Periscope

THE MEDULLA OBLONGATA OF LARVAL AMBLYSTOMA. C. Judson Herrick.
(The Journal of Comparative Neurology, Vol. 24, No. 4.)

The factors operating in either the ontogenetic or the phylogenetic differentiation of the correlation centers of the brain cannot be profitably investigated without a precise knowledge of the peripheral relations of each functional system represented in these centers and of the interrelations of these systems at every step in the progress of the nervous impulses transmitted by them during the course of normal functional activity.

In the analysis made by this author of the central course of the cranial nerve roots it has been found, he states, that the individual fibers of each sensory root of the V, VII, VIII, IX and X nerves bifurcate immediately upon entering the medulla oblongata into ascending and descending branches. The ascending and descending fibers of each root are united into distinct fascicles which retain their individuality from the superficial origin of the root upward and downward respectively throughout nearly the entire length of the oblongata. All of the somatic sensory root fibers divide in this way and many, if not most, of the visceral sensory fibers also do so. From this it follows that the white substance (stratum album) of the sensory region of the oblongata from the level of the spinal V tract dorsalward contains a series of longitudinal fascicles of root fibers, each of which is a functional unit and whose fibers are distributed peripherally to a particular species of sense organs. These fascicles of root fibers occupy the entire stratum album of this part of the oblongata, save for the presence of two additional bundles of correlation fibers (the tracts *a.* and *b.* of Kingsbury) and for a variable amount of a superficial neuropil in the marginal zone of the white substance. This arrangement is preserved throughout the length of the acustico-lateral area of the oblongata.

The neurones of the gray layer (stratum griseum) of the sensory region of the oblongata send their dendrites outward to arborize among the terminals of these root fibers and the synaptic connections here effected are made in accordance with a definite functional pattern; but this pattern is far less simple than that of the root fibers and there are few groups of neurones of the gray substance which can be regarded as the specific or pure terminal nuclei of particular functional systems of sensory roots. Most of these neurones effect synaptic connection with the white layer with more than one physiological type of root fibers, from which it follows that the function of primary receptor centers and correlation centers are in these cases united to some extent within the individual neurones of the second order. The white substance of the medulla oblongata of these Urodeles contains, in addition to the motor and sensory root fibers, a large number of correlation fibers, and the longer systems of these fibers are arranged in definite correlation tracts.

From the relations described in the preceding paragraph, it is evident that correlation tracts are intermediate in physiological type between those

of the spinal cord of these larvæ and those of the oblongata of mammals. In the spinal cord of larval Urodeles there is little evidence of localization of function in the sensorimotor apparatus, but each of the larger correlation neurones (and many of the peripheral motor neurones also) seems to effect synaptic relations with the entire stratum album, to wit, with sensory root fibers of all kinds and also with all of the long correlation tracts of the cord. In the mammalian medulla oblongata, on the other hand, each functional component of the various sensory roots of the cranial nerves terminates in a specially differentiated end-nucleus, from which neurones of the second order conduct the nerve impulses of their respective sensory types either directly to the motor centers through the reticular formation or by long tracts to higher correlation centers. These secondary tracts transmit unmixed specific sensory excitations of the same functional type as the roots with which they are functionally related. Finally in the oblongata of Urodele larvae a third type of correlation neurones is found. The peripheral neurones of the sensory roots of the cranial nerves exhibit a specificity of function which appears to be as precisely localized as that of the corresponding mammalian nerves and to show essentially the same arrangement of nerve components in the cranial roots. The regional localization of the end stations of these various functional types of root fibers is tolerably precise and clearly defined. But the sensory neurones of the second order are not arranged in similarly circumscribed nuclei related respectively to these definite end stations of the peripheral neurones. On the other hand, practically all of the neurones of the adjacent gray substance send their dendrites into at least two and often into several different end-stations, so that the same secondary neurone may be, and apparently habitually must be, capable of excitation by two or more diverse end organs. Thus, a single neurone of the oblongata may effect synaptic connection with glossopharyngeal fibers from taste buds and also with trigeminal fibers of tactile sensibility, with root fibers from the V and also from the VIII cranial nerves, or with fibers from the tactile sense coming in from the head by way of the V cranial nerve and with fibers of the tractus spinobulbaris conveying tactile impulses from the trunk region. Each sensory neurone of the second order in the oblongata is, accordingly, at the same time a correlation neurone and the apparatus for the sensory analysis of peripheral stimuli is greatly simplified as compared with the mammalian condition, though more perfect than that in the spinal cord of Urodeles. Nevertheless a certain degree of functional localization in the gray substance is evident. The fasciculus solitarius is the most distinctly separate bundle of root fibers and the related neurones of the lobus visceralis are evidently under the exclusive or dominant physiological influence of this system of root fibers. In the somatic sensory area the secondary neurones related with the V root fibers are tolerably distinct, though in all cases related also with other systems, particularly the VIII root, the secondary visceral tract and the underlying tegmentum. The neurones related with the VIII and lateral line roots form a fairly distinct group, the area acustico-lateralis, the more dorsal members of this system of neurones being related exclusively with the various lateral line roots (always with more than one of these roots) and the more ventral neurones having more diversified connections. In the adult the functional localization of specific terminal nuclei within the area acustico-lateralis is far more completely elaborated than in the larvæ. Though the physiological segregation of the secondary neurones into specific sensory centers is incomplete in these larvæ and few of the tracts

of the second order carry pure sensory impulses derived from a single functional system of peripheral root fibers, yet in most cases some one of these peripheral systems evidently dominates the pathway. In the further evolutionary history of these secondary pathways the dominant system in each case appears to have persisted to the exclusion of the subordinate connections, and the functions of correlation are thus transferred from the primary receptor centers to the reticular formation for the simple bulbar reactions and to the higher cerebral centers for the more complex reactions. We are, accordingly, able to recognize the mammalian equivalents of most of the amphibian correlation tracts, though the homology in all of these cases is incomplete owing to the imperfect segregation of the amphibian primary terminal nuclei of the cranial nerve roots.

The gray substance of the oblongata shows progressively more clearly defined areas of functionally distinct neurones as we pass from the spinal end forward. And the anatomical arrangement suggests that the capacity for diversified reactions is greater in those parts of the body innervated from the anterior end of the oblongata. Physiological observation, of course, shows that this is the case. In *Amblystoma* of different ages various forms of reflex connections are now known and these can be arranged in a graded series, starting from the primitive reflex apparatus of the very early swimming larva, which may be conceived of as suggesting some of the steps of the phylogenetic evolution of the mechanism of correlation as found in the brains of higher vertebrates. Coghill has shown that in the simple swimming reflex of the very early developmental stages of *Amblystoma* there is very little evidence of specificity of function even in the peripheral sensory neurones. Each of these neurones (the transitory giant cells of Rohon and Beard in the spinal cord) may connect peripherally with both the skin and the myotom, the cutaneous and the muscle sense innervation coöperating to maintain the swimming reflex. These transitory cells are in later developmental stages replaced by those of the spinal ganglia, in which the neurones concerned with cutaneous and deep sensibility are probably distinct as in higher vertebrates. In the spinal cord of the half-grown larva, however, the neurones of the gray substance show very imperfect functional localization, each of these neurones apparently being physiologically related to all types of peripheral sensory nerves. Here also any stimulus whatever on the trunk will evoke a simple swimming movement. In the medulla oblongata of these half-grown larvæ the peripheral neurones show a high degree of functional specificity, and the central neurones of the second order tend to be grouped around these special sensory groups. But the functional localization of these secondary neurones is not complete, each neurone having a dominant relation to some particular peripheral root but subsidiary connections also with other functionally distinct roots. Thus each primary bulbar center reached by terminals of root fibers is to some extent also a correlation center and the analysis of function in the reactions is still incomplete.

In the mammals the functional differentiation of the primary bulbar centers is complete and the functions of correlation are transferred to higher cerebral centers. Simpler total reactions of the more primitive sort are, however, still provided for in the formatio reticularis of these higher brains. The examination of the series of types of reflex pattern now known in *Amblystoma* suggests the dominance of the integrative function of the vertebrate central nervous system from its earliest phylogenetic phases. The simplest responses to external stimulation, such as

the avoiding reaction and the swimming reflex reaction of very young larvæ (Coghill), are simple total reactions involving the coördinated action of large masses of body musculature. Within such a unitary reflex system, which necessarily requires the orderly participation of extensive regions of the nervous system, more refined special movements may be differentiated, and this involves the segregation of particular functional areas within the original unitary system under the influence of the progressive differentiation of the receptor and effector apparatuses. Throughout this process of differentiation the correlation centers, as they become more individualized from the primary unitary system, are pushed farther and farther back from the periphery; but at no stage in the process is the primitive dominance of the integrative function of the system as a whole lost. The preservation of the functional integrity of the individual during the process of differentiation of its parts is the most important function of the higher correlation centers, as Sherrington has so graphically shown.

JELLIFFE.

DEMENTIA PRÆCOX AND MALINGERING. E. Hesnard. (Arch. de Med. et d. Phar. Navales, 1914, No. 4.)

Inexperienced and prejudicial observers frequently look upon the foolish conduct of the early schizophrenic as malingering especially if a medico-legal judgment is required. It is the invariable attitude of the prosecuting attorneys. The early symptoms of dementia præcox are such as to lead the practitioner to suppose that his patient is only pretending to be sick. This is well set forth in this recent study on the Importance of Absurd Answers in the Diagnosis of Insanity. Patients suffering from dementia præcox, just after the first onset, are, he says, as yet so little changed, and their mental powers are so slightly impaired, that it is difficult for the alienist to convince the friends of the patient, and even his medical advisers, that he is not wantonly perverse, but, on the contrary, sick with a truly serious disease. Dr. Hesnard recounts his observations on a case, that of a man who, much run down owing to early phthisis, became excited one day in his barrack-room, and had to be sent to hospital. In hospital he soon became calm, and thereafter was generally vague and irrelevant in his answers to questions, and at times incoherent, though occasionally his answers were shrewd and amusing. He could be made to speak more rationally if he was sharply questioned and his slumbering self-control awakened. His friends thought he was shamming, and asked him what he was doing it for, and they pointed out to him that he need not sham to get out of the service, as he was going to be invalided for phthisis anyway. Dr. Hesnard, after considering the case closely, concluded that the patient was not a malingerer, and believed that he recognized in him the onset of dementia præcox. The man looked strange and haggard and always wore a weak smile. Quiet generally when alone, he became uneasy and agitated when observed. He mimicked his medical attendant cleverly and could talk brilliantly. These cases are very frequent and are at times made the subject of medico-legal inquiry. The patient described by Dr. Hesnard died of tuberculosis, a frequent cause of death in schizophrenia.

JELLIFFE.