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SOME POINTS BEARING ON THE ASSOCIATION OF SENSORY DISORDERS AND VISCERAL DISEASE.

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IN the following pages I deal in a somewhat discursive and desultory manner with the result of several years' enquiry into the symptoms evoked in the sensory nervous system by disease of the viscera. For many years the subject has been present in my mind, and although for a long time I could not appreciate the value of all the phenomena, yet by carefully noticing each circumstance in every case, and by grouping the symptoms together, I formulated for myself certain tentative laws of a somewhat vague nature, trusting that with extended experience these would become more defined and be of a less general nature. What I have published on this subject¹ does not fully accord with the results obtained by Dr. Head,² and although in many respects his results are more reliable than mine, there are a few points on which we are in conflict. These points may seem to be here unduly emphasised, but my object in stating them is that a subject of such importance and of such practical utility should be established on a basis

¹ *Medical Chronicle*, August, 1892.

² BRAIN, Part I. 1893.

which cannot be gainsayed, and that the views of Dr. Head will be enhanced if he is able to rebut objections. On the other hand, these views may be all the better for being modified if they are found irreconcilable with fact. While I, therefore, take exception to some of his conclusions as being too exact, yet I heartily congratulate him on a brilliant and valuable piece of work, and only regret that space does not permit me to emphasise the many points in which my evidence fully supports his conclusions.

In pursuing the study of this subject it is necessary to divest the mind of all preconceived ideas bearing upon it and to note carefully every individual circumstance, however contrary it may appear to one's expectations and desires. One great difficulty is the unreliability of the patient. Pain of the most excruciating kind leaves in the mind but a very imperfect recollection of its exact site. In all cases the description of the pain prior to examination should be received with great caution, and instructions given to note accurately the exact site during an exacerbation or recurrence. In the latter case trustworthy accounts can generally be received even when the observer is not present.

I must confess I have also found it necessary to put a control on my own observations, by having them verified by a colleague. In making my observations I invariably had the most striking and important cases examined independently. Such phenomena as my colleagues could not verify I rejected, for if these sensory symptoms are to be of value they must be capable of being elicited by observers free from bias. And further, cases should not be recorded based upon recollections alone, for it is wonderful how far from the truth the memory may wander, when there is a favourite theory to be advanced.

I.—The Pain in Visceral Disease is a referred Pain.

When I had for some time, in systematically examining patients, employed the site of pain as an important aid to diagnosis, I gradually became impressed with the apparent fact that there was little or no evidence pointing to the situation of the pain in disease of the viscera, being situated

in the organ affected. This view was strengthened by the results of *post-mortem* examinations in two cases of gastric ulcer, where the sites of the ulcers bore no relation whatever to the seat of pain during life. When Ross¹ published his highly suggestive paper, I was greatly helped in obtaining an explanation of many of my observations. In conversation with Dr. Ross I dissented from his view of the so-called splanchnic pain, maintaining that there was no evidence whatever in support of it. He stoutly maintained the contrary opinion, and used as an illustration a case of gastric ulcer that he had then under observation, in whom there was a pain of great severity localised in a limited area. He said he felt convinced that, were he to push a long needle into this painful spot, the needle would inevitably pierce the ulcer. In opposition to this view (which is very widely held), I urged the fact that whilst the site of pain was absolutely stationary, the stomach (and its ulcer) executed movements of a considerable excursion, both by reason of the musculature of the stomach itself, as well as by the mechanical movements of respiration.

My attention being somewhat accidentally called to the presence of hyperæsthesia in a patient recovering from an attack of gall-stone colic, I made careful search for this phenomenon in other cases, and collected a large number of illustrative cases, intending in the first instance to submit them to Dr. Ross as evidence in favour of the somatic origin of his splanchnic pain. But this was never done, on account of his painful illness and deeply regretted death.

The sensory phenomena, besides pain, when present, exhibit an increased irritability of the peripheral nerves. This is evidenced more particularly by cutaneous hyperæsthesia, and exalted sensibility of certain sub-cutaneous tissues of the external body wall. The first of these can be demonstrated by the usual methods for testing the hyperæsthesia of the skin, while the latter can be elicited by lightly grasping the various structures through the skin between the thumb and fore finger. There can occasionally be demonstrated a differ-

¹ Ross, J., "On the Segmental Distribution of Sensory Disorders," *BRAIN*, January, 1888.

ence in the sensibility to this stimulation in the various sub-cutaneous tissues. Thus, when no hyperæsthesia of the skin exists, as tested by lightly stroking with a blunt pointed instrument, when the skin is grasped in the above manner, abnormal tenderness may be elicited. Similarly when the skin is not unnaturally sensitive the sub-cutaneous fat or mammary glands may be so. And again, while these structures may exhibit no abnormality, certain muscles may be extremely hypersensitive. Further, distinct tenderness may be found in pressure over certain vertebræ, and that when there is no increased sensitiveness of the tissues interposed between the vertebræ and pressing thumb. These tender vertebræ frequently afford very valuable evidence of the organ diseased. When hyperæsthesia of the skin is present along with this tenderness of the sub-cutaneous tissues, the two areas are not co-extensive—the tenderness of the sub-cutaneous tissues generally being spread over a larger area than, and even manifested at some distance from, the cutaneous hyperæsthesia. In such cases, if the nerve supply of the organ affected be carefully enquired into, an explanation will be generally found in the fact that the nerves supplying the organ are in connexion with the spinal nerves at different levels of the cord.

Pain, when felt by the patient in whom there is also increased sensitiveness of certain areas of the skin or sub-cutaneous tissues (limiting the term sub-cutaneous tissues to the structures of the external body wall), is generally situated within the area of hypersensitiveness. Now as these areas are these to which Ross usually referred his splanchnic pain (the pain in the organ itself), it seems but reasonable to expect that the pain would be produced in the nerves thus abnormally excited. That is to say, if the roots of certain nerves are excited to a degree that produces this increased sensitiveness of the external body wall, it may be reasonably assumed that the irritation of the nerve roots also produces the pain which is felt in the area of their peripheral distribution. That a pain can thus be referred has been accepted by many writers, and Ross adopts it in the explanation of the origin of his somatic pain. The only difference between this referred pain—the somatic—and the so-called pain of the organ

itself—the splanchnic—is one of locality, the latter having its seat in close relation to the situation of the organ affected. If we take the pain of renal calculus as an illustration, it will be found frequently that the pain extends from the lumbar region round the side and down the abdominal wall slanting inward to the scrotum with, it may be, retraction of the testicle. As it is known that the ureter occupies a somewhat similar situation, it is frequently assumed that the pain in such a case is felt in the ureter itself. But the 12th dorsal nerve in its peripheral distribution follows a somewhat similar course, and frequently after an attack of renal colic, the skin here is hyperæsthetic. It seems, therefore, much more reasonable to assume that the pain here is in reality due to some irritation at the root of the 12th dorsal nerve, and that the pain is felt in the area of cutaneous distribution in accordance with the law of eccentric projection of pain. This assumption is all the more reasonable when there is evidence of the irritation having extended to more distant nerve roots, as when the pain and hyperæsthesia extend to the regions of distribution of the 1st and 2nd lumbar nerves, and even having affected the motor centres, as evidenced by the retraction of the testicle, and feeling of loss of muscular power in the muscles supplied by those nerves.

But it is in the study of the pain in heart affections that the most striking evidence is furnished in favour of the view that the pain in visceral disease is not located in the organ. Many precise observations have been made supposed to demonstrate the sensitiveness of the organ. Walshe¹ and Balfour² speak of the heart becoming painful, and Peter³ has assumed that he could demonstrate this sensitiveness by exerting pressure on the organ. But in such cases where the exertion of this pressure elicits pain it can be readily demonstrated that the pain is really elicited from stimulation of the external tissues.

The hyperæsthesia of the skin associated with attacks of

¹ Walshe, W. H., "A Practical Treatise on the Diseases of the Heart and Great Vessels," London, 1873, 4th edition, p. 208.

² Balfour, G. W., "Clinical Lectures on Disease of the Heart and Aorta," London, 1876, p. 274.

³ Peter, M., "Maladies du Cœur," Paris, 1833, p. 36.

angina pectoris is no new thing, several writers mentioning the observation. It is needless to affirm, however, that a great many cases of angina pectoris suffer typical attacks without any symptom of peripheral hyperæsthesia, either of the skin or subjacent tissues. Such a case presented itself to me a short time ago where the patient died in the second attack of pain. In him no other sensory abnormality whatever could be elicited. The pain was situated across the lower third of the chest, extending slightly to the left. In such a case one might assume that the pain was undoubtedly in the heart. But is it so in reality? During the period that a patient suffers from an attack of angina pectoris the heart's movements still continue. The movement of such an abnormally sensitive organ would surely cause some variations either in the intensity or in the situation of the pain, and of this there is no evidence. Further, the pain of angina pectoris very often extends over a greater area than that covering the heart. In many cases this extension of the area takes place in a manner very instructive. In the first instance the attacks of pain may be limited to the præcordial region. As they increase in severity they extend further round the left chest and towards the arm-pit, and it may be down the inside of the left arm. The pain appears to be exactly of the same nature in the more distal parts as it is when it is located in the præcordia. It is a mere assumption to say that in the one instance the pain is in the heart, and when felt in more distant regions that it is due to reflex irritation of the spinal roots, particularly when the cutaneous area over which the pain is felt is supplied by nerves whose spinal roots are in immediate contiguity. This is more strikingly demonstrated when hyperæsthesia of the skin is likewise present. In such a case the pain is situated within the hyperæsthetic area, and this area can be demonstrated to be the region of cutaneous distribution of the 4th, 3rd, and 2nd dorsal nerves. The pain may even not be felt in the region of the heart at all. From the study of a series of cases extending over a period of years during which I have observed the attacks of angina pectoris first appear and develop, I have been able to observe a great diversity in the modes of attack. Although the symptoms of

pain are usually præcordial at first they are not invariably so. In one patient whom I have had under observation for two years with symptoms of aortic stenosis, the pain and hyperæsthesia in the first instance were situated over the anterior axillary wall and in the arm-pit. Lately the attacks have developed with extreme severity, and the hyperæsthesia now embraces the upper part of the left chest with the inner half of the left upper arm, the ulnar half of the forearm, and the little finger. There is also extreme sensitiveness of the left sterno-mastoid and trapezius muscles. This distribution of the pain and hyperæsthesia is so characteristic, as to leave no doubt of the distinct connection of the cardiac nerve supply with the nerve roots in the spinal cord supplying those hypersensitive structures. Thus the hyperæsthesia of the chest and arm is practically the field of cutaneous distribution of the upper four dorsal nerves of the left side, the roots of these nerves being connected with the sympathetic fibres that supply the heart. The tenderness of the sterno-mastoid and trapezius muscles, indicate irritation at the root of the spinal accessory nerve, and it apparently receives the stimulation from the heart through the medium of the vagus, the roots of the vagus and spinal accessory being connected. The sensory phenomena exhibit great variation in the locality of this distribution. Sometimes the dorsal nerves show no cutaneous hyperæsthesia, while the cervical nerves do. I have at present under observation a patient who has marked attacks of angina pectoris, and these I have noted developing during a number of years. In her there is very slight tenderness of the deeper tissues of the thoracic wall, whilst the left sterno-mastoid and trapezius muscles are extremely tender and the hyperæsthesia of the skin is limited to the left side of the neck, in an area corresponding to what I take to be the peripheral distribution of the 3rd cervical nerve.

But while most of the cases show the pain limited to, or originating in the præcordial area, other rare cases, manifest attacks of angina pectoris, which have no relation to the chest wall. In such cases the term *angina pectoris* is certainly a misnomer, but taking the term to imply that severe pain associated with disease of the heart, it will be found to

appear typically in regions distant from the heart. The following case is such a striking illustration of this, that on account of its importance I quote it at length.

Case of Chronic Fibrous Myocarditis and Calcification of the Coronary Arteries, with severe pain in the left forearm.—Female, age 60, consulted me on 30th July, 1892, complaining of great irritation in the privates which comes on periodically and sets up a great pain that strikes into the left forearm. These attacks occur several times a day, and last from fifteen to twenty minutes. She feels great depression when the attack comes on. She is very short of breath, and there is slight swelling of the legs. There is considerable difficulty in making water. There is great thirst, fair digestion, and constipated bowels. The patient is pale and wan, and the face has a pained and anxious expression. The body is well nourished. The tongue is very dry. The urine has a specific gravity of 1030, contains a trace of sugar, but from enquiry the quantity of urine passed does not appear to be abundant. The site of the irritation is very definitely limited to the inner surface and skin edge of the vulva. The arteries are large and slightly atheromatous. The pulse is full, soft, quick, and regular. The left side of the chest is tender to pressure, but there is no cutaneous hyperæsthesia. There is a very tender spot on pressure over the 2nd left rib in the nipple line, and the upper 3rd dorsal vertebra is very tender. There is no defined apex beat. The area of the heart's dulness begins at the 3rd rib in the parasternal line, and extends transversely from the middle of the sternum outward to the left for four and a half inches. The heart sounds are sharp and clear in all the areas, but in the aortic area the second sound is markedly accentuated, resembling a drum-tap. There is marked pulsation of the internal jugular veins, and tracings of this pulsation taken at the same time as the radial pulse, show the pulsation to be due to the contraction of the right auricle.

No abnormality can be detected in any other organ. The patient was directed to diet herself carefully, and, for relief of the irritation, to inject hot water into the vagina by means of a Higginson's syringe during the attacks and systematically night and morning. She was asked also particularly to note the exact site of the pain when it recurred and its connection with the irritation in the vulva.

In ten days' time she returned. The pain she found had no relation with the irritation, but came on always with exertion. It was situated in the left forearm, and she defined very clearly the

ulnar half of the forearm. Sometimes it was associated with a pain of less severity under the left breast. Under the treatment prescribed the irritation was greatly relieved, and the attacks had become much rarer.

The progress of the case was satisfactory so far as the urinary condition was concerned. The sugar after a few weeks' treatment disappeared from the urine, and the irritation also completely subsided. But the pain in the arm resisted all treatment. On one occasion she came to my consulting room in a terrible state of distress, and sat rocking the body to and fro, nursing her left forearm in her right hand. The onset of this paroxysm of pain had been induced in consequence of her having to hurry to catch the train by which she was coming to consult me. While she was under this attack I made a careful observation of the pulse and the site of pain. The pulse presented no change from its usual character, either to the touch or from the study of the sphygmogram. *The pain was exactly located in the ulnar half of the forearm*, no pain being complained of in any other part.

As I could give the patient no relief, she came into the Victoria Hospital under my care. She was put to bed, and not permitted to get up for three weeks. After the first week she had no attack, and after she was discharged she had them only very slightly and very rarely. I lost sight of her for a few months until the 9th of July, 1893, when she consulted me for an attack of diarrhœa. She said the old attacks of pain had never been so frequent since she had left the hospital, although occasionally they were still very severe, but were always limited to the left forearm. On examination during this visit I found only slight tenderness of the 1st dorsal vertebra and of the sub-cutaneous tissues in its neighbourhood. The heart presented no change except that the second sound, although still markedly accentuated, was not quite so clear, being somewhat muffled. She had her left forearm carefully wrapped in flannel, under the impression that it eased the attacks. There was no sensory abnormality demonstrable in the arm. On the 22nd I was asked to see her, as she was very ill. I saw her on the 24th. She was propped up in bed suffering from great dyspnœa, and the legs were greatly swollen. She died next morning.

Permission to examine the heart was obtained with difficulty, and only an incomplete *post-mortem* was therefore held. I sent the heart (which was empty and flabby) to Dr. Williamson, of Manchester, and his report is as follows:—

Heart weight, $10\frac{1}{2}$ oz. Left ventricle slightly enlarged, very slight thickening of aortic valves. Pulmonary, mitral and tricuspid valves normal. No atheroma of the aorta. The muscle wall of the left ventricle is of normal thickness and consistency; but in the cut surface there are a number of small pale whitish patches of irregular size and shape. Both coronary arteries are markedly atheromatous and calcareous from their aortic origin down to their small sub-divisions. The main arteries and their chief branches can be dissected out as calcareous tubes. The cardiac muscle of the left ventricle when examined microscopically does *not* present any signs of fatty degeneration (osmic acid). Sections show patches of fibrous tissue amongst the muscle fibres.

The pathological diagnosis is *marked atheroma and calcification of the coronary arteries; chronic myocarditis (fibrous)*.

There can be little doubt that the cause of the pain in this case was situated in the heart. Putting aside the situation of the pain, all the other phenomena pointed to the heart as being the *origo mali*; as, for instance, the suddenness of the attack engendered by exertion, the dull, terrible agonising nature of the pain, and the great sense of oppression accompanying it. The peculiar face of the patient was to my mind also characteristic of the expression in patients who suffer much pain associated with disease of the heart. Concerning the situation of the pain, it was at last entirely situated in the arm. Occasionally at first she did complain of pain under the left breast, but in the few attacks which I have witnessed the pain was entirely located in the arm. And the area here was extremely definite in its limitations. When asked as to its situation she always stroked the ulnar border of the forearm from the elbow to the wrist. There was never any other disorder of sensation in this locality, neither of the skin nor deeper tissues.

The area, then, in which this pain was felt was in the region of cutaneous distribution of the 1st dorsal nerve. Considering the marked disease of the heart substance and of the coronary arteries, there seems little doubt but that the stimulation from them proceeded to the root of the 1st

dorsal nerve, and the pain was then referred to its cutaneous distribution. Suppose now that the area of pain had corresponded to the area of distribution of the 3rd or 4th dorsal nerves in the chest—a circumstance far from unusual—would not one have said then that the pain was felt in the heart itself? And this view would have seemed all the more probable if there were complete absence of hyperæsthesia. It seems to me, in view of such a striking example as this case presents, that there is room for great doubt that the pain of an organ is necessarily situated in the organ simply because the pain may happen to be located in its neighbourhood. The pain in angina pectoris may extend in a direction the reverse of the course usually pursued, originating say at the wrist, and extending up the inside of the arm to the chest. Here it would seem that the irritation first affecting the root of the 1st dorsal spreads to neighbouring roots—characteristic of the manner in which the area of pain extends in diseases of other organs. Yet Walshe¹ looks upon such a manifestation as being an instance where “the brachial pain played the part of an aura.”

Studying the subject from a purely clinical aspect, such are, in brief, some of the reasons that influence me in considering the pain of visceral disease to be of a referred character, always somatic, never splanchnic. I willingly admit I am not able to explain the source of all pains, and many patients complain of pain to me unexplainable. Yet with this view present in my mind, and with extended experience these cases become less numerous.

II.—*The Sensibility of the Visceral Tissues.*

A certain amount of light is thrown upon this subject when the sensitiveness to stimulation of the viscera is considered. The relative great bulk of the organs to the nerves that supply them and the varied functions these nerves subserve, suggest the idea that there can be but a very limited amount of sensibility.

¹ *Loc. cit.*, p. 198.

In considering this subject it will be convenient to divide the tissues constituting the viscera into three, namely, the serous, muscular and glandular. This division will be useful in considering not only the sensitiveness of the tissues to ordinary stimulation, but also in considering the sensory disorders that arise during affections of the individual organs. To the methods employed for ordinary stimulation (touching, pricking, pinching, &c.) it is well known that the viscera are insensitive. But still, painful sensations can be aroused, and the symptoms thus elicited help in clearing up a good many obscure phenomena.

(A) *Serous Membranes.*

For many years when tapping for pleurisy I have been accustomed to note the sensations elicited when the visceral pleura came in contact with the canula. Coughing has been set up, but never any pain or other sensory phenomena. In like manner on testing the parietal and visceral pleuras with more facility in cases of excision of the ribs, I have failed to elicit any painful sensation. Richerand¹ long ago noted the insensibility of the pericardium, which he exposed in removing a portion of a scirrhus pleura. The insensibility of the peritoneum has been frequently demonstrated in operations affecting the various abdominal and pelvic viscera.

(B) *Muscular Tissue.*

In hollow muscular organs pain can be elicited by stimulating the muscle to contract, as after giving a distending enema the great gut contracts producing a referred pain in the abdominal wall midway between the umbilicus and symphysis pubis. The uterus can be made to contract, with the production of the pain in a similar area. The pains may extend in both cases to other regions, but in no sense are they felt in the contracting organ. But to any stimulation, save that which gives rise to powerful contraction, the muscular is as insensitive as any of the other tissues.

¹ Richerand A., "Elements of Physiology." Edited by James Copland. 2nd edition, 1829, p. 613.

The insensitiveness is still marked when the parts are inflamed. In a patient from whom a large piece of gangrenous intestine had been removed, the exposed gut a few days after was deeply congested and swollen. But stimulation of the peritoneal and mucous surfaces and intervening tissues was not perceived by the patient.

Seeing that it is the muscular tissues that evolve pain most readily, it will be best to study shortly the sensory phenomena associated with the hollow muscular viscera. No one doubts but that the pain felt during painful peristalsis of the bowel, or during uterine contractions, is produced by the muscular tissue. The pain so produced may be still felt after the contraction has ceased as a feeling of soreness, and hyper-æsthesia can frequently be demonstrated. It is a curious fact that the pains, and other sensory disorders that are most severely felt by patients, are those that arise from affections of the hollow muscular organs. I do not mean to imply that spasm of the muscle is necessary to the production of pain. In angina pectoris, this is manifestly not the case, notwithstanding many opinions to the contrary. But the pains, for instance, that are the most marked and can be referred with most certainty to the organ affected, are those of the heart, of the stomach, small and great intestine, and of the uterus. The pains, likewise, of gall stone and renal calculus are in all likelihood essentially those of hollow muscular organs. The calculus lodged in the substance of liver and kidney gives rise to no sensory symptom, but when it invades the hollow viscera connected with them then the pain is aroused. I have had frequent occasion to observe the persistence of pain, and hyperæsthesia after the expulsion outside the body of gall stone and renal calculus. In view of the possibility of these symptoms, and those also manifested so frequently in stomach affections, being associated with and probably due to spasm of muscular tissue, the following remark by Beaumont in his observation upon Alexis St. Martin is of interest.¹ "If the bulb of the thermometer be suffered to be drawn down to the pyloric extremity, and de-

¹ Beaumont, W., "Experiments and Observations on the Gastric Juice, &c." Edited by A. Combe, Edinburgh, 1838, p. 105.

tained there for a short time, or if the experiment be repeated too frequently, it causes severe distress, and a sensation like cramp or spasm, which ceases on withdrawing the tube ; but leaves a sense of soreness and tenderness at the pit of the stomach." I have little doubt in my own mind, but that the tenderness and soreness here described, was in reality due to a condition of hyperæsthesia of the skin or subjacent tissues. I usually find these phenomena when patients complain of such feelings in the epigastrium. In a case of lax abdominal walls Macdonnell¹ was able to palpate the under surface of the heart, and pressure upon the auricles gave rise to symptoms resembling angina pectoris. Without seeking, therefore, to insist that the pain in visceral disease is due in all cases to muscular spasm, I would seek to point out, first, that pain and other sensory phenomena are frequently associated with hollow muscular organs ; second, that symptoms exactly analogous to these produced by disease can be originated by artificial stimulation of the muscles of hollow organs.

(c) *Parenchymatous Tissues.*

Diseases of the parenchyma of an organ are not associated with very definite sensory symptoms. In fact, I have more than a suspicion that there are none. I have carefully enquired into the history, and watched the progress of many cases of acute nephritis from the onset, and yet have been unable to find any sensory symptom associated therewith. The ravages of consumption are notoriously painless, unless the pleura be involved. The pains of pneumonia are those observed in pleurisy.

A certain amount of pain can be elicited by pressure on a number of the organs (kidney, testicle, ovary, &c.). But here, so far as I have been able to make out, the pain is a referred pain.

When pain occurs associated with disease of an organ, it can frequently be demonstrated that there is an extension to the serous covering, as in the pleurisy of pneumonias. I have had frequent opportunities lately of studying the pains associa-

¹ Macdonnell, H., "Cardiograms from the Human Heart," *The Practitioner*, vol. xliv., 1890, p. 178.

ted with great enlargement of the liver from disease of the heart. In such cases pulsation of the organ is a frequent symptom, and in the course of an enquiry into the nature of this pulsation, I noted the frequent occurrence of pain over the distended organ. So far as I could make out it was evidently on the surface of the organ, and in one case where the pain and tenderness were very marked, there were found in the *post-mortem* examination numerous adhesions between the anterior surface of the liver and the abdominal wall.

I have already referred to the pains associated evidently with the ducts of certain organs (bile ducts, ureters), and it is a fact worth noting that diseases of a ductless gland like the spleen appears to be unaccompanied by any sensory symptoms. One great obstacle in regard to this theory of the painlessness of parenchymatous disease, is the pain associated with orchitis, unless it be due to the swelling pressing on the more sensitive tissues external to the organ. Otherwise, why inflammation of this organ should produce such pain, and inflammation of the kidney should be painless, I do not understand. I am conscious that many very capable physicians affirm with great assurance that there are pains distinctly associated with disease of the parenchyma of organs. But all I can say is that looking at the matter dispassionately I have yet found no distinct evidence of such a thing, and I do not feel justified in ascribing a pain, whose origin I do not know, to an obscure organ whose sensory manifestations I do not understand.

III.—The Character and Distribution of the Sensory Symptoms in Inflammation of Serous Membranes.

When all the sensory symptoms that can be elicited from a series of cases of inflammation of the pericardium or pleura, are grouped together, it seems very difficult to find a satisfactory explanation for them.

The assumption that the pain is local and due to stimulation of the peripheral nerves, the view most commonly held and supported by Ross and Head, as distinct from a reflex or associated pain, is not sufficient. A great variety of these sensory phenomena may present themselves in cases that are otherwise apparently identical so far as our means of physical

diagnosis are concerned. In looking over my notes of six cases of pericarditis I found that two presented no sensory phenomena, that a third had a slight pain referred to the upper part of the præcordial region, that a fourth had pain for a few hours of agonising severity across the middle of the sternum. I was summoned to see this patient between three and four in the morning, and the symptoms resembled those of an attack of angina pectoris—the ashen hue of the patient's face, the fear of impending death, and the agonising pain. The pulse was quiet and regular, and the only abnormality was a to and fro murmur over the area of the heart's dulness. After the subcutaneous injection of a large dose of morphia the pain abated. Later in the morning the pain had entirely gone, and the friction murmur had nearly disappeared, and in a couple of days had entirely disappeared. Since then (three years ago) the patient has had no recurrence. The last two cases presented somewhat similar phenomena; one of them only I will detail.

Case of Pericarditis with marked sensory disorders.—Male, aged 23, thin and meagre, had been under my care occasionally for nine months, chiefly on account of obscure abdominal symptoms (pain and diarrhœa). I had kept him under observation chiefly on account of marked pulsation in the veins of the neck and sometimes in those of the chest wall. The venous pulse was of the auricular type, *i.e.*, the main wave of the pulse was due to the auricular systole. There was also a marked extension of the heart's dulness to the right of the middle line for two inches. He had occasional attacks of violent palpitation in the night. On the 18th March, 1893, he left his work at eleven in the morning, feeling tired and exhausted. On the 21st he was seized with a pain of great severity in the chest, with difficulty in breathing. I saw him on that day and found him sitting up in bed, holding his body very rigid and breathing with evident difficulty, and on his face an expression indicative of great suffering. The pain struck from the præcordial region round to the left shoulder blade (so that he could not lift his left arm) and down the inside of the left arm and ulnar part of the forearm to the little finger. Any movement of the body caused pain, and he was too terrified to take a deep breath. There was extreme tenderness of the skin and sub-cutaneous tissues over the whole front of the chest as far out on both sides as the nipple line. Over the 3rd left costal

cartilage and adjacent portion of the rib, this tenderness to pressure was excessively acute. Careful note was made that the tenderness referred entirely to the tissues in the external body wall, and that the method to elicit this tenderness did not affect the heart substance. The pectoral muscles, and the structures forming the anterior and posterior walls of both axilla were also very tender. There was also slight tenderness to pressure of the left sternomastoid and trapezius muscles, one point over the trapezius immediately above the middle of the scapular spine being especially tender. The muscles over the back of the scapula were also very tender. On auscultation over the heart, a loud to and fro friction murmur could be heard over the whole heart. There was no murmur accompanying the heart sounds. The pulse was quick, small and regular, 110 per minute. The temperature was 103° F.

For three days these symptoms remained practically unaltered, the pain only yielding to large doses of opium. During the time he was so ill I asked two of my colleagues to visit him, who verified the diagnosis and the above description of the symptoms.

(In view of the resemblance of the symptoms in these cases to those of angina pectoris associated with disease of the myocardium, the suggestion has occurred to me that it is possible that the pain, even of pericarditis, may be due to the invasion of the muscular tissue of the heart by the inflammation).

In pleurisy similar phenomena are sometimes met with. Thus in a case recently under observation, the onset of well-marked dry pleurisy gave rise to no pain whatever. The friction was at first limited to the right base, and attention was only directed to the condition by a sudden rise in temperature. The friction extended after a couple of days round to the front, and could be heard over the lower third of the chest wall; at the same time symptoms of pain and tenderness on pressure were developed. There was no cutaneous hyperæsthesia, and the tenderness was well-marked on percussing the chest. This tenderness extended higher than the friction sounds, and it is quite possible that the pleurisy extended over a greater area than that over which the friction was heard. There was no tenderness, however, of the chest wall behind the posterior axillary line, although the friction sounds were heard over this area in

the lower part of the chest. But the interesting point in this case was the tenderness of the muscles forming the anterior and posterior walls of the right axilla. Thus, on gently grasping the skin no increased sensation was produced, but on grasping as gently the muscles, then the patient winced from the severity of the pain. On the other hand, no symptom of pain was elicited on applying the same test on the left side. Without entering minutely into the particular nerves here manifesting this abnormal sensitiveness of the axillary walls, it may be pointed out that none of them came within the region of the inflamed pleura.

Hilton has remarked upon the sensitiveness of the skin in pleurisy, and evidently considers it as due to reflex stimulation of the nerve root, comparing it to the pain felt on the inner side of the knee, in disease of the hip joint. In fact, Hilton bases an elaborate argument upon the intimate association of the nerves supplying a joint, the muscles acting upon the joint and the skin covering the muscles, and looks upon the great serous cavities as being analogous to the joints of the extremities. I have frequently observed well-marked hyperæsthesia in cases of pleurisy, and that in a situation that could not be explained by the pleurisy affecting the branch of a nerve and so producing the hyperæsthesia.

Case of Basal Pleurisy with abdominal Hyperæsthesia.—Female, aged 31, complains of pain in her left side, especially on taking a deep breath. The patient is thin, but fairly nourished. She lies in bed slightly propped up. The temperature is 100° F. The respirations are quick (32 per minute) and shallow, and each respiration is suddenly checked. The pulse is 104 per minute, small and regular. There is great pain and soreness in the left hypochondrium. An area of hyperæsthesia can be readily mapped out, extending as a band from near the middle line in front round the left side of the abdomen to the spinal column. The breadth of the band is about three inches. In the front the umbilicus is situated opposite the middle of the band, and at the sides it crosses the tips of the floating ribs, and terminates behind opposite the 12th dorsal and 1st lumbar vertebræ. The edges of the band are not well defined. The chest is resonant on percussion, and on auscultation the only abnormality is a small

area over which friction is very distinct at the base of the left lung behind. These symptoms persisted for a couple of days, then disappeared together, that is to say, on the third day the temperature was normal, the respirations quiet and free from pain, the hyper-æsthesia was gone, and no friction could be detected.

I have, in a great number of cases of pneumonia, found a patch of hyperæsthesia over the area in the abdomen where pain is so frequently complained of in such patients. This abdominal pain of pneumonia is a well-known symptom, but its association with hyperæsthesia has not been sufficiently recognised, although Valsalva mentions it in a case quoted by Morgagni.¹ I have rarely found it quite so extensive as in the above case, and I have always viewed it as being associated with diaphragmatic pleurisy, a view that finds support in the symptoms of such cases as the one just recorded.

A shoulder pain associated with disease of the abdominal organs has long been recognised, and has been the object of particular study by Peter,² who associated it with the phrenic nerve, irritation being conveyed by this nerve to the roots of the cervical nerves, and the pain referred to their cutaneous distribution—a view that receives the support of Ross. In several cases of basal pneumonia and of pleurisy limited to the lower margin of the lungs I have found not only this shoulder pain, but also a distinct field of hyperæsthesia on the shoulder. In such cases I have attributed the shoulder pain and hyperæsthesia to the accompanying diaphragmatic pleurisy (although it may be due to the vagus terminations being involved by the inflammation of the lung). It is difficult to account for these phenomena satisfactorily. Hilton describes the parietal pleura as being supplied by intercostal nerves. If so, they must be very scant. Some years ago I made a careful dissection of several intercostal nerves, first following the trunk of the nerve and

¹ Morgagni, H., "De sedibus et causis morborum," book ii., letter xx., article 30.

² Peter M., "Néuralgie diaphragmatique," &c. *Archives Générale de Médecine*, June 17, 1871.

tracing each twig to its destination, but I could not find a single filament going to the pleura.

If the suggestion be found tenable that the far-reaching pain and hyperæsthesia accompanying pericarditis is due to an extension of the inflammation to the myocardium, then the abdominal and shoulder pains of basal pleurisy may in like manner be due to an invasion of the muscular tissue of the diaphragm by the inflammation.

Of the sensory phenomena associated with disease of the peritoneum I have very little experience, and I am unable to give any definite results. I may say that since I recognised the hyperæsthesia associated with diseases of definite organs, I have had fewer cases of "peritonitis"—for sometimes the hyperæsthesia in, say, a case of pyelitis with retention of pus, gives rise to symptoms resembling the descriptions of extreme tenderness of the abdomen in cases of peritonitis.

When, however, the various sensory disorders associated with the diseases of the serous membranes are considered, there is some difficulty in getting a clear conception of how they are produced. At all events, the statement that "affections of the serous cavities of the body do not cause referred pain or cutaneous tenderness, but produce local pain which follows the lines of peripheral nerves, and is associated with deep tenderness over the affected point only" (Head) is not sufficient explanation for the conditions present in such cases as I have quoted above.

If this view of the absence of pain in the viscera be substantiated, it would lead one to surmise that the great organ of sensation, the skin, is altogether a later development in animal life, having for its function the protection of these viscera necessary to the maintenance of organic life. The sympathetic nerves would therefore have functions apart, and distinct from those of the spinal nerves. This independence of the sympathetic nervous system has received a very elaborate exposition by Davey.¹ Support

¹ Davey, J. G., "The Ganglionic Nervous System," London, 1858.

for this conjecture is found in the recent observations of Paterson,¹ who maintains that the sympathetic nervous system is developed independently in the mesoblast, and does not arise as an outgrowth from the cerebro-spinal system. The elaboration of this view necessarily leads to the discussion of matters pertaining to morphology and development—subjects which I am not qualified to discuss.

IV.—The relationship between the Areas of Cutaneous Hyperæsthesia associated with Visceral Disease, and the Areas of Cutaneous Distribution of Spinal Nerves.

In my earlier observations I had come to the conclusion that when there was a limited field of hyperæsthesia in any given case of visceral disease, it occupied a situation in some part of the cutaneous field of distribution of a spinal nerve, whose root was in intimate association with the root of the sympathetic nerves that supplied the affected organ. When the hyperæsthesia became more extensive, it spread in a somewhat diffuse manner into fields occupied by spinal nerves, whose roots are in close relation with the one originally affected. While, therefore, there was a continuity in the skin area affected, that continuity always occurred in a definite direction, namely, in accordance with the distribution of the spinal nerves whose roots are in close association. Thus, the hyperæsthesia in heart affections beginning in the 4th dorsal nerve distribution might spread up the chest, but instead of passing over the clavicle into the field of supply of the 4th cervical it passes down the arm along the fields of supply of the 3rd and 2nd dorsal. In spreading thus it did not necessarily affect the whole area of supply of one nerve root. Thus, one portion of the field of supply of the 4th dorsal nerve might be hyperæsthetic. As this area increased in size, it did not first spread over the whole field of supply of the 4th nerve, then invade the field of supply of the 3rd. Occasionally it might do so, but more frequently if the area was limited, as it usually is, to the anterior surface of the chest ;

¹ Paterson, A. M., "Development of the Sympathetic Nervous System in Mammals," *Philosop. Trans.*, 1890.

this area would extend into the armpit and down the arm without involving the posterior surface of the chest. There does not appear to be any law regulating this spreading. Thus, in four cases of gastric ulcer at present under observation, in all of whom there has been lately vomiting of blood, an examination shortly after the hæmatemesis revealed the following conditions relating to the sensory symptoms. In two there are absolutely no sensory symptoms. In one there is well-marked hyperæsthesia in the epigastrium shading off into a less definite field of hyperæsthesia that extends from the level of the umbilicus round to the left to the spinal column, and up over the thorax and down the inside of the left arm, and the ulnar half of the forearm to the little finger. In the fourth case the hyperæsthesia occupies the front of the abdomen, reaching on both sides as low as the groin, with a tongue-like projection into the front of the thighs, similar to that Head maps out as being characteristic of the distribution of the 12th dorsal nerve. On the right the hyperæsthesia reaches as high as the umbilicus, and on the left as high as the ensiform cartilage. It does not extend backwards on either side beyond the anterior axillary line. In this latter case there is remarkable extension of the area in which the uppermost epigastric reflex can be produced. In many persons the reflex contractions of the rectus abdominis muscle above the epigastrium can be observed to occur in three divisions corresponding doubtless to the divisions produced by the tendinous intersections. In this patient stimulation of the skin as high as the nipple frequently (and sometimes even the skin in the axilla) will provoke a contraction of the upper portion of the rectus on the left side. The skin here is not hyperæsthetic in the slightest degree.

V.—Overlapping of Sensory Fields.

In very few of the cases could the field of hyperæsthesia be delimited with certainty. Parts at the border would be hyperæsthetic at one time, and when one would return there would be some doubt, or a distinct assertion that the part was not hyperæsthetic. In the centre of any limited area the hyperæsthesia was more acute. Under these circum-

stances I did not think that the hyperæsthesia associated with visceral disease afforded a sufficiently accurate clue to the delimitation of the areas supplied by individual nerves, and I looked upon this variation in the intensity of the hyperæsthesia as being due to an over-lapping in the distribution of neighbouring nerves. This view was strengthened by the fact that I had seen evidence of a slight extension of the hyperæsthesia into fields supplied by nerves whose roots were not in neighbouring association. I considered also that I had obtained evidence of this overlapping from the study of the eruption in cases of herpes zoster.¹ When Dr. Head published his extremely exact delimitation of the fields, I imagined that I had not been sufficiently accurate in delimiting my fields. I therefore made another series of careful observations, and although in a few cases I appeared to get results that partly supported his views, I must confess to having utterly failed in the great majority of cases. Even in the study of a few cases of herpes zoster I could not get them to fit into any one of his fields. To demonstrate these several points I will quote the following three cases that merit publication for other reasons.

Case of Herpes Zoster without eruption.—Male, aged 53, complains of pain on the top of the right shoulder extending down the arm to the thumb. The pain began about three weeks ago, and has continued ever since. Sometimes it comes on in severe paroxysms, accompanied by a disagreeable smarting sensation. He can scarcely bear his clothes to touch his shoulder, and he can't wear his braces over the right shoulder because of the pain it causes. The paroxysms of pain have prevented him sleeping of late, and in consequence he is getting tired and weak. The patient is a big, stout man of healthy appearance. When stripped there is nothing abnormal to be observed in the skin of the right shoulder or arm. On testing the sensation, the skin on the top of the shoulder is markedly hyperæsthetic. The hyperæsthesia occupies a very characteristic situation, which can be easily mapped out, as it is so acute the patient has no hesitation in noting when the stimulation passes from the healthy skin to the abnormally sensitive. It begins abruptly in the neck about the level of the 3rd cer-

¹ Mackenzie, J., "Herpes Zoster and the Limb Plexuses of Nerves," *Journal of Pathology and Bacteriology*, vol. i., p. 332.

vical vertebra, and extends round the neck at that level to the middle line in front. It extends from hence over the top of the shoulder down the outer surface of the arm, and radial half of the forearm to the thumb. The posterior border of this area extends from the 3rd to the 6th cervical vertebra, then slants outwards at the level of the spine of the scapula to the posterior surface of the shoulder, then down the back of the arm past the side of the olecranon into the forearm to the thumb. The anterior border descends in the middle line to the level of the clavicle where it slants slightly outwards to the level of the third rib. It then runs transversely out to the front of the shoulder, where it descends in the front of the arm and forearm to the thumb (fig. 1). This area, although so distinct, does not evince the hyperæsthesia with equal intensity in all parts. Thus in testing round the arm, when passing from the healthy skin, the hyperæsthesia at the borders is not

FIG. 1.

so acute as towards the centre of the affected area. The under surface of the thumb is slightly anæsthetic. The same results are obtained on testing by heat.

Careful enquiry was made into the condition of all the other organs, but with the exception of a slightly furred and fissured tongue no abnormality could be detected.

The patient called to see me at intervals of five or six days, and each time I mapped out the hyperæsthesia, the results always being practically the same. In a month from the date of his first visit the hyperæsthesia had gone, and with it to a great extent the pain. For several weeks later the pain used to recur in slight paroxysms.

I have assumed this case to be one of herpes zoster, although in the strictest sense it has no right to the term herpes or zoster. But that it is essentially the same disease I have little doubt. The description of the pain—the

paroxysms, its wearing character preventing sleep, and its duration are exactly the symptoms described by patients who suffer from herpes. Although I have never read of any account of herpes zoster without an eruption, I think that it may not be so very rare. Some years ago I saw in consultation a patient said to be suffering from some painful disease of the spine. In her there was a distinct area of hyperæsthesia following the distribution of the 4th dorsal nerve. The pains were characteristic, and located chiefly within the hyperæsthetic area, but radiating into the arm. I detected on the back two small vesicles, and on the strength of this, suggested the diagnosis of herpes zoster. The medical man in charge attributed the blisters to his applications, but on enquiry they were not such as would give rise to vesication. The future progress fully confirmed this view of the case. Lately I had a patient with severe pain in her side, and a distinct band of hyperæsthesia embracing one half of the body. I was a few days in doubt what might be the nature of the complaint until it was disclosed by the appearance of a few vesicles in the epigastrium, the remainder of the hyperæsthetic field remaining quite free. Dr. Head has likewise noted similar cases, and von Bärensprung,¹ has described the intervals of skin between the eruption as being hyperæsthetic. So that it would appear that an eruption is not a necessary symptom in herpes zoster.

On the question of differential diagnosis the only alternatives that occur to me, are that this case was an irritation of nerve roots due either to disease of the vertebræ or to some visceral lesion. That it was not due to a disease of the bones is evident from the progress of the case. There was never any spinal tenderness. I made, as I have said, enquiry into the condition of all the other organs in the head, throat, thorax, and abdomen, but could find no clue. The vagus and phrenic roots being in association with the cervical nerves led me to make careful examination of the organs supplied by them, but the quest was vain.

For these reasons I consider the case as being due to an

¹ Von Bärensprung "Die Gürtelkrankheit," *Annalen des Charité-Krankenhauses*, Band ix., Heft. 2, 1861, p. 103.

affection of the roots of the 3rd, 4th, 5th, and 6th cervical nerves, and to be of the same nature as that which gives rise to the disease known as herpes zoster. And the case illustrates in a very definite manner the cutaneous area supplied by these nerves. The relations of this area to neighbouring areas are of considerable importance, and will be referred to later.

Herpes Zoster of the 3rd dorsal nerve with Hyperæsthesia.—Female, aged 13, has been under my care for over a twelve-month for mitral disease, with symptoms of cardiac failure. On the 10th August, 1893, I was consulted because of an eruption that had broken out on the right chest. There was very little pain except on the inner side of the right upper arm. The eruption consisted of clusters of vesicles disposed as an interrupted band round the upper part of the chest and down the inside of the forearm. In front the clusters were continuous at their borders and represented a band about two inches broad. The most internal portion was situated over the sternum opposite the 4th costal cartilage. A few vesicles trespassed across the middle line for quarter an inch. From here the band extended outward and slightly upward, crossing over the 3rd rib to the front of the shoulder. A few scattered vesicles extended as high as the 2nd rib, and as low as the nipple—some being situated on the nipple. Behind the eruption extended as a somewhat broader band from near the spinal column, the centre being opposite the 2nd dorsal vertebra, outward and slightly downward over the scapular spine to the posterior axillary fold. On the right arm the eruption occupied the inner surface, two streaks occurring on the anterior and posterior axillary folds, and other two streaks occupying the anterior and posterior surfaces of the inner aspect about the lower third of the upper arm. Surrounding the area of eruption was a wide field of hyperæsthesia. In front it was as high as the second rib and crossed the middle line for at least one inch. Behind it ascended as high as the level of the 7th cervical vertebra and also crossed the middle line for a very short distance. It descended the side of the chest in an irregular manner as low as the 10th rib. It also descended the arm embracing the area of eruption. The interrupted line in fig. 2 shows the hyperæsthetic area.

The hyperæsthesia in this case extends somewhat diffusely, yet in a definite manner. The irritation from the diseased root that produces the eruption spreads to neighbouring nerve roots. But in doing so it evidently does not necessarily affect

the whole of one root before it passes to the next. Just as was pointed out in relation to the hyperæsthesia associated with visceral disease, contiguous fields are affected, without of necessity the whole area of supply of individual nerve roots being affected. The extension of the hyperæsthesia likewise takes place in a definite direction, not passing for instance over the clavicles into the field of supply of a distant nerve root, but descending on the arm.

A comparison of these two cases also shows a distinct overlapping of nerves. While it is difficult to prove this overlapping by the study of areas supplied by neighbouring roots, the opportunity is readily afforded when contiguous areas of skin are supplied by nerves whose roots are wide apart.

FIG. 2.

The interrupted line embraces the hyperæsthetic area.

Thus the skin of the upper part of the chest is supplied by the 4th cervical that descends over the clavicle as far as the 3rd rib in fig. 1, while the area supplied by the upper dorsal nerves ascends as high as the 2nd rib, as in fig. 2. This overlapping can also be seen at the back in these figures. This same spreading of the nerve supply of one field into that of another is also demonstrable in the crossing of the hyperæsthesia to the opposite side in fig. 2. The eruption has also crossed for a very short distance, and this was more unmistakably demonstrated in fig. 3.

I have been unable to find in my cases of herpes that accuracy of delimitation that Dr. Head describes. If the eruption in fig. 2 be studied, it will be found to occupy a fairly distinct field. The bands on the front and the back of the chest represent a fairly distinct continuity. But they

will be found to correspond to none of the single areas described by Dr. Head. As a matter of fact, the eruption trespassed into the areas that he reserves for the 1st, 2nd, 3rd, 4th, and even 5th dorsal nerves. Yet the continuity of the eruption suggests to me very strongly the idea, that there is but one nerve root affected here—in all probability the 3rd. In fact, I look upon it as being a more complete delimitation of the same field that his case 14, fig. 13, imperfectly represents. This is, I think, strikingly evident in the posterior band, where it cuts by a straight band the wavy contours that he depicts. In making my notes of this case I carefully copied the outlines of Dr. Head's fig. 13, in order that the comparison might be as true as possible. These copies made by me were repeatedly verified.

As a further illustration of the disagreement of my observations with those of Dr. Head in this exact delimitation of the field of supply by individual nerve roots, I give the notes of another case of herpes zoster under the care of my friend Dr. Harwood, to whom I am indebted for the opportunity of seeing the case, and for his kindness in verifying the particulars.

Dr. Head describes the lower border of the field of supply of the 12th dorsal nerve as sending two tongue-like projections down, one on the front of the thigh, and the other over the side of the haunch. These depressions dovetail into the field of distribution of the first lumbar. In a few cases I have certainly found the area of hyperæsthesia associated with disease of certain organs assume this shape. But that it represents the exact limits of the 12th nerve only is not supported by the symptoms in the following case.

Case of Herpes Zoster of first lumbar nerve.—Female, aged 50, suffers from attacks of excruciating pain round the right hip, where an eruption has broken out. The eruption extends from the vertebral column at the lower lumbar region round the right hip to the front and inner surface of the thigh in a band from four to five inches in breadth. Its superior border is extremely well defined, slanting in almost a straight line from the vertebral column at the level of the iliac crest, round the side of the ilium midway between the crest and great trochanter, to the front of the thigh

a couple of inches below Poupart's ligament, and almost parallel with it to the inner surface of the thigh. The lower border is not so clearly defined. It leaves the vertebral column at the level of the upper part of the sacrum, passes round over the ilium, and on the front of the thigh it is more irregular, sending scattered patches as low as the lower third of the thigh. The eruption distinctly crosses the middle line behind for at least the distance of one inch (fig. 3).

FIG. 3.

Here we have an eruption pursuing a fairly defined course, the upper limits of which slant in almost a straight line from the vertebral column to the inner surface of the thigh. Even if one assumes that part of the 12th dorsal root is involved in this case, it is surely too much to expect that the disease has picked out the portions of the roots affected, whose cutaneous distribution exactly fills up the gaps formed by the irregular outline of the 1st lumbar. Here again, there is undoubted crossing of the eruption to the left of the middle line, a further proof of the overlapping of the nerves.

From the study of cases of herpes zoster, and of the hyperæsthetic areas associated with visceral disease, I have come to the conclusion that there is distinct overlapping of the fields of cutaneous supply of individual nerve roots, of pathic, thermic, and trophic fibres, as well as of those of ordinary sensation. In this respect the results are in harmony with those arrived at by Sherrington from observation of isolated areas producing reflex contraction, with those obtained by Paterson from dissection of fibres from individual nerve roots, and with the observations of Langley on the pilomotor nerves.

VI.—*Other Reflex Phenomena in Visceral Disease.*

Besides the symptoms elicited from stimulation of the sensory nerve roots, a great number of other phenomena may arise from the stimulation affecting roots of nerves with different functions. If we consider that a stimulation arises in an organ and is transmitted by afferent nerves to a more central situation, and if this stimulation be of sufficient force or of the proper quality to affect certain nerve roots with which it comes in contact, then, according to the function of the nerve root, there will arise phenomena peculiar to the organ stimulated. Thus, if it be a sensory nerve root, there will be an exaltation of its function, giving rise to exaggeration of its peculiar property, or, it may be, causing a lowering of its functional activity, as when anæsthesia occurs. If the nerve root so stimulated be motor in function, then there may arise spasmodic contraction, or even loss of power in definite muscle groups, slowing of the beat or palpitation in the case of the heart. If the nerve root be secretory in function, there may arise an increased activity of the gland whose root is stimulated. In one remarkable case of angina pectoris I had under observation, the attack used to radiate characteristically from the chest to the left arm, and up into the neck. At the same time there used to be a striking and excessive discharge of saliva from the left side of the mouth. In another case of angina pectoris with aortic aneurism, where the pain was wont to radiate down the inside of the left arm, in this area, after a series of attacks, there was gradually developed a streak of ecchymosis, six inches in length. No cause could be assigned for its appearance, and I assumed it to be an affection of the trophic fibres. Hilton refers to certain trophic changes in the skin from disease of the teeth, and I have seen a case of ulceration of the abdominal skin after an attack of gall-stone colic, but as mustard had been used locally, I could not satisfy myself that it might not have something to do with the ulceration. Did we comprehend fully the manner in which this stimulation arising in a diseased organ spreads, we might be able more clearly to understand the meaning of many obscure cases of perverted functional activity of the various organs in the body.

VII.—Effects of Stimulation of the Skin upon the Viscera.

A certain amount of light is thrown upon the subject of the relationship between the cutaneous and the visceral innervation by the study of the effects of stimulation of the skin upon the viscera. The subject from this aspect is akin to that of the cutaneous reflexes, and doubtless lies at the foundation of the effects of treatment by counter-irritation, &c. There are certain well-known effects produced in the viscera by stimulation of the skin, and these are frequently taken advantage of in practice, *e.g.*, the counter-irritation in the pit of the stomach to allay vomiting, and the application of cold to the abdomen to cause firm uterine contraction. A very interesting light is occasionally shed upon this subject by the results of operations, as in the fact that after operations involving the skin of the perineum (for hæmorrhoids and for repair of torn perineum), not unfrequently retention of urine follows. Hilton had noticed that soothing applications to the perineum were beneficial in certain forms of retention of urine. Berry Hart¹ has recently noted a very striking instance of this relation between perineal skin and the muscles involved in the urinary reflex. Remarking the frequency with which retention of urine followed operations on the perineum, he determined to avoid the skin in his sutures. In a series of cases in which this plan was carried out the result was eminently satisfactory, as retention of urine no longer occurred.

The interest from the point of view with which I am dealing here is, that evidently the sacral nerves supplying the perineum are in association with the muscles of the bladder, and not of the mucous membrane alone as Head inclines to suggest.

VIII.—Practical value of recognising the Sensory Symptoms produced by Visceral Disease.

Treating the subject in this somewhat desultory fashion, it is difficult to convey properly the help that is afforded by enquiring carefully into these sensory symptoms in one's every

¹ Hart, D. B., "Perineal suture in relation to retention of urine after labour," *Edinburgh Hospital Reports*, vol. i., p. 587.

day work. I might be permitted to single out a few instances for the purpose of illustrating the value of those symptoms.

I have elsewhere called attention to the particular value of the seat of pain in intestinal obstruction. I do not see a sufficient number of cases to enable me to speak dogmatically on the subject, but in those I have observed, the results have been as striking as they were instructive. The pain in any given case of obstruction is due to the peristalsis of the bowel above the part obstructed. If, then, the pain is situated about the umbilicus, radiating more or less to one side, never descending lower, then one can infer that the point of obstruction is above the great intestine. If, however, the pain be felt as low as midway between the umbilicus and symphysis pubis, then some portion of the great gut is above the point of obstruction. In the latter cases the pain may arise in the umbilical (or even epigastric area) and gradually descend. It is necessary to see the patient when the painful peristalsis is upon him and to enquire carefully of him during the pain, as otherwise the information is too vague to be of service.

The observations that these hints are based upon, are from a dozen cases of hernia of the small intestines, and half-a-dozen cases of obstruction in some portion of the great intestine. The diagnosis was verified either by operation or *post-mortem* examination. These are certainly far too few observations to base an absolute statement upon, but they are of value as suggesting a help in the elucidation of a notoriously difficult point of diagnosis.

The sensory phenomena due to visceral disease may mislead very skilled observers. During my earlier observations on this subject I was called in consultation to see a man in failing health, in whom there was great pain round the left half of the body. There were remarkably few symptoms, besides the pain, and I found a hyperæsthetic area extending from the epigastrium round the left half of the body to the 6th and 7th dorsal vertebræ, which were extremely tender to pressure. I was puzzled with the case, and could only suggest that there was something wrong with the stomach. The patient receiving no benefit from my suggestions, consulted a skilled and deservedly eminent neurologist,

who, on the strength of the tender vertebræ and hyperæsthesia, diagnosed disease of the vertebræ, and recommended the encasing of the patient in a plaster of Paris jacket. This was done, with no relief. In course of time the patient died, and his medical attendant wrote me saying that he had had a *post-mortem* examination, and there was cancerous disease of the posterior wall of the stomach at the cardiac end, and the vertebral column appeared perfectly sound.

The following case illustrates how misleading the sensory phenomena may be in another way. I was called, in consultation, to see a young lady whom her medical attendant informed me was suffering from peritonitis. A year previous, while at a fashionable health resort, she was laid up for four months with peritonitis. The appearance of the patient was typical of that disease, the drawn face, the small quick pulse, and the flexed knees and high temperature. She shrank whenever we ventured to touch the abdomen. Accepting the case as one of peritonitis, in seeking a cause, I proceeded to palpate the region of the vermiform appendix. But the patient would not let me touch the skin, it was so painful. Testing with a pin-head, I found the skin in this region acutely hyperæsthetic, and I was able to map out an area roughly corresponding to the distribution of the 11th and 12th dorsal nerves on the right side. On careful exploration I found that the other regions of the abdomen were not really tender, her desire to protect herself from pain making her frightened of being touched anywhere. On enquiry into the state of the urine, I was informed it was all right, but on examination there was a small quantity of pus. On careful cross-questioning, a distinct history of severe spasms, prior to the last illness, was elicited. I therefore gave the provisional diagnosis of pyelitis. In a couple of days there was an abundant discharge of pus in the urine, the hyperæsthesia disappeared, the temperature fell, and the patient made a quick recovery from her anxious condition.

IX.—*The Sensibility of the Subcutaneous Tissues.*

A knowledge of the sensibility of the subcutaneous tissues of the external body wall would be of great value. Are the pains of tissues lying under the skin referred or local? It seems almost absurd to ask the question, yet there are a number of very curious facts elicited when the subject is enquired into—as the well-known pain at the knee from in-

flammation of the hip-joint, and the hyperæsthesia of the skin associated with joint disease. That the subcutaneous tissues can become acutely sensitive, has already been illustrated, and the occurrence of afferent nerve fibres in muscles has recently been put beyond doubt by the investigations of Sherrington. But when one comes to examine the matter it is very difficult to obtain satisfactory results. I have been in the habit for a long time of performing operations (after rendering the skin anæsthetic) without eliciting the slightest symptom of pain. Lately a number of hernias has been operated upon in the Victoria Hospital without an anæsthetic, and after the skin was cut no pain whatever was elicited. The last one, however, on which I operated, did not yield such conclusive results. In this case, when dissecting the tissues overlying the hernia, the patient occasionally called out. On testing the portion of tissue, the cutting of which had caused pain, I never could reproduce the sensation. After the hernia was reduced, I brought the deep parts together by a series of catgut sutures, until all the tissues, save the skin, were approximated. In such cases I do not suture the skin, but hold the edges together, and paint the line of incision with celloidin solution. This dries quickly and brings the skin edges firmly together. In this manner the whole of the tissues, from peritoneum to subcutaneous fat were systematically stitched, and there was not the slightest pain evoked.

In many ways the knowledge that subcutaneous tissues are practically insensitive to stitching is of great practical value. Thus in recent ruptures of the perineum, the torn surfaces can be brought at once accurately together, with practically no suffering on the part of the patient by avoiding the skin in suturing. When skin sutures are employed, the suffering is frequently so great that the perineum cannot be satisfactorily stitched without an anæsthetic.

These facts were matters of common knowledge in pre-chloroform days, and many surgeons of to-day are no doubt cognisant of them. In conversation with an aged surgeon, who had seen much practice before chloroform was introduced, he informed me that it was always understood that after the skin was cut no pain was suffered during an operation, unless occasionally when a nerve was cut.