

Observations of the Glomerular Degeneration in the Protocerebral Neuropile of the Prawn, *Penaeus japonicus* BATE

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Abstract

In the supraoesophageal ganglions of the adult prawns, especially well matured females such as the parent prawns, contrary to under-aged ones, there almost observed a histological degeneration of the glomeruli, which compose the neuropile mass of the ganglion. The area of changes is restricted within a specific region, that is the median neuropile or protocerebral bridge that consists of two glomeruli connected across the midline, associated with the surrounding cells of the anterior ganglion cell group. The degenerated tissues show an assembly of ellipsoid-shaped spots, which are positive to periodic acid-SCHIFF (PAS). Therefore, the degeneration may be pathologically named as the mucous degeneration. It seems that because of its higher occurrence at matured age, the maturation of gonad or the aging of certain organ(s) such as the nauplius eyes might affect its proper function of the median neuropile, though it is uncertain at present as for the primary factor.

As for the nomenclatures of cell groups on the superficial layer of the supraoesophageal ganglions in decapods, there has been no definite uniformity among such workers as BETHE¹⁾²⁾, HELM³⁾, KRIEGER⁴⁾, TURNER⁵⁾, and others. According to HELM, they can be separated into six groups as results from his comparative studies. On the other hand, the author has investigated them previously in *P. japonicus*, and tried to give them eight names⁶⁾. Well during classification of the cell groups, it has been recognized by the author that a probable pathological change exists at the restricted region of the cell group of anterior, which is correspondent to the cellulae anteriores of HELM. Such a phenomenon has been hitherto untreated by other workers.

Materials and Method

Under-aged and well matured prawns, *Penaeus japonicus* BATE, 5-20 g and 90-120 g respectively in body weight, were dissected for extirpation of the supraoesophageal ganglions. As sampling, the former was brought from the culturist, and the latter was applied to the parent prawns of spawning stage that were obtained from the fisherman. Then the tissues were fixed overnight with an equally mixed solution of sat. picric acid and sat. mercuric chloride, dissolving Na_2SO_4 at the rate of 4%. After dehydration with a graded series of aqueous butanol solutions, preparations were

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embedded in paraffin. The sections prepared by cross-cutting were stained with periodic acid - SCHIFF (PAS) and hematoxylin.

Results and Discussion

The supraoesophageal ganglion, defined as the main ganglionic mass anterior or superior to the oesophageal canal, is given another name as the brain. According to BULLOCK and HORRIDGE⁷⁾, it is the principal association center for the whole body so far as it directly receives excitation from the sense organs of the head and from ascending interneurons from the ventral cord. From it run motor neurons to some of the muscles of the head and descending premotor interneurons which initiate movements coordinated in detail by ganglia of the ventral cord. Embryologically it is considered that there are two functional regions, proto- and deutocerebrum of the unsegmented anterior ganglion. Moreover, the tritocerebrum is thought to be the first of the chain of primitively postoral ganglion. Anterior region defined by usage as protocerebrum receives the nerves of the eyes and frontal organs, and contains four types of neuropile masses as follows. i) The optic ganglions, ii) The central body, which is situated in the center of the ventral side of the protocerebrum. It is a spindle-shaped uniform mass of neuropile, running transversely across the protocerebrum, and considered to be a meeting point of axons from diverse parts of the brain. iii) The protocerebral bridge, which is the name given to a median neuropile mass, lying across the front of the brain. It consists of two glomeruli connected

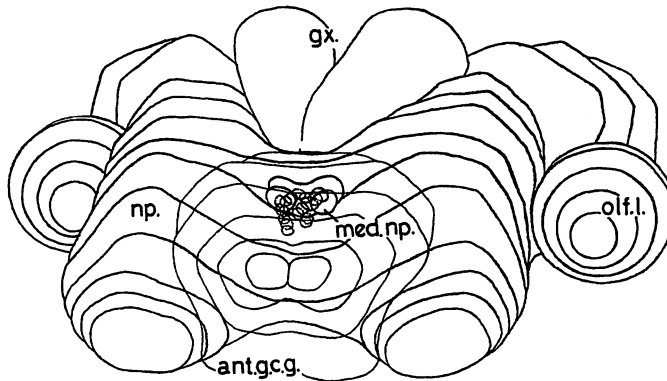


Fig. 1. Diagrammatic representation of the neuropile mass of the supraoesophageal ganglion. The anterior ganglion cell group occupies a comparatively large area of the front of the protocerebral neuropile, and in its central region, there exists a small median neuropile (protocerebral bridge) which consists of two glomeruli connected across the midline, associated with the cell group. Local degenerations of the glomeruli are recognized in this median neuropile. In the figure, they are represented as many circles of dotted lines. Abbrev., ant. g.c.g.: anterior ganglion cell group, gx.: giant axon, med.np.: median neuropile, np.: neuropile mass of the ganglion, olf.l.: olfactory lobe.

across the midline. iv) The ocellar centers, of which neuropile areas occur at the roots of the nerves from the anterior median nauplius eyes (frontal organ). The deutocerebrum is the region of the endings of the antennal sensory nerves. Here also are the antennal motor centers and a commissure connecting the deutocerebrum on two sides. It consists of four regions as follows. i) The medial antennular neuropile, ii) The lateral antennular neuropiles on each side, iii) The olfactory lobes on each side, iv) The parolfactory lobes. The tritocerebrum is the ventral, posterior, or inferior part of the brain which gives rise to nerves to the labrum, the stomatogastric system, and a post-oral commissure. The corresponding appendage is the second antenna. It is not obviously divided into regions; i) The tegumentary neuropiles on each side, ii) The antennary neuropiles on each side.

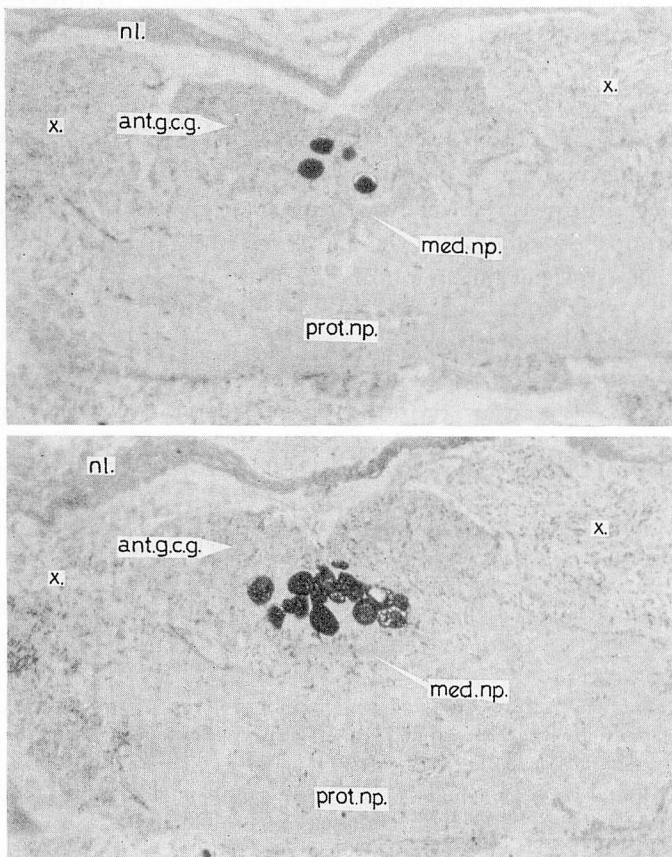


Fig. 2. Compared photographs of the local degenerations in the median neuropiles of two specimens, which are situated at the median of the cross-sectioned protocerebrum of the supraoesophageal ganglion. Dark spots indicate the PAS-stained degenerated areas of the glomeruli, and they show a restricted distribution within the neuropile. Abbrev., ant.g.c.g.: anterior ganglion cell group, med.np.: median neuropile, nl.: neural lamella, prot.np.: protocerebral neuropile, x.: axon bundle to an optic lobe.

On its superficial layer of frontal median of the protocerebrum, the nerve cells form a comparatively large colony, which has been named previously⁶⁾ as the anterior ganglion cell group (Fig. 1). The above mentioned median neuropile is buried in this group, associating possibly with it. In this restricted median neuropile, there observed an assembly of some ellipsoid spots though their number showed individual fluctuations (Fig. 2). Especially in the aged prawns such as matured ones, their occurrences were conspicuous, contrary to under-aged ones. These spots were sites of the degenerated glomeruli of the neuropile, which were replaced by the PAS-positive substance. In these spots, almost hollow ones existed in some cases. Therefore, the degeneration may be pathologically named as the mucous degeneration, based on abnormal accumulation of polysaccharide or mucoprotein. Originally the glomeruli of the neuropile are dense tissues, provided with a well developed vascular system. It seems that the local vascular system may participate with the degeneration in forming these spots. Though it is uncertain at present as for the primary factor, the degeneration might be considered to be produced relating to those functions of the frontal organ or the optic peduncles because of its topographical distribution and their fiber-tract informations by previous workers. Moreover, its higher frequency of occurrence at aged prawns, especially well matured ones, may indicate a possibility that the maturation of gonad or the aging of certain organ(s) such as the nauplius eyes would affect its proper function of the median neuropile.

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