HERRICK'S "AN INTRODUCTION TO NEUROLOGY"*

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During the past twenty-five years the clinical neurologists have been losing faith in neuropathology as a prime method for the solution of their problems. Perhaps in the first place they were misled into hoping too much from this method. Be that as it may, there is now something of a tendency "to throw out the baby with the bath" and to reduce to a minimum the anatomical data which are utilized.

The anatomy of the nervous system both normal as well as pathological has suffered from this shift of interest. Of course, in this case, as always, there is some reason for the present state of affairs. In the first instance anatomical relations have been over-interpreted and further during the last two decades the finer anatomy of the nervous system has been so assiduously cultivated that the great mass of data collected was in danger of becoming a burden unless the facts could be classified and strung on a stout physiological thread.

The move toward this solution has been slow, and in the meantime the gap between neuro-anatomy and clinical neurology has remained only too evident.

Herrick's "Introduction to Neurology" helps to bridge this gap in a very satisfactory manner, for it presents the anatomy of the human nervous system in its physiological relations.

The book contains 137 illustrations, mainly Schemata, with full legends. Of the 338 pages of text, 45 pages are in fine print—used for the presentation of details—and 39 pages are given to a glossary-index containing concise definitions of all of the newer technical terms. Thus, within the remaining 254 pages on which the illustrations also appear, the author has succeeded in presenting the main facts of neurology as they stand to-day. This means compact writing. The book is avowedly an intro-

* Herrick, C. Judson. *An Introduction to Neurology*. W. B. Saunders Co., Phil. and London, 1915, p. 355.

duction or outline and this limitation is consistently kept in mind. It is so written, however, as to be instructive to the physiologist, clinician and psychologist, or in other words, any student who requires a concise statement of neurological facts. With each chapter goes a bibliography, and these bibliographies taken together comprise the titles of the important contributions to neurology.

Guided by the idea that the best understanding of the nervous system is to be had by viewing it as a mechanism at work, our author starts with the reflex circuit (a term preferred to reflex arc) as his unit, and proceeds to show how the entire nervous system can be regarded as arranged so as to furnish such reflex circuits, which increase in complexity as, one after another, the more cephalic divisions of the central system (medulla oblongata, thalamus and cortex), are involved in the reactions. This arrangement holds good for the entire vertebrate series, but, as we ascend in the scale, the increasing development of the cephalic divisions brings about responses better and better adapted to favor the welfare of the organisms as a whole.

The book opens with the statement of general biological ideas, nervous function and the characters of the neuron. Then the discussion of the reflex circuit, anatomical and physiological leads to an account of the general anatomy of the nervous system. This is followed by an examination of the larger divisions and parts. It is of interest here to note that while six chapters are required for even a brief description of the sources and pathways of incoming impulses, a few paragraphs amply serve to indicate the arrangement of the efferent neurons. The remainder of the text is given mainly to describing the arrangement and functional connections of those neurons which mediate between any incoming impulses and the neurons of final discharge (efferent neurons). This allotment of space alone serves to indicate the enormous relative development of the afferent and central divisions of the nervous system in the higher vertebrates.

In the course of the presentation our author elects to write the words neuron and axon (sic) without a final e. From Sherrington he adopts the terms receptor (exteroceptor; interoceptor and proprioceptor) for the sense organ; and effector for the organ of response. Moreover he has formulated a more precise use of the terms correlation, association and coördination, terms

sometimes indiscriminately applied. The cells to which afferent impulses are delivered or between which they pass before they reach the neuron of final discharge, are called correlation neurons. This is the more general term. But the activity of such correlation neurons in the cortex is linked with consciousness and these cortical elements are, therefore, distinguished as association neurons.

Coördination describes the orderly activity of effectors but whether we should distinguish coördination centers as a third class of central neurons seems doubtful, though our author does so (page 181). As matters stand the typical group of coördinating neurons is represented by the cerebellum. It will be noted that the expression reflex circuit has been used in place of reflex arc. The analysis of the reflex by Dewey has drawn attention to the facts on which this change is based. The same afferent axon by its collaterals delivers impulses to the correlation neurons in the region of its immediate entrance into the central system and at the same time by its main axon or other branches to more remote correlation neurons, so that impulses returning from the higher to the lower center find a prepared, rather than indifferent, neuron on which to act. A like relation is found between the effector and the central neurons. A circulation of impulses is thus suggested. This is a concept of much value and on it our author lays due stress.

The convenient term reflex pattern is also utilized. This term, suggested by Sherrington, was applied originally to the form of the functional response to a stimulus, but as such a response implies a structural basis more or less precise in arrangement it is hard to escape the use of the word pattern in the structural sense (p. 312). The term is excellent, but it would be helpful if it could be so modified as to make precise in each instance the sense in which it is applied. In the matter of technical terms the text follows the B. N. A. except in a few instances. The most notable departure is made in the case of the bundles of fibers which appear in the cross section of the spinal cord. As the analysis of the cord proceeded in the hands of the earlier anatomists, the names applied were largely based on the local relations. The B. N. A. established the general term fasciculus for such bundles, but our author has advanced a step and while retaining the term "fasciculus" for the bundles composed of

fibers having various or undertermined functions, he has used the term "tractus" for those bundles, the connections of which are known, giving in the second part of the name the origin and termination of the constituent fibers, e. g., (1) Tractus spino-tectalis; (2) Tractus tecto-spinalis. It is not always easy to use a nomenclature so defined in such a way as to avoid criticism, but the introduction of the distinction which it allows is a definite advance.

In the presentation before us we find as distinctive features the emphasis placed on the reflex circuit, as the unit of functional response, and the application of the results of comparative anatomy to the appearances found in the human nervous system. Our author is peculiarly well qualified to write from this latter standpoint and he has used his advantage with discretion. From comparative anatomy come several general concepts which do not always appear in the text books. One of these is the concept of nerve components. The older descriptions assumed, for the most part, a uniform function for each of the spinal and cranial nerves. It has been shown, however, that bundles of fibers of diverse function are to be found in most, if not all, of these nerves; that in different vertebrates the same morphological nerve may have a different set of components and also that components of like functional value may connect with the central system by way of several different nerves. These relations serve to direct attention to the functional groups of fibers as contrasted with the structural groups, and the change in view has proved very helpful. Associated with these studies is the concept of the gray substance of the axial nervous system as comprising four functionally distinct cell columns in each lateral half. Enumerated from the dorsal to the ventral position, as they appear in a cross section of the cord or medulla, these cell columns are named somatic sensory, visceral sensory, visceral motor and somatic motor. The consequences of this arrangement are far reaching and are worthy of careful consideration from the standpoint of the clinician.

Comparative studies show also many remarkable variations in the central cell groups, especially in those of the bulb. Among the lower vertebrates, some forms depend for their principal reactions largely on a single sense and it often follows that this sense organ and its central connections are in such cases almost

monstrously developed. Thus there are forms depending mainly on the sense of smell or of taste or touch or vision and in each instance showing a relative over-development of the neural structures concerned. The study of these and other instances of unbalanced structure has furnished a clue to the significance of various cell groups in the human bulb otherwise difficult to interpret. For example it has thus been possible to clear up the arrangement of the nuclei of the vestibular apparatus—from which the cerebellum has been elaborated, and also to interpret such a cell group as the nucleus of the fasciculus solitarius, the center of the taste (p. 234). But the applications of these comparative studies extend still farther. By their aid it is possible to distinguish between the primitive thalamus (paleothalamus) and the large additional mass (neothalamus), as it appears in man and the anthropoids, with its various cell groups and highly elaborated cortical connections. Using like methods it has been possible also to follow the evolution of the neopallium or the part of the cortex (pallium) superadded to that primitively associated with the olfactory apparatus.

In dealing with the functional problems the general somatic sensations have received careful consideration and the results obtained by Head and his collaborators have been incorporated. Of special interest in this connection is the problem of the mediation of pain. The questions here are many. Are there special afferent nerve fibers for pain only, or do some terminals of these somatic fibers yield sensations of pain while other terminals of the same fibers mediate different sensations, or can over-stimulation of any of these fibers give rise to sensations of pain? Our author discusses these questions and concludes that there may possibly be some special pain nerves, but also that "most sensory nerves may upon occasion function as pain nerves."

The questions here put in connection with nerves mediating pain, may be equally well asked with regard to the other sensory nerves and they serve to raise the ghost of the doctrine of specific energies. Although it is not much discussed, and is usually criticized adversely, the doctrine of the specific energies of nerves still casts its shadow over neurology. The rigid form of this doctrine, the form with which Helmholtz worked, looks upon the sensory nerve fiber as an unbranched thread running from its peripheral termination, where to be

sure it might be represented by a number of terminal filaments, by way of a ganglion to its center, there to mediate one kind of change the specific central response for that fiber. The structural picture on which this doctrine was based can no longer be accepted. We now know that the afferent neuron sends into the central system an axon which always branches and often forms connections remote from one another and plainly associated with diverse correlation centers, while the nerve fiber passing to the periphery from this same ganglion cell in many cases branches several times in its course, sends these branches to different peripheral localities and at the periphery may, in the skin at least, be connected with more than one type of sensory end organ. This calls for a reconsideration of the problem and it seems possible, therefore, to think of nerve impulses as having distinctive characters that determine which one of the many possible paths each type of impulse is to follow within the central system. Here is a field open for further study. In man the pathway for pain formed by central neurons in the spinal cord is represented both by a diffuse arrangement as in lower forms and also by a well marked tract. (*Tractus spino-thalamicus lateralis*). The recent observations of Head and Holmes make it probable that in the cell groups of the thalamus, where these fibers end, we have a center stimulation of which gives rise to our sensations of pain. It has been customary to associate changes in consciousness with the activity of the cortex only, but in view of these results we must now grant certain cell groups in the thalamus a like dignity.

The last chapters of the book treat of pleasure and pain (we need a better word antithetic to pleasure) and of the human cortex; its structure, functions and evolution. In the course of these chapters a new picture is given of the relation of the higher centers which increase in complexity from the bulb to the thalamus and from the thalamus to the cortex. In place of the usual notion of the impulses from complex higher centers acting on lower centers which are more or less indifferent or passive, our author points out that the incoming impulses set or adjust for discharge circuits of increasing complexity, as these impulses pass to higher and higher centers and as a consequence the return impulses from the cortex which release the final response, act by selecting one out of several circuits which are held ready

for action. Thus the integration of the incoming impulses is continually in process at each level and impulses from above act in a large measure to release mechanisms partially prepared.

It has been one purpose of this review to show that Herrick's book is an introduction to a more significant neurology than is usually presented to us, for starting as it does with the reflex circuit as the unit of function and keeping the physiological relations in the foreground it illuminates the structural arrangements within the nervous system in a way that is both unusual and stimulating.