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A RECENT TENDENCY IN DESCRIPTIVE NEUROLOGY

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It has been the custom in describing and teaching the central nervous system to divide the brain and cord into the gross morphological units—cerebrum, basal ganglia, thalamus, mid-brain, pons, cerebellum, medulla oblongata and spinal cord with its four regions and two enlargements. These divisions are studied in detail, and it is shown how the various masses are derived from a simple neural tube and its three "primary" vesicles. Extraordinary emphasis is laid on the mechanics of the mysterious chorid plexus and the foramen of Monroe. Having completed the identification of such macroscopic features it is customary to determine microscopically the internal structure of these separate divisions, proceeding from the cord toward the brain or in the opposite direction. Descriptions then usually conclude with the enumeration and course of the projection fibers and paths connecting the morphological divisions. In other words we are accustomed to descriptions of the nervous system based essentially on form, and we visualize it as a piece of inert architecture.

Inasmuch as our first knowledge of the central nervous system pertained to its form it is natural that the first descriptions should take on a morphological character—both in the human brain, toward which attention originally was almost exclusively directed, and also in the case of the comparative and embryological studies which have appeared later. As a consequence we have at our disposal an "orderly" arranged mass of strictly morphological details that may be said to have reached a high degree of completeness. The little that has in the meantime been discovered by other workers concerning the functional significance of the various brain parts has until recently had but small influence on our analysis of the nervous system. The priority and predominating bulk of the morphological matter have completely controlled the custom of descriptive treatment.

The first break in the traditional treatment was about ten years ago when Edinger published his enlarged book of lectures.[1] He had discovered the advantage of combining the study of form and function, and produced a work best characterized as an embryological and comparative anatomy illuminated by experimental and clinical data. Though he does not succeed in entirely breaking away from the time-honored method of dividing the brain, yet he does succeed in making one constantly feel that the brain is a living mechanism. The immediate acceptance of this book and its consequent wide circulation and numerous editions testify to the appreciation of the innovation on the part of his readers.

It was the same feeling for the functional character of the nervous system that influenced Meyer in his paper on brain structure.[2] He is more radical than Edinger, and discards the morphological divisions such as the pons, mid-brain, etc., as units of description. In place he proposes to divide the nervous system into a series of functional transverse laminæ or segments. These do not necessarily correspond to metameres. In the spinal region the portion of cord which corresponds to a single nerve root constitutes a segment. The cranial region he divides into five segments, based on their peripheral connections:

1. Visceral segment, regulating the mechanism of respiration, of articulation and deglutition.

2. Auditory-facial-abducens segment, regulating equilibrium, hearing, and the movement of eye, face, and ear muscles.

3. Mastication segment, regulating movements of jaw and sensation of face and fauces.

4. Optic segment, with optic nerve and muscles of eye-ball.

5. Olfactory segment, the only segment that has afferent fibers alone.

These divisions are shown in the accompanying figure, which is based on Meyer's Fig. 6, the cerebral and cerebellar mechanisms having been omitted.

In these functional segmental units Meyer sees a repetition of type which he resolves into the following elements:

1. Segmental neurones—efferent and afferent nerves.

[1] Edinger, L., Vorlesungen über den Bau der nervösen Zentralorgane des Menschen und der Tiere, Leipzig, 1896. This was preceded a few years by a smaller book of ten lectures for physicians.

[2] Meyer, A., Critical review of the data and general methods and deductions of modern neurology, Jour. of Comp. Neurol., Vol. VIII, 1898.

2. Intersegmental neurones—means of coordinating various segments, *e. g.*, ground bundles.

3. Supersegmental neurones—elaborated centers for special mechanisms, *e. g.*, cerebellum.

With this framework he sketches out the nervous system of low forms, such as the worm, and then proceeds to higher forms, working in, in a general way, the details of the most highly organized nervous system. His proposed analysis possesses many features that commend it for clinical and didactical use.

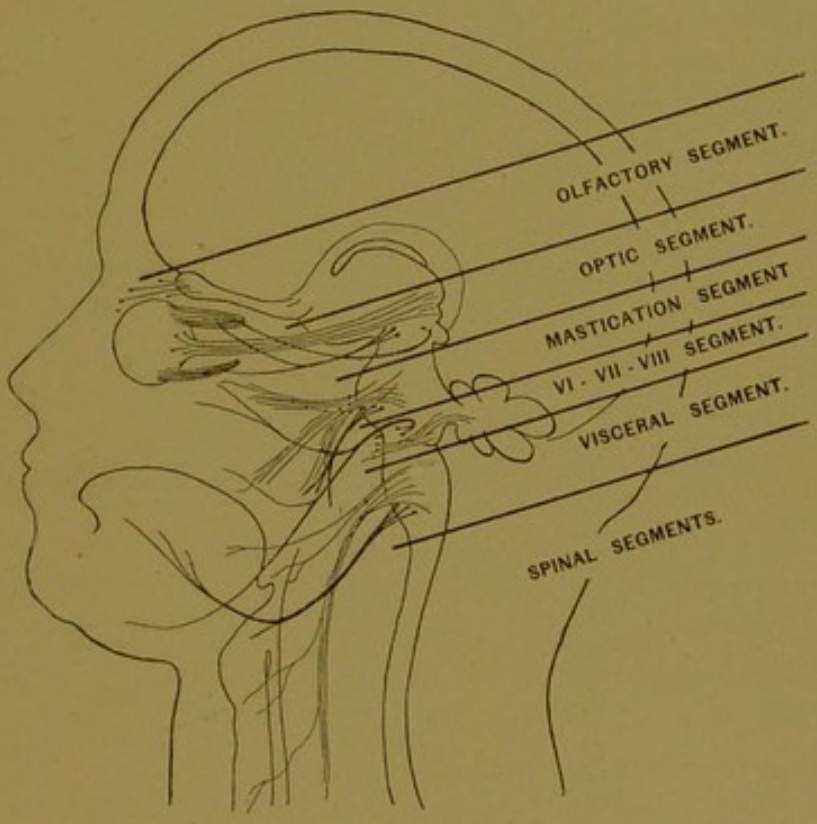

FIG. 1. Diagrammatic profile of the head, showing the subdivisions of the central nervous system proposed by Meyer. Sensory fibers are indicated by fine lines, and motor fibers by heavy lines. The term "segment" is not used in a metameric sense.

A third notable stride toward a functional description of the central nervous system has just been made by Johnston, in a book which is likely to receive much consideration.[3] Like Meyer, he discards the customary morphological method of treatment and traces its structure and phylogenetic history entirely on the basis of function. His functional

[3] Johnston, J. B., The nervous system of vertebrates. Philadelphia, 1906.

units, however, differ from those of Meyer in being made in a longitudinal direction, while those of the latter consist as we have seen of transverse segments.

There are, according to Johnston, two main activities in the vertebrate organism: first, actions in relation to external world (somatic), and secondly, internal activities having to do with processes of nutrition and reproduction (visceral). In each case there is a two-fold activity on the part of the nervous system; reception of stimuli and motor responses. Thus the nervous system consists of four functional divisions:

Somatic sensory elements.
Somatic motor elements.
Visceral sensory elements.
Visceral motor elements.

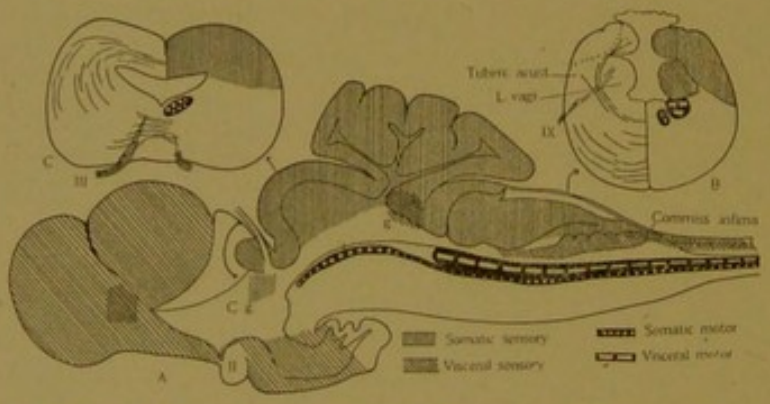

FIG. 2. Profile and two transverse sections of a simple vertebrate brain, showing arrangement of the four primary divisions of the nervous system. After Johnston.

With certain exceptions each of these divisions is represented in each segment of the nervous system, and all of the segments of a given division are serially homologous. Structurally and functionally they constitute bilaterally four longitudinal columns, which, according to him, are the primary elements of the nervous system and are more fundamental than the metamerism of the body. The arrangement of these divisions is shown in Fig. 2, which is taken from Johnston's book.

In addition to the four primary divisions there are the group of brain centers and tracts which perform functions of correlation and also the specialized sympathetic system. Under these headings then he classifies the whole nervous mechanism. The method of treatment adopted

by him is an outgrowth in part of his previous studies and in part is based on the work of others, among whom are Strong, Herrick, C. J., and especially Gaskell, who deserves credit for first showing the identity of the visceral and somatic divisions. This, however, is the first time that the whole vertebrate nervous system has been gone over and functionally divided and described in longitudinal systems as has been done in the book under discussion.

Though it is probable that Meyer's system of segments could be readily adapted to didatic purposes by those working with the human brain and would be of immediate advantage clinically; yet the serial overlapping of structures makes any system based on transverse laminæ difficult to apply for purposes of finer analysis. Meyer encounters this difficulty in his facial-abducens-auditory segment. The facial nerve and its pars intermedius belong functionally and structurally to the glossopharyngeus and vagus group, and aside from position, have nothing in common with the vestibulo-cochlear apparatus, with which, however, in his system he is forced to include them. This difficulty is avoided in Johnston's scheme. His longitudinal divisions seem to be completely adequate in the cord and hind-brain. There is much, however, in the fore-brain that such a system leaves involved in difficulties, and in some of his interpretations other people may disagree with him. Thus, regarding the olfactory apparatus, which he classes under the visceral sensory system, there are those who may be inclined to consider it, like the optic apparatus, as belonging to the cutaneous or somatic sensory system. It may be expected that such complexities will be straightened out as we lessen the amount of functional ignorance that still persists concerning this region. Judging from Johnston's success thus far in demonstrating one fundamental (functional and structural) character of the four primary longitudinal systems, we have reason to hope that that there is here an adequate basis for the analysis of the central nervous system.

The work of the writers that have been referred to in this paper indicates that there is a wide-spread feeling of dissatisfaction with the existing cumbersome and lifeless descriptions in neurology; and though it is not safe to predict what the details of the future analysis are to be, it is, nevertheless, evident that the said analysis will be made in terms expressing function.

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