THE BRADSHAW LECTURE ON THE INFLUENCE OF THE SYMPATHETIC ON DISEASE.

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By EDWARD LONG FOX, M.D., F.R.C.P.,
Consulting Physician to the Bristol Royal Infirmary.

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DOES the study of hemicrania show definite abnormality of the sympathetic? The peculiarity of pain referred to only one side of the head is associated with very opposite vascular conditions.

1. In tonic or spastic hemicrania, the prevailing phenomenon is tetanus of the muscular coat of the arteries on the affected side of the head, in the region supplied from the cervical portion of the sympathetic nerve. That this is the condition of the vessels is shown by the hard cord-like temporal artery, the pale and sunken face, the small eye, the diminished temperature. The pupil is dilated during the height of the attack from increase in the tonic excitation of the dilator fibres, which arise from the cilio-spinal centre, and follow the course of the cervical sympathetic. The extreme action of these fibres overcomes abnormally the contracting power on the iris of the oculo-motor nerve. The subsequent contraction depends on a secondary diminution in innervation, akin to fatigue, corresponding to the condition of the vaso-motor fibres. Thus too, towards the end of the attack, the ear becomes red and warm, and the conjunctiva, from relaxation of its vessels following the tonic spasm, becomes injected. Increase of saliva, with a certain tenacity of this secretion, is met with in this form. Eulenberg and Guttmann consider that the pain is caused by tonic spasm of the unstripped muscles of the vessels (as in cramp and colic); that is, from pressure on nerves of sensation distributed within the muscular tissue. But it is not quite certain which branches of the fifth nerve are affected by the pain. Some localise the pain in the frontal branches, but it is more probable that the branches implicated are those which supply the dura mater, coming from all three divisions of the fifth nerve.

2. The other form, hemicrania neuro- or angio-paralytica, is characterised by relaxation of vessels, arterial hyperæmia, and increase of temperature on the affected side. The state of this side of the head and face is not unlike that of an animal, in which the cervical sympathetic has been cut. But the explanation of the pain in this variety is not straightforward. It is said to be due to irritation or compression of the nerve-elements by the temporary increase of the blood-pressure, and the greater quantity of blood in the small arteries and veins. But pain is not usually felt from congestion, at least pain of the acute intensity of hemicrania. And although in the later stages of the spastic form, when the vascular spasm gives place to dilatation, the paretic congestiveness does not perhaps equal the marked hyperæmia of hemicrania angio-paralytica, yet it is remarkable that in these latter stages of the spastic form the pain diminishes *pari passu* with the spasm, whilst, in fact, the vessels are getting more or less into the same condition that is said to cause the pain in the paralytic form. The symptoms, however, of each form of this affection, especially the oculo-pupillary phenomena, point to the cervical sympathetic, or to the corresponding half of the cilio-spinal region of the cord as the part specially implicated. And the success of caffeine, quinine, guarana, and ergot in the paralytic variety, and of nitrite of amyl, carbonic acid inhalation, hot drinks, etc., in the spastic, points to the same conclusion.

The frequent occurrence of nausea, vomiting, muscæ, tinnitus, and foul taste, are all points directly or indirectly associated with the sympathetic; and not only is tenderness met with on pressure over the last cervical and fourth dorsal vertebra, but deep pressure over the cervical ganglia excites pain. Dr. Latham's dictum is good for the spastic form, that the disease is characterised by a morbid activity of the sympathetic nerve, in consequence of a defective control or inhibition by an exhausted or enfeebled cerebro-spinal system. In hemicrania alternans, where the patient is affected sometimes by one form, sometimes by the other, the law of paretic fatigue following inordinate action

may afford the explanation of the paralytic form. In other cases, this paralytic form must owe its causation to depressing influences affecting the whole system, and especially the nervous centres, such influences being particularly those of climate, of mental strain, or of venereal excess.

Proceeding in the region of the cervical sympathetic, exophthalmic goitre comes next in order. Certain coarse lesions have been found in the cervical sympathetic with this group of symptoms. Eulenberg and Guttmann have collected nine such cases. The inferior ganglion is most frequently affected. In Dr. Warner's case, there were lesions of the sympathetic on one side of the head. The right side of the face was flushed up to the middle line, the right pupil dilated, the right iris much darker in colour of late years than the left. The thyroid normal. In a case quoted by Woods, the lower cervical ganglia, especially the right, were thicker and redder than normal. There was increase of connective tissue, growth of nuclei, and of spindle-shaped cells; ganglion-cells were few. In Dr. Shingleton Smith's case, there was marked shrinking of the cells of the inferior cervical ganglia. In one case, mentioned at the Congress by Dr. Gueneau de Mussy, there was decided pigmentation of the face, due to defect of innervation, caused by the enlargement of thoracic glands about the bronchi and trachea, in the immediate vicinity of the vagus, giving rise to irritation of the vagus.

Seeligmüller mentions a smith in whom, eight days after a severe blow above the clavicle, dilatation of the pupil and of the palpebral chink, exophthalmos, pallor, diminution of temperature, and flattening of the left cheek occurred, depending on clonic narrowing of the arteries. Other observers have noticed induration and hypertrophy of connective tissue, chiefly of the lower cervical ganglia, with pigmentation of cells. Perhaps the most consistent view has been expressed by Professor Möbius, when he says that exophthalmic goitre is not an independent disease, but is a group of symptoms, partly depending on local lesions of the medulla oblongata, or the cervical cord, or the sympathetic, but partly occurring more or less in the course of severe neuroses, such as hysteria and the various psychoses. But, whilst some of the phenomena point to lesion, direct or reflex, of the sympathetic, it is not possible to credit this system of nerves with the causation of all the symptoms.

The exophthalmos itself could only be associated with the sympathetic by means of a persistent tetanic contraction in the unstripped ocular muscles, and for this there is little physiological analogy. This protrusion of the eyeballs seems to depend on deposit of fat behind the eyeball, and on venous hyperæmia, even if some spasm of the unstripped orbital muscles co-operate in its production.

One symptom connected with the eye, first noticed by von Gräfe, is due to disturbed innervation of Müller's unstripped orbital muscles; an immobility of the upper lid, which no longer follows the movements of the eyeball, as in health. This interference with the consensus of the movements of the lid with that of the globe, especially when the latter is directed downwards, may precede the exophthalmos, and is not seen in protrusion of the eyeball from mechanical causes.

The two chief sympathetic symptoms, then, are the goitre and the accelerated action of the heart; and both these phenomena are connected with paresis of the sympathetic rather than with irritation. The goitre seems wholly caused by enlargement and dilatation of vessels in the thyroid. The arteries are tortuous and pulsating, and the veins engorged. The temperature of the part is somewhat higher than of other parts of the body. It is true that division of the cervical sympathetic is not followed by this swelling of the gland, but in exophthalmic goitre we have not only conditions answering to division of the sympathetic in the neck, but extreme acceleration of the heart's action as well.

The palpitation is more difficult of explanation. If it be due to irritation of the sympathetic, the irritation must be persistent, which is contrary to physiological experience. If due to paralysis, the usual effect would be syncope; because, the influence of the cardiac nerves being cut off, the inhibitory action of the vagus would suffice to antagonise the automatic energy of the cardiac ganglia. Eulenberg and Guttmann seek to explain it by allowing a paralysis of the cervical sympathetic, the first effect of which will be a vaso-motor dilatation of the cardiac vessels (the coronary arteries); and this dilatation, by permitting a greater flow of blood to the muscular tissue of the heart, stimulates the cardiac ganglia to abnormal activity. It seems strange, however, that a similar result does not always ensue, when the action of the cardiac nerves is cut off. What need, indeed, is there, under this theory, that syncope should ever take place? Dr. Handfield Jones, however, believes that the palpitation in exophthalmic goitre is due to paralysis of the vagus. The implication of the sympathetic is shown by the perspiration and diarrhoea so common in exophthalmic goitre, as well as in the occur-

rence of pigmentary disturbances, instances of which have been already given. Trousseau has seen vitiligo in connection with it, and Leube scleroderma.

The drawing now shown, by the kind permission of Dr. Burney Yeo, is that of a case in which, with profuse perspiration, and constantly recurring diarrhoea, the exophthalmos implicated the left eye only, whilst the right side of the thyroid was enlarged. This crossing of the symptoms seems to Dr. Yeo to prove the central origin of the lesion. But there is nothing improbable in a lesion of the inferior cervical ganglion of one side co-existing with lesion of the superior cervical ganglion of the other; nor, indeed, in an affection of the cilio-spinal centre on one side coinciding with that of the spinal vaso-motor centre on the other.

Nor is the subject of progressive hemiatrophia facialis less wanting in elements of controversy. Pierson speaks of the sympathetic being affected, as evidenced by the prominence of the eyeball, and dilatation of the palpebral fissure, diminution of temperature in the auditory meatus of the affected side, and atrophy of the affected ear. Most authors mention some change of colour in the skin, pale or brown patches on the face or on the neck, sometimes preceded by an eruption of an cedematous or herpetic character.

Neither paralysis nor irritation of vaso-motor nerves experimentally gives rise to simple progressive atrophy of all or most of the tissues. Romberg considers the disease a tropho-neurosis. Baerwinkel places its seat in the ganglia of the trigeminus. Stirling thinks it is due to disturbed function of vaso-motor nerves included in the trigeminus, and destined for the vessels of the head. Eulenberg and Guttman speak of slight atrophy of one side of the face, as observed in some cases of injury of the sympathetic in the neck; and they quote Brunner's case, in which more or less of the phenomenon of progressive facial hemiatrophy seemed to depend on persistent irritation of the cervical sympathetic. Dreschfeld agrees with Romberg. In his case the vessels were not affected; but this is not always found. Sometimes there are distinct changes in the vascular tone, not necessarily connected with the atrophy: the power to blush may be lost, and may be restored without any other improvement. Dr. Dreschfeld considers that in his case the atrophy was not due to any affection of the facial sympathetic, or of the motor or sensory portions of the fifth nerve, but that it is a tropho-neurosis, following the course of the fifth nerve.

Another theory, that of Laude, denies the disease to be a neurosis at all, but a primary atrophy of the fatty tissues, the elastic tissue remaining unaffected, its retraction causing the falling in of the other soft parts and the contraction of the capillaries, the latter leading to further disturbance of nutrition. Virchow says the exact seat of the disturbance lies within the domain of the peripheral nerves; that is, a primary inflammatory lesion of the throat and face escapes on to the nerves, and so to the ganglia.

That the symptoms are due to a neurosis is demonstrated by their association with headache, with paralysis, with irritation of the cervical sympathetic, or with epilepsy: neuroparalytic ophthalmia, neuralgia, and anæsthesia of the fifth nerve, often accompanying them. It may exist coincidentally with migraine.

The muscles take no share in the atrophy. The subcutaneous fat, the proper tissue-elements of the cutis, and even the epidermoid structure, take no part in the disease. The secretion of the sebaceous follicles is arrested; that of the sweat-glands persists, but is frequently diminished. The bones of the face, and even the nasal cartilages, share in the atrophy, and sometimes the tongue, the vault of the palate, the soft palate, and the uvula. The eye, if affected at all, shows lesions associated with intracranial disturbance of the fifth nerve, which may end in destruction of the organ.

In the very few recorded cases of definite recognisable lesion of the cervical sympathetic in this disease, there has been absence of oculo-pupillary phenomena. It seems certain, therefore, that all the branches of the nerve are not considerably implicated. Is not the connection between the cervical sympathetic and the phenomena of this disease less absolutely direct? The lesion may be one of the fifth nerve, whether of its sensory and trophic branches, of its trophic and vaso-motor, or sometimes of its vaso-motor, trophic, and sensory, all together. In some instances it may be a direct disease—that is, from blood-changes, from a depressed condition of cerebral centre, from definite lesion of the nerve itself. But, instability in the nerve or its ganglion being present, the phenomena may be set up from without; and here certain conditions affecting the cervical sympathetic may act in a reflex manner. No morbid state of the cervical sympathetic, moreover, could exist without some vaso-motor phenomena, some interference with the vascular tone of the facial vessels; and this would render the tropho-neurosis of the fifth more certain in its course. The position of the

sympathetic is important, often almost all important, but in most cases secondary, affording the centripetal irritation in a reflex arc.

The objections to any theory are manifold: not only that the absence of *post mortem* records leaves all theories unproven, but because the atrophic influence of this supposed morbid state of the fifth nerve is not in accordance with experiment.

The heart has been seen to have been affected in many of the diseases that have been considered. It is specially influenced by disease or disorder of the sympathetic. Palpitation, as we have seen in discussing Graves's disease, may be from irritation of the cardiac nerves, the inhibitory action of the vagus being unchanged, the palpitation being then intermittent and often associated with dilated pupil; or, the cardiac branches being normal, palpitation would result if the accessory branches of the vagus were paralysed, in which case the palpitation would be continuous. That either of these conditions may be induced by direct or reflex influence, is only in accordance with ordinary experience.

The action of the heart would go on for a time by means of the cardiac ganglia alone, if the influence both of the cardiac nerve and of the vagus were removed; but absolute palpitation would not ensue, unless the paralysis of the cardiac nerves had caused such dilatation of the coronary arteries as would increase considerably the amount of blood brought for the nutrition of the heart, and so stimulate exceedingly the cardiac ganglia. Palpitation from terror would be by means of paralysis of the cardiac branches of the vagus; palpitation from indigestion, or from a gouty condition of blood, would be by way of stimulation of the sympathetic cardiac nerves, or of the ganglia from which they proceed. The ganglia in the structure of the heart are the reflex centres through which the excitation of the blood reaches the muscular apparatus. In suspense, the action of the heart is short and sharp; in fear, almost paralysed; under excitement, usually intermittent.

The symptoms of angina pectoris are seen under very various pathological conditions. The most pathognomonic symptoms are substernal pain, the feeling of anxiety, the disturbance of the heart's action. The pain has its origin in the cardiac nerve-plexuses, and persists even if the vagus be divided; proving that the sympathetic cardiac nerves contain sensory fibres. The pain is looked upon as the most important phenomenon, and the group of symptoms stand out as neuralgia of the heart. But it is not always so. One meets with cases with a slow feeble pulse, some faintness, a feeling of anxiety, and a sense of impending dissolution, without pain, or at least without pain for a long time. In such cases, if not cured (and being sometimes reflex, with the heart's structure healthy, they may be cured), the attacks become more frequent and intense, and sooner or later pain will be added. The communication between the cardiac plexus and the anterior division of the four upper cervical and first dorsal nerves, explains the transmission of pain to the regions supplied by the cervical nerves. As the first dorsal nerve seems to form part of the lower end of the brachial plexus, and as there are freer anastomoses of nerves on the left side than on the right, the reason of the sense of pain down the left arm is apparent. This connection of the brachial plexus with other nerves will bear further investigation. I have lately met with a case in which pressure on any part of the left brachial plexus, even grasping the upper part of the left arm, caused violent eructation. The woman was accustomed to grasp her upper arm for this purpose when she felt oppressed with flatulence.

The conditions under which angina pectoris occurs may be said to follow an anatomical distribution. According to circumstances, the automatic ganglia of the heart may be irritated or paralysed; the inhibitory action of the vagus may be increased by irritation; the cardiac nerves may be paralysed; the vaso-motor nervous system may be so influenced as to induce change in the tone of the vessels, and consequent change of blood-pressure, and, as a writer in *Ziemssen's Medicine* says, with, perhaps, some affection of the depressor nerve of Ludwig.

The influence of this depressor nerve is felt in a large number of diseases. On section of this nerve, irritation of the peripheral end has no effect; but irritation of the central end causes pain, lowers the pressure of blood in the arteries, arrests the respiration, and retards the heart. As to the mechanism of the depression, it is a reflex action exercised on the splanchnic vaso-motor nerves, producing relaxation of the intestinal vessels; thereby a large way is opened to the passage of blood from the arteries into the veins, and pressure is lowered. It is not the activity of the splanchnic vaso-motor nerves, but the reflex suspension of their activity, that is obtained by the irritation of the depressor nerve.

The cardiac reflexes are met with frequently. When one excites a

sensory nerve, or one of the posterior spinal roots, there is generally observed a passing lowering of pressure. Brusque percussion of the abdomen may arrest the heart's action. Simply touching the peritoneum will do this when it is inflamed by exposure to air. In many cases of peritonitis, the reflex action on the circulation is remarkable. All nervous action which lessens the movement of the heart is transmitted to it by the vagus.

This is scarcely the place to pass in review the various forms of angina, except to say that in most the sympathetic is primarily or secondarily implicated. We all recognise that the pathological anatomy is very variable. Cardiac lesions may be present, sometimes of the cardiac ganglia themselves, hyperæmia, interstitial inflammation, hyperplasia of connective tissue, and fatty pigmental degeneration; in some cases, destruction of ganglion-cells, and caseous infiltration of connective tissue. Such lesions are only exceptionally seen in angina. These ganglia are more usually affected by any lesion that deprives them of their proper blood-supply, as narrowing of the coronary arteries from disease. This coronary lesion often exists without angina, and angina without coronary lesion.

Pressure by diseased glands on the cardiacus magnus, and on a branch of the vagus, has been seen. Rokitsky saw the right phrenic and the cardiacus magnus involved in a dark blue hard knot, which also implicated the descending branch of the left vagus. Lancereaux has seen congestion and inflammation of the cardiac plexus, and Seeligmüller hyperplasia of the connective tissue elements in the same plexus.

Section of the great sympathetic dilates the vessels more than is normal; on the other hand, irritation of this nerve contracts the vessels almost to complete effacement of their calibre. It seems certain, therefore, that the physiological state of the vessels is that of mean contraction—in other words, vascular tone, and the preservation of this tone is one of the chief offices of this system of nerves. Of the brain, the cord, the ganglionic plexus on the arterial wall, the sympathetic ganglia, a pathological standpoint enables us to choose the sympathetic ganglia as possessing a primary, if not wholly absolute, influence on vascular tone associated with the vaso-motor centres in the medulla oblongata and spinal cord.

The motor nerves that preside over muscular contraction, and rule the local circulation, are the nerves that issue from these ganglia of the great sympathetics, creep along on the arterial walls, and can be followed into the middle muscular coat of the arteries. The vaso-motor apparatus, therefore, is in a state of permanent activity, never in repose, never inert. The muscular tunic of the vessels is in a state of semi-contraction—in other words, of vascular tone. Variations in this tone will be the necessary sequence of various modifications of the nervous apparatus. This tone is modified, as Dr. Mahomed has said, by alterations in the vessels themselves—atheroma; sclerosis; fatty, calcareous, and amyloid degeneration; senile changes, syphilis, scrofula, alcoholism, etc. There is at least some reason to believe that aneurysm sometimes results from blood-changes that affect the vaso-motor nerves, the consequent loss of tone permitting the formation of aneurysmal dilations.

It is found by experiment that general loss of tone can only be obtained by complete destruction of the medulla oblongata and spinal cord; but partial lesions of the cord will enfeeble the vascular tone in the parts of the body which are, by their vaso-motor nerves, in relation with the region of the cord situated behind the seat of lesion. This state of tone is a reflex act. For a reflex movement, several factors are necessary: a contractile tissue, centripetal fibres, a centre of reflexion, and centrifugal motor fibres. In a vessel, the factors of this arc exist: the middle tunic of the vessel; the centrifugal vaso-motor fibres; the bulbo-spinal centre; and, in addition to it, the sympathetic ganglion, that may act, and probably does act, as an independent centre for reflexion; and, lastly, centripetal sympathetic fibres in the vascular walls, that are irritated or excited by the blood. Sensory nerves may often act as the centripetal fibres in these reflex actions.

All the phenomena of reflex congestion, and of reflex dilatation of the vessels, from any cause, are only instances of enfeeblement or abolition, more or less complete, more or less persistent, of the vascular tone. The only nerve that clearly determines a reflex vaso-dilator action on all the vessels of the body, is the depressor nerve.

The reflex mechanism of vascular tone is seen better in the heart and arteries. Let there be, from any cause, a constriction of most of the small arteries of the body, there is, as a consequence, increase in the arterial tension. The heart strives to overcome this excess of tension, and must employ more energy for this purpose: its contractions become more vigorous, more rapid. This effect is not purely mechanical, but is under nervous influence. Under increased intra-arterial pressure,

the blood in the ventricle also undergoes, at the moment of systole, and of the opening of the sigmoid valves, an excess of tension. This impresses some excitation at the endocardial extremities of the centripetal nerves of the heart—in this case the vagus. The impression is carried up to the bulb, from which and the cervical cord is reflected a centrifugal irritation, by way of the sympathetic cervical cord and its ganglia, to the intracardiac ganglia; and so increased energy and increased rapidity of the movements of the heart. The inverse phenomenon—dilatation of vessels—induces inverse conditions; but the mechanism is nearly the same, except that the centrifugal nerve will be the spinal accessory.

Reversing the order of the phenomena, if the left ventricle from any cause be abnormally full of blood, the spinal impression on the peripheral extremities of the cardiac nerves is carried up by the depressor nerve to the bulb; and thence, by means of dilator nerves, a general reflex dilatation of vessels takes place, and especially by way of the splanchnic nerves on the vessels of the mesentery; and the heart is relieved of its pressure.

So, once again, if an abnormally small amount of blood be in the heart, the reflex action originates from the cardiac nerves, and will react on the vaso-constrictors; the vessels contract, and the blood, receiving an increased *vis a tergo*, flows more abundantly to the heart. Thus, the heart may, up to a certain point, play the part of regulator of the vessels, or at least it exercises a certain influence on their tone; whilst inversely the vessels, too, rule, up to a certain point, the energy and frequency of the movements of the heart.

Nor is it necessary that the bulbo-spinal centre should always be the centre for these reflex arcs. The sympathetic cardiac ganglia, the ganglia of the cardiac plexuses, the ganglia in the walls themselves, may be the centres for these actions of the heart; whilst, for the vessels, the centres may be sought in the minute ganglia round the vessels themselves, and even in their walls.

The pressure of the blood within the arteries is the product of several factors: 1. The introduction of waves of blood into the aorta by the ventricular systole; 2. The resistance the blood meets with in its course through the small vessels; 3. The reaction of the elastic walls of the arteries on the blood contained in them. This latter factor is the most important one; and, as the calibre of these vessels depends essentially on the degree of vaso-motor activity, this system plays no small a part on the intra-arterial pressure.

It is scarcely necessary here to point out the manifold examples of the variation of arterial tension. In what disease, indeed, is it absent? In what morbid conditions, therefore, will not the sphygmograph be of importance in an early stage? But it may be permitted to quote Dr. Mahomed's account of the series of pathological events in so-called inflammatory Bright's disease: 1. A poisoned condition of blood by uric acid or other effete material, as in scarlatina, measles, erysipelas, pregnancy, or a severe chill; 2. Arrest of the action of one of the excreting organs; 3. Increase of tension in the arterial system; 4. Transudation of the crystalloids of the blood through the kidney; 5. Albuminuria, followed by dropsy and the usual symptoms of Bright's disease; 6. Changes in the kidney and other excretory organs, as in the intestinal tract and skin, produced by acute, and afterwards prolonged, congestion, and high arterial tension, viz., exudation and plugging of tubules or follicles, fatty degeneration and absorption, and, lastly, contraction. Probably it is in the pre-albuminuric stage of Bright's disease that the importance of the sphygmograph is most clearly seen.

There are certain vaso-motor neuroses of the extremities that have lately been described by various observers. In a less degree, we most of us meet with them from time to time, and recognise the condition as one of paresis, if not of paralysis, of the peripheral vaso-motors. It may be associated with heart-disease, as in the case mentioned by Dr. Semmola at the International Medical Congress, of paralytic action of the heart due to bulbar injury, with a feeling of oppression, palpitation, sometimes even murmur; with marbling of hands and forearms (paralysis of peripheral vaso-motors); and showing *post mortem* pigmental degeneration of the bulbar nuclei of the vagus, and of vaso-motor nuclei, and, as a consequence, fatty degeneration of cardiac muscles.

Long ago, Dr. Handfield Jones quoted a case of Graves, of neuralgia of the feet and legs, the disorder not confining itself to the cerebro-spinal nerves, but involving in a high degree the sympathetic nerves also. There were pain, heat, and vascular congestion of the feet and legs, alternating with pallor, cold, and absence of pain.

But the ailment has been fully described in various countries, and with especial accuracy by Dr. Weir Mitchell. He speaks of it as a

disorder of the feet and legs generally. There is pain, especially when the foot is hanging down, but also in many cases in any position. It is sometimes associated with lesion of the spinal cord. There is flushing of the feet, both venous and arterial, and tenderness. It is generally relieved by the horizontal position; but occasionally exercise causes the feet to become cold, producing contraction of vessels. Rest seemed to induce flushing in Sir James Paget's case; at any rate, was followed by it. The pain generally precedes the vaso-motor phenomena. Dr. Mitchell thinks the disease is similar to one termed acrodynia (pain in the extremities), which was epidemic in France in 1829-30.

Other American physicians describe a similar affection of the fingers. They become so cold as to seem frozen rods. There is tingling and burning on putting them to the fire. The skin is red in patches; sometimes abscesses form at the tips of the fingers. Mitral stenosis has been found associated with it, perhaps as its cause. Dr. McBride speaks of the fingers becoming dead reflexly through the vaso-motor system; and Dr. Allan Hamilton looks on the disease as excessive irritation of the local sympathetic vaso-motor filaments. I need not say that such an opinion is founded on analogy rather than on proved anatomical facts, as the vaso-motors of the ultimate vessels of the extremities are still unknown to us.

In this ailment, there are two chief varieties: one with phenomena of paralysis of blood-vessels, the other with symptoms of contraction, especially of the vessels of the extremities.

In diffuse paralysis of the vaso-motors, there is an intolerable sensation of pulses and heat over the body. The face is red, especially the lips and the nasal mucous membrane. It is sometimes accompanied by profuse sweating, and in some cases the vaso-motor phenomena show themselves exclusively in the extremities.

A partial cramp of vaso-motors, confined to the extremities, or to the fingers, is seen sometimes in angina pectoris. In washerwomen, this cramp is associated with itching and pain. "The finger dies;" there is pallor of fingers or of the whole hand, diminution or loss of sensation to touch, stiffness of the fingers, and local diminution of temperature. It may be cured by faradisation.

More rare is the diffuse cramp of the vaso-motors, extending over all the extremities, especially at puberty. In this latter form, Seeligmüller says, the cyanosis depending on venous stasis in the capillaries and veins is a consequence of deficient *vis à tergo*, and does not result from a primary paralysis of the nerves supplying the small veins.

The contractile form may lead to secondary changes, as scleroderma; and Dr. Hadden's recent paper on the connection between vaso-motor contraction of the peripheral arterioles with myxœdema is an important contribution to the same line of thought. It is sometimes accompanied with the phenomena of vascular contraction in the brain and medulla oblongata, such as disturbances of breathing, attacks of syncope, with delirium, etc.

Dr. Sturge has recorded a case of vaso-motor disturbance of the leg, with diminution of reaction both to the constant and induced currents, when the rheophores were applied to the muscles. He also thinks it due to over excitation of the vaso-motor centre.

Seeligmüller describes hydrops articulo-rum intermittens as a chronic affection of the vaso-motor nerves; the swelling is rapid, and equally rapid the going down. There is dilatation of all the vessels which supply the synovial membrane of the joint. The vaso-motor nature of the disease is rendered probable by its occasional coincidence, with exophthalmos and with angina pectoris.

Closely allied to vaso-motor cramp of the peripheral vessels, is symmetrical gangrene of the extremities. There is no lesion of heart or arteries. It chiefly occurs in females, especially the young. It seems to be caused by cold or by moral emotion. One, two, or three fingers may be affected symmetrically, or all the fingers and toes simultaneously. The pulse may be perceptible at the root of the segment of the gangrenous member. Raynaud thinks the interruption of blood is due to spasm of the small vessels, under the influence of excitation of vaso-motors; an excitation which is generally reflex, either from external cold, or some affection of the genital organs, and is transmitted to the small arteries and veins.

Vulpian thinks the centre of this action is in the cerebro-spinal centre, and that this is shown by the symmetry of the disease; he doubts also whether the arteries are always healthy. But all the phenomena may be produced through the media of vaso-motor ganglia placed in the course of the vaso-motor nerves, and the bulbar centre may have nothing to do with it.

Dr. Bernhardt, of Berlin, has recorded two cases of vaso-motor neurosis of the extremities in the *Archiv für Psychiatrie und Nervenkrankheiten* for last year. His second case is remarkable as being unilateral, but this may be explained from the symptoms probably de-

pending on unilateral accident. Both his cases were treated successfully by faradisation.

Such cases in their full intensity are not common; but, I repeat, lesser degrees of the disorder are not unfrequently met with in persons, especially young women, otherwise tolerably healthy. I have seen two in the last few months.

In considering some of the diseases affecting the abdominal viscera, it is well to remember that the vaso-motor nerves of the liver have their origin in the floor of the fourth ventricle, pass through the cervical and upper dorsal region of the spinal cord and the rami communicantes opposite the fourth and fifth dorsal vertebrae, to join the sympathetic, and finally enter the liver as the hepatic plexus; that the splanchnic nerve is a direct inhibitory nerve, and passes into the dorsal region of the cord; that it contains also the vaso-motor nerves of the small intestine, and that its inhibition of peristaltic action may be due to decrease of the amount of blood in the intestine; that, as we have seen, reflex action on this nerve may so far manifest a paretic influence on the intestinal vessels, that an extreme storage of blood is produced in these vessels, lowering arterial pressure everywhere, retarding the heart, and even causing syncope; that this afflux of blood, this temporary hyperæmia, may result in diarrhoea, and is probably the explanation of diarrhoea in many morbid conditions—markedly in cholera; in cholera, too, the semilunar ganglia have been found diseased; that the peristaltic movement of the intestine is automatically excited through the parenchymal ganglia, though it can be accelerated from the abdominal and thoracic sympathetic system, and inhibited by the splanchnic nerve; and that extirpation of the coeliac and mesenteric plexuses leads to hyperæmia and ecchymosis.

Hermann says that it is still unproven whether the diarrhoea, the consequence of the extirpation of the mesenteric plexus, depends on the influence of the secreting nerves or on disturbance of the circulation. I think the latter condition is an important element in its causation. He mentions that in a dog, in which all the ganglia of the coeliac plexus were extirpated, there was great emaciation. Although life was prolonged, there was great weakness, no loss of intellect, and, after three weeks, recovery. When the animal was killed, no abnormality of the chyle-forming organs was found. Lansansky therefore concludes that this plexus is not necessary to life.

Most of the experiments on the coeliac plexus prove that it is sensitive to pain. In a similar way, we meet with hyperæsthesiæ of the solar, mesenteric, hypogastric, and spermatic plexuses. That that form of gastric neuralgia that is termed lead-colic, is connected with toxic lesion of the sympathetic (as of other nervous tissues), seems proved by its association with the small hard pulse due to cramped narrowing of the whole peripheral arterial system, with whiteness and coldness of the face and extremities. The cardiac energy is diminished; the apex-beat is scarcely felt; the pulse may vary from 30 to 60 in the minute. In two cases, lesion of the sympathetic has been found. In one, there was an increase of volume, and a greyish-yellow colour of the abdominal ganglia; in the other, sclerosis of the connective tissue in the coeliac plexus. Asthma, vertigo, perspiration, tenesmus, suppression of urine, and palpitation are all met with in connection with lead-colic.

The two following cases show a divergence as regards sensation that is interesting. A gentleman became very suddenly affected with acute myelitis. In the course of two or three hours he became absolutely paralytic (motor and sensory); the sphincters were useless. There was girdle-pain just above the umbilicus, up to which spot anaesthesia was complete. For the eight days he lived, his appearance was remarkable from the very intense intestinal distension. Under ordinary circumstances, such distension would have caused much pain; but, although he resembled a barrel in appearance, he complained of no pain below the umbilicus, though the pain and distress above this point, consequently partly on the impossibility of diaphragmatic action, was considerable.

The other case was that of a young lady, aged 17, not hysterical. It was thought that she had tired her spine by over-riding. Constipation had been troublesome for six months before her illness, and it persisted as a marked symptom for many weeks. As a rule, very large and drastic enemata were retained, but from time to time faecal masses were got rid of, in one of which, on a single occasion, were found some peas, which she had eaten raw or imperfectly cooked fully two months before; the peas had sprouted in the bowel. The agony this girl experienced was extreme, although all the symptoms were those of almost complete paralysis of the plexuses of the sympathetic that rule peristaltic movement. In this case there was tenderness along the spine, from the mid-dorsal region down to the coccyx. I presume the case should be called one of neurasthenia, possibly with hereditary predisposition, as the mother had been a martyr to gastric neuralgia; as it would not

be likely that irritation of the splanchnic, and so increased inhibition of peristaltic movement, would persist for so long a period.

Of course the same objection may be made to the long persistence of reflex paralysis; but another case under my own observation is somewhat striking on this point. A very sensible and active shopwoman, thirty-six years of age, gave the following account of herself. She believed she had been born blind of the right eye. At any rate, she remembered, when she was a very little girl, being taken to see an oculist in London, who said that she would never see. She could not distinguish light with the right eye. In January of the present year, she had a canine tooth on the right side of the mouth extracted. She immediately became conscious of light, and in a few days entirely gained sight in this eye. The optic disc and retina were perfectly normal, yet for thirty-six years she was quite blind, apparently from some reflex influence connected with the alveolus of this canine tooth. With such an instance, it may be well not to speak of the impossibility of reflex irritation or reflex paralysis being persistent for long periods. But the neurasthenia of the abdominal sympathetic in adult life may be only due to premature old age. The deficiency of peristaltic action, and often more or less of intestinal secretion, that is often met with in old age, depends on exhaustion, on deficient blood-supply, quantitative or qualitative, to the parenchymal ganglia, or on commencing atrophy of the spinal cord; and is simulated much earlier in life by anything that depresses power, such as various exhausting diseases, the nerve-fatigue consequent on coition, prolonged travel, etc.

Injury of the vaso-motor centre for the liver in the medulla oblongata, or of the nerves that arise from it, in their course down the spinal cord, or from the cord to the hepatic plexus, leads to paralytic dilatation of the vessels of the liver, producing hyperæmia and diabetes mellitus. Claude Bernard found the exact spot in the medulla oblongata, close to the origin of the vagus, between the nucleus of this nerve and of the acoustic. He proved that the vagus has nothing to do with the diabetic phenomena, but the sympathetic in its relation to circulation. The mechanism is by means of paralytic dilatation of these vessels of the liver, causing an increased flow of blood, and thus, by transformation of the glycogen, an augmentation in the quantity of sugar formed; this, entering the general circulation, shows itself in the urine.

The vaso-motor nerves of the liver can also be paralysed by injury of the cervical and upper thoracic ganglia of the sympathetic. Division of the splanchnic nerves does not cause diabetes. Apart from experiment, there are not many cases on record that definitely show a connection between diabetes and the sympathetic. It has been seen in lesions of the cerebellum, especially of the vermis, of the optic thalami, the crura cerebri, the pons Varolii, the middle crura of the cerebellum, and in injuries of the medulla oblongata. I have sometimes seen it follow small hæmorrhages in old people in the motor area of the cerebral convolutions. But saccharine urine has been seen in a case of sciatica, and has disappeared when the sciatica was cured. Symmetrical sciatica has been observed in association with diabetes; and I have seen symmetrical neuralgia of the fifth nerve under the same circumstances. In three cases of diabetes, there was also hyperidrosis unilateralis; and Burdel found sugar in eighty cases out of eighty-one of intermittent fever. The glycosuria became slighter when the fever lost its intermittent, and took on its remittent type. Verneuil has recorded a similar case.

Not only is the vaso-motor action on the hepatic vessels a necessary element in the production of diabetes, but Schiff speaks of the same influence on the capillaries of the general circulation. The immediate mechanism for producing diabetes is the formation of a substance that can easily be transformed into glucose, and the presence of a ferment to induce this transformation. Schiff declares that the ferment is also produced in the capillaries of the general circulation, with the necessary element of stasis of blood; and conditions which lead to stasis are all-important to this end.

Diabetes may be a term that includes diseases of various origin. It is perfectly certain that congestion of the liver, necessary as it may be to the formation of the products that induce diabetes, is not in itself the one and only cause. How many cases of congestion of liver come before our notice, in which these diabetic phenomena do not obtain. But in a large number of cases, a number that increases the more readily we realise the relation of one part of the body with the rest by means of nervous influence, the floor of the fourth ventricle is the centre of a reflex arc for diabetes. Its centrifugal effects are not carried to the liver by the vagus—the cervical ganglia are not involved. The bulbar influence is carried down the cord, most probably, I believe, if we could only trace them, by sympathetic fibres which pass along the cord simply as along a roadway, and not partaking of the nature of

the organ, and, joining the arch between the last cervical and the first dorsal ganglion, are transmitted down the splanchnic nerves to the solar plexus; whilst some communication may also take place along the thoracic ganglia and the first abdominal ganglion, and the solar plexus be reached thus. Thence fibres go, to make up the hepatic plexus, and to rule the condition of the circulation in the liver. But this is not all. Over and above the dilatation of vessels and the increased hyperæmia of the organ, there are transmitted through the same channels other fibres that influence the phenomena of nutrition and secretion, fibres that play a part in the liver resembling that played by the fibres of the chorda tympani which excite secretion in the submaxillary gland.

The influence of the sympathetic system, therefore, is very great in diabetes. It includes direct or reflex lesion of a bulbar centre, or lesions so near as to be almost direct; hyperæmia of the liver; sometimes stasis in the capillaries of the general circulation; an influence on the secretion of glycogen, and of the ferment necessary to its transformation.

Nor is this the only condition of liver influenced specially by the sympathetic. In a case recorded by Dr. Shingleton Smith, of acute atrophy of the liver, not only was this organ very small, but there was found an atrophic condition of nerve-cells in the sympathetic ganglia. And certain injuries to the solar plexus cause increase of the circulation of blood in the liver, and increase of bile.

Injury to a spot in the floor of the fourth ventricle in close proximity to the diabetic point induces polyuria, evidently from increase in the activity of the intrarenal circulation. The polyuria is the primary condition, and is the result of the morbid state of the renal vaso-motor system. Temporary polyuria under the influence of strong emotion is of everyday occurrence; but Dr. Crichton Browne has mentioned a case of a boy in the late Dr. Begbie's wards, who was placed, very much against his will, in bed with a patient who was suffering from diabetes. The boy expressed a fear that he would catch the disease; and certainly, from the influence of emotion on the medulla oblongata, and so on the renal vessels, he became the subject of polyuria.

The recognition of the part taken by the vaso-motors of the kidney in this complaint has led to a more successful treatment of a hitherto difficult disorder. Faradisation over the kidney, and ergot, have proved useful remedies.

We come, lastly, to those diseases that are associated with pigmentation. Irritation of the splenic plexus reduces the size of the spleen. Division of the splenic nerves causes distension of spleen by dilatation of vessels. Jaschowitz divided the sympathetic in the spleen, and caused increased flow of blood, and a copious deposit of hæmatine pigment in its cells. Dr. Coupland, in his lectures here last year, stated that the liver seems to be the chief seat of the destruction of red corpuscles; for not only does the blood passing out of this organ contain comparatively fewer corpuscles than that entering it, but its cells are laden with pigment derived from the blood, which they excrete with but little modification in the bile.

Melanæmia is a transitory condition, quickly replaced by melanosis of the spleen, liver, and bony marrow. The pigment is first taken up by the white corpuscles. The small vessels are sometimes obstructed by pigment. The spleen is enlarged. The splenic cachexia is associated with destruction of red corpuscles, and consequent marked anæmia. The dark colour of the skin is produced by abundance of pigment in the vessels of the cutis. The granular pigment in the blood exists either free or in cells, or in little hyaline coagula. It is equally distributed in the heart and great vessels. The white corpuscles are occasionally increased. Much pigment means great destruction of red blood-corpuscles. The spleen is especially affected, but often after intermittent fever it is amyloid, and contains little pigment, and in this case the liver and bony marrow contain much.

In the spleen and bony marrow the capillaries pass into very wide veins—a circumstance that must act in diminishing the rapidity of the blood-current. This is an important factor in all pigmentation. There is more or less stasis of blood-current; and in this, too, the influence of the sympathetic system comes in. First comes lesion of sympathetic ganglia, especially in the abdomen, influencing the production of pigment; then the circulation of abnormal blood in the vessels, reflexly influencing their calibre; then stasis of greater or less intensity; then pigmental deposit.

Dr. Paget's beautiful case, mentioned at the Congress, well illustrates lesion of the ganglia. It was an example of lymph-adenosis, with brown pigmentation of the skin. The semilunar ganglia and solar plexus were involved in a closely aggregated mass of enlarged lymphatic glands. The pigmentation here was associated with another sympathetic symptom—profuse perspiration.

In Hodgkin's disease, lymphadenoma, the spleen may be enlarged from more causes than one; but in the form that depends on destruction of the circulation, there is much hyperæmia and a copious deposit of pigment; occasionally this is seen in the skin.

The influence of the nervous system over the proportion of the various constituents of the blood has been recognised by many physicians. Dr. Wilks speaks of fatal anæmia after shock to the nervous system, and quotes Sir Henry Marsh's case of a young lady who accidentally poisoned her father by giving him laudanum instead of black draught. The occurrence so pressed on her mind that she took to her bed, became anæmic, and before many months had elapsed died, without any apparent organic disease.

Dr. Coupland says: "The intimate relation of the nervous system with all parts of the body point to an extensive control over blood-formation, and over nutrition and secretion; so that, under certain conditions, the nervous system may bring about an anæmia other than by the exhaustion of material supplied to it by the blood."

In a case of fatal anæmia, under the care of Dr. Greenhow, reported by Dr. King, the then medical registrar to Middlesex Hospital, the reporter says that "the case must be regarded as one of defective blood-nutrition, due to morbid changes occurring in nervous centres connected with the sympathetic system, centres which normally preside over the blood-vascular and lymphatic glands, superintending the production of that highly complex fluid, which it is the special function of these glands to elaborate." In a very marked case of anæmia, associated with cerebro-spinal sclerosis, I found almost all the abdominal viscera markedly pigmented, and to a less degree the brain also.

These questions should be looked upon in connection with the known fact, that direct irritation of the solar plexus by experiment is followed by the appearance of numerous pigment-granules in the blood; whilst staining also follows irritative action on the solar plexus from cancer of the stomach, cirrhosis, and other affections of the abdominal organs. A staining in the face in phthisis is spoken of by Dr. Gueneau de Mussy as a sign of the presence of abdominal tubercle—a connection we all frequently verify.

Discoloration will occur from the action of local irritants, as heat, light, blisters, etc. In every such case, a slight local vaso-motor paralysis is induced, and more or less blood-stasis.

Anxiety may induce pigmentation that may almost remind one of Addison's bronzing. I have seen this very marked in a gentleman, from whom it disappeared when the anxiety passed away; and such cases are not uncommon. In a large number of cases, however, there is a morbid condition of the blood itself. Many years ago, Mr. Teevan recorded a case in which tension and irritation of the brow and eyelids was followed by an exudation of a blackish fluid, which persisted for eight hours, and recurred constantly during four months. The case was explained by Erasmus Wilson as depending on an altered action of the follicles of the skin of the eyelids, resulting from vascular congestion; this vascular congestion being probably vicariously to imperfect menstruation. De Mericourt, too, described a blackish, sometimes bluish, exudation on the skin, which discoloured linen, but could not be washed away, and which was connected with uterine derangement. It was worse in hot weather, and during effort, under emotion, or from fatigue.

By the kindness of Dr. Swayne, I show here plates of the arms of a lady, whose case has already been reported by him in the *Obstetrical Transactions*. The subject was a blonde, with rather florid complexion, brown hair, and blue eyes. At the time of her confinement, there was a peculiar appearance of the skin of both forearms and hands. There was a very general discoloration of the skin of the forearms, more marked on the dorsal than on the palmar aspect. On the dorsal aspect, it occupied all the surface of the arms, and existed in patches on the hands, the knuckles, and all the fingers. The skin in these spots was of a rich yellowish-brown colour, or as dark as the skin of a mulatto. The skin has been similarly affected in each preceding pregnancy; and the dark colour first appeared about the end of the third month, and increased *pari passu* with the development of the areola, until it attained its acme at the time of labour. After delivery, it soon began to diminish in intensity, and in about three months had entirely disappeared. Her mother had two children, and in each of her pregnancies both the arms and the neck were spotted in a similar way; and, being a very fair woman, the discoloration was still more evident than it was in the daughter.

A case like this only shows in an unusual position, and in an inordinate degree, phenomena that are met with in most cases of pregnancy. The mammary areola, the staining of the forehead, the less frequent pigmentation of the abdominal surface in pregnant women, are conditions that own one and the same cause: 1, the cachexia consequent on the pregnant state; 2, uterine irritation; 3, transmission of this uterine

irritation to the solar plexus; 4, the consequent formation of an abnormal amount of pigment; and, lastly, the further transmission of irritation to some of the vaso-motor nerves, determining in various positions the vascular congestion and stasis necessary for the deposit of the pigment.

Many other cachexiæ possess all the necessary factors for pigmentation, if only direct or reflex influence on the vaso-motors be induced. In leukæmia, pernicious anæmia, tertiary syphilis, cancer, even chronic rheumatism, gout, and phthisis, the production of pigment from irritation of the solar plexus may constantly occur. Blepharal melasma is common during menstruation. In some women, it is permanent, associated with chlorosis or melancholia, especially in non-fertile middle-aged women. Pigment is rarely symmetrical in women. Blepharal melasma of the lower lids is very rare in men; but, when it occurs, it seems connected with sexual excess or some genito-urinary disorder.

Dr. Laycock considered the nervous sources of pigmentation to be two: one due to certain cerebro-spinal influences, the emotional; the other due to the peripheral influence of the sympathetic, without consciousness. The latter is the form in which the genital system is frequently the starting-point; but the sympathetic system is largely implicated in the emotional form also. When emotion is seen to paralyse the vaso-motors of various parts of the body, to dilate the pupil, to materially interfere with the action of the heart, to influence perspiration, the amount of urine, the catamenial function, the sexual feeling, it is impossible not to look at emotional pigmentation as essentially a sympathetic disorder. Laycock mentions the case of a woman who, in the French Revolution, incurred the anger of the Parisian mob, and with difficulty escaped being hung in the streets. Her terror caused a gradual black discoloration of the whole body, and this remained with her for life.

The reflex influence on pigmentation is beautifully shown in some experiments and observations of Pouchut. A young turbot varies in colour with the colour of the rock or of the sand on which it rests. These changes depend on the greater or less absorption of light by the bottom (whether of sand, rock, etc.), so they must be regarded as true reflex acts, having, Pouchut believes, their centre in the brain, and their starting point in retinal impressions. His experiments prove that it is the great sympathetic which governs the chromatic function. It forms the route of transmission for the influence going from the brain to the cutaneous chromoblasts; indeed, the retinal impressions transmitted to the corpora quadrigemina may be directly reflected on the vaso-motor centres.

Addison's disease, purely a disorder of the sympathetic, owns a causation similar to other pigmentary changes. The changes have been well defined as (1) a lesion of the sympathetic nervous system; (2) inflammatory processes in the connective tissue of the suprarenal glands; (3) from the products of the inflammation ensues a paralytic condition of the vaso-motor fibres of the sympathetic, and consequently an imperfect distribution of blood; (4) on this are to be saddled all the phenomena of the disease—anæmia, disturbance of nutritive functions, bronzed skin, and a secondary affection of the blood.

Eulenberg and Guttmann have collected twenty cases, with more or less lesions of the abdominal ganglia, and twelve in which no lesion was recognised.

The original disease of the suprarenals may have spread to them from inflammatory conditions in their neighbourhood; but the phenomena of the disease are due to the extension of the lesion to the nerve-elements. Kolliker found thirty-three nerve-trunks in the right suprarenal capsule; and many observers have found the medullary portion of the capsule, which is essentially a nerve-centre, in a state of hyperplasia of the connective tissue, and gradually becoming mere fibrous bands. Even in cases in which lesion of ganglia cannot be found, the phenomena may arise from reflex irritation starting from the cortical portion of the gland. The disorder is associated with vertigo and other nervous phenomena; sometimes with a fetid odour of skin like that of a negro; with sighing, yawning, hiccup, and irritability of stomach.

In a case lately under my care, the dark pigmentation of skin, that was the sequence of prolonged ill-health and anæmia, in a girl with a very phthisical family history, was associated with all the symptoms of exophthalmic goitre.

Dr. Semmola considers the disease one of the ganglionic centres, independent of the suprarenal capsules; and the possibility of this view is confirmed by a case recorded by Dr. Fowler, in which, with all the phenomena of Addison's disease, there was no lesion of the suprarenals, but the ganglia were compressed by a tumour in the abdomen.

The influence of the sympathetic touches every normal function of the body, every abnormal disorder. It needs no saying, therefore, that

the present sketch is essentially inadequate. But it may be said, *en résumé*, that this system is the connecting link for function between all organs; that its close brotherhood, I had almost said cohesion, with the cerebro-spinal nerves and centres, brings into association in a thousand ways the purely nervous phenomena with those more primarily sympathetic; that it is frequently the seat of coarse lesions, but that, where the same symptoms are met with, when these coarse lesions or injuries cannot be recognised, it is only fair to believe in an irritability, a morbid condition of the sympathetic ganglia, the anatomical elements of which may probably present themselves to means of research, as these become more accurate.

In congestion, in hyperidrosis, in some forms of angina pectoris, in sunstroke, in the regulation of vascular tone, and in its many abnormalities, in vaso-motor neuroses of the extremities, in symmetrical vaso-motor gangrene, in some varieties of aneurysm and of albuminuria, in diabetes mellitus, in diabetes insipidus, in hysteria, hypochondriasis, and other forms of neurasthenia, in those protean disturbances of the economy that are excited by emotion, and lastly in pigmentation, including Addison's disease, the influence of the sympathetic seems primary, and almost, if not wholly, independent. In inflammation, including practically inflammatory disorders of all organs, in fever, in hemicrania, in exophthalmos, in progressive facial hemiatrophy, and in epilepsy, the part played by this system of nerves is secondary, though important. In most of these, however, as of other ailments, the cardiac phenomena, the conditions of vascular tone, the perspiration and diarrhoea, the marvellous influence of the abdominal nerves and vessels on the distribution of blood in the body, are evidences of collateral and coincident disturbances of the sympathetic.

This system is far more than a chain of transmission from the higher nervous centres. It often stands alone; far more often in correlation with the cerebro-spinal system.

REMARKS

ON

SUBINVOLUTION OF THE UTERUS.

Being an Introduction to a Discussion in the Section of Obstetric Medicine at the Annual Meeting of the British Medical Association in Worcester, August 1882.

By JOHN WILLIAMS, M.D., F.R.C.P.,

Assistant Obstetric Physician to University College Hospital, London.

SUBINVOLUTION of the uterus is a condition of very frequent occurrence, and one credited with a very important place in the diseases of the sexual organs of the female; and yet so little is accurately known about it, that I think most of us would hesitate before making any positive assertions about its causes or its results. Whether a halting state of mind be favourable to opening a discussion, depends upon the way in which the subject is regarded. For my part, I feel it not a little inconvenient. I shall have to bring before your notice some statements respecting subinvolution which have often been reiterated, but for which I have been able to find little or no substantial evidence; I shall also call your attention to certain observations made during recent years, which have an important bearing upon the subject under discussion. I must express my regret that these are so meagre; but I trust the discussion will be the means of eliciting not opinions only, but facts calculated to elucidate a question of which little is known, and the investigation of which is surrounded by many difficulties.

Before referring to subinvolution, I must direct your attention to the process, to the arrest of which the condition is due, the process of involution of the uterus after delivery. This consists in the fatty degeneration of the enormously developed fibre-cells of the uterus, and their gradual disappearance by absorption. This process of decay is followed by one of regeneration and growth, whereby a new uterus is formed in the place, and from the ruins, so to speak, of the old one. The process of fatty degeneration is said to begin about the fourth day, and not later than the eighth, and to be completed in about four weeks. At the end of this time the formation of new fibre-cells is said to commence, and the organ is completely renovated about the end of the eighth week. This is the true process of involution, the restoration of the organ after delivery to the state which is natural to it when not impregnated. Any failure in the process of degeneration or of regeneration leads to subinvolution of the uterus. Clinically, however, involution consists in the reduction of the volume of the puerperal

uterus to the size of the unimpregnated organ. We can appreciate no more than this, and this only imperfectly by the bedside. A full account of the process can be given only when its course has been worked out both anatomically and clinically; and until this has been accomplished we can have but an imperfect knowledge of the causes of its arrest, and of the part which such arrest plays in the diseases of women.

Heschl has studied the process of involution from the anatomist's point of view, by examining the uteri of women who had died at different intervals after childbirth. He found that the uterus weighs, immediately after delivery, 1 lb. 6 or 7 oz., to 2 lbs. 7 oz.; at the end of a week, 1 lb. 3 to 5 oz.; at the end of two weeks, 10 to 11 oz.; at the end of five weeks, 5 to 6 oz.; at the end of two months, 1½ to 2½ oz.; and concluded that the highest rate of decrease in the volume of the uterus occurs during the second week after delivery.

Clinically, several methods have been adopted to determine the rate of involution.

1. It has been estimated by measuring, day by day, the height of the fundus above the pubes. This method is open to the objection, that the measurements are affected by the varying conditions of the bladder and rectum. With care, this can be overcome—at least, in a great measure. Another source of error, and a more formidable one because it cannot be eliminated, is the fact that the difference in the measurements taken depends, not upon the difference in the size of the uterus simply, but upon this *plus* the sinking of the organ into the pelvis, consequent upon the decrease in its volume.

2. The length of the uterus has been estimated by daily measurements by means of callipers, one arm of which is placed in the vagina, and the other on the abdominal wall over the fundus. This method is also open to serious error, owing to the dilated and flabby state of the cervix, and to the impossibility of directly applying the outer arm to the fundus.

3. The transverse measurement of the uterus at its widest part has been daily taken. It has been shown, however, that even this measurement is greatly affected by the condition of the bladder; but, since the bladder can readily be emptied before the measurement is taken, this method is calculated to give more accurate results than the other two.

These three plans are available only for the first eight or ten days after labour; that is, so long as the fundus is well up above the brim of the pelvis.

4. To avoid the errors to which the preceding methods are open, as well as to enable the investigation to be carried on after the uterus has sunk into the cavity of the pelvis, the length of the uterine cavity has been measured by means of a sound or graduated bougie.

This has been done daily for the first eleven days after birth by Milsom; and Dr. Sinclair has measured the uterus once just before discharge in a large number of women confined in the Boston Lying-in Hospital, the day of discharge varying from the ninth to the seventieth after delivery. This method of catheterisation, as it has been called, appears to me to be liable to equally serious errors as the others during the ten days following delivery, in consequence of the flabby and dilated state of the cervix. After the uterus has sunk into the pelvis, however, catheterisation, combined with bimanual examination, is the only method to which recourse can be had.

The practical outcome of observations hitherto made is this. The uterus, as a rule, sinks into the pelvis on or before the twelfth day after delivery. In many cases, the organ disappears behind the pubes earlier. Jules Guérin, after having observed twenty-one cases, concluded that this happened about the fourth day. Wieland found it happen about the tenth day. Serdukoff found the fundus two to three inches above the pubes on the seventh day. Milsom found it two inches above the pubes on the eleventh day. In one hundred and thirteen cases, I found the organ in the pelvis on or before the twelfth day in ninety-six.

In some cases, the uterus is in the pelvis immediately after delivery, when involution has not begun. In others, again, the organ may be felt above the brim on the fifteenth or sixteenth day, although involution has proceeded normally. I am not going to discuss the reasons for this difference, but mention it merely to point out that the disappearance of the uterus behind the pubes is not an infallible sign of healthy involution. At the same time, it seems to me to be the best practical test we can adopt; and I will assume that the uterus has undergone normal involution when the fundus cannot be felt above the brim on the twelfth day, and *vice versa*; although this assumption will lead to some errors.

The process of involution may be arrested at any time during the stage of degeneration or of regeneration; and I may say at once that, in so far as I know, we have no means of discerning in any given case what period the process failed,