pains give rise to many wrong diagnoses, the principal error being to attribute the symptoms to peritonitis.

96. Appendicitis.—The nature of the symptoms in appendicitis has already been indicated on page 43. From the study of the case given there it will be

seen that the symptoms are entirely reflex. In every case there are features peculiar to the individual, so that great variations as to the amount of pain, extent of hyperalgesia and muscular contraction are met with. But the nature of the symptoms and their distribution and mechanism of production are sufficiently indicated in the illustrative case given on page 42 to make clear the principles underlying the most salient symptoms of appendicitis.

There are a few symptoms present in exceptional cases that need a passing notice. The nature of the attacks of "appendicular colic" is to me very obscure. In some cases the pains have been so distinctly referred to the umbilical region that I have considered the question whether the intestine above the inflamed appendix may not have been stimulated to violent peristalsis. That the colic in appendicitis may be due to violent peristalsis, at all events in some cases, seems possible from the following experience. A man aged 40 years had suffered for four years from violent attacks of colic and pain in the abdomen. He had seen several physicians and surgeons and ultimately a diagnosis of gall stones was made, and he was operated upon. No gall stones were found and no relief was obtained from the operation. I was asked to see him and I obtained, with difficulty, a clear notion of the site of his suffering and the spread of the pain. The pain started always just at the lower part of the epigastric region and descend slowly in the middle, increasing in severity to the lowest part of the umbilical region (space c, Fig. 8, p. 117). It might stop in this neighbourhood for some time, but did not descend lower. From this account, we reasoned that the pain

was due to some hollow viscus, that as it persisted most severely in the central regions of the abdomen, gall-stone colic and the colic from a renal calculus could be excluded. The only hollow viscus that could cause pain in this region was the small intestine, and the radiation of the pain indicated that the peristalsis had started high up and stopped at the end of the small intestine. A painful peristalsis occurs only above the provoking cause, so that we could infer the cause would be found at the lower end of the small gut. Moreover as in the great majority of cases the appendix is the provoking agent at this place, the probability was that the appendix was affected. Acting on this diagnosis an operation was performed. The small intestine was found deeply injected, especially at its lower extremity and the appendix was found red, inflamed and adherent to the neighbouring structures. Its removal was followed by complete freedom from attacks of colic.

The appendix wall itself contains a muscle coat, and the contents are frequently confined by blocking of the passage, so it may perhaps be surmised that the colic arises from a spasm of the muscle coat. The reference of the pain to the middle line would be in accordance with the experience that peristalsis of any portion of the digestive tube causes pain in the middle line, and parts that have developed from the tube, as the gall-ducts and appendix, follow the same law.

I cannot satisfactorily account for the predominant symptoms from the appendix being so distinctly one-sided, seeing that it is developmentally a portion of the digestive tube. But it is interesting to note that as in the case of the gall-bladder and ducts, and

even of the heart, though the most severe pains may be situated across the middle line, the radiations and persistence of the phenomena are one-sided.

In extension of the inflammation in appendicitis other structures become involved, and these then give rise to the symptoms peculiar to themselves. When the inflammation affects the parietal peritoneum, and adhesions form with it, these symptoms will be found characteristic of peritoneal adhesions, as pain and tenderness over the part (*see* page 200). This fact may account for many of those aberrant symptoms in appendicitis, as when it is situated in the pelvis and adherent to adjacent parts.

97. Affections about the Anus and Perineum. —A somewhat complicated series of symptoms arise in affections about the anus, in consequence of the nervous distribution passing gradually from the autonomic to the cerebro-spinal system. As at the junction of other mucous and cutaneous surfaces the sensibility becomes profoundly modified, and there is a transition area where certain forms of cutaneous sensibility, such as pain, become more acute. This difference in sensibility is well seen in the case of piles, for so long as the pile does not encroach upon the tissues supplied by the cerebro-spinal nerves, no direct pain is felt, whereas pain of the most distressing character is felt when the pile encroaches on the mucous membrane supplied by the cerebro-spinal sensory nerves. Pain, however, may be felt from an internal pile, and it is then referred to the back, over the upper part of the sacrum. I have seen much relief afforded from this pain by free hæmorrhage from an internal pile. This referred pain is sometimes extremely distressing in cases of ulceration

within the rectum, especially after the bowels are moved. When the ulceration or fissure involves the sensitive marginal mucous membrane, the pain becomes at times agonising and prolonged, and is felt in an ill-defined area all around the anus and over the sacrum.

There is an intimate relationship between this region and the bladder, irritation at the anus producing frequent micturition, and sometimes spasm of the sphincter vesicæ. This reflex is well seen in women where the perineum has been torn at the birth of a child and afterwards stitched up, retention of urine being a frequent result. This reflex is probably limited to the skin of the perineum, as if care be taken in stitching the perineum not to include the skin in the stitches retention of urine is less likely to occur. The skin supply for this region is from the lower sacral nerves, and the nerve supply for the sphincter vesicæ is from the autonomic sacral nerves—that is, from the same region of the cord.

98. Perineal Reflex. — A curious connection exists between the perineum and the respiratory and other centres. This is seen particularly well in parturition, where, when the child's head presses on the perineum, the contraction of the uterus is sometimes greatly stimulated, and the mother is compelled to "bear down" with uncontrollable energy. In patients lightly under chloroform the traction made by the forceps when the head reaches the perineum sometimes causes the patient to breathe in a deep and laboured fashion. Apart from its scientific interest this latter reflex has to be borne in mind in the administration of chloroform, as by the deep

respiratory movements a greater amount of chloroform may be taken than is desirable.

99. Functional Symptoms.—Our knowledge of the symptoms arising directly from abnormal functions of the digestive tube is limited to the condition of the fæcal evacuations. These again must be studied in association with other phenomena, as pain, fever, distension of the abdomen. It is scarcely necessary to insist on the systematic examination of the fæces by the physician himself in all abdominal cases, and the patient should be instructed to observe for himself the character of the dejecta. The character of the normal stool is fairly constant, soft and moulded, yellowish-brown in the adult, pale whitish yellow in children and the milk-fed. The colour may vary with the food and with drugs. The absence of bile gives the characteristic pale drab-coloured stools. There may be an admixture of the stool with abnormal contents from the intestinal tract, as blood, mucus and pus. Blood from near the anus, as in piles, is usually unmixed with the fæces, either free or staining the fæcal mass. When its origin is higher up it becomes mixed with the food, and undergoing certain chemical changes, becomes black and "tarry" looking. The character of the mucus in the stools may give some idea as to its source; small jelly-like masses accompany the diarrhœa from an inflamed swollen gut, shreds or membrane-like pieces are seen in affections of the colon and rectum. Other abnormal constituents may be present as undigested food, gall-stone, intestinal sand.

The character of certain stools is fairly typical, as the diarrhœic, with hard scybalous masses, indicating that scybalæ are lodged in some part of the

digestive tract, and setting up irritation; the "pea-soup" stools of typhoid fever and of pneumonia; the "'rice water" stools of cholera; the "frothy stools" of infantile diarrhœa. The shape of the stool may be modified by its passing through a constricted passage near the anus. The recognition of obstruction, partial or complete, need not be insisted upon.

100. Structural Symptoms.—Symptoms due to changes in the bowels are very often difficult to make out, owing to the mobility of these organs, and the ease with which they can become distended with flatus. Except the cæcum and a small portion of the ascending colon and the rectum, there is no part in which changes can be with certainty located on account of shifting and distension of the intestinal coils. In addition to this, tumours and thickenings in any part of the abdomen so readily convey the tympanitic note from the bowel that percussion is seldom of much use in detecting these when they are in the walls of the bowel. A further complication arises when small portions of the muscles of the abdominal wall become hard and contracted (*see* page 72). Manifest changes in the bowels should always be considered with reference to the reflex phenomena already described.

CHAPTER XVI.

AFFECTIONS OF THE URINARY SYSTEM.

101. Symptoms of Affections of the Kidney. —As in the affections of other glandular organs, there are practically no sensory symptoms evoked by disease of the kidney structure. Backache is sometimes put down as present in inflammation of the kidney, but considering how frequent backache is some doubt may be entertained whether the kidney is the cause. For a great many years I have carefully inquired into the symptoms in all sorts of cases of albuminuria, acute and chronic, and I could find no evidence of pain of any form referable to the kidney trouble. All the symptoms of kidney disease (apart from alteration in the size of the organ) are found in the chemical examination of the urine, in the frequent micturition, or as the result of its impaired secretion on other organs and systems (vomiting, headache, convulsions, changes in the cardio-vascular system, dropsy).

Functional Symptoms.—In the routine examination of all cases inquiry should be made into the

question whether the patient has to get up at night to pass urine, and, if such is the case, the urine should be examined for albumen or sugar. The presence of albumen should lead to the careful examination of other systems, particularly the heart and blood vessels, because it is the effect of the impaired kidney function on these that offers the best guide as to the importance of the albuminuria. It must be borne in mind that the presence of albumen is not in itself a matter of moment. It only indicates that albumen is passing through the secretory cells, and long experience has taught that when this happens there is an injury to these cells which prevents the elimination of other matters, which, being retained in the blood, have a deteriorating influence on other organs. It is for this reason that the significance of the kidney affection is often determined by the symptoms in other organs and tissues.

Structural Symptoms.—It is only when there is a considerable increase in the size of the kidney that we can detect its presence clinically with assurance. And even then the subject has to be of a somewhat spare habit. Normally we recognise a certain fullness under the lower ribs in either flank, which rather indicates its presence than gives a clue to its size. It is the relative greater fullness on one side that leads to the recognition of the increase in the size of this organ, and the absence of this fullness which leads to the suspicion of a displaced kidney. The nature of the enlargement in any given case is surmised from the presence of other symptoms, as pus or tubercle bacilli in the urine, the cancerous cachexia, etc.

Movable Kidney.—The careful palpation of the

abdominal cavity with the walls relaxed may reveal a movable kidney. It is often present without symptoms, but its presence may be associated with a good deal of vague, indefinite pain, dilatation of the stomach, and more or less nervous disturbance of a "neurasthenic" kind. Obscure attacks of vague pains, nausea and collapse have been ascribed to a movable kidney, and it is well to bear this in mind, for such attacks may be attributed to appendicitis or other intestinal lesion, or to renal colic.

102. Symptoms of Affections of the Pelvis of the Kidney and Ureter.—*Nerve Supply of the Ureter.*—The efferent nerves supplying the pelvis of the kidney and the ureter come from the inferior mesenteric, spermatic and hypogastric plexuses. The level at which these nerves leave the cord can be inferred from the study of the nerves implicated in the reflex phenomena in cases of renal calculus. From this study the nerves passing from the pelvis of the kidney and the ureter can be inferred to reach the spinal cord at the level of the lower thoracic and upper lumbar nerves. The distribution of the pain and the stimulation of the muscles to contraction, in a case of renal colic, such as that described on page 44 give a clue to the cerebro-spinal nerves reflexly stimulated by the sympathetic nerves from the pelvis of the kidney and the ureter. The pain arising in the back above the crest of the ilium, passing round the front and slanting down into the testicle, as in the shaded area of Fig. 13, page 183, traverses the fields of distribution of several spinal nerves from the eleventh thoracic to the second lumbar. In like manner the contraction of the muscles that accompany the pain gives a clue

to the motor cerebro-spinal nerves that have been stimulated. In the case described on page 44 contraction of the flat muscles over the iliac fossa (the external and internal obliques, and the transversalis abdominis) was produced, the lower portion of these muscles being supplied by the lower thoracic nerves. The contraction of the cremaster muscle, which is often such a distinct feature in cases of renal colic, implies a stimulation reaching the spinal cord at the level of the first and second lumbar nerves. It is interesting to note that a portion of the fibres of the cremaster are continuous with the internal oblique, and both of these muscles contract in renal colic. The genital branch of the genito-crural nerve contains the motor nerve to the cremaster muscle, and also the sensory nerve to the tunica vaginalis, which latter becomes so hyperæsthetic in renal colic when the pain "shoots into the testicle," and it is manifest that it is to the peripheral distribution of this nerve that the pain is referred. It is to be remembered that the scrotal covering of the testicle is supplied by the sacral nerves, and the skin of the scrotum is never affected in renal colic. (For further evidences of testicular sensibility *see* p. 37).

Non-striped muscle enters into the structure of the pelvis of the kidney and of the ureter, and in consequence we have the reflex symptoms developed to a very marked and characteristic extent. While any circumstances that can arouse the severe contraction of this muscle seem to provoke the pain and attendant phenomena, the presence of a renal calculus is, in the great majority of cases, the immediate cause. The following description, while referring to renal calculi, also applies to other

causes, as pus or tuberculous ulceration, which may set up a painful contraction.

The position of the pain, its characteristic radiation, and the attendant muscular contraction, have been referred to and illustrated by the case described on page 44. The place where the pain starts is of very great importance as giving an idea of the approximate site of the stone. It must be remembered that the gradual shifting of the pain from the back round to the front and down to the groin, is not an indication that the stone itself is gradually being shifted and driven down the ureter. Nor must it be imagined that because the distribution of the pain has a vague resemblance to our notion of the position of the ureter that the pain is felt "along the ureter." The pain in its radiation is passing along some path in the spinal cord, and thereby affects the cord centres of the nerves distributed to the body wall in the area shaded in Fig. 13. Doubtless the peculiar path is directly associated with the nerve supply of the pelvis of the kidney and of the ureter, and as each part passes into peristalsis a definite portion of the spinal cord receives a corresponding stimulus, just as happens in the case of the peristalsis of the bowel.

Bearing this in mind, it will be seen that when the pain keeps recurring and starting from the same place the stone is stationary, and its presence stimulates a peristaltic contraction. Hence when we find repeated attacks starting at the back we may safely infer that the stone is lodged in or near the pelvis of the kidney. There is some doubt whether a stone in the kidney surrounded by glandular tissues and not protruding into the pelvis can ever arouse

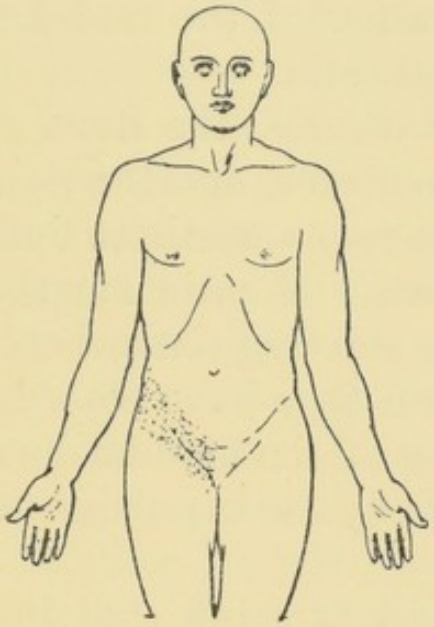


FIG. 13.

The shaded area shows the distribution of the cutaneous hyperalgesia after an attack of renal colic. The band traverses portions of the fields of distribution of the eleventh and twelfth thoracic nerves and of the first lumbar. The tunica vaginalis and the lower portion of the left abdominal muscles were also hyperalgesic.

the pain characteristic of renal calculus, for it seems that contraction of muscle is the cause of the pain, and the calculus acts as a stimulus to the contraction.

The explanation of the locality of the pain is that the spinal centres of some fibres of the eleventh thoracic nerve which are distributed in the back are first stimulated, that as the peristaltic wave passes down it sends stimuli to other centres of the eleventh and twelfth nerves whose fibres are

distributed in the area shaded in Fig. 13, and later to the genital branch of the genito-crural nerve which is distributed to the tunica vaginalis; hence the pain which shoots into the testicle and the tenderness of the testicle, or rather of the tunica vaginalis, after an attack of renal colic.

In a number of cases the stone seems to stick on its way down the ureter, and the pains then start at a lower level. One may sometimes find a patient with a history of attacks of pain starting in the back, then after a time starting somewhere in the front of the abdomen; then they have ceased, and the symptoms of irritation of the bladder have appeared for a period, followed by the expulsion of a calculus and complete relief.

I am disposed to think that in these cases the stone is lodged at the entrance of the ureter into the bladder. We know from observation on the bowel that violent peristalsis takes place above the point of obstruction, while the bowel below does not contract, and it seems that the same is true of the ureter. In these cases the pain passes down as low as the testicle, and this would imply, if my reasoning is right, that the peristalsis has extended to the lowest portion of the tube. It is not likely if the stone were lodged in the middle of the ureter, and completely blocking the lumen, that a peristalsis would be set up in the part below. This is a point worth considering by those who have the opportunity of locating the stone by operation, and seems to be the explanation in the following case.

Male, aged 32, consulted me, with the following history. He had emigrated to America two years previously. For the first year he had enjoyed good

health, but during the past year he had been in such constant suffering that his health was shattered, and he had returned to his native country, in the hope that the change might do him good. He was spare and thin, walked with a slight stoop, and his face was drawn and anxious. In conversation he was nervous and irritable, and I had the greatest difficulty in getting from him a distinct account of his complaint, as he had become extremely neurotic, and mixed his mental impressions and his digestive troubles with the description of pains in various parts of his body. With strict inquiry I found that his illness began with severe attacks of pain in his back, which he referred to the left lumbar region. For three months these attacks continued until he became weak and ill. After this the pain shifted, starting over the iliac fossa and striking into the testicle, and his testicle became tender, so that it hurt him to wear his breeches. In the past few months this pain had disappeared, and he was now suffering from great perineal pain, especially at the end of micturition. From the account given by the patient the salient points have been selected, leaving out the numerous other symptoms from which he suffered, and which he had mixed up in almost inextricable confusion, besides giving his own irrelevant views as he went along. It was evident that the patient had had a renal calculus, which had shifted its position and was now in his bladder, and his long suffering had reacted on the nervous system, producing very characteristic neurotic or neurasthenic symptoms. I sounded his bladder and could find no stone, but assured him that there was a calculus in his bladder. A few days

after he again called to see me, a totally different man, erect and smiling, and held out to me, in the palm of his hand, a calculus, the size of a small bean, which he had passed the previous day. My reading of the symptoms was, a renal calculus, at first lodged in the pelvis of the kidney, then at the lower part of the ureter, and finally in the bladder. The suffering had weakened and exhausted the nervous system and produced other widespread phenomena. I have already drawn attention to the well-known fact that prolonged suffering tends to produce a hypersensitive nervous system, so that other affections, such as gastric flatulence, produce exaggerated symptoms.

The reflex symptoms resulting from a renal calculus may be much more extensive, and give rise to symptoms indicative of other lesions, as already referred to on page 76. There I have instanced a case where I was summoned to do a laparotomy for obstruction of the bowel. When I saw the patient the symptoms certainly pointed to an obstruction of the bowel, for no fæces or flatus had passed for two days, the abdomen was greatly distended, and all the muscles firm and rigid. I had much difficulty in passing my finger through the anus, on account of the firm contraction of the sphincter. The patient had had severe pains, which he very vaguely described as passing over the abdomen. While puzzling over the case he was seized with a severe spasm of pain, and I insisted upon his placing his hand on the site when it started, and on following its course when it radiated. The region thus indicated was perfectly typical of the pain of renal colic, starting in the lumbar region, and passing round

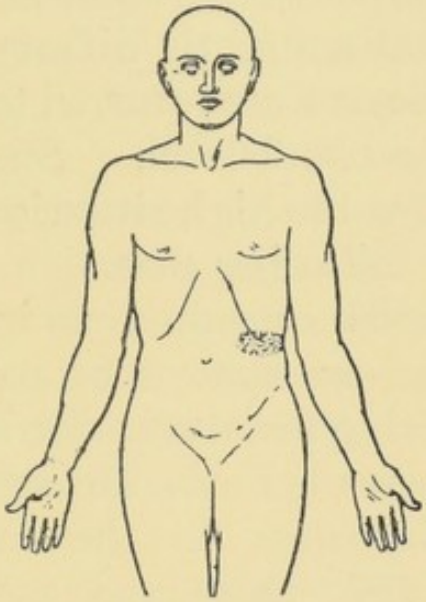


FIG. 14.

The shaded area corresponds to the site of pain and cutaneous hyperalgesia in a case of renal calculus after an attack of colic.

and down to the groin, as in the shaded area of Fig. 13. I unhesitatingly said that the patient had a renal calculus, and that the abdominal distension and obstruction was due to the unyielding contraction of the sphincters, which, with the contracted abdominal muscles, were the evidence of a widespread viscero-motor reflex. The patient then stated that some few years ago he had had a similar but milder attack, followed by the passage of a small

calculus. He was given some morphia and chloral, two days later he voided a small calculus, and all the symptoms disappeared.

The nerve supply of the viscera and their connection with the cerebro-spinal nerves is fairly constant. Sometimes it would seem as if the centres in the cord were at a slightly different level, so that the sensory symptoms were referred to regions higher or lower than the usual level. Such is the interpretation I give for the high situation of the sensory symptoms in the following case.

Male, born 1864, consulted me in October, 1900, complaining of severe spasms of pain from which he had been suffering five days. He had had similar attacks twelve years before. He referred the pain with great definiteness to the area shaded in Fig. 14, page 187, this area corresponding to a region of deep cutaneous hyperalgesia—that is to say, the skin here was very tender if gently raised and gently pinched, but showed no increased sensitiveness to light scratching with a pin head. This area of tenderness extended round to the spine. I was in doubt as to the cause of these attacks of pain. The onset and character of the sensation corresponded to an attack of renal colic, but I had never seen a case with the pain and tenderness so high. Under treatment (rest and opium) the attacks subsided. He again consulted me for a similar series of attacks in October, 1903. He had had an occasional attack in the interval, but they were becoming more frequent. There was still present the characteristic area of deep cutaneous hyperalgesia, as in Fig. 14. During one of these attacks the pain suddenly passed into the left lumbar

region, and then round to the front of the abdomen, to the groin and into the left testicle. At the same time he was conscious of the testicle being forcibly drawn up. When I examined him there was much tenderness on pressing the lumbar muscles and the left testicle. Under rest and opium the pain subsided, and two days later in voiding urine he passed a small calculus. There was complete freedom from pain until October, 1905, when he again had a few attacks of pain referred to the area shaded in Fig. 14. This pain passed downwards to the groin and testicle, and again he was conscious of the testicle being firmly drawn up. He rested in bed four hours, and upon micturating he passed another small calculus. He has remained free from any further attack.

103. Symptoms of Affections of the Bladder. —The bladder in its development is derived from two sources, the allantois and the cloaca. From the former there comes the upper division, and from the latter the fundus of the bladder (the trigone). The nerve supply of the bladder is likewise from two sources, from the upper lumbar region and from the sacral autonomic (second and third sacral) (*see* Fig. 1, page 27). As a result of this nerve supply the sensory symptoms are felt in two regions, in the hypogastric region, where the upper lumbar nerves are distributed, and in the perineum and along the penis, where the sacral nerves are distributed. The pain from an over-distended bladder, as in retention of the urine, is felt mainly above the pubis, and resembles in its situation and character the pain of uterine contraction or the pain of peristalsis of the lower end of the great gut. This pain is intermittent

in character, and is due to the passage of waves of contraction over the bladder. When there is much irritation of the bladder, as in acute inflammation of its mucous membrane, or in the presence of a stone, the contraction of the bladder at the end of micturition is sometimes very severe, and the pain is then felt both above the pubis and in the perineum, also along the penis. In many cases of stone, the pain from the perineum to the point of the penis is the most distinct, being felt most severely at the end of micturition, but severely also at other times, and particularly if the patient is jolted. The viscero-motor-reflex is usually not well marked, but I have noted contraction of the lowest division of the recti in cases of stone in the bladder.

The act of micturition is a reflex that may be stimulated into activity in a great many ways. Normally there is a distinct relationship between the distension of the bladder and the act, filling of the bladder setting up reflexly the contraction of the muscular wall, which results in the expulsion of the urine. In the child the act of micturition is purely reflex, but with advancing age the individual acquires more or less voluntary control of the act of micturition.

In addition to the muscle wall of the bladder the abdominal muscles may assist by compressing the bladder, and in expelling the last drops the perineal muscles (especially the levator ani and the accelerator urinæ) play an important part. The act of micturition in the infant, or the calls to micturate in the adult, may be so frequent as to raise the question of some abnormal accentuation of the stimulus. This may arise in a great many ways, as

in the excessive quantity of urine secreted (in diabetes and certain forms of Bright's disease), the irritating nature of urine as in concentrated or very acid urine, the presence of abnormal ingredients as oxalates, pus, blood, calculi. The wall of the bladder may be inflamed and irritated, so that a small quantity of normal urine may serve as a stimulus. Stimuli from other organs and tissues affecting the spinal centres of the bladder may provoke frequent micturition, as in affections of the kidney, ureter, anus, and perineal region. Or there may be an irritable focus in the cord, due to lesion of some other viscus, which invades the bladder centre, so that impressions from the healthy bladder have an exaggerated effect and cause the frequent micturition seen in such cases as renal calculus, appendicitis, affections of the ovary and uterus, and piles. In these cases there will always be found some region of hyperalgesia in the external body wall characteristic of the particular organ at fault. A cause of frequent micturition often overlooked is over-distension of the bladder from some such obstruction as enlarged prostate in the male, or pregnancy or pelvic tumour in the female. Examination of the resonance above the pubes may reveal the dullness due to a distended bladder in the male, but when there is a pregnant uterus, or other tumour, it may not be possible to recognise the distended bladder. The doctor, misled by an account of frequent micturition, may fail to detect the trouble, and very serious consequences may result from this being overlooked. In pregnancy, with retention of urine of this sort, the patient may die if relief is not speedily obtained.

Functional Symptoms. — Although the chief

function of the bladder is to retain and expel the kidney secretions, it, like other mucous membranes, has a secretion of its own. The secretion is normally only perceptible in very delicate analysis of the urine. The contents of the bladder may irritate the mucous membrane, so that its secretion may be more abundant, and may become perceptible as a haze at the bottom of the glass when the urine has cooled and stood for some time. This mucous secretion may increase in quantity with the irritation or inflammation of the bladder wall, till the urine becomes thick and viscid, and even blood-stained, according to the degree of inflammation. Pus also may be secreted from the inflamed mucous membrane, or from an ulcer. These abnormalities, however, are to be detected by following the usual routine of urine examination, with which I do not propose to deal.

Structural Symptoms.—Changes of the organ can only be detected by its increase in size above the pubes, or by exploration with the finger in the rectum or vagina. In either case, when abnormalities are detected, additional evidence has to be sought by examination of the bladder by the catheter, by sounding, by X-rays, or by use of the cystoscope.

CHAPTER XVII.

AFFECTIONS OF FEMALE PELVIC ORGANS.

104. *The Uterus.*
105. *The Ovaries.*
106. *The Vagina.*

I have been unable to satisfy myself as to the sensibility of some parts of the female pelvic organs. The uterus above the cervix is certainly insensitive to ordinary stimuli, for I have many times tested the interior, with my whole hand in the uterus, during and after labour, and in scraping out the contracted uterus. The pains during labour are undoubtedly referred, as I shall describe later. I cannot form any definite opinion of the sensibility of the cervix, or for that matter of the vagina. In regard to the cervix I have been able to pinch it and to prick it, with no sensation, but on the other hand great pain is often experienced when an attempt is made to dilate it. But whether this is a direct or a referred pain I could not decide. The patient is so conscious of the stimulation of the external genitals and to the discomfort in the sensitive parts, that her statements become affected by suggestion, and the reference is too confused to be of use. In the same way the extent of the supply of cerebro-spinal nerves to the vagina is not understood, nor could I

determine the limits by stimulation, for the sensory nerves are modified for special sensations. The tendency to exaggerated reflexes in most cases adds to the confusion, for such patients will say they experience a sensation before they are stimulated, and in their apprehension they anticipate or exaggerate the result. A further complication results from the difficulty in diagnosis, it being very rare to obtain a satisfactory proof of the nature of the ailment in cases showing what seemed the most typical evidence of referred symptoms. In the following brief description the subject is dealt with so far as reliable evidence could be obtained.

104. The Uterus.—The pain of uterine contraction is a distinctly referred one, though this seems scarcely probable on superficial observation. In palpating the pregnant uterus during labour the onset of the contraction and the pain are simultaneous and evidently so distinctly related that it seems improbable that the pain is not a direct one, especially when the pain is so often described as being felt across the abdomen in the region where the uterus is felt contracting. But if the matter be inquired into more carefully it will be found that the pain is frequently not felt across the abdomen, but across the back at the level of the top of the sacrum. Here again the hasty observer has attributed the pain to the child's head "distending the cervix," or "pressing on the lumbar plexus"; but this pain is referred here before the cervix is distended, and also after the child is expelled, during the "after pains," when the uterus can be found to contract, although the patulous cervix is untouched. This pain in the back is found not only in labour at full term, but also

during a miscarriage. The pain referred to the front of the belly, between the umbilicus and pubes, is also present when the uterus is not an abdominal organ but a pelvic one, as in miscarriage, after-pains, and other causes that induce uterine contraction. It is well seen in the severe spasms of pain that occasionally occur when some fluid from a vaginal douche escapes into the uterus and sets up uterine spasm.

In rare cases we may find the pains due to the contraction of the pregnant uterus referred to a distinctly lower level, and in one case the pains were all felt across the upper front portion of the thighs.

Very exact delimitation of the area of pain is not possible, but the region in which uterine pain may occur extends from the tenth thoracic to the third lumbar nerves, though in any individual case it is restricted to a limited portion of that distribution.

105. The Ovaries.—The nerve supply of the ovary is not exactly known, but, like the testicle, its development starts higher up in the abdomen than the position it occupies in adult life. The testicle has been shown to be developed between the tenth and twelfth dorsal vertebræ, and the nerve supply presumably comes from the same region. So far as I have been able to make out, the pain felt in ovarian trouble is referred to the lowest part of the abdomen of one side, and over the groin in the position in which the testicular pain is felt. The lowest portion of the abdominal muscles in this situation readily becomes hyperalgesic and contracted. This characteristic region of tenderness has often misled observers into the belief that the pain evoked by

pressure in this region was due to a "tender ovary," a statement with some truth in it, but not in the sense intended, for the ovary itself in such cases is not affected by the pressure, the pain of the pressure arising from the stimulation of the hyperalgesic skin or muscle.

Beyond an indefinite patch of hyperalgesia of the skin in the region of the groin, extending sometimes for a variable distance down the thigh, I have not been able to make out much that is reliable in regard to the hyperalgesic area of ovarian disease. It is in these cases we often find such widespread areas that it is doubtful how much is due to the actual ovarian lesion.

Associated with all forms of pelvic trouble are a number of other reflexes. Thus the breasts frequently become tender, especially at the menstrual period. A cough is sometimes spoken of as being "uterine," or of ovarian origin, but I have not been able to convince myself of such a thing. Vomiting is a frequent reflex symptom, particularly in pregnancy, but here it is probably not of a reflex nature, but toxæmic. As I have already remarked it is sometimes a pure reflex, as in the vomiting associated with the uterine pains. The effects of stimulation of the ovary have not led to a very definite result, partly because of the difficulty in doing this without stimulating the sensitive orifice (anal and vaginal). The ovary like the testicle is partly covered by germinal epithelium, and this may modify the sensitivity.

106. The Vagina.—The character of the pain in vaginal affections is so ill-defined that it is difficult to say whether it is direct or referred. This is seen in the cases of urethral caruncle, where the pain

may be of a very severe form and the localisation so vague that the detection of the cause is often a matter of some difficulty. It resembles in some respects the severe vague pain of an anal fissure. A powerful reflex contraction of the muscles that act as sphincter of the vagina, on certain conditions of irritation of the vaginal mucous membrane, may produce vaginismus.

CHAPTER XVIII.

PERITONITIS AND PERITONEAL ADHESIONS.

107. INSENSITIVENESS OF THE PERITONEUM. — I have already referred to the fact that the serous surface of the peritoneum is insensitive to any form of stimulation, but that the external layer of the parietal peritoneum is an extremely sensitive structure, stimulation of which produces the sensation of pain (page 35). It is commonly assumed that the peritoneum is an extremely sensitive structure, particularly when inflamed. I must say, however, that I have found no evidence of any increase in the sensibility of the inflamed serous surface when I have stimulated it directly, and I have done this repeatedly in patients free from any form of analgesic. To a certain extent the popular misconception of the sensibility of the peritoneum has arisen from the fact that no attention has been paid to the hyperalgesia of the structures of the external body wall, including the external layer of the parietal peritoneum. The result has been that the evidence of peritonitis is almost invariably based

on the pain and tenderness on pressure — evidence which, as I have endeavoured to demonstrate, is not due to peritonitis, but to the hyperalgesia of the structures of the external wall. That peritonitis may produce these symptoms is true, but it does so in the same way as the viscera produce them—*i.e.*, by reflex stimulation. The reason of the insensibility of the peritoneum is the same as that for the insensibility of the viscera, namely, that the nerve supply of the peritoneum arises from the sympathetic, with the exception of the external layer of the parietal peritoneum, where the nerve supply is from the cerebro-spinal nerves.

108. Symptoms in Peritonitis.—If we take a case of acute peritonitis a careful analysis of the symptoms reveals their true nature. Thus, in a case of ruptured gastric ulcer, where there was an extensive peritonitis limited to the upper part of the abdomen as shown by post-mortem examination, the patient lay on her back with the knees drawn up, partly to relax the abdominal muscles, and partly to avoid the pressure of the bed-clothes on the abdominal wall. She shrank at the first attempts to palpate the abdomen, and when the skin was tested it was found extremely hyperalgesic, the lightest touch producing the sensation of pain. The area over which this hyperalgesia extended had no definite relation to the extent of the peritoneal inflammation. Thus, for instance, in marking out the limits of the cutaneous hyperalgesia I found it extended for a few inches up over the chest and down over the thighs, the margin fading away indefinitely. The sensibility of the muscles of the abdominal wall could not be tested on account of the hyperalgesia of the skin over

them. They were, however, partially contracted, and the lightest palpation produced a rapid and strong reflex contraction.

In less extensive peritonitis these symptoms may be limited to a small portion of the abdominal wall, and when they are present it is impossible to distinguish them from the hyperalgesia and muscular contraction due to some visceral affection. The hyperalgesia following an attack of gall-stone colic, or due to a gastric ulcer, is almost invariably attributed to a "peritonitis," and this view is supposed to be proved when, during operation for gall-stones, a certain number of peritonitic adhesions are found. While peritonitis can produce hyperalgesia of the external body wall, it should always be borne in mind that the viscera can also do this, and when hyperalgesia is found in gastric ulcer, after gall-stone, renal or bowel colic, the cause of the hyperalgesia is in all likelihood not peritonitis, but the presence of an irritable focus in the spinal cord, the outcome of the violent visceral stimulation.

109. Symptoms in Peritoneal Adhesions (Parietal).—I have broken down adhesions and found them insensitive, but when they are attached to the parietal peritoneum, dragging on them may produce severe pain. Ramström also describes the serous surface of the parietal peritoneum as insensitive, but that pulling on the adhesions attached to the parietal layer causes pain, thus agreeing with my own observations. I attribute this to the fact that the inflammation that resulted in the production of the adhesions had extended to the peritoneal layer supplied by the cerebro-spinal sensory nerves. The difficulty in distinguishing between visceral pain

and the pain due to the invasion of the external body wall is very great. In many visceral ailments the inflammatory affection extends and involves the sensitive structures of the abdominal wall, and with this extension a new train of symptoms arises, which may lead to wrong inferences if these differences in the sensibility of the structures are not clearly kept in view. One can easily see how appendicitis may give rise to symptoms which are entirely confined to the reflex group, until the inflammation extends to the abdominal wall, when another series of symptoms may arise which are produced by a different mechanism, and are detected in the immediate region of the inflammation.

For the study of the symptoms of adhesions those formed after operation offer the best opportunity, inasmuch as their presence can be inferred and the operation has determined the condition of the viscera. Maylard says : "It is doubtful whether any opening of the general peritoneal cavity ever takes place without the subsequent formation of adhesions, for no tissues of the body seem so ready to exude a plastic cementing material, which glues almost at once any structure lying in contact with it." It is probably due to these adhesions that so much pain and tenderness is felt after some simple abdominal operation, even when the operation is purely exploratory, and no injury has been done to any viscus. The hyperalgesia in such cases is often muscular, and associated with a lively reflex of the hyperalgesic muscles, so much so that their exercise, as in walking, may result in their shortening from an increase of their tonic contraction, for a longer or shorter time. Small portions of these

muscles may remain firmly contracted for long periods, and sometimes they so closely resemble a tumour in the abdomen that it is impossible to tell whether the hardness is a contracted muscle or not.

In a case of pyloric stenosis, in which gastro-enterostomy had been performed, muscle pain and tenderness persisted in the left rectus muscle. As the patient experienced no relief, she again consulted the surgeon who had performed the operation. He detected a small tumour in the abdomen, and insisted on an operation for its removal. I thought the tumour was a contraction of a portion of the fibres of the left rectus muscle at the upper portion of the second interseptal division. As, however, the surgeon was very confident of his opinion, and I was less sure of mine, the abdomen was opened. No tumour was detected, but there were numerous fine adhesions attached to the parietal peritoneum, stomach, and bowel. It was manifest that the apparent tumour had been entirely muscular, this contraction being in the nature of a reflex, for there was no extension of the inflammation from the adhesions to the muscles.

110. Symptoms in Peritoneal Adhesions (Visceral).—Adhesions limited to the visceral peritoneum may produce no symptoms, or they may produce very well-marked reflex contraction of the muscles, with more or less hyperalgesia of the skin or muscles. This subject has not been worked out, and I have only been able to investigate it to a limited extent. It seems, however, one worthy of attention, and there are plenty of opportunities for its study, if careful notes of the condition be made before

operation. For many years I applied it in the diagnosis of ovarian tumours to ascertain whether there were likely to be adhesions or not. Then I found that when the muscles of the belly-wall were not contracted and not tender there were no adhesions between the ovarian cyst and surrounding structures. When, however, there was much muscular contraction and hyperalgesia, adhesions were always found between the tumour and the surrounding organs. As, however, these observations were made and verified in only some twenty cases, they are manifestly insufficient for a definite statement, but I put forth this suggestion as a line of observation well worth consideration.

CHAPTER XIX.

AFFECTIONS OF THE LUNGS AND PLEURA

111. Nature of the Subjective Sensations.—Owing to the constitution and the accessible situation of the organs, the physicial signs of affections of the lungs are readily ascertained, and have been so well explored that I shall do little more than touch upon some of the reflex phenomena. Even though these phenomena can be so readily recognised, their mechanism is far from clear. The chief reflex which presides over the movements of respiration involves the employment of the muscles of the body-wall over such a large area that the symptoms often become very complicated. The subjective sensations of the patient arise also from such a number of causes that it is often impossible to understand how they are produced. As in other parenchymatous organs, no form of stimulation of the lung tissue seems to be capable of producing sensation directly or reflexly.

Below the epiglottis there is no sensation elicited from stimulating the air passages, though coughing is readily induced in certain regions. The lung itself is insensitive to stimulation when healthy (as is seen when an exploring needle penetrates the lungs) or when diseased. It is well known that the lung may be acutely inflamed, torn by an apoplexy, ulcerated and scooped out by a tuberculous process, and no sensation be felt by the patient. When pain arises in connection with affections of the lung, it is from the implication of the pleura in the disease process, or from the muscles of respiration becoming sore and tender from excessive exercise.

Although no pain arises in connection with lung affections, other sensations appear, as the sense of breathlessness, "air hunger," and a sense of suffocation. These sensations may be the occasion of acute distress, and provoke attempts at deep inspiration.

Dr. Haldane considers it "probable that 'air hunger' is always due to excitation of the respiratory centre in consequence of an abnormal condition of the blood. Nothing else is known to produce 'air-hunger.' The excitation may be due to (1) excess of CO_2. This is the normal excitant. The excess of CO_2 may be due to hindrance to entry or exit of air (asthma, bronchitis, etc.), or to hindered penetration of CO_2 from the blood to the alveolar air (pneumonic or dropsical conditions in the lung). A second cause is diminished alkalinity of the blood. This acts just like CO_2 on the centre. A typical example is the hyperpnœa of diabetic coma (oxybutyric acid in the blood). If want of O_2 arises in the tissues from hindered absorption of O_2 by the lungs, from defective

circulation (as in certain forms of heart failure) or other cause (CO_2 poisoning, poisoning by nitrites, or other substances, which disable the hæmoglobin, etc.), the blood also becomes less alkaline from lactic acid formation, or lactic acid is formed in the centre itself. The centre is thus stimulated, and hyperpnœa, as a secondary result of want of O_2, results. Want of O_2 does not seem to be a *direct* stimulus to the centre. It is only in a limited number of cases that pure O_2 can relieve dyspnœa."

112. The Respiration.—The movements of respiration consist in the contraction of certain muscles, increasing the size of the chest cavity, and producing the inspiratory act. The muscles employed in the act of respiration are the diaphragm, the external intercostal muscles, the levatores costarum, and serratus posticus superior. As these muscles in their contraction enlarge the cavity of the chest by raising the thorax and twisting the costal cartilages, and thus stretch the elastic tissue of the lungs, so when they cease to act the thorax falls by its own weight, assisted by the recoil of the costal cartilages and of the elastic tissues of the lungs. The thoracic cavity is thus reduced, and the air is expelled. It is possible that the internal intercostal muscles contract with each expiration. In both forced inspiration and expiration a large number of accessory muscles may take part in the respiratory movements.

Although the nerve supply of these muscles involved in respiration come from widely separated portions of the cord, they are all under the dominance of one centre in the medulla oblongata — the respiratory centre—the *nœud vital* of Flourens,

situated in close proximity to the nuclei of the vagus nerves.

The normal rate of respiration is from fourteen to sixteen per minute, when the body is at rest. Abnormalities are usually considered from the standpoint of increase in rate and violence of the act of respiration. There are, however, conditions of slow respiration, apart from mechanical obstruction, which are of some interest as they are associated with certain neurotic conditions, and the slow respiration produces a form of heart irregularity (sinus arrhythmia). However variable the rate, Dr. Haldane points out that the alveolar ventilation will be the same—the frequent breathing being shallow, and the slow breathing deep.

Although the physiology of respiration so clearly defines the method by which respiration is regulated, yet there is nothing so perplexing to explain as the influences that operate in producing abnormal forms of respiration. In any given case of increased frequency of respiration it is difficult or impossible to say whether the condition is the result of imperfect aeration or reflex stimulation. The presence of non-striped muscle fibres in the smaller bronchi leads to the surmise that these may become tonically contracted, and therefore prevent the entrance of air to the alveoli.

This action seems all the more probable when we reflect that asthma is so often the outcome of a remote stimulation, as from the nasal cavity, and that muscular contraction is very susceptible to reflex stimulation. Dyspnœa of a very severe form may arise from peripheral stimulation, as is seen in pneumonia, or pulmonary apoplexy, when the

breathing may be greatly increased in frequency and in violence. The alteration in the breathing is not the outcome of a diminution of the breathing space by the inflammatory exudation, or apoplexy, for the rate of breathing may suddenly return to the normal, with no diminution in the extent of the affection of the lung. Presumably here the increased respiration is the outcome of a reflex, but whether the stimulation played directly upon the respiratory centre, or whether it caused a reflex spasm of the bronchial muscles, we cannot tell. The dyspnœa arising from other sources is equally obscure. Dr. Haldane considers "the respiratory trouble in heart failure to be due (at least mainly) to the slowed circulation, and consequent imperfect aeration of the tissues. The deficiency of O_2 in the tissues will cause increased formation of lactic acid, and consequent diminished alkalinity of the blood, and consequent necessity for an abnormally great removal of CO_2 from the blood. The increased respirations may also materially assist the circulation by aspirating more venous blood towards the heart. The breathless healthy person is breathless from excess of CO_2 in the arterial blood. In heart disease there is no excess of CO_2, or deficiency of O_2 in the arterial blood, but this condition exists in the tissues owing to the slow circulation. Slight hyperpnœa will diminish the CO_2 in the arterial blood, and thus compensate for excess of CO_2; but hyperpnœa cannot appreciably increase the oxygen in the arterial blood, and therefore cannot compensate for the want of O_2 in the tissues. The patient is therefore blue, although his breathing may not be noticeably increased. Exertion during any condition where the circulation

(particularly in the coronary vessels) is defective, and cannot be increased in response to the increased need for blood, will lead to a fall of blood pressure, the heart being incapable of supplying enough blood to correspond to the increased flow (vaso-dilatation) in the working muscles. Fainting will thus be caused. The same effect is seen in CO_2 poisoning, where even a slight exertion produces fainting with absolute certainty, and may be fatal."

113. Reflex Symptoms.—*Cough.*—Coughing is essentially a reflex phenomenon, the centre for which is one of the numerous areas associated with the main respiratory one in the bulb. The stimulus is conveyed from the periphery by some branch of the vagus. The result of the stimulus is to cause first a deep inspiration, which is followed by a closure of the glottis, then by a sudden and powerful contraction of the muscles of expiration which forces the air through the resisting glottis. By this process the air drawn into the lungs by the preliminary inspiration is driven out with such force that all movable matter in the larger tubes is swept out. The area that most readily excites the cough reflex is the mucous membrane of the larynx, the nerve supply being from the superior laryngeal nerve, a branch of the vagus. The respiratory tract below the larynx, and the lung tissue seem to be incapable of originating the stimulus. The cough in affections of the lung arises only when the secretion has been carried by the contractions of the bronchial muscles, and by the cilia of the respiratory tract so far upward as to reach the sensitive region about the larynx. Thus it is that in pneumonia the cough may be only slight, and only provoked when the secretion has passed up the

respiratory tube. In phthisis and abscess, and all cases where there is abundant expectoration, it is to be noted that the starting of a cough after a period of quiescence is followed by a persistence until the accumulated matter is expelled. The first cough is initiated by the gradual conveyance of the phlegm to the sensitive area, while afterwards the cough forcibly expels the contained matter, and so keeps up the irritation until there ceases to be forced out any more secretion. This sensitive region may be stimulated by the inhalation of cold air, and it seems to be the starting place of the spasm of uncontrollable coughing in whooping-cough. While this is probably the true explanation of the great majority of cases, coughing can also be excited by stimulation by other means. When a pleuritic effusion is aspirated, scratching the visceral pleura will often produce a cough, or irritation of the branches of the vagus that go to the stomach or ear may produce coughing. It is always well to exclude the possibility of irritation in the larynx, before assuming the presence of the more remote stimulation. A very curious cough reflex is sometimes present in persons who have an occasional extra-systole. This is usually due to the ventricle contracting prematurely before the auricle, and the individual may be conscious of this, and may give at the same time a short cough—without the preliminary inspiration. In hysteria violent and persistent coughing may occur either from a trivial laryngeal irritation, or it may be in consequence of some other reflex irritation.

Sneezing.—A reflex of a somewhat similar nature to that of coughing arises from stimulation of the mucous membrane of the nose. It differs from

a cough, inasmuch as there is no closure of the glottis, and the blast of air is sent through the nose as well as the mouth. It also differs from the act of coughing in always being a pure reflex. Coughing can be done voluntarily, but sneezing cannot. Sneezing can be inhibited by biting the upper lip, or pinching the edge of the nasal bones, even after the preliminary inspiration, and by a mental reaction, as when another person is observed to imitate the act.

Persistent attacks of sneezing are commonly associated with a swelling of the erectile tissue over the turbinate bones in the nose, and a free secretion from the mucous membrane of the nose and eyes.

114. Functional Symptoms.—*Aeration of the blood.*—Impaired function is seen in the degree of aeration of the blood, and in the character of the expectoration. Aeration of the blood is the main function of the lungs, and imperfect aeration is manifested in the production of the reflex phenomena (air-hunger, increased respiratory movements) and in the colour of the blood. The former of these symptoms has already been discussed; the latter is observed mainly in an abnormal colour of the external tissues, as in the lips, cheeks, or skin generally.

As with all other respiratory symptoms, the production of the signs of imperfectly aerated blood is obscure and complicated. The face may show a slight degree of duskiness, the redness be a little darker than that of health, or the redness of the lips a little deeper in cases, say, of mitral stenosis. Blueness of the lips may be due to imperfect aeration of the blood in the lungs, but it also may be due to slowing of the circulation. It is remarkable how

much darker the venous blood becomes if the rate of flow through the capillaries be diminished. This is probably the cause of the cyanosis in congenital heart disease. In some cases there has been found a great increase in the number of red blood corpuscles, and a certain degree of duskiness is found in cases of polycythemia. Where there is a duskiness due to some permanent condition as polycythemia, or the cyanosis of congenital heart disease, exertion often increases the depth of the cyanosis.

In failing hearts, with embarrassment of the pulmonary circulation, a very considerable duskiness may be evident, as also in cases where there is obstruction to the entrance of air into the lungs. As the heart is exceedingly susceptible to oxygen, imperfect aeration of the blood has a very marked effect upon it, a diminished supply of oxygen acting speedily in stopping its action, and in the administration of chloroform this is one of the most important facts to be borne in mind.

Expectoration.—Expectoration is the product of perverted function, and may be due to a secretion of the respiratory tract or lungs. It may also come from regions outside the lungs, as when an abscess or pleural effusion bursts into the lungs, or bronchi. It is the most frequent cause of cough, and coughing is due to the attempt to get rid of the secretion. The expectoration is conveyed in the first place by the contraction of the bronchial muscles, and by the cilia of the respiratory tract to the bronchial tubes, till an excitable part is reached, when coughing is induced, and the blast of air expels the accumulated secretion. The force exercised in compressing the chest helps to expel secretion accumulated in any

part of the respiratory tract, or in the lungs and pleural cavity, so long as there is an exit.

The character of the expectoration indicates its source, a transparent and frothy expectoration coming from the upper air passage, while the more viscid comes from the lower, or from near the alveoli, as in the early stages of pneumonia, when it is usually stained more or less deeply with blood. A clear, pink-stained mucus may result from a pulmonary apoplexy. A purulent sputum is due to a lesion of some standing. In bronchitis the sputum gradually changes from a mucous to a muco-purulent character. An abundant muco-purulent sputum is found in chronic bronchitis and old standing catarrhal pneumonia. With an excess of fever, the latter condition may resemble an attack of acute croupous pneumonia, but the abundant purulent secretion serves to indicate the nature of the illness. The secretion from phthisical cavities is also purulent. When large quantities of pus are expectorated, the source is a cavity in the lungs or pleura, or a subphrenic abscess, as a suppurating hydatid cyst of the liver.

The microscopic examination for bacilli and elastic fibres is fully detailed in text-books.

115. Structural Symptoms.—Structural symptoms are recognised by changes in the consistence of the lung tissue, in the invasion of the normal resonant area by structures of more solid consistence, changes in the shape of the chest wall, and the presence of accessory sounds or the modification of the normal respiratory sounds in auscultation. It is not my purpose to enter into the details of these changes, and I merely point out here that the existence of any abnormal state can only be ascertained

by thorough knowledge of the normal condition of the lungs. The position of the lungs in relation to other organs, the modification of the signs of the lung in the different regions of the chest, should all be familiar through the systematic examination of a great number of healthy people. In all these observations, and more particularly in the examination of abnormal or diseased lungs, the recognition of the abnormal signs depends on the comparison of the signs in one individual with another, or in the comparison of the signs on opposite sides in the individual examined. As there are infinite gradations, it requires careful training to recognise many of the more delicate but none the less very important phenomena.

116. Affections of the Pleura.—*Insensitiveness of the Pleura.*—If the affection of the lung gives rise to no sensation of pain, the same cannot be said of the pleura, for the pains associated with pleurisy may be of the most violent kind. In consequence of this well-recognised fact, the pleura is supposed to be an extremely sensitive structure, though, as a matter of fact, it is as insensitive as the peritoneum to ordinary stimulation. In a great number of cases, when the ribs have been resected, I have repeatedly explored the pleural cavity for any evidence of sensation, and I could employ no form of stimulation capable of producing pain. When I probed the visceral pleura, even to penetrating the lung, no sensation was produced; when I scraped the surface of the parietal pleura no sensation was produced, unless I pressed with some force, when a vague sensation was experienced, due probably to the pressure being exercised on the structures of the external body wall.

117. Nature of the Pain in Pleurisy.—From the result of such experience one is forced to consider carefully how the great pain felt in pleurisy is produced. Inquiry into the nerve supply of the pleura is fruitless, for there is practically no information about the matter in either anatomical or physiological text-books. Although I carried out a series of careful dissections of intercostal nerves to their finest branches, I could detect none entering the pleura. Whether there is a layer containing fine nerve endings outside the pleura similar to that described by Ramström lying outside the peritoneum, I do not know. A careful study of all the phenomena connected with a painful pleurisy reveals the mechanism by which it is produced, and gives some indication of its nerve supply. The most severe pain occurs in the movements of respiration, and is due to the painful contraction of the intercostal muscles. In the abdominal muscles the muscular hyperalgesia and tonic contraction can be demonstrated. It is not so easy to do this in the case of the intercostal muscles, but there is good reason for inferring that the viscero-motor reflex is as definite in pleuritis as in peritonitis. The muscles are often tender on pressure, and their contraction is not only painful but ends in a spasm which restrains the movements of the chest. The symptoms of pain and violent contraction are identical with those that occur when the muscle is hyperalgesic, apart from a pleurisy, as in the painful contraction of the intercostal muscles in "muscular rheumatism," and in those cases where the hyperalgesia extends into the chest wall from affections of other viscera, as in gall-stone disease (*see* page 160).

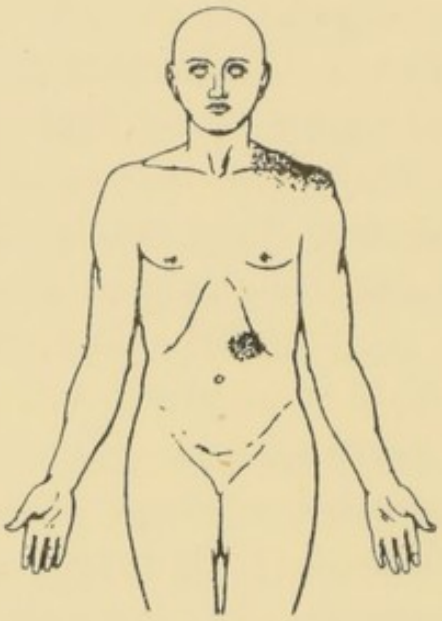


FIG. 15.

Areas in which pain and hyperalgesia were present in a case of diaphragmatic pleurisy. The shaded area on the left shoulder is in the cutaneous distribution of the fourth cervical nerve, and is an evidence of the conduction of a stimulus from the diaphragm by the phrenic nerve, which leaves the spinal cord with the fourth cervical nerve. The phrenic nerve contains afferent fibres as well as efferent (motor), and it is in all probability by the former that the stimulus is conveyed to the centre of the fourth cervical nerve in the cord. The shaded area in the abdomen is in the region of distribution of the 8th and 9th thoracic nerves.

The mechanism of the pain can also be inferred from those cases in which it is felt at a distance from the inflamed pleura. When the diaphragmatic pleura is inflamed the pain may be felt in two regions very widely separated, namely, in the abdomen below the ribs and on the top of the shoulder (Fig. 15).

It not infrequently happens that the onset of pneumonia is accompanied by a severe pain in the abdomen, and the skin in the region where the pain is felt may be found extremely hyperalgesic. (Not infrequently, and particularly in the young, this pain misleads in the diagnosis, giving the impression that some abdominal viscus is at fault.) The area in which this hyperalgesia is found is within the peripheral distribution of the eighth and ninth thoracic nerves. I have no distinct proof that in such cases the pain and hyperalgesia are due to pleurisy, and not to the lung affection, except for the very common experience that the inflammation of the lung is painless, while inflammation of the pleura is usually associated with pain, and the hyperalgesia may be detected in basal pleurisies without pneumonia. It is evident that there must be some correlation between the lesion and the area of hyperalgesia, and as no nerve from the region of the eighth or ninth thoracic nerves supplies the lungs it is reasonable to conclude that the nerve supply from the inflamed pleura must be from this region. The pain felt in the shoulder is more instructive. It is, however, a somewhat rare phenomenon, but in the few cases I have seen in which there has been cutaneous hyperalgesia, the area could be marked out very distinctly, and was found to be within the distribution of the

fourth cervical nerve. I have already dealt somewhat fully with the distribution of the phrenic nerve and its relation to the fourth and fifth cervical nerve (*see* page 48). Its distribution being to the diaphragm, and not to the lungs, permits of the reasonable inference that the pain and hyperalgesia in the shoulder found associated with pneumonia are due to the pleurisy and not to the pneumonia.

From the consideration of these facts we can draw the inference that the pain in pleurisy is due to a reflex stimulation (viscero-sensory reflex), and that as there arises also a hyperalgesia of the intercostal muscles, their contraction is not only painful, but their continued exercise increases the violence and painfulness of their contraction. As happens in all muscles affected by a visceral stimulus (viscero-motor reflex) there is a great tendency with exercise for the muscle to be tonically contracted, and hence the constrained and limited movements of the chest wall present in pleurisy.

CHAPTER XX.

AFFECTIONS OF THE CIRCULATORY SYSTEM.

There is no system in the body whose function can be so well observed, and whose size and position can be better made out than that of the circulatory system. As a consequence of this accessibility the circulatory apparatus has received a great deal of attention, and innumerable methods are employed in the investigation of its action. The value of many of these methods is unquestioned, but unfortunately the tendency has been to place undue reliance on the results obtained by mere physical examination,

and to neglect the more important indications to be derived from the reflex phenomena, chiefly expressed in the sensations felt by the patient.

118. Heart Failure.—In order to realise fully the meaning of cardiac symptoms, it is necessary to appreciate the mechanism of heart failure. By heart failure is meant the inability of the heart to maintain the circulation efficiently. The lack of efficiency may be made evident in extreme cases by such signs as orthopnœa, dropsy, unconsciousness. On the other hand, the failure of the heart to maintain an efficient circulation may be manifest long before these extreme symptoms appear. The first sign is a feeling of distress when the patient makes an effort. This may vary within very wide limits; for instance, turning over in bed may exhaust the heart's strength, or the patient may be unable to walk across the room, or up a flight of stairs, without some form of discomfort checking him. The exhaustion of the patient's strength in such circumstances is seen simply as a limitation of the heart's power to respond to effort. Each individual has become accustomed to what he can do with comfort, and he recognises his heart failure by not being able to exert himself with comfort to the extent he had formerly done. The symptoms produced in health by over-exertion are frequently identical with those produced by slight exertion when the heart has become weakened and where this slight exertion is more than can be done with comfort. It will thus be seen that the symptoms of heart failure are really recognised by a limitation of the field of cardiac response, that is, the patient finds he is stopped, on a slight exertion, by the

symptoms which, when in health, only stopped him after a prolonged, exhausting exertion.

This weakness of the heart can be expressed in another way, namely, the premature exhaustion of reserve force. It is because the heart possesses the power to lay up a reserve of force that it is able to respond to calls on its energy, so that it can accommodate itself to the varying activities of the body. When the body is at rest the heart not only overcomes the resistances opposed to its work with ease, employing only a portion of its power, but it is at the same time building up a store of energy ready to be liberated when the next call is made by the body for more work. After severe bodily labour the store of reserve force becomes exhausted, and if the labour be persisted in, there arises a feeling of distress, which expresses the exhaustion of the heart's reserve force. It is this faculty of building up a sufficient reserve store that distinguishes a healthy heart from a weakened heart, and the first evidence of weakness is shown by a too speedy exhaustion of the reserve. This is made evident by distress being aroused when the individual undertakes some form of exertion he had been wont to do with ease—that is, by a limitation of the field of cardiac response.

It will thus be seen that the symptoms of heart failure in the first instance are personal, due to the patient's recognition of his limitations. The estimate is therefore a very variable one, and depends on each individual recognising his own limitations, and detecting when these limitations become narrowed. Each individual obtains a fair estimate of his power of exertion, and this is his measure of health. A limitation of these powers in an intelligent patient

calls attention to his condition. It will further be observed that the main symptoms of exhaustion of reserve force are the same when a healthy heart exhausts its store after a prolonged effort as when an enfeebled or diseased heart exhausts its limited store by a slight effort. These symptoms are in the main subjective and reflex, though certain changes may also be made out in the size of the heart and its rate and rhythm. It is, however, the subjective and reflex symptoms that are of the greatest importance, whatever may be the nature of the functional disorder or structural lesion.

It will frequently be found that patients whose hearts show many forms of functional and structural abnormalities (valvular murmurs, cardiac enlargement, irregular action) have such a store of reserve force that they can pursue laborious occupation with ease and comfort, and live to a good age. On the other hand, patients may show no physical sign of abnormality; the heart may be normal in size and in rate, and regular in rhythm, and the sounds be clear and free from murmur; but the reserve force be so small that the slightest exertion entails at once distressful symptoms of heart exhaustion, and the lives of these persons may be very precarious.

119. The Nature of the Symptoms.—The value of symptoms thus depends upon the estimation of the amount of reserve force stored up in the heart muscle. An imperfect valvular apparatus is but an embarrassment to the heart muscle in its work. We can detect that valvular imperfection by the presence of a murmur, but we can only draw a very limited conclusion as to its bearing on the heart's work. This is really obtained by considering the

amount of reserve force, and the estimation of the reserve is made by observing how the patient's heart responds to effort. The same rule applies to other forms of circulatory changes, as affections of the myocardium and of the arterial system. When, therefore, we detect what we consider to be an abnormal sign, we must not draw our conclusions from that sign alone, but must consider how far it has proved an impediment to the heart's action, and this is done by estimating the amount of reserve force. In doing this a wise discretion must be exercised, for other factors may have precipitated the exhaustion. An individual may have an organic lesion, as a valvular defect, but in addition may have been subjected to a life that predisposes to exhaustion, as excessive labour, improper or insufficient food, mental anxiety, sleeplessness; and such factors, rather than the mere valvular flaw, may be the actual cause of the exhaustion of the reserve force. Or the individual may have a sedentary occupation, wherein, owing to lack of judicious exercise, his reserve force has gradually diminished, until some unaccustomed but not excessive effort calls attention to the limited field of cardiac response.

Not only must a careful calculation be made of these accessory, and it may be all-important, factors, but there must be a recognition of the significance of the cardiac abnormalities or supposed abnormalities. I do not enter here on the points which indicate the nature and seriousness of such abnormalities as, for instance, murmurs and heart irregularities, but I wish to insist upon the fact that the clinician should familiarise himself with such

points. For instance, a young person may have a fainting attack, and when lying quietly in bed the pulse is found very irregular. This sign, which is a perfectly normal one, though rarely recognised as such, is not infrequently linked up with the fainting attack with which, as a matter of fact, it has no connection, and the patient is subjected to unnecessary treatment and restriction, and he becomes alarmed by the idea that he has a weak or diseased heart. In advanced life another form of irregularity is of extreme frequency (the extra-systole), and the recognition of its presence, with some limitation of the field of cardiac response, often leads to the conclusion that the irregularity is in some way responsible for the other cardiac signs, and energetic but futile means are taken in the attempt to cure the irregularity. In the same way this morbid dread of the unknown leads to the idea that certain cardiac symptoms as pain, especially when dignified by the term of angina pectoris, is of very grave significance. It it be once realised that pain is as constant a symptom in affections of the heart as in other hollow muscular organs, and that the pain is as readily induced by adequate causes in the heart as in the stomach, a truer perception will be obtained of the symptoms of many obscure heart affections. I shall show later that pain is one of the expressions of an exhausted heart muscle, and in order to appreciate its significance the conditions that have led up to the exhaustion of the heart muscle should be ascertained—a matter usually of no great difficulty, and these conditions will guide us to a safe conclusion.

If the idea be followed up that the earliest of heart symptoms are simply due to an exhaustion of the store of reserve force, it will be found that there is a great resemblance in the reflex symptoms among all forms of heart affections—functional and structural. The most important symptoms are confined mainly to the patient's sensations and demand careful consideration. The mechanism by which they are produced is not at all times clear, and some of them are undoubtedly reflex; although I cannot give a full explanation of their production, I attempt here a brief description of the most important of the subjective symptoms and some of the phenomena associated with them.

120. Consciousness of the Heart's Action.—Under normal circumstances the movements of the heart and circulation are carried on without the individual being conscious of their action, unless he voluntarily directs his attention to the subject. When the heart is over-stimulated it may contract with such force that the individual becomes conscious of its action. The stimulation may arise from a great many circumstances, as, for instance, from heat, either by a rise in the patient's temperature or from a hot bath. It may arise from nerve stimulation, as from mental excitement, or from some peripheral irritation in the viscera. Its significance is greatest when it arises in consequence of exhaustion of the heart; coming on in consequence of bodily exertion, it is often the first sign of exhaustion of the reserve force. When it is thus produced, it forms a valuable sign for estimating the amount of reserve force present in the heart-muscle. It gives no indication

of the conditions that have led to this exhaustion, for it may occur in a healthy heart after prolonged exertion, as well as in a diseased heart after a very slight exertion. Under these circumstances the heart's action is usually rapid as well as forcible, but in some cases there is not much increase in rate. The consciousness of the heart's action is often spoken of as palpitation. While it may not occasion much suffering, there are individuals of a neurotic type in whom this consciousness of the heart's action causes much distress. In these patients the heart may be quite healthy, and the palpitation is then the action of an undue excitability of the sympathetic nerve supply of the heart As other portions of the nervous system are abnormally excitable the heart's action may cause considerable distress bodily and mentally. In patients with this neurotic temperament, where there is real heart trouble, as in mitral stenosis, palpitation on exertion may be so readily induced that it acts as a protection from over-exertion, because, in order to avoid its occurrence, the patient is perforce kept quiet.

The occurrence of palpitation should always lead to an examination of the nervous system as well as of the heart's condition.

Other sensations of the heart's abnormal action may be felt by the patient. A gentle fluttering may be felt within the chest during a period of irregular action. This may be brief and transient, or, as in certain cases of paroxysmal tachycardia, it may continue during an attack of many hours. Accompanying the latter condition there is often a feeling of exhaustion which leads the patient to

rest, or to go about carefully and quietly. When the heart resumes its normal action the patient is at once conscious of a change and of a sense of relief. A more common sensation is that when the heart is felt to stand still, in what is called intermittent action of the heart. This sensation is usually felt in cases of extra-systole, which is so frequent in advanced life though occasionally present in the young. Here the ventricle contracts prematurely, and often before the auricle; the individual is not conscious of this premature beat or extra-systole which is followed by a long pause, and it is this pause which often alarms the patient. After the long pause the next beat is frequently big and powerful, and the patient may be conscious of the shock due to this. In nervous people this big beat often causes much mental anxiety.

Another curious reflex is sometimes met with in these extra-systoles, the patient giving a little gasp or cough when the extra-systole occurs.

121. Breathlessness.—Breathlessness is so frequently associated with affections of the heart, that its occurrence under any circumstance necessitates a consideration of the heart's condition. It is so common a sign of exhaustion of the reserve force, that in an inquiry into a patient's cardiac symptoms the amount of exertion that can be undertaken before breathlessness occurs should be carefully inquired into. In many cases the breathlessness may occur independently of any bodily exertion, coming on when the patient is in bed, and persisting till the patient has to sit up and breathe in a laboured fashion (orthopnœa).

The mechanism by which breathlessness is

brought about in heart affections is far from clear, and so many factors are concerned in respiration that any endeavour to explain its cause would lead to such vague and indeterminate speculation that, in the present state of our knowledge, little good would result. The great point is to observe the fact, to exclude other possible causes of breathlessness (as affections of the lungs, mechanical obstructions to the breathing, anæmia, and other blood affections), and then from a study of the cardiac conditions to determine the nature of the exhaustion that has been produced. This is seldom a matter of much difficulty when a sufficient experience of the various forms of heart disease has been acquired. The presence of a demonstrable lesion in the heart may be a guide, as shown by modification of the heart sounds, or changes in the size, rate and rhythm of the heart. In the absence of these the age of the patient may be suggestive—if old, degenerative changes in the myocardium; if young, the probability of some general infection, as tuberculosis; if middle-aged, the possibility of exhaustion of the reserve force from over-work, worry, bad nourishment—in fact, the consideration of the factors that tend to exhaust the reserve force of the heart, breathlessness being often the first sign of such exhaustion.

Apart from breathlessness brought on by exertion there are some definite forms of breathlessness which are recognised as especially associated with heart affection. The best known of these is the Cheyne-Stokes respiration, where periods of apnœa alternate with periods of laboured breathing. Another characteristic form is that in

which patients are seized in the night with attacks of breathlessness, and have to sit up and breathe in laboured fashion for periods of varying duration, from half-an-hour to several hours. This form of laboured breathing is sometimes spoken of as cardiac asthma, and its onset is often mistaken for the more common form of asthma. When asthma is found to occur in people of middle or advanced age for the first time, the possibility of its cardiac origin should always be borne in mind.

In many cases the patient breathes quietly though hurriedly, with no distress, and the respiratory condition may, in consequence, be overlooked, though the rate of respiration may be from twenty to thirty times per minute. With failing hearts (as in typhoid fever, in conditions in which elderly people are forced to lie in bed, or in valvular disease) this rate tends to increase, and on examination respiration is found to be shallow and limited to the upper portion of the chest. In such cases there will almost always be found evidence of stasis or œdema at the bases of the lungs. The first sign of this condition, apart from the increased rapidity of the respiratory movement, is the detection of fine crepitations on deep inspiration heard over the base of the lung, on that side towards which the patient habitually lies. My usual method of detecting this is to ask the patient on which side he has lain, and then to ask him to sit up and to auscultate the base of the lung on the side on which he has lain. This is the first step in the physical examination of the patient. If done at a later stage the movements may have deepened the respiration, so that the crepitations have disappeared. One usually detects the fine

crepitations on the first full and deep inspiration. In the early stages of pulmonary stasis, after this thorough ventilation of the bases of the lungs, the crepitations disappear. If measures are not taken to stop this tendency to œdema, or if in spite of all endeavours the œdema increases, the crepitations become more numerous and persistent, and the lung resonance may become impaired. In fatal cases the bases of the lungs become dull, there is an absence of the respiratory sounds, and post-mortem the lungs are found sodden and airless. In suitable cases there can be detected coincident with these lung symptoms evidences of the dilatation of the right heart, as epigastric pulsation due to the filling and emptying of the dilated right ventricle.

A sense of suffocation is an occasional symptom in heart affections. It may be the first sign of exhaustion of the reserve force, coming on when the patient exerts himself. It may suddenly seize a patient when he is lying in bed. Its mechanism is obscure. The sensation is usually referred to the upper part of the chest and throat.

122. Viscero-sensory and Viscero-motor Reflexes.—Under these terms I include such sensory phenomena as pain and hyperalgesia of the skin, muscles, mammary glands, and the contraction of the muscles, which gives rise to a sensation described "as if the breast bone were breaking." After obtaining a full account of the patient's sensations and experiences, if careful inquiry be made in regard to a number of symptoms, as pain, constriction of the chest, soreness of the chest or arms, frequent micturition, increased flow of saliva, bad dreams, there will be found a number of phenomena which

the patient does not include in his description, because his mind is occupied with the sensations which cause him suffering and discomfort. The accurate noting of these less obtrusive phenomena will often throw a flood of light on many an obscure process and reveal the mechanism by which the more obtrusive phenomena are produced.

In the physical examination careful testing for hyperalgesia should first be made. The skin of the left chest should be lightly pinched and compared with that of the right. The breasts should be lightly compressed and the resultant sensations compared. The tenderness to pressure of the pectoralis major where it forms the anterior wall of the left axilla should be tested. In the same way the skin of the neck and the sterno-mastoid should be tested. The upper edge of the trapezius muscle where it passes from the scapula to the neck should be lightly compressed along its whole border, and it will sometimes happen that certain areas will be found very tender. These are places where a small nerve trunk is pressed upon. Special areas of tenderness may sometimes be found, as under the left breast, and over the second and third ribs in the nipple line. In one patient, where this latter tenderness was very marked, I found, at the post-mortem examination, on dissection, a small nerve trunk (the internal anterior thoracic nerve).

Angina pectoris affords an excellent illustration of the application of the principles I have endeavoured to enunciate, as the symptoms can be with certainty referred to the organ at fault, and because the complex of symptoms that are included in an attack of angina pectoris are capable of being

analysed with great precision. This is, in a great measure, due to the peculiar distribution of the sensory nerves in whose peripheral distribution the characteristic phenomena are shown, and whose centres in the spinal cord and medulla are in close relationship to the centres of the autonomic nerves of the heart (sympathetic and vagus). The cases I cite demonstrate that the term "angina pectoris" includes a number of reflexes, and I give in detail the more conspicuous of these, namely, sensory reflexes, where the pain and hyperalgesia affect the chest, arm, head, and neck; motor reflexes, resulting in spasm of the intercostal muscles; secretory reflexes, shown by profuse secretion of saliva and urine. Some cases show other reflexes, as the respiratory, but the discussion of these would lead me beyond the object I had in writing this book.

Notwithstanding the numerous papers devoted to the consideration of angina pectoris, practically none have dealt adequately with the analysis of the symptoms present during an attack. Angina pectoris is often surrounded by such tragic circumstances that it forms a suitable theme for disquisition, and on that account we too often get the lurid description of an impressionist artist instead of the plain, matter-of-fact description of an accurate observer. A careful sifting of all the details brings out the fact that the essential principles underlying the pains associated with affections of the heart differ in no way from those of any other hollow muscular organ. So terrifying is the attack to the patient that his perceptions of the details of his suffering are generally confused, so that often no clear account can be obtained from his description;

but if he is intelligent and is asked to note particulars in subsequent attacks, he may be able to throw a very valuable light on the onset and character of the sensations he experiences. The observations made by the physician of patients during an attack also afford great help in this respect.

123. The Viscero-sensory Reflexes in Dilatation of the Heart and Liver.—Before dealing with the more characteristic attacks of heart pain, which go by the name of angina pectoris, I wish first to draw attention to the very distinct sensory evidences that arise from the dilatation of the heart. These sensory symptoms are practically identical with those that arise in cases of distension of any other viscus, as the stomach, bladder or liver. To illustrate this I select cases where the dilatation of the heart occurs rapidly, and is followed by a rapid distension of the liver, such as we find in certain forms of paroxysmal tachycardia. In certain of these cases the rhythm of the heart starts suddenly at some abnormal place in the auricle or ventricle, or at the fibres joining auricle and ventricle. The heart at once beats with great rapidity, but fails to maintain the circulation, and in consequence we have very rapidly developed great dilatation of the heart, fullness of the veins, enlargement of the liver, and dropsy. I have seen a number of these cases, and in two particularly I have observed some fifteen to twenty attacks, of which the following is a typical description.

The patient may be in good health and no abnormality be detected save, in some cases, the occurrence of an extra-systole. Suddenly the heart's rate becomes greatly accelerated, to 150 beats

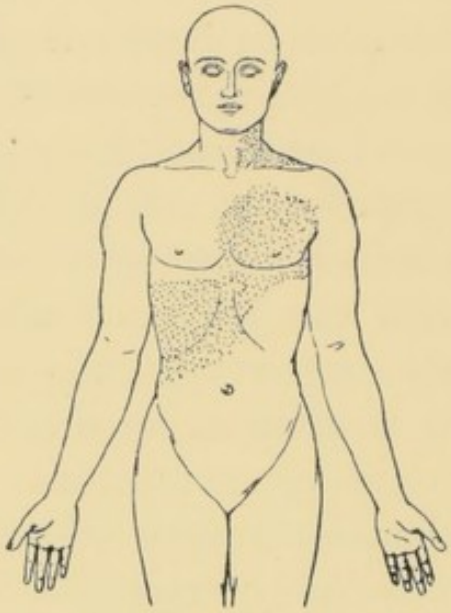


FIG. 16.

The areas shaded in the neck, chest and upper part of the abdomen represent the distribution of cutaneous hyperalgesia in a patient suffering from acute dilatation of the heart and liver.

and more per minute. In a few hours the patient's face becomes dusky, the lips swollen and livid, and there appears great shortness of breath on exertion, marked increase in the size of the heart, distension and pulsation of the veins of the neck, and enlargement and pulsation of the liver. The jugular and liver pulsation are of the ventricular type. Pain and oppression may be felt over the chest. The skin and deeper tissues of the left chest become extremely tender on pressure in the area shaded in Fig. 16. If the left pectoralis major muscle be grasped where it

forms the axillary fold it will be found extremely tender. The skin of the left side of the neck may also be tender, and if the left sterno-mastoid muscle and the left trapezius muscle, above the middle of the scapula, are lightly grasped they may be found exquisitely sensitive. The skin and muscles over the liver will also be found extremely sensitive to pressure, and the parts hyperalgesic extend over a much larger area than the enlarged liver. If the heart's rate revert to the normal the patient at once experiences great relief, and in a few hours all signs of the circulatory disturbances disappear. The hyperalgesia may last with diminishing severity for a few days. The tenderness of the skin and muscles in the regions described above may be found in patients during the early stages of dilatation of the heart from any cause, and is very common in heart failure secondary to mitral disease. In some cases one can tell when improvement is taking place by noting the diminution of this tenderness.

There can be little doubt as to the mechanism by which the hyperalgesia of the tissues in the three regions is brought about. The relation of the dilatation of the heart and liver with these sensory phenomena is undoubtedly that of cause and effect. The tenderness to pressure of the tissues in the left chest is due to stimulation of the afferent sympathetic nerves by the dilated heart. These nerves stimulate the sensory centres of the third and fourth thoracic nerves in the spinal cord, so that a stimulus reaching them from their peripheral distribution gives rise to a painful impression. The tenderness of the left sterno-mastoid and trapezius muscle, and of the skin of the neck, is due to the

afferent fibres of the "bulbar autonomic" system—that is the vagus, conveying a stimulus to the sensory roots of the second and third cervical nerves. The hyperalgesia of the tissues covering the liver is due to stimulation of the sensory centres in the spinal cord by the afferent sympathetic fibres from the engorged liver.

124. The Pain of Angina Pectoris is a Viscero-sensory Reflex.—The usual description given of the pain in angina pectoris is that it is felt in the heart and shoots into the arm, or that there are two pains, a local pain in the heart and a referred pain in the arm. If, however, a careful analysis be made of all the symptoms present, facts will be found that practically demonstrate that in angina pectoris there is but one kind of pain, and that its production is in accordance with the law I have attempted to establish, namely, that it is a viscero-sensory reflex. One is not able in every case to demonstrate the proofs of this hypothesis, but facts derived from suitable cases afford legitimate conclusions applicable to all cases. Shortly, these facts are, that the pain in the very gravest cases may be felt in regions distant from the heart; that this pain is identical in character with that felt over the heart; that the pain may originally start in parts distant from the heart, and gradually approach and settle over the heart; and, lastly, that the tissues of the external body wall, in the exact region in which the pain was felt, may be found extremely hyperalgesic after the pain has passed away. From this last fact it is inferred that, inasmuch as the seat of pain corresponds to the region of hyperalgesia, therefore the pain was due to stimulation of the

hyperalgesic nerves. To assume otherwise would be to ignore a principle that explains satisfactorily the sensation of pain wherever arising.

The following observations illustrate this point. They are examples chosen from a large number of cases that demonstrate the same feature. For the sake of brevity only those points bearing upon this argument are referred to.

Female, aged 30, suffering from stenosis of the aortic, mitral, and tricuspid valves, was seized with a violent pain referred to the outer part of the left side of the chest wall. The pain passed off, but a sense of soreness and smarting remained over the part in which the pain was felt. On examining her I found a portion of the skin of the chest extremely tender to touch, corresponding to the area shaded in Fig. 17.

A few days later she began to suffer from attacks of pain in the left breast and down the inside of the left arm, and on examination I found that the hyperalgesia had extended and occupied an area similar to that shaded in Fig. 18.

These attacks of pain became so severe on the slightest exertion that she was obliged to keep to her bed. She partially recovered from these attacks, but they recurred with increased severity. When suffering the most severe attacks the hyperalgesia embraced nearly the whole of the left chest and inside of the left arm, and also a portion of the right chest. The left sterno-mastoid muscle and trapezius also became very tender, and the patient would sometimes complain of pain on the inner surface of the right arm, at the elbow, where also I found a patch of cutaneous hyperalgesia. Two years and a

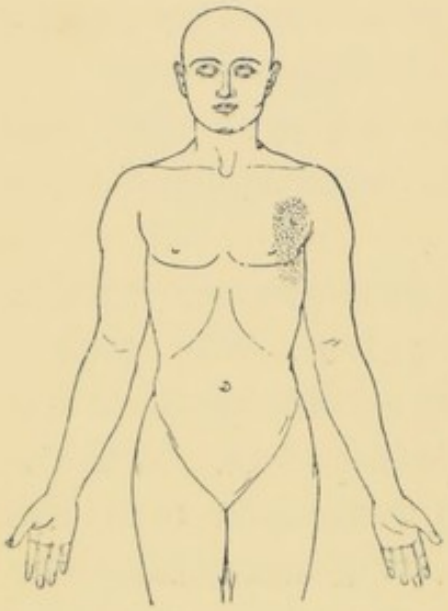
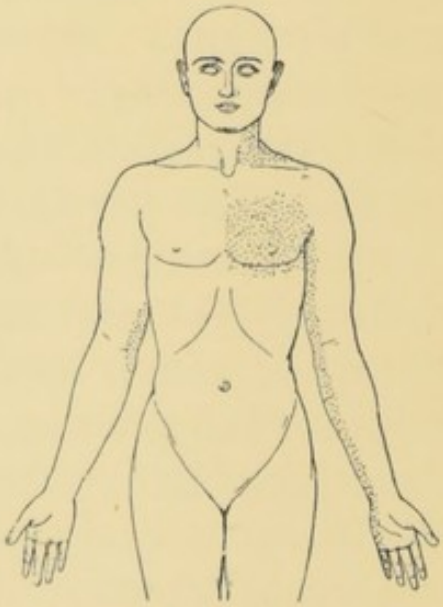


FIG. 17.

The shaded area shows the distribution of the cutaneous hyperalgesia after the first attack of angina pectoris (compare with fig. 18).

FIG. 18.

After repeated attacks of angina pectoris the pain and hyperalgesia extended to the regions shaded here. Note the areas in the neck and inner side of right elbow (compare with figs. 6 and 7.)



half after the first attack of pain she was recovering from a series of violent attacks, when, on getting out of bed, she fell forward and died immediately.

The fact that in this case the attacks of pain were followed by a hyperalgesia of the skin in the region where the pain was felt, and the further fact that the pain started at a distance from the cardiac region, and was often felt most severely at a distance from the heart, proves that the cardiac pain in this case was a viscero-sensory reflex, and that the pain felt over the precordia was presumably of the same nature.

Female, aged 56, with high blood pressure, suffers from pain in the foot (gout), and has had several severe attacks of true angina pectoris, in which the pain is referred over the left chest and through to the shoulder. After the attack she passes a large quantity of clear urine, and the skin and deeper tissues of the left breast and the left sterno-mastoid and trapezius muscles become very tender on pressure. In one attack the pain was felt in a limited area over the second left interspace, and next morning I found the skin and deeper tissues at this place extremely tender to the slightest pressure.

In this instance, also, the hyperalgesia of the skin corresponded to the region where pain was felt, and is presumptive evidence in favour of the view that the pain as well as the hyperalgesia is the result of the viscero-sensory reflex.

Male, aged 42, consulted me on October 18th, 1905, complaining of pain in the left little finger and ulnar border of the left arm and forearm, coming on when he exerted himself at his work and on going

up hill. For some months he suffered from a dull aching pain at the back over his shoulder blades. I found dilatation of the aorta, slight incompetence of the aortic valves, and slight enlargement of the heart (verified at the subsequent post-mortem examination). The blood pressure was 150 mm. Hg. During the following weeks the pain in the left arm increased in severity, gradually extended up the arm till it was felt in the axilla, and finally invaded the left chest. At first the pain was wont to start at the little finger and to pass rapidly up the arm, but latterly it seized him with such severity and suddenness that he could not tell where it began. It usually held him with the greatest severity either over the heart or in the inner surface of the left arm immediately above the internal condyle. I particularly asked him to note in his frequent attacks if there was a difference between the arm pain and the chest pain, and his reply was that there was no difference in the character of the pain, but, if anything, the arm pain was the worse. Sometimes the pain was very severe up the left side of the neck and behind the left ear. Under treatment he seemed to make considerable improvement. During January, 1906, these attacks recurred. During some of them the pain was so agonising that he felt he was dying, and wished to die. The pain was equally severe in chest and arm, and saliva sometimes dribbled from his mouth. On February 12th, the least exertion was sufficient to induce a severe attack of pain, from three p.m. to seven p.m. he was scarcely free from pain, and ultimately became unconscious. When I saw him next day he was having another series of attacks. He was keeping

his left arm very still, and helping himself to food entirely with his right hand. He told me he dare not move his left arm, as even the act of lifting the left hand to his mouth was sufficient to induce an attack. His pulse was extremely soft and weak. His blood pressure had fallen to 95 mm. Hg. During the following night he had another series of attacks, became unconscious and expired.

I omit many details in this case on purpose to emphasise the regions in which the pain was felt in a case of the most severe form of angina pectoris. It seems to me that no other explanation save that of the viscero-sensory reflex can satisfactorily account for the pains in this case, and to attempt to distinguish the chest pain as a heart pain and the pain in the arm as a referred pain would be arbitrary, illogical, and opposed to the evidence. The radiation of the pain from the hand to the chest was practically of the same nature as the more common radiation of the pain from the chest to the hand. The pain in the neck and behind the ear on the same hypothesis would be induced by the stimulus passing from the heart by the vagus, a view that would also explain the increased flow of saliva during some of the attacks, points to which I shall afterwards revert.

It is interesting to note here that the movement of the left arm would induce an attack of angina pectoris. I have already pointed out (page 89) that a stimulus from any source reaching an irritable focus in the cord will cause the characteristic pain to arise. In the next observation the stimulus reached the cord from the skin of the chest.

The two following observations of attacks of

angina pectoris which I witnessed illustrate true heart pain of the most severe type at places remote from the heart.

Male, aged 14, suffering from adhesive mediastinitis, with enormous enlargement of the heart. The patient lay propped up in bed. As I was gently testing the sensibility of the skin outside and under the left nipple the patient was suddenly attacked with severe pain. He gave a great sob, and leant forward with his left upper arm across his chest, and his right hand pressing it gently. He rocked backwards and forwards with deep sobs, while tears streamed down his cheeks. His pulse became very soft and his face pale, with beads of perspiration on his forehead. In a few minutes the pain subsided and he lay back exhausted. Afterwards he said that, on my touching a certain spot, a pain shot from his chest to his arm, and during the whole time the awful pain remained in his arm, and he put his hand over the fleshy part of the upper arm. His doctor told me he had given up examining him by auscultation, because on a few occasions, on applying the stethoscope, attacks similar to those I had witnessed were induced.

Female, aged 60, complained of pain of agonising severity limited to the ulnar border of the left forearm. Coming to see me one day she hurried to catch the train, and when she reached my consulting room she sat down. In a few minutes the pain seized her, and she took up her left arm and nursed it across her breast with evidences of great suffering. The pain subsided in a few moments, and she said she felt as if she would have died. The pain was felt nowhere but in the left forearm.

Three months afterwards the patient died from heart failure. At the post-mortem examination there was found marked atheroma, calcification of the coronary arteries and extensive chronic fibrous myocarditis.

In this last case the pain was doubtless limited to the highest sensory nerve centre (first thoracic), whose fibres are associated with the sympathetic supply of the heart.

125. Evidences of the Viscero-motor Reflex. —So far I have dealt with the viscero-sensory reflex, and evidence no less striking can be found of the viscero-motor reflex among the group of symptoms included in the term "angina pectoris." Some would limit the term "angina pectoris" to that class of cases where, in addition to the pain, there is a sense of constriction in the chest, amounting at times to a sensation as if the chest were gripped in a vice, or as if the breast-bone would break. I am convinced that these sensations arise from spasm of the intercostal muscles, and correspond to the hard contraction of the flat abdominal muscles in affections of the abdominal viscera. If one watches a case of what is called "muscular rheumatism" where the intercostal muscles are affected, and where these muscles are stimulated by the slightest movement to violent cramp-like contractions, one cannot but be struck by the resemblance to the description given of the "gripping" sensation experienced by patients suffering from certain affections of the heart. I have watched the attacks in such cases and could find no difference between them and those where the sense of constriction was the chief symptom in heart disease. The

viscero-motor reflex may be present alone, or, as is more commonly the case, it may be associated with pain. The purely viscero-motor reflex is seen best in the elderly, where it may be considered as a symptom of one form of the terminal affections of the heart due to arterio-sclerosis or old age. I have found it a precursor of steadily advancing cardiac weakness, and although for a time considerable relief may be afforded the changes in the heart are so advanced that, in the nature of things, only one end can be looked for. The three following observations illustrate these views.

Male, aged 82, with large tortuous arteries, was seized while walking with a sense of constriction across the chest that compelled him to stand still. These attacks became so frequent and so severe that he could scarcely walk fifty yards before he had to stop and lean against the wall. He described the sensation as one not of pain, but as if somebody gripped the upper part of the chest with a strong hand. With rest and suitable treatment these attacks gradually disappeared. Three months later the heart suddenly became irregular (auricular fibrillation), dropsy set in, and he died seven weeks later from heart failure.

Male, aged 56, was seized with a spasm which held his chest as in a vice when he walked up a hill. There was no pain but the sense of constriction and a sense of suffocation produced such discomfort that he was forced to stand still. Within a few minutes the chest would feel free but the sensation would at once recur if he attempted further effort of the same kind. Thus, in going to business, he had to go up a steep hill, but frequently found it impossible to do

so, and then had to go downhill and reach his destination by another and less steep road.

Female, aged 78. Two years before her death she experienced attacks of breathlessness with a sensation of constriction across the chest. This feeling of tightness was so readily set up that she was obliged to stay in bed. The attacks disappeared, but recurred again shortly before her death. These latter attacks were accompanied by slight precordial pain. She became gradually weaker and died. At the post-mortem examination the coronary arteries were found markedly thickened, with calcareous patches in their walls.

The following experience illustrates the fact that the viscero-motor reflex is a symptom distinct from the pain.

Male, aged 48, consulted me on November 25th, 1905, for a pain he felt across the middle of his chest. He had felt a slight pain here for some months on walking up a hill. He was a master-builder and on this day, while watching his men at work, feeling cold, he began to help them to dig up some earth to warm himself. He did this for a quarter of an hour with a good deal of energy. He then examined a few partially built houses, running up and down a great many steps. On his way home he became conscious of pain in his chest, and as it continued to increase in severity he called on me. I examined him carefully, and found a slight dilatation of the heart with an impure first sound. The blood pressure was 130 mm. Hg. On his way home the pain increased in severity, and after he reached home it became very violent. A colleague saw him and prescribed opium, which relieved him. When I

saw him next morning he gave a graphic account of his sufferings. He said : " In the tram coming home the pain got worse, and after getting home it became so severe that I felt I was going to die. The pain spread from my chest down my left arm to my little finger. You asked me, when I saw you yesterday, if I felt any gripping sensation, and I did not know what you meant; but, by George, I know now. When the pain was at its worst, I felt my chest suddenly seized as in a vice, and I rolled on the floor in agony. The pain and the gripping eased off for a time and then came on again. This continued till I got the opium. This morning I awoke all right, but at 10.30 that gripping sensation came on and held me tight for ten minutes. I dare not move for fear the awful pain should come on, and I felt every moment it was about to come, and I was in such terror of it that the sweat poured off me."

With rest and treatment these attacks grew less, till he only felt a slight pain when he over-exerted himself.

So far the symptoms I have dealt with have been mainly concerned with the reflexes connected with the sympathetic nerve supply. Equally instructive symptoms, though less frequent, can be shown to arise from stimulation of the vagus. At its centre in the medulla this nerve is in near relationship to the upper cervical nerves, and, it would seem, more particularly the sensory nerves supplying the sterno-mastoid and trapezius muscles. Not only may these muscles become extremely tender in various heart affections, but the pain from heart affections

may be felt in the region of distribution of the cervical nerves as already noted. The following observations also show the same thing.

Male, aged 62, complained of great pain striking into his chest and behind his ears when walking. Thus, in going to his work, he allowed seven or eight minutes to walk to the station, but now it took him over half an hour, as he had to stop on account of the pain every fifty yards. After accurately noting the pain he described it as arising in the left breast, extending across to the right breast, seizing him in the neck, and extending up behind the ears, where it held him with great severity. In showing me the situation, he laid the fingers of both hands over the insertion of the sterno-mastoid muscle into the mastoid process. On one occasion the pain extended from the breasts to the armpits, and down the side of each arm to the elbow.

This patient dropped dead while at his work, and on post-mortem examination I found extreme calcareous degeneration of the coronary arteries.

126. Organic Reflexes occurring during an Attack of Angina Pectoris.—Other very striking phenomena are sometimes met with during an attack of angina pectoris. During or after an attack an abundant flow of saliva and the secretion of large quantities of pale urine may occur; both symptoms I suggest are due to reflex stimulation of nuclei in the floor of the fourth ventricle. Possibly the polyuria may be of the same character as that in diabetes insipidus, which, as is well known, may be induced in animals by puncture of the floor of the fourth ventricle.

Male, aged 58, of gouty diathesis, complained of pain, induced by the slightest exertion, which arose in the left breast, passed up the armpit, and extended down the inner surface of the left arm to the little finger. During an attack an abundant flow of saliva took place into the left side of the mouth. These attacks became so frequent that he could only walk a very short distance without inducing an attack. He died while sitting at his desk, and at the post-mortem examination I found that the heart had ruptured, and the coronary artery was very atheromatous. Where the rupture had taken place the myocardium had nearly disappeared.

Male, aged 46, whose work entailed periods of great muscular exertion, complained of pain striking into the chest when walking up a hill. If he stopped as soon as he felt the pain coming on, it passed off, but if he persisted the pain increased to an agonising severity and radiated into both arms, but worse into the left, as far down as the little finger. At the same time the chest was gripped, so that he was forced to straighten himself and to breathe deeply, and at the same time his mouth filled with saliva, and an aching pain was felt in the throat. A few minutes after each attack he had to pass urine, which was always abundant and very clear. These details I had from him after he had carefully noted a number of attacks.

127. Summation of Stimuli as a Cause of Angina Pectoris. — The fundamental functions of the heart muscle correspond to those of other involuntary muscles that form the walls of hollow organs; these functions being modified to suit its

special work. Like the other viscera the heart is insensitive when stimulated in a manner that provokes pain when applied to the tissues of the external body wall. I have pointed out that a long strong contraction of a hollow organ can produce pain, and that this is undoubtedly the cause of the severe pain associated with renal calculus, gall-stones, spasm of the bowel, and uterine contractions. Can the heart give rise to pain in a similar manner? On account of the modification of its functions, the heart cannot pass into a prolonged state of contraction. Immediately it contracts, the function of contractility is abolished and the muscle passes at once into a state of relaxation, and for this reason the pain cannot be produced by a "spasm of the heart." But I suggest that the heart muscle may produce pain when it is confronted with work greater than it can readily overcome, a condition which produces strong peristalsis and pain in other hollow viscera. But the pain in the heart arises by a slightly different mechanism. A skeletal muscle will contract in obedience to stimulation of a sensory nerve going to the spinal centre of its nerve, if a stimulus of sufficient strength be applied. If the stimulus be too weak, no contraction follows, but if this weak stimulus be frequently and rapidly repeated, then the muscle contracts in accordance with the law of the summation of stimuli. I suggest that the heart muscle induces pain on the principle of summation of stimuli. If we minutely study our cases we shall find that the pain rarely arises at the first exposure of the heart to the effort that induces the pain. Sometimes effort has been undertaken a few minutes before the pain comes on,

and in certain cases it may not come on for hours after the causal exertion has ceased.

From such observations we can infer that the heart muscle was exhausted by the exertion, and so great was the exhaustion of the reserve force that it was unable to regain its reserve on cessation of effort; thus the exhaustion persisted till it culminated in an attack of angina pectoris.

CHAPTER XXI.

ESTIMATION OF THE VALUE OF SYMPTOMS.

In this chapter I endeavour to sum up the general principles which have been applied in more detail in the earlier chapters. That the interpretation of symptoms should be imperfect can readily be recognised, for not only is the subject too vast to be dealt with in a few pages, but the knowledge to deal with it efficiently is lacking. I confine myself, therefore, to a few general principles that have been of service to me in my endeavours to estimate the value of symptoms in individual cases.

128. THE RELATION OF THE SYMPTOMS TO THE GENERAL STATE.—Before a final opinion is formed of the value of any symptom, the physician must consider the patient as a whole, and the relation of any abnormal sign to the general health. The patient's complaint may be of a trivial nature, and the examination of the different organs may reveal

no abnormality; nevertheless the contemplation of the patient's whole economy may help one not to dismiss the symptoms too hastily because of their seeming triviality. Malignant disease of the stomach may cause the symptoms of a simple indigestion, but a slight loss in weight and a slight change in the patient's colour may ultimately be found to indicate the grave nature of the illness. The description of the patient's complaint may be given in such terms that the physician may fancy it is exaggerated and due to the patient being of a neurotic habit. This may be true, yet the complaint from which the patient suffers may have so undermined his strength that the neurotic habit has been induced by his prolonged suffering. It is necessary to state this because the presence of many reflex phenomena is apt to be pooh-poohed, because of the manifest hypersensitiveness of the patient's nervous system. There is no doubt that in people of a neurotic habit there is a greater tendency for reflex phenomena to be readily produced, yet the phemonena should not on that account be ignored, but should be utilised for the purpose of discovering the lesion if possible, and the neurotic tendency being duly discounted, their true value should be estimated. However widespread such symptoms as pain and hyperalgesia may be, there is always some irritation in the cord, induced, as a rule, by some trouble in the viscera or external body wall. This was well illustrated in the following case, which was under my observation for many years. I attended the patient during several attacks of rheumatic fever from 1880 to 1884. She developed well-marked symptoms of aortic, mitral, and tricuspid valvular disease, and was for years

very short of breath occasionally, but had no pain or hyperalgesia. In 1895 she began to complain of pain, particularly after meals, referred to the lower part of the epigastric region, with a limited area of hyperalgesia. The pain became very severe, so that I came to the opinion that she had a gastric ulcer near the pyloric orifice. The hyperalgesia spread widely round to the left chest. She kept in bed for a few weeks, but began to go about her household duties before the pain and hyperalgesia had disappeared. She then began to have attacks of pain in the chest on exertion, slight at first, but gradually becoming more severe, until they resembled in every respect attacks of angina pectoris. Coincident with the pain, hyperalgesia appeared in the chest and arm. The distribution of this hyperalgesia, due manifestly to the heart lesion, coalesced with that due to the gastric ulcer, so that there was an extensive field of hyperalgesia embracing the left chest and abdomen, from the level of the second rib to below the umbilicus. At the patient's death there were found the lesions of the three valves mentioned, and an ulcer at the pyloric orifice. Anyone seeing the patient after the development of the extreme field of hyperalgesia might have attributed the whole condition to some such vague complaint as "neurasthenia," particularly if the nature of the cardiac lesions were not detected. I have seen another case with very severe attacks of angina pectoris and widespread hyperalgesia where no cardiac abnormality could be detected. The extraordinary acuteness and extent of the sensory phenomena might have led to the surmise that there was only a neurasthenic condition, yet at the post-mortem examination the

coronary artery was found almost impermeable, and the muscle of the heart greatly degenerated. The rule I make in these cases is to recognise the fact that, however exaggerated the reflex symptoms, and however neurotic the patient may be, the symptoms are nevertheless due to actual affection of some viscus, and a careful consideration of all the other features of the case will lead one to an approximately correct estimation of the value of the symptoms.

129. Remote Effects of the Lesion. — Not only may the continuance of a visceral lesion and prolongation of suffering lead to the exhaustion of the patient's nervous system (which is probably the reason for the ease with which the reflex phenomena are produced in many people), but the original ailment, in consequence of persistent suffering, may alter the whole mental balance of the patient. Previous to an illness he may be sensible, unselfish, and considerate of his relatives and dependents, but during illness he may become utterly selfish, wear out the patience of his children and dependents with his peevishness and want of consideration, in order that his own requirements and comforts may be satisfied. Patients in this condition are extremely difficult subjects for diagnosis, for it is to their interest to magnify their complaints, and it is difficult to estimate the value of their symptoms. This is particularly the case if one searches for hyperalgesia of skin or muscle, for they readily complain of pain and tenderness. To discriminate the symptoms in such people the distribution of the sensory phenomena (pain and hyperalgesia) affords a very good guide. Thus if one tests for hyperalgesia of a heart affection, and the symptoms are found to

extend up the chest and over the clavicle, one might reject the symptoms, for the skin over the clavicle as low as the second rib is supplied by the fourth cervical nerve, while below it is supplied by the second thoracic, so that the extension of the hyperalgesia from the second thoracic to the fourth cervical is not conceivable, nor have I ever found it to occur. So it is in other complaints; the peculiar distribution of the sensory phenomena in affections of any given organ being unknown to the patient, one can test his reliability by noting the distribution of his pain and hyperalgesia.

This method of discrimination is also to be used in distinguishing true visceral sensory phenomena in cases of suspected hysteria and malingering. If the symptoms are found to follow the distribution peculiar to one organ, even if the patient be evidently hysterical, then it may be concluded that there is an affection of the viscus, and it remains to make careful consideration of the other factors in the diagnosis in order to estimate what value the symptoms possess.

The intensification of reflex phenomena is particularly noticeable where the conditions of living have reduced the bodily strength, through worry, sleeplessness, or improper nourishment. I have been particularly struck, for instance, with the symptoms of angina pectoris that may be induced in young people who have had a long and trying period of strain. Women who work hard for their living, or who look after household duties during the day, and have to attend an invalid parent or ailing child during the night, who are frequently disturbed in sleep, or who pass the greater part of the night in

constant attendance, become gradually exhausted, and the struggle may go on until an attack of pain in the chest imperatively calls attention to the exhausted heart. In such people the attacks of angina pectoris may be extremely severe, and the hyperalgesia may be widespread, affecting both sides of the chest (the left breast particularly often becoming extremely tender), and, it may be, the neck, particularly the left sterno-mastoid and trapezius muscles.

In estimating the value of the symptoms in such cases the history of the patient's life gives an indication, and one can then recognise, with assurance, the condition of the heart that has provoked these manifestations.

Similar exaggerated symptoms, having a peculiar distribution, may arise should any other organ be affected; as in stomach affections, a slight indigestion may give rise to such symptoms as to make it difficult to tell whether some more serious condition, as gastric ulcer, may not be present.

In doubtful cases one feature when present may be taken as a rule to distinguish an affection of an organ from some general nervous manifestation, that is the viscero-motor reflex. Unfortunately this symptom is practically limited to affections of the abdominal organs, and needs to be sought for with care, lest a too susceptible superficial reflex be started. But when detected it may be looked upon as demonstrating the presence of some visceral trouble.

130. Relation of Symptoms arising from different Causes.—When a patient presents himself one may be able, on physical examination, to

detect some abnormal condition to which one can refer with certainty the cause of the patient's suffering. It may happen, however, that we detect an abnormality having no direct bearing upon the complaint of the patient, and in the absence of one having such a direct bearing, there is too often a tendency to refer the patient's complaint to the presence of the recognisable abnormality. There is no doubt that symptoms may be provoked by lesions remote from the place where they are experienced, as in referred pain, and there is no doubt that many other symptoms may be produced by lesions of remote organs, as in the widespread effects of kidney disease. But keeping all this in view, there is still need of a wise discretion in estimating the influence of lesions in which there is no recognisable connection with the symptoms. Thus epileptic attacks may be brought on by affections of the heart as in heart-block (Adams-Stokes syndrome), where the left ventricle becomes so slow in its action that the brain does not receive a sufficient supply of blood. In consequence of this anæmia the patient may faint or have an epileptic seizure. The well-recognised connection between a heart abnormality and an epileptic attack in this particular instance has led to the assumption that, if a patient has epilepsy, and at the same time has some affection of the heart such as irregular action, there is a connection between the two. Under such circumstances it is necessary to recognise the nature of the irregularity, and as it is now possible to demonstrate with precision the different forms of heart irregularity, the recognition of the particular form of irregular heart action at once permits of determining the

probabilities of the heart being the cause of the epileptic attack in any given condition. Irregular action of the heart being so common, the occurrence of epilepsy is in the majority of cases due to an independent affection, and there is no causal relation necessarily present between the two conditions.

I have already referred to errors arising from attributing the cause of symptoms to some demonstrable structural affection, which may be merely coincident or independent.

It is impossible to lay down rules applicable to all cases, and I write this in order that the subject should in every case receive consideration, since the recognition of the possibility of error may prevent the error being made.

131. The Bearing of Symptoms on Prognosis. —Of all branches of medicine there is none which has received so little real consideration as the matter of prognosis. The subject itself is one which has to be considered in nearly every case that comes under the notice of a medical man. Its importance is appreciated in all stages of life, and the just consideration of the meaning of symptoms is of cardinal importance in regard to the patient's future.

In addition to recognising the meaning of any abnormal sign or symptom, we should endeavour to acquire a knowledge of what bearing it has upon the future history of the patient. This knowledge can only be obtained by watching how patients exhibiting the abnormality withstand the storm and stress of life. This should be a special object of every general practitioner, for it is he who has the opportunity of watching individual cases over a long

period of years, and of estimating the bearing of any abnormality on the patient's future life.

Sometimes our profession as a body does not sufficiently recognise its responsibility in regard to prognosis. When an individual submits himself for an opinion he does so with such implicit confidence that the verdict given may alter the whole tenor of his life. He may, for instance, be seeking to enter some profession, when a preliminary medical examination reveals what the medical man takes to be an abnormality. An imperfect knowledge of its nature may, and unfortunately often does, lead to its being regarded as presaging possibly grave consequences, and the candidate is rejected. He is thus shut off from the prospect of his chosen calling, and, knowing the reason of his rejection, passes through life uneasily apprehensive of some impending disaster, whilst all the time the supposed abnormality may be a sign of little or no consequence.

If we look at an insurance form we realise the hardships to which applicants are exposed. "Is the pulse regular?" "Are the sounds of the heart pure?" "Is the urine free from albumen?" If such questions are answered in the negative the applicant is either rejected or is penalised for life by having to pay a higher premium, and, in addition, he is burdened with the consciousness of infirmity.

I dwell on this matter with some insistence, because I have known of so many instances in which gross injustice has been done to individuals, not only from a pecuniary aspect, but in having imposed upon them great expense, unnecessary treatment, and mental disquiet, because the meaning

and prognostic significance of some simple symptom had not been recognised.

A serious responsibility is thrown upon every practitioner at times in advising upon other questions. Should a man give up his business ? is a question upon which advice is constantly sought, and whether the individual be a statesman or a labourer the greatest care is necessary in formulating the answer. "Should a woman with some heart affection marry?" or, "If she be pregnant, should the pregnancy be allowed to proceed?" are problems that every general practitioner at one time or another will have to meet; and if he seeks for guidance in the text-books, he finds merely general views which he cannot apply to the individual case. This fact alone should arrest the attention of the profession, and make it conscious how insufficient are the indications for an intelligent prognosis.

In estimating the value of any abnormal sign, or in determining the condition of the patient, a clear idea must be obtained of the mechanism by which any given symptom is produced, and of the effects that the underlying lesion has upon the economy. It is impossible to give here indications that would be of value, partly because the subject traverses the whole field of clinical medicine and partly because I am not competent to deal with the matter, being only impressed with the importance of the subject and the necessity for its further consideration. So far as my experience goes, I can only say that one should never base a prognosis upon the presence of a single symptom, but should carefully investigate the effect of any abnormal sign on the functional efficiency of the organ and upon the

economy as a whole. The presence of albumen in the urine is often a sign of variable import. In many cases it is a sign of great gravity, and this being recognised, it is too often regarded as being invariably a serious matter. It is now recognised that its significance depends on the conditions inducing it, and it may appear when there is no serious affection of the kidney, or when the kidney affection is of such a nature that it may have little effect upon the system. Cases of albuminuria should not therefore be hastily condemned until a complete review of the whole circumstances of the case, such as the history of the illness, the condition of the other constituents in the urine and their effect upon the circulatory system, has been made. In the same way the presence of a cardiac murmur or irregularity, or even an attack of angina pectoris, should never be considered as affording grounds for a grave prognosis until the whole circumstances of the case are taken into consideration. I mention these instances merely as indications as to what course to pursue when doubts arise as to the significance of any abnormal sign.

The symptoms which arise reflexly in like manner have to be carefully weighed. Intensity of suffering may have no relation to the gravity of the complaint. Toothache causes no anxiety as to the prognosis, though the immediate suffering is severe. Were the cause of the pain not so easily recognised the agonising distress would at times be viewed with the gravest anxiety. Extreme suffering from some trivial disease may be found among the symptoms of many organs. When it is recognised that the most agonising pains are associated with the

contraction of non-striped muscular fibres, it will be realised that the cause inducing a contraction capable of calling forth violent pain may be of the most varied kinds, trivial as well as important. Even in the matter of angina pectoris the violence of the pain bears no necessary relation to the gravity of the heart complaint. In many cases the only sensation brought on by exhaustion of the heart muscle may be limited to a mere sense of constriction, and this, if properly appreciated, may indeed be the one sign which calls attention to the serious condition of the heart. I have repeatedly been consulted by elderly people for this sense of constriction across the chest when they exerted themselves, and in many cases it was the earliest symptom that heralded the termination of the patient's life. On the other hand, some of the most violent attacks of angina pectoris have occurred in people in whom the exhaustion of the heart was but temporary, and the restoration of reserve force resulted in a complete cessation of pain and in permanent recovery. Between these extremes there are many intermediate forms, and it needs a careful inquiry into all the circumstances before a definite prognosis can be given.

In regard to the reflex phenomena the tendency to the exaggeration of symptoms by people with a hypersensitive nervous system must always be borne in mind.

132. The Bearing of Symptoms on Treatment. —The due appreciation of the mechanism by which symptoms are produced has a profound influence on treatment. It is often stated that treatment has to be symptomatic, that is, the symptoms are to be

treated because the nature of the affection inducing those symptoms cannot be detected. Whole systems of treatment are based upon this idea, and though at times we may be forced to accept this line, it should always be done with regret at our incapacity to recognise the underlying cause of the suffering. A constant endeavour to make out the meaning of these symptoms, which have perforce to be treated without knowledge of their cause, will gradually diminish the number of patients who have to be treated symptomatically.

As pain is the most common complaint from which so many suffer, its relief is an aim of our treatment. But it should never be supposed that the assuagement of pain is the only object. It has become stereotyped to say "remove the cause," and if this advice had not become so much of a platitude more attention might be given to the "search for the cause." The recognition of the cause can only be attained in the majority of sufferers by a recognition of the mechanism by which the suffering is produced. Recognising, for instance, that contraction of non-striped muscle produces a referred pain, the knowledge of how the pain is produced leads to the recognition of the hollow viscus producing it. There must be an abnormal stimulus exciting the muscle to contraction, and experience leads us to conclude what is the most common cause likely to produce the stimulation in a particular viscus. A pain with accompanying phenomena located in a certain region informs us that the stimulus arises from the gall duct or the ureter. Experience tells us that a gall-stone or renal calculus is the most frequent cause. The absence of symptoms indicative of any other lesion

confirms this view. On recognising that this is the cause the question arises. Can we remove it ? In the vast majority of cases this is only possible by surgical operation, and the question of the propriety of this procedure has to be considered. If, as is often the case, this proves inadvisable, then the treatment must proceed on other lines, and the recognition of the mechanism by which the pain arises again gives indications. As it is manifestly due to the strong contraction of non-striped muscle, measures that will relax the contraction of the muscle will naturally be the remedy in this particular case for the time being.

On the other hand, if the pain be aroused by some hollow muscular organ, where it is possible by simple means to remove the cause that stimulates the contraction, to this end treatment should be primarily directed. If, for instance, the indications point to the pain arising from painful peristalsis of the bowel, the inquiry will proceed to find out the probable nature of the stimulus. If there has been a history of constipation, or incomplete evacuation of the bowel, the retention of scybalous masses is suggested as the cause of the peristalsis, and the treatment will be guided to measures that will lead to evacuation. So also with regard to any other viscus that can be emptied, the recognition of the nature of the symptoms affording the best guide for a rational and effective treatment.

In an organ, such as the heart, that cannot have the cause of the suffering removed by some mechanical process, the consideration of the conditions that induce the symptoms leads to a rational guide in treatment. As I have pointed out, any symptom of suffering points to an exhaustion of the reserve

force, whatever be the nature of the functional exhaustion or structural lesion. The recognition of this indicates that treatment in the first instance must be directed to the restoration of this reserve force, and this can be done when consideration of the factors inducing the exhaustion are appreciated, such as over-work, worry, sleeplessness, or the hampering effect of some organic lesion. This demands careful investigation into the special features of each individual case.

These remarks may seem so evident as to be altogether unnecessary, as everyone recognises them. But though as a matter of theory they are the commonest of platitudes, as a matter of practice they are often neglected. If we consider the matter in relation to the treatment of heart affections, for instance, it would be found that, whatever the nature of the heart failure, a routine method of treatment is, with few exceptions, invariably adopted. Thus heart failure is supposed to demand what are called "heart tonics," and the usual treatment is to prescribe the tonic which is dictated by the fancy of the physician or by the fashion of the day. In our inquiries into systems of treatment, such as are elaborated at places like Nauheim, it will be found that routine methods are employed, after few or no discriminating inquiries into the peculiar features of each case. One could indefinitely extend illustrations, drawn from other systems, where rule of thumb treatment is followed, to the neglect of the simple and obvious methods suggested by the careful appreciation of the meaning of symptoms.

I have already pointed out that treatment may be a factor in diagnosis—so-called diagnosis "ex

juvantibus"—the manner in which symptoms react to treatment being often a useful help, as, for instance, the use of mercury or iodide of potassium in suspected cases of syphilis. But it is necessary also to appreciate when possible the manner in which the treatment acts. It must be the experience of everyone who has seen a large number of cases of stomach affections, that many cases of great suffering, where there is a manifest structural lesion, obtain relief by some simple remedy or change in diet. Thus in pyloric stenosis with dilatation of the stomach the patient may have suffered for a long period, and some simple remedy, as bicarbonate of soda, may give instant relief and freedom from suffering for a long time. So also a change in the diet may have the same result. Too often such remarkable experiences are mistaken by physician and patient as evidences of the curative value and potency of the drug or system of diet, and so we get the exaggerated praises of different drugs and systems, so common nowadays. If it be recognised that some constituent was present in the stomach which occasioned the sufferings of the patient, and that the drug had neutralised its effects, or the change of diet had prevented its formation, it would have led to a truer appreciation of the benefits obtained by the treatment. It cannot be too strongly insisted upon that the reflex symptoms, which are those that are thus "cured," may arise, not from the actual lesion, but from a susceptibility to stimulation, or from some agent capable of inducing an adequate stimulation, and that the symptoms give no clue to the nature of the stimulation or to the agent causing it.

The recognition of the meaning of the reflex

phenomena is of much use in so many ways that it is scarcely possible to do more than indicate certain phases of their value. The muscular contractions and hyperalgesia are always indications that some active process is going on. In cases of gastric ulcer, for instance, the treatment may have been so successful that the patient's sufferings are relieved and a "cure" is said to have resulted. But a careful examination of the left rectus muscle may reveal tenderness of its upper division with increased tone; and these symptoms indicate that the stomach lesion is still so active that it keeps up an irritable focus in the cord, and give indication that the treatment should be continued if a permanent recovery is to be attained. Occasionally one meets with cases where this viscero-motor reflex has been recognised and taken as the factor needing treatment. In gall-stone disease, when there is present the tell-tale sign of contracted muscles in the epigastrium, energetic means, as baths, electricity, massage, are frequently employed to reduce the "hardness" of the belly wall!

The conception of the nature of the reflex phenomena may give a more direct aim to our therapeutic endeavours. I have already pointed out how the suffering in stomach affections may be due to the accidental presence of an agent that is capable of producing pain, and that remedies may neutralise the effect of the agent without modifying the disease process. It is conceivable that an effect may be produced in other ways, whereby treatment may influence the reflex symptoms at some portion of the chain between the lesion and the mental conception of the suffering. Thus a drug may act upon the muscular spasm when it causes pain, or it

may act upon the spinal cord at the level where the visceral nerve stimulates the sensory nerve. It is just possible that it is here the relief is obtained in certain forms of counter irritation. Thus I have seen a patient with a pyloric ulcer of the stomach obtain relief by a blister on the epigastrium over the limited area in which the pain was felt. This blister did not directly affect the ulcer, because the ulcer did not lie at the same level (*see* Fig. 11). Nor could one imagine that any reflex effect was produced in the ulcer itself. It seems more probable that the stimulus from the skin affecting directly the peripheral distribution of the sensory nerve prevented by some inhibiting process the stimulus from the viscus passing to the sensory cells in the spinal cord. This seems the more reasonable, because it was found that on the healing of the blister the old pain from the ulcer returned, but if the blistered skin were kept raw by the application of some ointment the pain from the ulcer was subdued. This view receives support from the result of recent researches of Sherrington, by which it has been shown that nerve paths may be stimulated from a variety of sources, but that of several contemporaneous stimuli one stimulus may be received and the others inhibited.

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