Electron Microscopy of the Paraventricular Organ in the Sparrow
(Passer domesticus)

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Summary. Characteristics of the ependymal cells of the Paraventricular Organ (PVO) in the sparrow are strongly dilated ergastoplasmic cisternae filled with a moderately dense substance, the absence of cilia and a long basal process ending around capillaries. Elongated cells having a pale cytoplasm ("light cells") are interposed between the ependymal cells. These cells protrude into the ventricle lumen with a bulbous cytoplasmic swelling; centrioles and several dense-core vesicles occur frequently in them.

Two types of nerve cells have been identified in the PVO. The more superficial cells — called type-I neurons — have a dendrite-like process which, after passing the ependymal layer reach the ventricle surface and end there freely with a bulbous swelling ("club"). The whole neuron contains dense-core vesicles of an average diameter of 840 Å; the extensive Golgi region is located in the dendrite.

The larger type-II neurons situated in the deeper layers show a folded nuclear membrane, large mitochondria and rarely dense-core vesicles; the Golgi apparatus is enclosed in the perikaryon.

The nerve cells are embedded in a feltwork of glial and neural processes the latters showing often synaptic (axo-dendritic) junctions. The majority of the synapses are supposed to occur between the axon-like processes of the type-I neuron and dendrites of the type-II neuron. Axo-somatic synapses can be found not infrequently on the perikarya of the latters.

The nature of the free ventricular endings of the neurons and the possible function of the PVO are discussed in the text.

The paraventricular organ ("organon vasculosum hypothalami") was described by Kapfers (1920/21) in fishes and reptilia as a paired ependymal formation on the lateral surfaces of the 3rd ventricle. Since this description, its existence has been demonstrated by Charlton (1928), E. Legait (1942), Fleischhauer (1957, 1960), H. Legait (1959), Diepen (1962), Vigh and coll. (1962, 1964) etc. in many vertebrate species. Although no physiological investigations have been made concerning the function of the organ, its morphological appearance led most authors to attribute a secretory role to it.

Most recently (Vigh, Teichmann, and Aros, 1967) a group of nerve cells ("nucleus of the paraventricular organ") has been described in the paraventricular organ (PVO). The nerve cells were found in all vertebrate species and were regarded as the neuronal component of the paraventricular ependymal organ.

The presence of nerve cells casts new light on our understanding of the PVO. The latter cannot be considered any more as a simple ependymal differentiation similar to the subcommissural organ, but ought to be envisaged as a complex of special ependyma and nerve cells. All these considerations raise new problems regarding the function of the organ.

As electron microscopy could be expected to give more information on structural details, an electron microscopic analysis was undertaken with special atten-
tion focused on the neuronal constituents. The present observations were made on the sparrow, partly because the PVO is particularly well-developed in birds, partly because it is the PVO of the sparrow, which contains in considerable quantities an aldehyde-fuchsin positive substance similar to that of the subcommissural organ.

To our knowledge, only a brief summary has appeared as yet about the electron microscopy of the PVO in the suppon (Takeichi, 1965). The observations presented here are in many respects in agreement with the findings of Takeichi but many new data will be added.

**Material and Methods**

Six sparrows (*Passer domesticus*) of different age and sex were used within 3 to 24 hours after having been captured. After decapitation the calvary was removed with scissors, the 3rd ventricle set free and several drops of the fixative was dropped into it. Part of the lateral wall of the ventricle containing the PVO was excised and put into the fixative, a modified hypertonic formaline-glutaraldehyde mixture (Karnovsky, 1965). The 50 per cent Fisher glutaraldehyde described originally was replaced by a 25 per cent Fluka glutaraldehyde solution, purified from acidic compounds by ion exchange resin (Vadsz, 1966). After 30 min of fixation at room temperature, the block was trimmed under the dissecting microscope and fixed for a further 90 min. Washing in 0.16 M phosphate buffer overnight, postfixation in a 1 per cent phosphate-buffered osmium solution (Millong, 1961) for 2 hours, dehydration in ethanol and embedding in Araldite (Durecupan ACM, Fluka, Buchs, Switzerland).

The plane of sectioning was adjusted with semithin sections, so that cross sections were made from the groove-like PVO (approximately in frontal plane of the brain). Ultrathin sections were contrasted with a 10 per cent uranyl acetate solution in 50 per cent methanol followed by staining with lead citrate and examined in a JEM 6C electron microscope. The PVO was mapped using a montage composed from a series of electron micrographs of specimens mounted on wide-mesh grids, and was compared with adjacent semithin sections stained with Azur-II-Toluidine blue solution.

**Key to Abbreviations.** bb basal body of cilia; c club-like ending; cs centrosome; d dendrite; cap capillary; db dense body; dc dense-core vesicle; ep ependyma; er endoplasmic reticulum; G Golgi apparatus; lc light cell; m mitochondria; mt microtubule; mb microvesicular body; n nucleus; nt neuro-tubule; p perikaryon; ss supraependymal space; v ventricle; vp ventricular process (dendrite); I type-I neuron; II type-II neuron.

**Observations**

**Light Microscopy**

The PVO is a groove-like formation on the lateral wall of the 3rd ventricle that can be recognized under the dissecting microscope as a pink band leading from front to a slightly caudal direction. On light microscopic preparations (Fig. 1) the PVO is characterized by its well-developed ependyma giving the impression of a high cylindric epithelium. The ependymal cells — in contrast to the ependyma of the 3rd ventricle — are elongated having dense oval nuclei and devoid of cilia. The lower level of the ependymal layer contains spindle-shaped or fibre-like bodies selectively stainable with aldehyde-fuchsin. Between the ependymal cells light elongated cells are interposed exhibiting a pale cytoplasm ("light cells") and an oval nucleus of loose chromatin structure. The surface of the PVO is covered by a layer formed by club-like or fan-shaped cellular processes.