steadily advanced, till eventually that branch of therapeutics now known as medical hydrology may be said to have gradually emerged from a form of empiricism, based largely on tradition and superstitious belief, to a recognized branch of scientific medicine.

I think we may justly claim that the work of this Association, in stimulating the study of medicine and the allied sciences, has contributed largely to the remarkable advances made in the treatment of disease during the last century. It is interesting to note that of the eleven names mentioned of those present at the original meeting at Worcester, when the Association was first founded, two are those of Dr. Edward Barlow and Mr. Soden, both of Bath; also that Bath supplied no fewer than six members of the original Council of the Association. It is further recorded that at the first Annual Meeting, held in Bristol on July 19th, 1833, Dr. Barlow, who became President in 1838, gave "an address of a retrospective nature"; so that ninety-two years ago, almost to the day, the original members of this Association were probably listening to an address given on almost the same lines as that which I have ventured to deliver to you to-night.

A Lecture

ON

SOME INVESTIGATIONS OF SENSATION.*

BY

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Of all the many research workers upon sensation, none have made such valuable and extensive contributions to our knowledge as Dr. Henry Head, who has not only provided us with a new vision of the loss of sensibility following division of a peripheral nerve, but has demonstrated the whole sensory pathway from the end-organs to the optic thalamus and sensory cortex. By devising measurable tests and employing these for study of each individual element of sensation, he has shown that such terms as "diminished sensibility" have no meaning, and if we examine accurately the sensory disturbance in cases where such terms have been used we commonly find that one or more elements of sensation are lost and others retained. The latter information, in the light of our present knowledge of the sensory pathway, is of value and primary importance for the purposes of diagnosis and treatment.

The classical experiment upon Head's own arm constituted the crucial test of his views upon peripheral sensation and established the existence of the two systems, epicritic and protopathic, in cutaneous sensibility. There appears to be ample evidence that these two systems are independent and do not depend simply upon a modification of the same system of nerve fibres and end-organs. The most striking support appears in the reverse dissociations of the two systems which were discovered in his own hand. At the periphery of the area of sensory disturbance was found a strip where epicritic sensation was lost and protopathic retained, whilst a small triangular portion was also discovered where the condition was complementary, epicritic sensation being intact and protopathic lost. In my own investigations of sensation I have encountered the same complementary dissociations of the two systems. Further proof of the existence of the two systems is to be observed during the recovery after suture of a peripheral nerve; invariably recovery of the elements constituting protopathic sensibility occurs first and most completely, while epicritic sensibility returns at a later period, and as a rule makes a less perfect recovery.

To these two systems found in cutaneous sensation Head added a third—deep sensibility—which was capable of

responding to pressure, passive movement of joints, and pain caused by excessive pressure. He found that a part endowed solely with deep sensibility possessed not only the ability to recognize a pressure stimulus, but also the power to localize it with remarkable accuracy. Furthermore, it was decided that "the fibres subserving this form of sensation run mainly with the motor nerves, and are not destroyed by division of all the sensory nerves to the skin." Our knowledge of deep sensibility is based almost entirely upon an investigation of the residual sensation in the experiment upon Head's own arm, and less attention has been given to it than to cutaneous sensation, only scanty information proportionately being available concerning its recovery after nerve suture. It has become almost the rule in clinical work to test only one element of sensation (recognition of contact of pressure) in order to discover whether deep sensibility is disturbed, and this has probably delayed advance in our knowledge of this important division. Owing to certain observations which I made in the course of routine examinations of patients with peripheral nerve injuries, it appeared advisable to make a full investigation of deep sensibility, following the fundamental principles enunciated by Head. In the time at my disposal it is only possible to set out very briefly some of the results of this research, and I shall therefore confine myself to three aspects of the subject.

I. Residual Sensation after Division of a Purely Cutaneous Nerve.

Head selected the radial and musculo-cutaneous nerves for his experiments because they are described by anatomists as purely cutaneous in distribution, and his investigation was primarily concerned with cutaneous sensation. From a careful study of the sensory loss after division of the musculo-spiral or radial, I have found that the distribution exhibited in Head's hand was exceptional, and that usually the radial nerve does innervate subcutaneous tissues. This was easily demonstrated in respect of recognition of passive movement, which element of deep sensibility was clearly defective in 12 out of 14 patients suffering from division of the musculo-spiral or radial nerves. Confirmation of this observation was obtained by a study of the residual sensation in four patients with division of both the median and ulnar nerves. These and similar investigations of the sensory loss consequent upon the division of other nerves seem to make it clear that no nerve of sufficient size to be of clinical interest, or to be selected for experimental work upon sensation, is distributed exclusively to skin. This makes it almost impossible to isolate cutaneous or deep sensibility, and complicates seriously investigations upon peripheral sensation. Furthermore, it is advisable for anatomists to delete in future the misleading qualifications "purely" or "solely" of such nerves as the radial.

II. Innervation of the Deep Tissues.

Head's work led us to believe that the subcutaneous tissues were mainly innervated by fibres which ran with the motor nerves and reached such structures as the joints by following the tendons. Such a view appears to be true if we depend for our knowledge of deep sensibility upon the results of testing the recognition of pressure alone, since we find no loss of this element of sensation after division of the median or ulnar nerves at the wrist. If we investigate all the elements of deep sensibility under such conditions we discover that deep sensibility is grossly affected. After division of the median or ulnar nerve at the wrist it is found that the recognition of passive movements of the metacarpo-phalangeal and interphalangeal joints of the digits supplied by the nerve is as seriously disturbed as when the nerve is divided in the forearm or arm. Measurable tests also demonstrate that the power of localization is defective in the field of distribution of the nerve under investigation. It is probable that the other two elements of deep sensibility are also dependent to a considerable extent upon branches which pass directly from the nerve trunks to the tissues. There seems to be no doubt that deep sensibility is affected seriously by division of the median or ulnar nerves in the neighbourhood of the wrist; and Dr. O. M. Duthie, working in the anatomy department

* Abstract of a lecture given during the visit of the Inter-State Post-Graduate Assembly of America to Manchester, June, 1925.

of this university, in a study of the loss of sensation in twenty patients suffering from division of tendons (uncomplicated by any nerve lesion), has recently confirmed this observation.

III. Recovery of Deep Sensibility.

From the study of the recovery of the deep sensibility after nerve suture in a large number of patients it has become evident that deep and cutaneous sensations are strikingly comparable. Just as Head found two stages in the recovery of cutaneous sensation, two similar ones have been found in the study of deep sensation. Two elements of deep sensibility (recognition of contact and pressure pain) recover early and very completely, as a rule during the stage of protopathic recovery; while the other two elements (localization of pressure and recognition of passive movement) recover later and less perfectly, as in the case of epicritic sensation.

When we notice the elements of sensation in both cutaneous and deep sensibility, which recover early and late, in connexion with Head's researches on the sensory cortex, we seem to get some light upon the problem as to why two stages in recovery are found. It has been suggested that protopathic sensibility recovers earlier than epicritic because the former is more primitive and regenerates at a more rapid rate. Such an explanation supposes some structural difference in the two systems, but Adrian has shown that it is highly improbable that there is any definite structural difference in the fibres concerned with protopathic and epicritic sensation. A simpler and more effective explanation is suggested when we take into consideration all the forms of sensation, in both skin and the subcutaneous tissues, which return during the later stage of recovery. The forms appearing late, and which more frequently exhibit imperfect recovery, are those which Head has proved to have cortical representation; while the forms which recover early and more completely and constantly are those which may be expected to persist after destruction of the sensory cortex. Therefore it appears more reasonable to discover an explanation of the two stages of recovery in the central nervous system, rather than to find it due to a different rate of regeneration of two sets of fibres which anatomically appear to be identical. After suture and regeneration of a peripheral nerve a much longer period must be expected to elapse before the fibres subserving cortical forms of sensation function correctly than in the case of the fibres conducting thalamic aspects of sensation, since a very much more complex readjustment and re-education is necessary after regeneration in the former case than in the latter. This central explanation of the two stages in recovery also offers obvious reasons for the more perfect and complete recovery, after nerve suture, of those elements of sensation which have thalamic representation.

Summary.

To summarize the more important results of these investigations of deep sensibility, I would suggest:

1. No nerve of sufficient size to be of clinical interest is distributed solely to skin, and in consequence it is practically impossible to isolate cutaneous and deep sensibility.
2. The principal innervation of the deep tissues is by nerve fibres which arise from the main nerve trunks and pass directly to the end-organs. The supply by fibres which accompany the motor branches and pass to their final distribution along tendons seems to be only supplementary.
3. It is necessary to divide deep sensibility into two systems, comparable to Head's subdivision of cutaneous sensation. Recognition of the contact of pressure and the appreciation of pressure pain recover early, while the recognition of passive movement of joints and the localization of a pressure stimulus recover late and less perfectly.
4. A more satisfactory explanation of the reason for the two stages of recovery in both cutaneous and deep sensibility is to be found in the central nervous system, from a study of those forms of sensation which are dependent upon the sensory cortex and the thalamus.

5. For a classification of the elements of sensation affected by division of a peripheral nerve the following scheme may prove serviceable:

I. Cutaneous Sensibility:

Thalamic (early recovery).—Discrimination of wider difference of temperature. Cutaneous pain.

Cortical (late and less perfect recovery).—Appreciation of lightest form of touch. Localization of lightest form of touch. Discrimination of finer differences of temperature. Recognition of two compass points, simultaneously applied, as two.

II. Deep Sensibility:

Thalamic (early recovery).—Appreciation of contact of pressure. Pressure pain.

Cortical (late and less perfect recovery).—Recognition of passive movement of a joint. Localization of pressure.

A British Medical Association Lecture

ON

THE NERVOUS CHILD AS SEEN IN MEDICAL PRACTICE.*

BY

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THE nervous child may be described as one who is capable of intense emotions which can be quickly aroused and over which he has insufficient control. His nervous system is unstable. This is made very manifest in sickness, and certain symptoms thus aroused may long act as a reminder. Guthrie states that individual instability may be shown in defective control of the lower nerve centres by the higher.

There are two types of the nervous child, which were called by Leonard Guthrie (1) the unrestrained emotional type, and (2) the restrained emotional type.

In the first type the child is as a rule thin and of slight build. The face is not infrequently pale, sallow-complexioned, and dark lines may be visible beneath the eyes. Cameron has called attention to the nervous stance which so many of these children adopt, in which the abdomen is very prominent, the shoulders thrown well back and the head slightly forward; lordosis is not infrequent, and winging of the scapulae is sometimes seen.

Although the nervous child appears to be a mass of animation and is possessed of restless energy, he tires easily. The vasomotor nervous system would seem to be a source of trouble in many cases, as instanced by the dusky-looking hands and feet, and sometimes chilblains or even Raynaud's disease, and the quick changes of colour which may occur in the cheeks and lips. Palpitation, precordial pain, tachycardia of a functional nature, abdominal pains, mucous diarrhoea, constipation, headache, and migraine, may be all due to vasomotor disturbance. Hyper-sensitiveness of taste, hearing, sight, smell, and touch are usually present, and especially the last named. No wonder that as babies they are difficult to feed. The intelligence may be normal or above, but occasionally it is below the normal average.

The nervous child is filled with restless energy, but unfortunately determination is not commensurate with his energy, and it is not difficult for him to be discouraged from his purpose. Difficulties seem to him to be greater than they really are. He may often enter into things with enthusiasm if the impulse so moves him, but he works with almost fierce energy for a short period and is only too ready upon the least feeling of exhaustion to leave his purpose uncompleted. It is strange, but this child, so often clever, is apt to be rather amiss in judgement and common sense. Trifles worry him, and yet he does not always appear to have it in him to do what is necessary to overcome the difficulties which cross his path. The child is generally timid, and in the majority of cases he will not protect himself if attacked by another child. Nearly every neurotic child is imaginative, fearful of trouble, and rather apt to believe in that which is superstitious. Many

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