(table 1) following cadmium treatment may be attributed to the low titers of estrogens following loss of large follicles (the follicular cells of which are the source of estrogens) in the ovaries of treated frogs.

It is suggested that cadmium even in low doses severely affects the vitellogenic growth of oocytes due probably to the dysfunction of the liver, altered metabolism and possible reduction in the blood and nutrient supply to the growing follicles thereby drastically reducing the fecundity of the female frog *R. tigerina* which is commercially an important species.

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STOMODEAL NERVOUS SYSTEM OF *HIEROGLYPHUS FURCIFER* (ACRIDIDAE—ORTHOPTERA)

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JANET proposed the name stomodeal nervous system in insects. It innervates the organs arising from the stomodaeum and forming a seat of endocrine activity[1]. The investigations of Koestler[2], Bordas[3] and Nabert[4] are more informative. Later, studies on retrocerebral complex of various insect groups were made[5–8]. Many investigators have also described in detail the stomodeal nervous system in a series of selected species of insects[5, 9–12]. The present study deals with the stomodeal nervous system of an Orthopteroid insect, *Hieroglyphus furcifer*.

The specimens for the present study were collected locally during September and October. The heads of freshly killed insects were dissected in insect Ringer solution and the tissues overlying the brain cleared away. Methylene blue[9] and Delafield's haematoxylin techniques[10] were applied on the dissected area. Methylene blue technique proved to be more suitable for the study of smaller nerves. The dissections were carried out in distilled water under a stereoscopic binocular microscope.

The stomodeal nervous system of *H. furcifer* comprises the frontal ganglion and its nerves, the recurrent nerve, the retrocerebral complex and the ingluvial ganglion and its nerves. The retrocerebral complex consists of median hypocerebral ganglion, paried corpora cardiaca and corpora allata.

The small and oval frontal ganglion lies on the anterodorsal surface of the pharynx, in front of the brain and is connected with it by a pair of frontal ganglion connectives. These connectives arise from the anterolateral side of the ganglion which runs laterally outwards and then curve medially to meet the basal side of the tritocerebral lobe of the brain. Anteriorly the frontal ganglion gives rise to a median, long and slender nerve, the frontal nerve[13] or the procurrent nerve[14]. The frontal nerve runs on the basal side of the pharynx innervating the walls of the labrum. Three short and slender nerves (N_1 N_2 N_3) emerge from each anterolateral side of the frontal ganglion; out of these N_1 is slightly longer than the rest. The various nerves emerging from the frontal ganglion, supply the pharyngeal muscles and the labral muscles. From the posterior end of the frontal ganglion arises a long and thin nerve which runs posteriorly to connect the frontal ganglion with the hypocerebral ganglion. This nerve is known as the recurrent nerve. On its way to the hypocerebral ganglion the recurrent nerve gives rise to five pairs of short and thin nerves which innervate the corresponding areas of the oesophagus. The frontal ganglion is connected with the protocerebrum by a slender median nerve, the nervous connectivus arising from the posterodorsal side of the frontal ganglion.

Cazal[7] pointed the term retrocerebral complex for the ensemble of retrocerebral glands, their nerves and the hypocerebral ganglion. The paired portion of the retrocerebral complex according to Willey[10] includes the anterior corpora cardiaca and the posterior corpora allata.

Hypocerebral ganglion appears as a swelling of the recurrent nerve and remains completely hidden by the dorsally situated corpora cardiaca. It is a very small and elongated structure, lies immediately behind the brain on the posterodorsal aspect of the oesophagus. Anterolaterally it is connected with the corpora cardiaca by a pair of short and thick nerves while

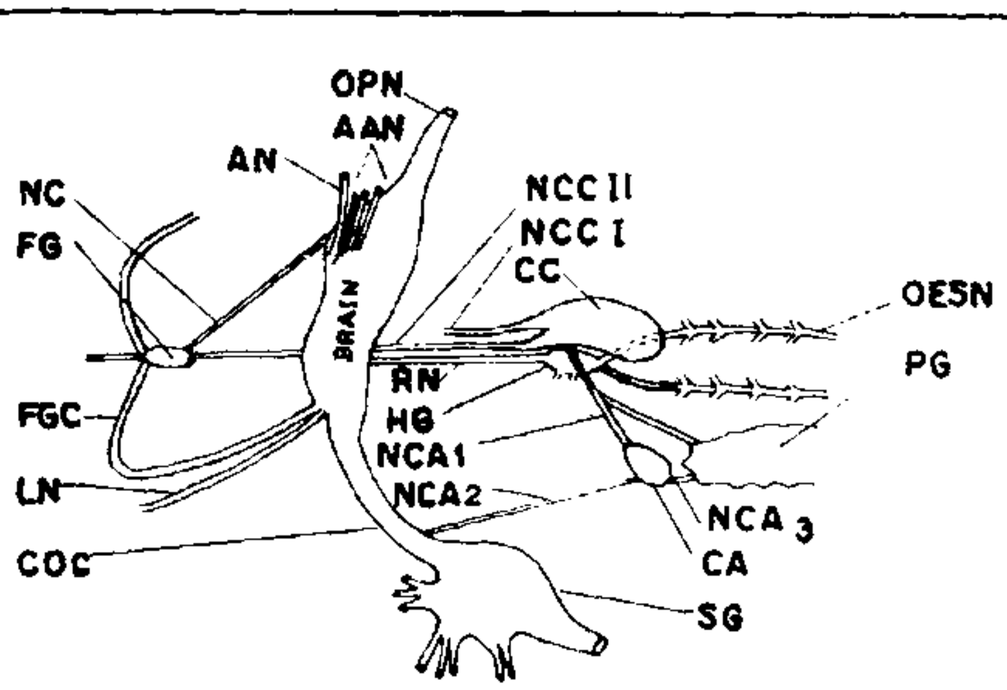

Fig.-1.

Brain, suboesophageal ganglion, prothoracic gland and stomodeal nervous system, lateral view.

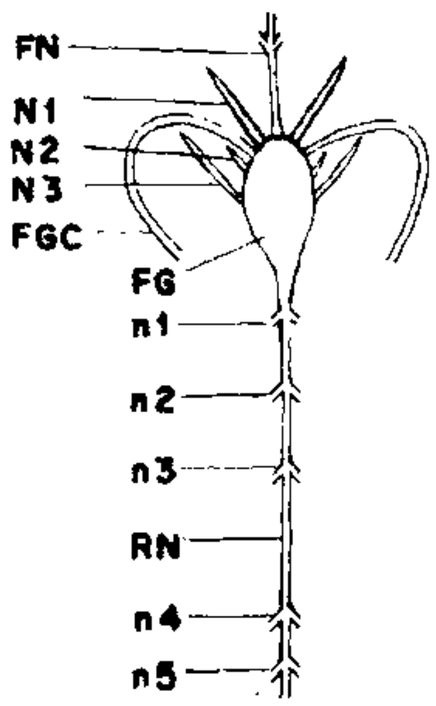

Fig.-2.

Frontal ganglion and its nerves.

Figure 1. Brain, suboesophageal ganglion and stomodeal nervous system, lateral view

Abbreviations used for various terms

AN	Antennary nerve
CA	Corpora allata
CC	Corpora cardiaca
COC	Circumoesophageal connective
FG	Frontal ganglion
FGC	Frontal ganglion connective
FN	Frontal nerve
GN	Gastric nerve
HG	Hypocerebral ganglion
IG	Ingluvial ganglion
LN	Labral nerve
N_1 N_2 N_3	One to three nerves given out from each side of the frontal ganglion. n_1, n_2, n_3, n_4, n_5 – five pairs of nerves given out from recurrent nerve.
NC	Nervus connectivus
NCA_1, NCA_2, NCA_3	First, second and third nervi corporis allati
NCC_1, NCC_2	First and second nervi corporis cardiaci
OESN	Oesophageal nerve
OPN	Optic nerve
RN	Recurrent nerve
SG	Suboesophageal ganglion

posteriorly it continues as a pair of long and thick oesophageal nerves. A number of short and delicate branches emerge from the hypocerebral ganglion to innervate the muscles of the oesophagus. The oesophageal or the posterior recurrent nerves run on the lateral sides of the oesophagus and crop and terminate into the ingluvial ganglia. Each round and small ingluvial ganglion gives rise to many thin nerves which innervate the wall of the crop and hepatic caecum. The oesophageal nerves give rise to many long, thin and delicate branches which innervate the dorsolateral and ventrolateral sides of the crop through out its length.

Situated dorsally above the hypocerebral ganglion are the paired corpora cardiaca. In *H. furcifer* these are large and oblong structures which have fused together posteriorly. However, anteriorly, they remain free. The corpora cardiaca are connected with the brain by two pairs of nerves, the nervi corporis cardiaci I and II. The first pair of these nerves arises from the mid-posterior margin of the tritocerebral lobes and continues posteriorly to meet the anterior end of the corpora cardiaca.

The elliptical corpora allata are situated on postero-lateral sides of the oesophagus. A pair of long and slender nerves, the nervi corporis allati connects the corpora allata with the sub-oesophageal ganglion. A pair of short and slender nerve from the middle of each nervi corporis allati connects it with the corpora cardiaca. Another pair of short and slender nerves connects the corpora allata with the brain.

The stomodeal nervous system of *Hieroglyphus furcifer* is discussed in the light of the earlier studies. Cazal[7] stated that the nervus connectivus is present throughout the insecta except Salatetoria. Willey[10] showed the presence of this nerve in all the Blattoids studied by him. However, Nasbitt[5], Bickley[6] and Steinmann[15] did not mention this nerve. In their studies, they either overlooked it or failed to identify it. In *H. furcifer*, however, a well-developed nervus

connectivus is found to be present. Khatter[11] also showed its presence in *Schizodectylus monstrous*. Posterior recurrent nerves have been utilised as a basis of classification of Orthoptera and related orders by Nasbitt[5] who placed the families like Mantidae, Blattidae, Phasmidae and the order Isoptera and Dermaptera in one group as they all possess a single, posterior recurrent nerve. He placed families like Tettigonidae, Rhaphidophoridae, Gryllidae and Acrididae in another group as they possess a pair of posterior recurrent nerves. The presence of paired oesophageal nerves and ingluvial ganglion in *H. furcifer*, a member of the family Acrididae, also supports Nesbitt's contention.

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ON THE STRUCTURAL ADAPTATION OF AN INTESTINAL BREATHER *LEPIDOCEPHALICHTHYS GUNTEA* (HAM.), A TORRENTIAL LOACH

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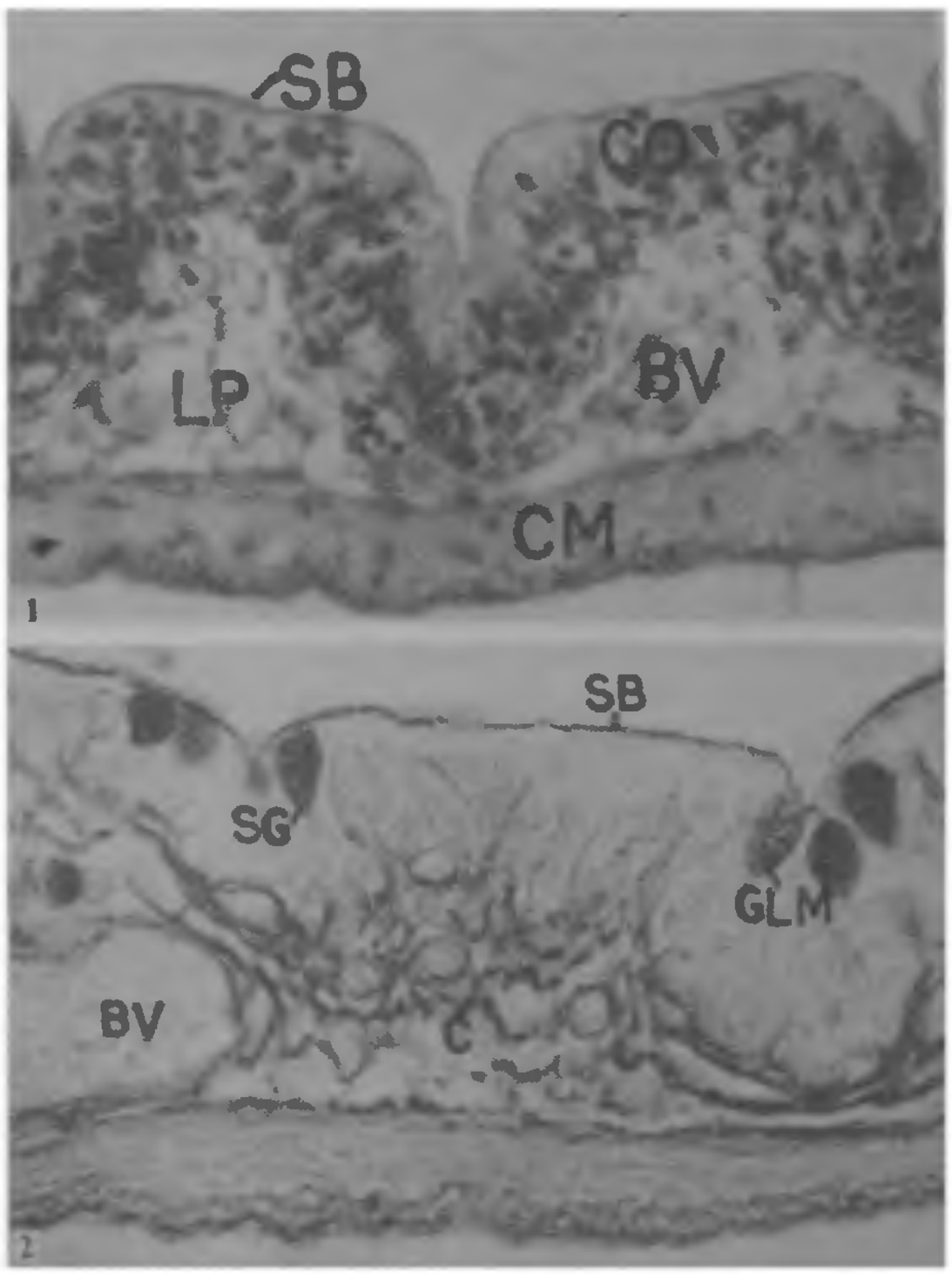
DEPLETION of dissolved oxygen is considered to be the primary factor which has stimulated the evolution of accessory respiratory organs among teleosts[1-5]. However, it is also believed that aerial respiration, as exhibited by a few teleosts inhabiting torrential mountain streams, is an adaptation for drought only[6], since these streams carry well-oxygenated water during the wet season. The *Lepidocephalichthys guntea*, a torrential loach has been observed to use posterior region of intestine as an accessory respiratory organ. The present communication is the first report of the structural modification of the specialized region of the intestine in relation to its aerial respiratory habit.

Live fishes from local streams were collected and pieces of intestine were fixed in alcoholic Bouins.



Figures 1, 2. 1. T. S. of posterior intestine showing striated boarder (SB) of undifferentiated columnar cells (CO) of stumpy villi with large number of granulated cells. The lamina propria (LP) is rich in blood vessels (BV). Note the thin layer of circular muscle (CM) in the periphery (× 400). **2.** T.S. of same showing PAS-positive goblet cells (SG) with large number of globular masses (GLM). Note the collagen fibres (C) in submucosa. A large blood vessel is also evident (BV) (× 400).