

THE CONDUCTING ELEMENT OF THE NERVOUS
SYSTEM AND ITS TOPOGRAPHICAL RELA-
TIONS TO THE CELLS. By STEFAN APÁTHY,
Professor in Kolozsvár (Klausenburg).

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AN ABSTRACT BY STEWART PATON, M. D.

Apáthy's first communication was made before the third Zoological Congress, Leyden, in the autumn of 1896. He then demonstrated: (1) Conducting substance ("primitive fibrils," "elementary fibrils") in invertebrates. (2) Conducting substance in vertebrates, *lophius rana*, *triton*, *lepus*. (3) Motor and sensory conducting tracts and primitive fibrils and their distinguishing characteristics in *hirudo*, *lumbricus*, *lophius*, *triton*, etc. (4) Nerve-cell and topographical relation of conducting primitive fibril to cell in *hirudo*, etc. (5) Anatomical relations of ganglion cells to other kinds of cells and to one another. (a) "Cell bridges." (b) Anastomosis between ganglion cells. (c) Continuity of primitive nerve fibril from one conducting tract into another in the center and at the periphery. (6) Topographical relations of conducting primitive fibrils to ganglion cells in *hirudo*, *lophius*, *triton*, etc. (7) Topographical relation to sensory cells. (8) To muscle cells. (9) To ciliated and gland cells. (10) Free ending of conducting primitive nerve fibrils at the periphery in *hirudo* and *lumbricus*.

Preparations were fixed and stained in various ways, chiefly by Apáthy's gold, haematein and methylen blue methods.

The fundamental idea of this research is as follows:

Apáthy believes in the fibrillar character and individuality of the conducting primitive fibrils. Apáthy has never seen an ending for the conducting primitive fibril, peripherally as well as centrally unbroken. As in anatomical sense the circulatory sys-

tem is unbroken artery, capillary vein—so is the nervous system.

Ganglion and nerve cells are essentially different. The latter are analogous to muscle cell and produce a conducting substance, the neuro-fibril precisely as the muscle cell produces a contracting element—the myofibril.

The conducting primitive fibril grows toward the center in ganglion cells and toward the periphery in sensory cells. The ganglion cell is introduced in the conducting tract (“ist bloß eingeschaltet in die leitende Nervenbahn”) just as are the elements which generate the current in a battery.

The ganglion cell produces the impulse to be conducted. The nerve cell produces a conducting substance.

The “neuroganglion cells” which are originally phylogenetically of the same origin, are divided into two classes of cells which show histological as well as histogenetic differences.

Ganglion cells produce not only a constant “Strom” the tonus, but react as well to external influences. Stimuli cause changes in tone, quantitative as well as qualitative. The nerves themselves may exert a secondary influence.

The paths by which the growing conducting primitive fibril reaches the ganglion cell in one direction and the sensory cell in the other exist before the development of the primitive fibrils. These paths are “intercellular bridges,” described by various observers. They are protoplasmic processes which from the first division of the germinal cells into the cells of the organism are invariably directly or indirectly connected with each other. These protoplasmic processes or bridges are at first simply masses of undifferentiated protoplasm incapable of conducting until the specific conducting substance, the “neuro-fibril” develops. The conducting substance consists of neuro-fibrils. A greater or smaller number of these may be united into a morphological unit namely, a conductive primitive fibril. The conducting primitive fibril may be the product of a simple nerve cell. Groups of ganglion cells may be interposed either in the centripetal or centrifugal course of the primitive fibrils. Nerve cells may produce a great number of elementary fibrils which may be united sooner or later to form primitive conducting fibrils. The primitive fibril of one nerve cell, with certain exceptions, can unite with primi-

tive fibrils from other nerve cells to go to various ganglion cells. In the same way the nerve splits up into primitive fibrils before it reaches the sensory cells. Every sensory cell (worms and mollusks) receives only one primitive fibril. One nerve cell generally connects with several cells by one or more primitive fibrils, and one ganglion cell may be connected with several nerve cells; but one sensory cell is connected with but a single ganglion cell. Part of the conducting primitive fibril may be followed into a ganglion cell, while another part may pass into a network of very fine fibrils. Primitive fibrils may receive primitive fibrils from other nerve cells and these may unite again to be continued into ganglion cells. After demonstrating the arrangements of the primitive fibrils which are formed by the union of the elementary fibrils, Apáthy proceeds to the consideration of the morphological differentiation of the sensory and motor nerves. He says that in the motor nerve the cylinder process is a very strong primitive fibril with a perifibrillar sheath containing little myelin, but with a very sharply differentiated glia sheath for every primitive fibril. The sensory primitive fibril is much thinner. The other points of difference between the two kinds of nerves are considered at some length by the author. All kinds of primitive fibrils in the animals so far examined run in spiral lines (Taf. 23—No. 3). Considerable space is devoted to the consideration of the morphological characteristics of the primitive fibrils.

The nerve cells and glia cells have been carefully studied by the author in the *hirudo*. Apáthy discusses the various nuclei to be found in the nervous system, and then calls attention to the cells to which these nuclei belong. The distinguishing characteristics of the cell as well as of the nuclei are dwelt upon at length. Apáthy says that in the ganglion cells the primitive fibrils form a network in the cell-bodies, but that no network is seen in the protoplasm surrounding the nuclei of the nerve cells. Other characteristics are noted, p. 583.

Glia cells may be looked upon as nerve cells which have lost the power of giving rise to primitive fibrils while on the other hand they still retain their function of forming glia fibrils. The nerve cells do not give origin to glia, but only to primitive fibrils.

The conducting primitive fibrils penetrate in the somatoplasm

of cells and form a network inside of the cell. Neither a beginning nor ending of the neuro-fibrils have been seen in a ganglion cell. The fibrils have no connection with the nucleus. The ganglion cells in *hirudo* and *lumbricus* are described at length and the histological differences between nerve and ganglion cells are pointed out. The ganglion cells of the vertebrates described are those in the cord and medulla of *lophius*, *triton* and *bos*.

As in the lower animals, the primitive fibrils reach the ganglion cells by way of the anatomical processes and splitting up into thin neuro-fibrils, pass over into the neuro-fibrillar network in the somatoplasm.

Ganglion cells in vertebrates (in the cord) have one process, seldom more, into which the somatoplasm is not continued. This process is achromatic in comparison with the other processes, which are chromatic. The achromatic process may or may not form the motor axis cylinder. In certain cells this process does not leave the cord, but splits up into various branches.

The so-called axoplasm is in no sense a continuation of the somatoplasm of the ganglion cell.

In sympathetic ganglion cells, Apáthy says that he has demonstrated the network which connects the spiral or cellulipetal with the straight or cellulifugal fibre.

Several pages are devoted to the consideration of the anastomoses between central and peripheral ganglion cells.