THE British Medical Journal.

THE JOURNAL OF THE BRITISH MEDICAL ASSOCIATION.

LONDON: SATURDAY, JANUARY 7TH, 1922.

An Address ON CERTAIN ASPECTS OF PAIN.

DELIVERED BEFORE THE SHEFFIELD MEDICO-CHIRURGICAL
SOCIETY, DECEMBER 8TH, 1921.

BY
HENRY HEAD, M.D., F.R.S.

PAIN and discomfort are the oldest defensive reactions of the organism, and potentially unpleasant stimuli form the basis of most primitive reflexes. Even the simplest animal shuns pain and moves in the direction of pleasure. All such impulsive actions allow of little choice, and any part of the body exposed to a harmful form of stimulation is urgently withdrawn. Sensory impulses capable of evoking pain or discomfort are therefore most important factors in the life of even the highest organism, although their action may be almost automatic.

In man, however, where they not only cause impulsive reflexes, but also produce conscious discomfort, pain is the most urgent symptom with which the medical man is compelled to deal. At the same time it forms one of the most important diagnostic aids, if rightly interpreted. But in so many cases its meaning is misunderstood; the intensity of the patient's suffering cries for relief, and attention is more often focussed on easing the pain than upon its diagnostic significance. These difficulties of interpretation are greatly enhanced by misunderstanding of what is generally comprised under the term "pain." Almost any stimulus of great intensity is liable to produce discomfort. Tickling the sole of the foot is extremely disagreeable, but in no circumstances can it be strictly said to be painful. Localized pressure, steadily increasing in amount, becomes more and more uncomfortable, until at last it evokes a sensation that can be justly called pain. But when a faradic current is applied to a sensitive part like the foot, the first disagreeable sensation is strictly one of pain, and the impulses upon which it is based pass up the spinal cord in adjacent and analogous tracts to those for heat and cold. Supposing, however, that these paths are interrupted, so that the patient cannot experience pain in the strict sense of the word, a strong faradic current, which appears to him first of all as a kind of tingling, will rapidly become so disagreeable that he withdraws the limb exactly as if he was still exposed to painful impressions. At the same time he may complain that it causes intense discomfort.

Obviously, then, what is popularly called pain may contain two elements: First of all, there is a true specific sensation, exactly equivalent to that of heat, cold, and touch. Secondly, there is discomfort or that unpleasant feeling tone, which

may accompany many other sensations besides those which have a right to be called specifically painful. This unpleasant feeling may be associated with touch in the form of tickling or itching, with pressure, as an intolerable sensation we call "crushing pain," with heat as "burning," and with cold as that disagreeable state that we know so well when our hands and feet are chilled.

But it is a matter of no importance from the point of view of the organism whether the sensation evoked be a strictly specific one of pain, or what should be more truly called discomfort. Both lead to the production of reflexes that tend to remove the affected part or even the whole animal from the place or object productive of such unpleasant experiences. Reactions of this kind are impulsive and urgent; once they come into being, the movements they produce are uncontrolled; they permit of no choice. It is therefore most important that the impulses which underlie any of these disagreeable sensations should be diminished in extent, or actually inhibited, in favour of those sensory impressions more capable of leading to discriminative action. But, on the other hand, the mechanism underlying the production of pain and discomfort must remain in full

physiological activity, so that it can play its part in defence of the organism, whenever noxious stimuli reach a high grade of intensity.

Such dominance of a higher centre over the activities of another, subserving more primitive modes of response, is exemplified by the relation between the cortex and optic thalamus. This is the end-station for all those afferent impulses subserving the more affective forms of sensation, such as pain, heat, cold, tickling and all forms of discomfort. On the other hand, the functions of the cerebral cortex are responsible for the more discriminative aspects: the appreciation of size, shape, weight, texture, together with the relative intensity and spacial relationships of various external stimuli. These two sensory centres are not independent of one another, but the activity of the cortex exerts a dominant influence over the response of the optic thalamus. Now it sometimes happens that a gross organic lesion destroys the path of these controlling influences, and the thalamus is set free to manifest its reactions unchecked. Every stimulus capable of evoking discomfort or pain, and even in some cases pleasure, now produces an exaggerated effect on that half of the body opposite to the lesion.

Here we see expressed, in the form of two anatomically separable centres, that dominance of higher and more discriminative functions over those inducing impulsive reactions, which is so characteristic of the activity of the central nervous system. The same laws are at work in painful manifestations of visceral origin; but here no structural changes can separate the controlling mechanism from the centres which receive these potentially disagreeable impulses.

FIG. 1.—To represent diagrammatically the anatomical arrangement of the paths and centres concerned in sensation. Two distinct paths exist in the spinal cord: a crossed secondary path in the ventro-lateral column, which conveys impressions of pain, temperature, and touch, and a second uncrossed path in the dorsal column, which also conducts tactile impulses, together with those that underlie the sense of posture, appreciation of movement, discrimination of two points and the recognition of vibration, size, shape, form, weight and consistency. This second path decussates in the medulla oblongata, but runs separate from the first path, at least as high as the pons. All these secondary sensory fibres, now crossed, terminate in the ventro-lateral region of the optic thalamus. Here the impressions they carry are re-grouped and distributed along two distinct paths. The one carries impulses to the cerebral cortex, the other towards the more mesial parts of the optic thalamus. In addition, fibres pass from the cortex to terminate in the lateral nucleus of the optic thalamus. (From Head and Holmes, *Brain*, 1911-12, vol. xxxiv, p. 172, and *Studies in Neurology*, vol. ii, p. 593.)

We are now dealing with a delicate equipoise, which can be upset by additional weights thrown into either scale.

Pain of Visceral Origin.

Afferent impulses from the viscera do not normally enter consciousness. The eupeptic knows nothing of the processes of digestion beyond a gentle sense of well-being; but under normal conditions afferent impressions from the internal organs are capable of arousing pain and discomfort. Some have tried to maintain that the viscera are "insensitive" and incapable of generating afferent impulses of this order; but no one who has ever suffered from the passage of a renal calculus or a true referred pain from inflammation of the pulp of a tooth will look upon such statements as anything but hair-splitting dialectic. All power of conscious response to heat, cold, and touch is certainly absent from the great part of the stomach and intestines, and pain cannot be produced by burning, cutting, the prick of a pin or other sharp instrument. Internal surfaces are unable to respond to such artificial stimuli to which they have never been exposed during the life of the individual or the race. But the hollow viscera, such as the stomach and the bladder, react briskly to changes in tension, which are their natural mode of stimulation.

Even if a stimulus is capable of exciting these sheltered parts of defective sensibility, it does not usually produce a sensation on account of the resistance of the nervous system to such potentially disagreeable impressions. But a sensory response may follow, whenever these visceral impulses become sufficiently strong to overcome the inhibition by which they are normally held in check, or when the forces opposing their passage are in any way diminished. Once the path has been opened and the dominance of the higher centres overcome, a weaker visceral stimulus will be followed by sensation; to this diminished resistance is due the production of pain from otherwise inadequate causes, especially where visceral irritation has been long continued.

Bearing these facts in mind, let us examine some actual examples of pain produced by visceral disease and see to what further laws we are led by such consideration.

Now, we have reason to believe that the viscera have a double afferent supply. One of these corresponds to that

becomes agonizing during the long deep inspiration which follows a cough, a laugh, or a sneeze. It is absent when the side is at rest, and is relieved by any treatment that fixes the chest, such as successful strapping.

This pain is frequently associated with tenderness on pressure or percussion in the intercostal spaces. By this means an area of distinct deep tenderness can sometimes be marked out, and it is within these limits that pleuritic friction can usually be heard. The pain and tenderness seem to be due definitely to inflammation of the parietal pleura and possibly even to that which covers the lung; both disappear when serous fluid is effused, but may persist over the upper border of purulent effusion in empyema.

Whenever a serous cavity is affected and the parietal wall is inflamed, local tenderness of this kind, evoked by deep pressure, is liable to make its appearance. This is often of profound diagnostic value. With pericarditis it is frequently possible to elicit tenderness on pressure. Placing the end of the stethoscope lightly upon the chest in an intercostal space produces no pain, and friction may not be audible, but, on increasing the pressure, not only does the patient complain of pain, but the rub becomes more evident. Such an association between the increase of tenderness on pressure and the clearness with which friction becomes audible is often an equally definite diagnostic point in pleurisy.

In many cases of inflammation of the appendix the same law can be applied. In the early stages, before perforation has taken place, widespread pains may be present in the abdomen, corresponding to the afferent supply of the upper parts of the digestive tract. Such pains are due to abnormal movements of the stomach and intestine, and express the reaction of normal parts to a lesion situated in some allied physiological system. But when the appendix becomes perforated and inflammation of the peritoneum ensues, these referred pains are replaced by local manifestations, accompanied by deep tenderness over inflamed parts. Sometimes it is difficult to determine whether tenderness of the abdominal wall is due to its deeper or more superficial structures, and whether it has a local significance or is part of the manifestations of a referred pain. This can be decided by the following method of examination: When the pain is due

FIG. 2.—To show the area of deep tenderness evoked by pressure or percussion in a case of acute pleurisy. (From *Brain*, 1896, vol. xix, p. 233.)

FIG. 3.—To show the superficial tenderness present in a case of aneurysm of the ascending portion of the aorta. (From *Brain*, 1896, vol. xix, p. 171.)

deep system, which in the limbs supplies muscles, tendons, and joints; this remains intact when all cutaneous nerves are severed. The peculiar aptitude, possessed by a part innervated from this deep afferent mechanism, is the power of responding to stimuli, which produce alterations in form or pressure. Excessive tension may even evoke pain, and "cramp" is the reply of the end-organs of this system to abnormal muscular contractions. Parts innervated in this manner are insensitive to light contacts, pricking, heat and cold; but they are endowed with definite local signature, and the patient is capable of appreciating within certain limits the site of the stimulated spot.

Thus, when the pleura is inflamed, the pain, stabbing in character, is intensified by every respiratory movement, and

FIG. 4.—To show the distribution of the eruption in a case of herpes zoster. The post-mortem examination showed an inflammatory lesion in the second thoracic posterior root ganglion. (From Head and Campbell, *Brain*, 1900, vol. xxiii, p. 439.)

to local peritonitis, the loin is not tender either to superficial stimulation or to deep pressure; but on passing steadily forwards a point is at last reached, about the level of the tip of the eleventh rib, where pressure evokes pain. In front of this a considerable area of deep tenderness can usually be discovered occupying the right iliac fossa. Had the pain been referred, superficial tenderness would have been found in the loin corresponding to the posterior portion of the segmental areas affected.

When serous membranes, such as the pleura, pericardium, and peritoneum, are inflamed, the pain has a definite local significance, and the tenderness is increased by pressure—in fact, these cavities behave like the inner surface of joints.

This deep system of afferent nerves supplies not only the muscular and other subcutaneous tissues of the limbs and trunk, but also innervates similar parts of the internal organs. Some forms of colic belong to this order; they are the equivalent in the intestine of muscular cramp. Abnormal movements produce disagreeable sensations, associated with distinct impressions of some change in posture. These are the conscious results evoked by the painful aspect of those proprioceptive impulses, which Sherrington has shown to have

FIG. 5.—To show the superficial tenderness present in a case of aneurysm of the aorta. (From *Brain*, 1896, vol. xix, p. 175.)

so profound an influence on the regulation of posture and movement.

But the majority of pains arising from visceral disease have not this localizing value. They are referred into parts remote from the site of the lesion. They cannot be interpreted without a knowledge of the relation of afferent impulses to the segments of the central nervous system.

The distribution of the pain in a man who suffered from an aneurysm of the first part of the aorta is illustrated in Fig. 3. The point of greatest intensity was situated just above the inner condyle of the humerus; distinct superficial tenderness was present over the area marked on the figure. To what does this area correspond?

You are aware that the common form of herpes zoster is due to inflammation of the posterior root ganglion. Now it so happens that, when this structure is subjected to a violent irritative process of this kind, severe necrotic changes occur over the peripheral distribution of certain of its fibres associated with severe pain its centripetal manifestation. The system to which these fibres belong is what Bayliss called "autonomic"; they are capable of conducting impulses in either direction according to the specific nature of the end-organs to which they are attached. Some of them conduct centralwards like all other afferents, and their impulses evoke pain and discomfort; others produce a so-called "trophic" effect on the periphery.

Thus, by a fortunate chance, the extent of a herpetic eruption, when fully developed, represents the distribution of the fibres of this system which pass through some particular ganglion. Now, the distribution of these fibres corresponds closely with the segmental arrangement of painful impulses in the spinal cord; consequently it is possible, by studying the extent of the eruption in cases of herpes zoster, to obtain a knowledge of the form assumed by the areas of segmental

distribution and also their numerical significance.

I therefore give a drawing of a case of herpes zoster, which was proved by *post-mortem* examination to be due to inflammation of the second thoracic posterior root ganglion. (Fig. 4.) You will notice how extraordinarily closely its distribution corresponds with that of the tenderness present in the man who suffered from aneurysm.

But such isolated and restricted areas of pain and tenderness rarely occur as a consequence of visceral disease; they are of great scientific interest but of little practical importance. The next figure (Fig. 5) shows a more common condition produced by aortic disease. The tenderness not only occupies the second thoracic area, but spreads into parts supplied by the nerves of the cervical plexus.

The next figure (Fig. 6) shows the extent of the tenderness in a patient who suffered from severe mitral stenosis, where the rigid slit-like valve permitted some regurgitation. I give for comparison, first (Fig. 7) the distribution of a herpetic eruption, proved by *post-mortem* examination to be due to inflammation of the sixth thoracic posterior root ganglion, and then another (Fig. 8) showing the parts supplied by the seventh thoracic. It is obvious how closely the pain and tenderness in the case of mitral stenosis is corresponded to the sixth and seventh thoracic areas.

To what, then, are these areas of referred pain and tenderness due? It is evident

that they must be produced by abnormal physical conditions within the cavities of the heart or the aorta. Tension is the most effective stimulus to any hollow organ; experiments on the gall bladder have shown that it may be cut or burnt without the production of any reflex changes, but the injection of even a small quantity of fluid so as materially to raise the pressure, will cause a profound disturbance due to the afferent impulses so generated. But to return to the conditions within the heart: it is obvious that in such a case of mitral stenosis as I have just mentioned, the work of the auricle is obstructed by the severe narrowing of the orifice, and in addition, blood is forced back into it, at the moment of its diastole, from the contracting ventricle through the incompetent valve. These abnormal conditions set up afferent impulses which pass to the central nervous system. There they excite certain segments of the spinal cord to such an extent, that all potentially painful impulses passing into them produce an exaggerated effect. Certain areas on the body, such as those shown in Fig. 8, become tender to such stimuli as the dragged point of a pin, or pinching up the skin between the thumb and forefinger.

The balance of afferent impressions in the central nervous system is upset by the potentially disagreeable impulses impinging on these segments of the spinal cord. At first the central resistance may be sufficient to inhibit them, or at any rate to prevent a disturbance of consciousness. But, if they

FIG. 7.—To show the distribution of the eruption in a case of herpes zoster. This proved on *post-mortem* examination to be due to inflammation of the sixth thoracic posterior root ganglion. (Head and Campbell, *Brain*, 1900, vol. xxiii, p. 470.)

FIG. 8.—To show the distribution of the eruption in a case of herpes zoster. This proved on *post-mortem* examination to be due to inflammation of the seventh thoracic posterior root ganglion. (Head and Campbell, *Brain*, 1900, vol. xxiii, p. 471.)

are sufficiently intense or of long standing, sensation is aroused; the pain is then projected to those parts of the surface of the body supplied by the affected segments, and these areas become tender, reacting excessively to any potentially disagreeable stimulus. They therefore reveal the afferent supply of the organ, which gave rise to the potentially painful impulses. It is obvious, therefore, that certain abnormal conditions of tension within the auricle can produce pain and tenderness, referred to the sixth and seventh thoracic and adjacent segmental areas. On the other hand, diseased conditions of the aorta and the ventricle may be associated with similar areas higher up on the chest, or in the region of the third and fourth cervical.

For the explanation of this remarkable phenomenon it is necessary to recall the embryological development of the heart. Evidently its afferent visceral innervation is upside down in relation to the present position of the adult organ. At one stage of its development, the heart consisted of a single tubular vessel, the hinder end of which was continuous with the great veins, whilst the anterior end bifurcated into two primitive aortae. At this time the heart lay in the middle line and clearly showed a division into three chambers; the hindmost of those becomes the auricle, the middle portion the ventricle, the most headward the bulbus aortae and ultimately the ascending arch of the aorta. This tube then becomes bent on itself, so that the hindmost or auricular portion comes in the adult to lie higher than the middle or ventricular portion.

Thus, the plan upon which the sensory supply of the visceral afferent system is laid down seems to be very antique and to represent an early stage of vertebrate development. Afferent impulses from the heart enter the segments of the central nervous system, just as if the auricles were still the hindmost portion of the heart and as if it was a median organ. Moreover, the segments affected jump from the fourth cervical to the first or second thoracic, omitting the upper limb, which has budded out at a later stage of development.

It will be noticed that Figs. 5 and 6 show not only areas of tenderness upon the trunk, but also upon the scalp. This is an aspect of referred pain arising from visceral disease which has been unaccountably neglected. It is obvious that, if some organ in the head, such as an eye, ear, or tooth, is affected, referred pain may be produced occupying areas on the face or scalp. But it is not usually recognized that tenderness, due to afferent impulses from some organ in the thorax or abdomen, may be accompanied by areas of tenderness on the scalp. What is the explanation of this remarkable phenomenon?

I must again ask you to follow me in certain developmental considerations (Fig. 9). That nucleus of the trigeminal nerve which supplies the greater part of the scalp, together with central connexions of the first and second cervical, form the somatic portion of a great complex of segments of which the visceral part is represented by what may be called the vago-glosso-pharyngeal. This supplies afferent fibres to the heart, the lungs, the oesophagus, stomach, and upper part of the intestine.

Now we have already seen that, when visceral afferent end-organs are exposed to a suitable stimulus capable of exciting them to action, impulses are poured into the central nervous system, and parts on the surface of the body in connexion with those segments become tender and over-react to external stimulation. Supposing that some organ supplied with afferent fibres from what may be called the vagus-complex sets up such impulses, the scalp becomes tender, because it is that portion of the surface of the body which is in direct relation with the excited segments.

The site of the headache and tenderness does not indicate directly the organ which is responsible for their production; they cannot be classed as "cardiac" or "gastric" neuralgias. The position of the tender areas on the scalp depends more on the segmental level of innervation of the painful focus than on the actual organ affected. Thus, the higher the areas of tenderness present upon the trunk, the further forward will they be found upon the scalp and vice versa.

Spread of Visceral Pain and Decreased Central Resistance.

Referred pain of visceral origin and the tenderness which accompanies it may be confined to the territory of a few

segments only, representing the nerve supply of the affected organ. But in the larger number of cases met with in daily practice this is not the case; if the stimulus is extremely severe—as, for example, during an attack of gall stones or renal colic—the pain may spread widely, even in otherwise normal persons; not only does it become bilateral, but it is liable to extend both upwards and downwards into regions that stand in no direct nervous relation with the affected organ (Fig. 10).

Should a referred pain become chronic, this forms an even more important cause for its diffusion; it tends to spread by the fact of its duration. For not only is the general resistance of the patient worn down by the disease, but the passage of painful impulses is facilitated by time; impulses can now excite pain which previously failed to do so.

Certain segmental areas seem to make their appearance with especial ease when central control is diminished, although they are situated far apart upon the body; thus, pain in the loins or over the forehead is liable to occur whenever general resistance is lowered. Organs, such as the uterus and breast, stand in close mutual connexion, and within twelve hours of labour referred pains not uncommonly appear in the front of the chest and in the scapular regions. These come and go with the "after-pains," and can be increased by the action of ergot or by manipulating the uterus.

These phenomena of generalization or spread of visceral pain and tenderness are of such common occurrence that they form an important factor in the clinical picture of many diseases. Diffusion of potentially painful impulses is normally prevented by that natural inhibition exercised by the central nervous system over disagreeable impressions; once this is relaxed, they spread widely. Normally, they would have been prevented from influencing consciousness, or would have been strictly confined to areas appropriate to the organ affected.

Certain general bodily states form potent causes of such diminished automatic control. Of these, menstruation is one of the most important in women. This physiological act may

be accompanied by referred pain, confined strictly to those segments which stand in direct relation with the pelvic organs; or the morbid sensations may occupy the whole of the body and lower extremities below the level of the umbilicus, with or without the cervical areas and occipital region of the scalp; finally, the head, trunk, and even the limbs may become painful and tender in parts that have no direct relation to stimuli within the pelvic organs. The extent to which such widespread generalization occurs depends more on the temperamental condition of the patient than on the intensity of the painful irritation or severity of the underlying organic changes.

Many women have a tendency to be what is called "neurasthenic"; strictly speaking, this unsatisfactory term should be confined to symptoms expressive of chronic nervous exhaustion. This state is characterized by a profound diminution of general control, exercised in the nervous system by the activities of one level over those of a lower one. This applies not only to physiological processes in the spinal cord and lower parts of the brain, but also to the mental

activities of the patient. Attention wanders, memory is defective; sleep, that most salutary means of increasing central control, fails. Under such circumstances any cause for pain, even the normal passage of blood through the lower segments of the uterus, may start painful impulses, which, in consequence of diminished automatic resistance, spread widely over the body.

A sudden rise of temperature frequently causes widespread generalization of pain. Follicular tonsillitis or any parenchy-

FIG. 9.—A diagram to explain the occurrence of headache and superficial tenderness of the scalp due to some affection of an organ within the chest or abdomen.

FIG. 10.—The upper figures show the superficial tenderness which was present before an attack of paroxysmal pain of cardiac origin. The lower figure shows the wide diffusion which appeared when the attack was over. (From *Brain*, 1895, vol. xix, pp. 210-211.)

matous affection of the tonsils is frequently associated with superficial tenderness on the same side, extending from the lower part of the mastoid almost to the middle line in front; this I have called the "hyoid" area. Suppose, however, that the onset is sudden and is associated with fever, we may now discover pain and tenderness on both sides of the neck, over the forehead, the occipital region, and even in the back or other parts of the body or limbs.

Anaemia is another cause of diminished general resistance to painful impressions. The patient may be profoundly anaemic and yet suffer from no pain or tenderness; but as soon as some source of pain is present, it at once begins to spread; toothache in an anaemic patient is a diffuse affection, extending far beyond the areas directly connected with the affected organ. If the local cause is removed, pain does not of necessity cease, at any rate immediately; for when central resistance has once broken down, control is recovered with difficulty.

In all these cases the pain originated in some definite and recognizable cause; it spreads widely because of the severity or long duration of the stimulus, or in consequence of the relaxation of central control. But sometimes pain and tenderness of this order may become widely diffused, in consequence of some debilitating psychological state, such as anxiety or emotional shock. Neuralgia and superficial tenderness of dental origin not uncommonly assume undue proportions owing to insomnia and worry, and the mental state of the patient has a notoriously profound influence over pains originating in the pelvic viscera.

Occasionally, central resistance to potentially disagreeable impulses is temperamentally so low that pain may appear without any obvious cause for peripheral stimulation. Some women are rarely free from tender spots in various parts of the body, representing the maxima of one or more of these tender areas. They form foci from which pain may generalize widely under the influence of emotion or other conditions, which lessen the dominant power of higher centres. No gross visceral stimulus is required. The central apparatus is already in an explosive condition, and any relaxation of physiological control leads to an outburst of energy manifested in widespread discomfort. In such cases, the order in which the phenomena appear does not follow rules that can be laid down for pain of visceral origin. Severe pain over the lower part of the abdomen and back may be accompanied by headache and tenderness situated over the forehead; the trunk can be widely affected without the head and neck, or vice versa. Such want of harmonious correlation points to the central origin of these morbid phenomena; they are not the direct expression, however extensive, of peripheral stimulation.

If we responded constantly and inevitably to all stimulation of peripheral end-organs, we should be automata, the victims of indiscriminate reactions. But, with the gradual evolution of its functions, the central nervous system acquires ever-increasing control over afferent impressions produced by the action of external forces. Such development takes place not only in the race, but in the life of the individual; and it is to this that we owe our power of acquiring new reactions and facilities.

Even in the fully developed nervous system of man, the acquisition of some new aptitude is associated with increasing central control over sensory impressions; we learn to adapt ourselves to the conditions around us, and cease to be the victims of unco-ordinated reactions. These are controlled or suppressed, not by the will, but by the power of adaptation, which is one of the most potent automatic factors in the activity of the central nervous system.

During the evolution of function, the power of responding in a more primitive manner is not lost. The mechanism of the older and more immediate reaction remains intact; but its activity is held in check, ready to become manifest, should the noxious stimulus grow unduly intense. Everyone, however healthy, is liable to suffer from pain during the passage of a renal calculus. But, in states of disease, this automatic control is likely to break down, less from the violence of the stimulus than from causes which lower physiological vitality. These may be both physical and mental; exhaustion and anaemia are no more potent than fear and anxiety.

The extent of this automatic control over sensory impressions not only varies from time to time, but is subject to extreme temperamental differences. As an automatic process, it takes its place with the other subconscious activities, which are of such fundamental importance in physiological aptitudes and instinctive reactions.

Pain and discomfort are among the most important of these conditions. I hope I have convinced you that, when the afferent impulses underlying these sensations and affective states impinge on the central nervous system, they disturb its balanced activity as a whole. The result they produce depends on the constitution of the organism, and not only on the site of the affected organ or the nature of the disease.

An Address

ON

PROBLEMS INVOLVED IN THE CONGRESS OF THE SEXES IN MAN.

DELIVERED TO THE OXFORD MEDICAL SOCIETY

BY

ARTHUR THOMSON,

LEES PROFESSOR OF ANATOMY, OXFORD.

I AM deeply sensible of the honour you have conferred upon me by inviting me to give your annual address. I confess in many instances such appeals are rather irksome—for they entail the preparation of an elaborate address. Now the delivery of such addresses is not in my line, and to impose on you the dreary task of listening to one would, I feel certain, not be fruitful of any good results. But in this instance I welcome the invitation, since it provides me with an opportunity of acquiring much-needed information, based on personal experience. Doubtless in the practice of your profession many of you must have pondered over some of the problems it will be my privilege to submit to you, and it will be to everyone's advantage if you will freely express your opinion.

My address, if address it can be called, will rather take the shape of a statement of the problems which still beset us in our attempt to unravel the mysteries of Nature.

Who that has studied the structure of the mucous membrane of the uterus has failed to be struck by the richness of its glandular elements? When we proceed further, however, and come to inquire what the function of these glands may be, we are at once plunged into the realms of uncertainty. The generally accepted views are far from satisfying. We are told that it is an admirable arrangement whereby Nature provides a suitable bed in which the impregnated ovum may be nourished, but a little reflection proves that this is not altogether a satisfactory explanation. The fertilized ovum, through the agency of its outer or trophoblastic layer, possesses the remarkable power of making a bed for itself, as exemplified in the many instances on record of extra-uterine foetations. May I recall to your memory the fact that the zygote may establish perfectly effective nutritive relations with the tissues with which it may happen to be in contact, be they tubal, peritoneal, or ovarian? The effective cause of its final destruction is the absence of such mechanism as the uterus provides for its ultimate expulsion into the outer world. This, and the fact that, according to modern views the glands play no part in the formation of the placenta, disproves the theory that these glands are an essential feature in the mechanism necessary to establish a nutritional connexion between the mother and the foetus.

As glands, what then is their function? Are they secretory or absorbent? In truth the views on the subject are very vague. Marshall,¹ a recognized authority on the physiology of reproduction, is discreetly silent on this subject, though he quotes the opinion of others to the effect that in the premenstrual period the increase in the size of the glands is supposed to be due to a collection of the secretion of the gland cells within the lumen of the gland.

Young,² in discussing the changes in the mucosa prior to and during menstruation, referring to the factors concerned, says: "Whether these are due to an activity of a secretory nature on the part of the epithelial cells, or whether an activity on the part of the stroma, also secretory in nature, can only be a matter of theory." On the other hand, whilst describing³ the pre-embedding changes in pregnancy, he describes the changes which occur in the pig as of the nature of marked "infiltration of the superficial layers of the mucosa with lymph. At the same time there is an active glandular secretion in process which leads to a marked expansion of the gland lumina." Similar changes, says he, are seen in the sheep and cow, where the blastodermic vesicles