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Short Communication

Development of the pituitary gland in *Catla catla* (Hamilton)

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Abstract

Development of the pituitary gland in *Catla catla* is studied in eight successive stages, from the time of the formation of the ectophyseal analage at 5.8-mm long hatchling to the regionation of the different neuro-endrocrine components of the pituitary at 160-mm long immature, under-yearling fish.

Key words: *Catla catla*: development, pituitary gland, adenohypophysis, neurohypophysis.

1. Introduction

Though voluminous literature is available on the morphology and histocytology of the pituitary gland of adult teleost fishes, the development of the teleost pituitary has been studied only in a few cases (trout[1], Fundulus[2], Salmo salar[3], Abramis[4]). Some information on the development of the pituitary gland in post-embryonal and young stages of *Gasterosteus*[5], *Cyprinus carpio*[6], herring[7] and *Chanos*[8,9] is available. However, the only information on the development of the pituitary gland of Indian freshwater teleosts is that on *Ophicephalus* (*Channa punctatus*)[10] and *Clarias batrachus*[11]. While there is some information on the development and morphology of the pituitary gland of cyclostomes and elasmobranchs[12], comparable details on that of teleost fishes are lacking. Hence, during the present studies, an attempt has been made to describe the development of the pituitary gland of *Catla catla* which is one of the commercially important major carps of India.

2. Material and methods

Immature adults and different developmental stages of *C. catla* were obtained during the breeding season from the Tungabhadra reservoir fisheries unit of the Central Inland Fisheries Research Institute during July 1984. The younger stages of the fish were fixed in Bouin's fluid *in situ* and after post-fixation, dehydrated in alcohol and cleared in xylene, before embedding them in paraffin wax. Their sections were cut at 5 μ thickness. In the case of advanced stages, the brain with pituitary was dissected, fixed in Bouin's fluid and were processed for histological purpose. Sections were stained with haematoxylin-eosine as well as Cleveland Wolfe Trichrome stains and were observed for histological details.

3. Results and discussion

Stage 1. The beginning of the formation of the pituitary analage was noticed in the hatchling of 12 hours old. This stage also corresponds to the period when pigmented eyes are noticed and the body has a yellowish hue on the dorsal side above the yolk sac. The pituitary analage at this stage comprises an ectodermal epithelial mass, lying in close contact with the brain floor, in the region of the diencephalon (fig. 1). This region is referred to as the 'post-optic lamina' (PL). The hypophysis of *C. catla* arises as a solid ingrowth of cells from the ectodermal epithelium. This mode of origin resembles the one that is observed in several other species of teleosts[1-3,6,9,10]. The first appearance of this thickened epithelium is noticed at the 5–6 mm stage, but an ectophyseal analage is noticed only at the 5.8 to 6.00 mm stage. There is a progressive development of this analage and a distinct neuroendocrine structure is noticed only in later stages.

Stage 2. At twenty-four hours after hatching, the ectodermal epithelial mass in the region of the post-optic lamina shows further thickening and hyperplasia. It also assumes an ovoid shape. This 'ectophyseal analage' of the pituitary is still not completely

Fig. 1. Mid-saggital section of the brain of a larva at stage 1 (5.6 mm TL; 12 hours after hatching). Note the formation of the pituitary analage (EA) in the region of the post-optic lamina (PL) (× 100).

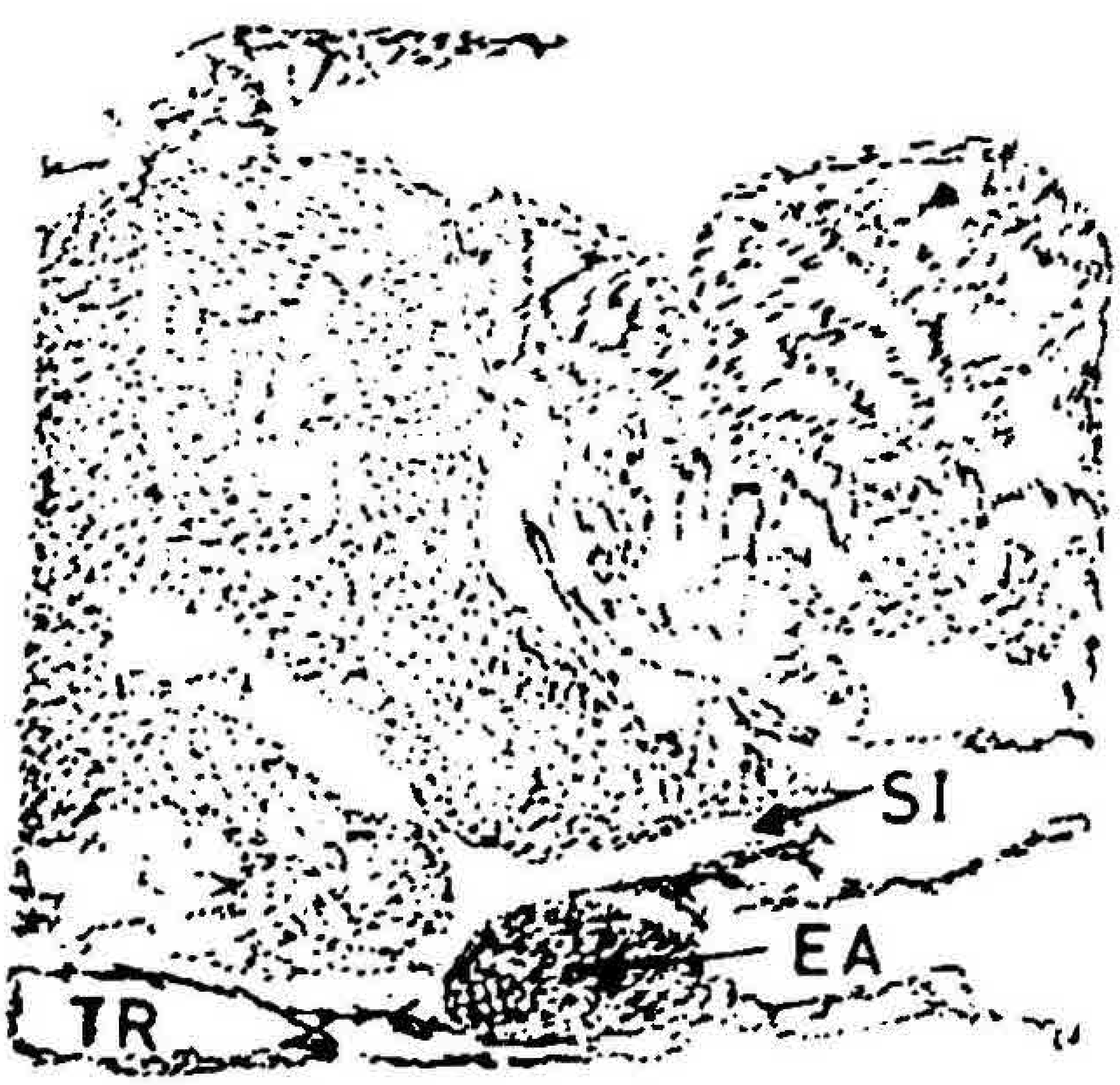

Fig. 2. Mid-saggital section of the brain of a larva at stage 2 (5.8 mm TL; 24 hours after hatching). to show the ectophyseal analage (× 50). EA: Ectophyseal analage; If: Infundibulum; SI: Saccus Infundibuli; TR: Trabeculae; YS: Yolk sac; PL: Post-optic lamina.

separated from the ectodermal epithelium of the pharyngeal roof. It corresponds to a morphological appearance of black chromatophores along the edge of the upper margin of the yolk sac. The pigmentation in the eyes also becomes dense and the position of the oral aperture of the larva is discernible as a slit (fig. 2).

Stage 3. By seventy-two hours after hatching, the formation of the saccus infundibuli (SI) and the undifferentiated pituitary is noticed. Several structural modifications also take place *viz.*, the development of the mouth and its continuity with the foregut cavity. The ectophyseal analage increases in size and gets separated from the buccal epithelium. From the diencephalic floor, a diverticulum (saccus infundibuli) develops and extends up to the tip of the notochord.

Stage 4. By the fifth day after hatching, the analage increases in size and it becomes a prominent structure. The cells from the post-optic floor and saccus infundibuli proliferate to meet the ectophyseal analage and spread along the dorsal side of the latter (fig. 3). It shows the beginning of the formation of the neurohypophysis, thus forming the definitive neuroendrocrine component. However, differentiation among the cell types of the glandular part (adenohypophysis) does not appear to have taken place, though the post-larva shows characteristic pattern of coloration.

Stage 5. By the fifteenth day after hatching, the components of the pituitary become evident. The pituitary is closely situated near the parasphenoid bone and the nervous tissue encroaches the posterior and dorsal part of the adenohypophysis. However, the pituitary stalk is not significantly noticed. The distinction between the parts of the adenohypophysis cannot be clearly made out. All cells appear equal in size and show chromophobic reaction (fig. 4). However, morphologically the post-larva assumes the typical species-specific pattern of chromatophores.

Stage 6. As a fry, on twenty-fifth day after hatching, the pituitary gland becomes more elongated antero-posteriorly. While the invasion of the neurohypophyseal processes into the adenohypophysis is noticed, it is not extensive (fig. 5). Further, the histological

Fig. 3. Section passing through the brain of a larva at stage 4 (fifth day after hatching). Note the beginning of the infundibulum (IF) and the glandular component (PC) (× 1050).

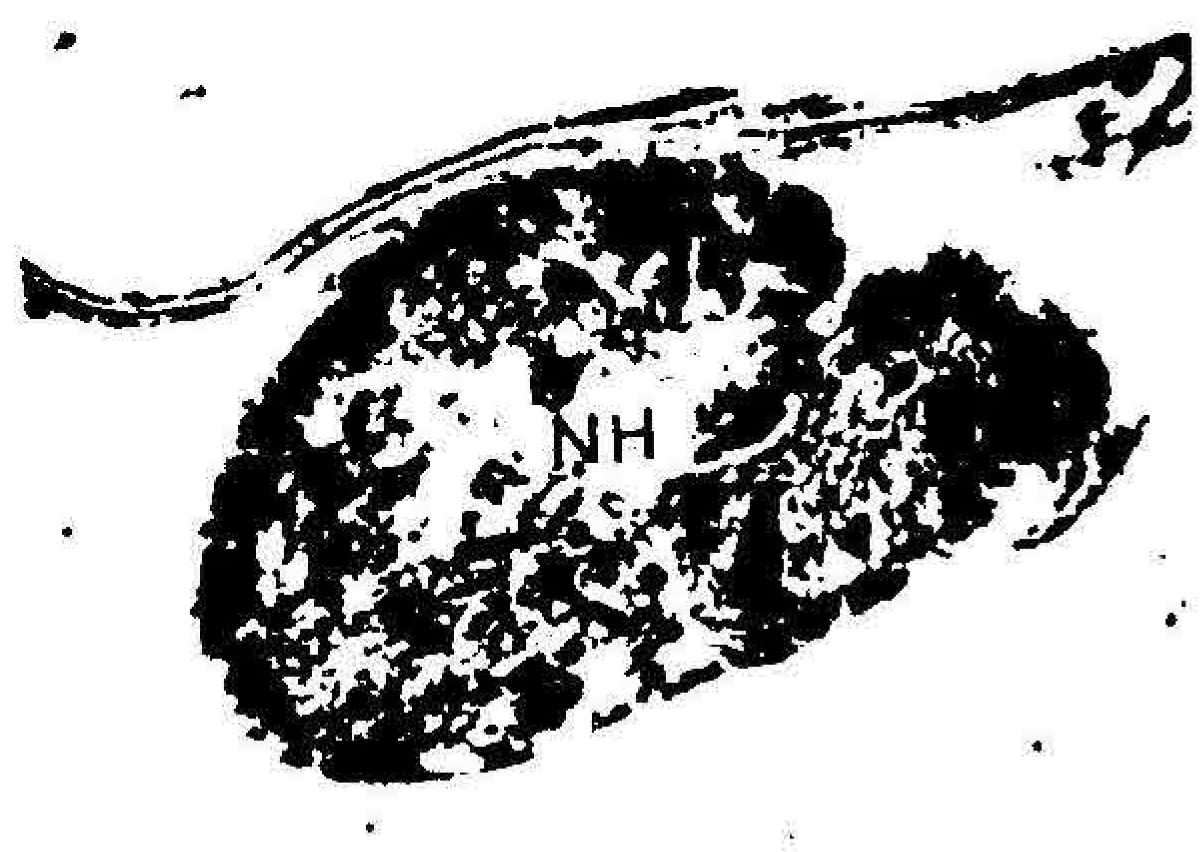

Fig. 4. Section of the pituitary of a post-larva at stage 5 (fifteenth day after hatching). Note the undifferentiated glandular component of the adenohypophysis (AH) (× 150).

FIG. 5. Section of the pituitary of a post-larva at stage 6 (Fry: twenty-fifth day after hatching). Note the neurohypophyseal processes (NH) invading the adenohypophysis (AH) (× 95).

FIG. 6. Section of the pituitary of a fingerling (stage 7). Note the typical neurohypophyseal (NH) and adenohypophyseal (AH) components of the pituitary gland. The interdigitations of the neurohypophyseal processes with all the components of the adenohypophysis is evident (× 125).

elements of the adenohypophysis remain still indistinct. The fry exhibits distinct morphological resemblance with the adult.

Stage 7. At the fingerling stage *i.e.*, two to three months after hatching, the pituitary gland exhibits the typical neuroendocrine features. The adenohypophysis can be easily distinguishable as a glandular component, different from the neurohypophysis (fig. 6). The neurohypophyseal processes intimately interdigitate with most of the adenohypophysis. The pituitary stalk becomes highly distinguishable. However, the different regions of the adenohypophysis are still not discernible.

Stage 8. In an immature adult female of *C. catla*, the distinct features of the adult pituitary are discernible. The hypophysis appears like a compact cylindrical structure, situated ventral to the brain to which it is attached by a prominent pituitary stalk (fig. 7).

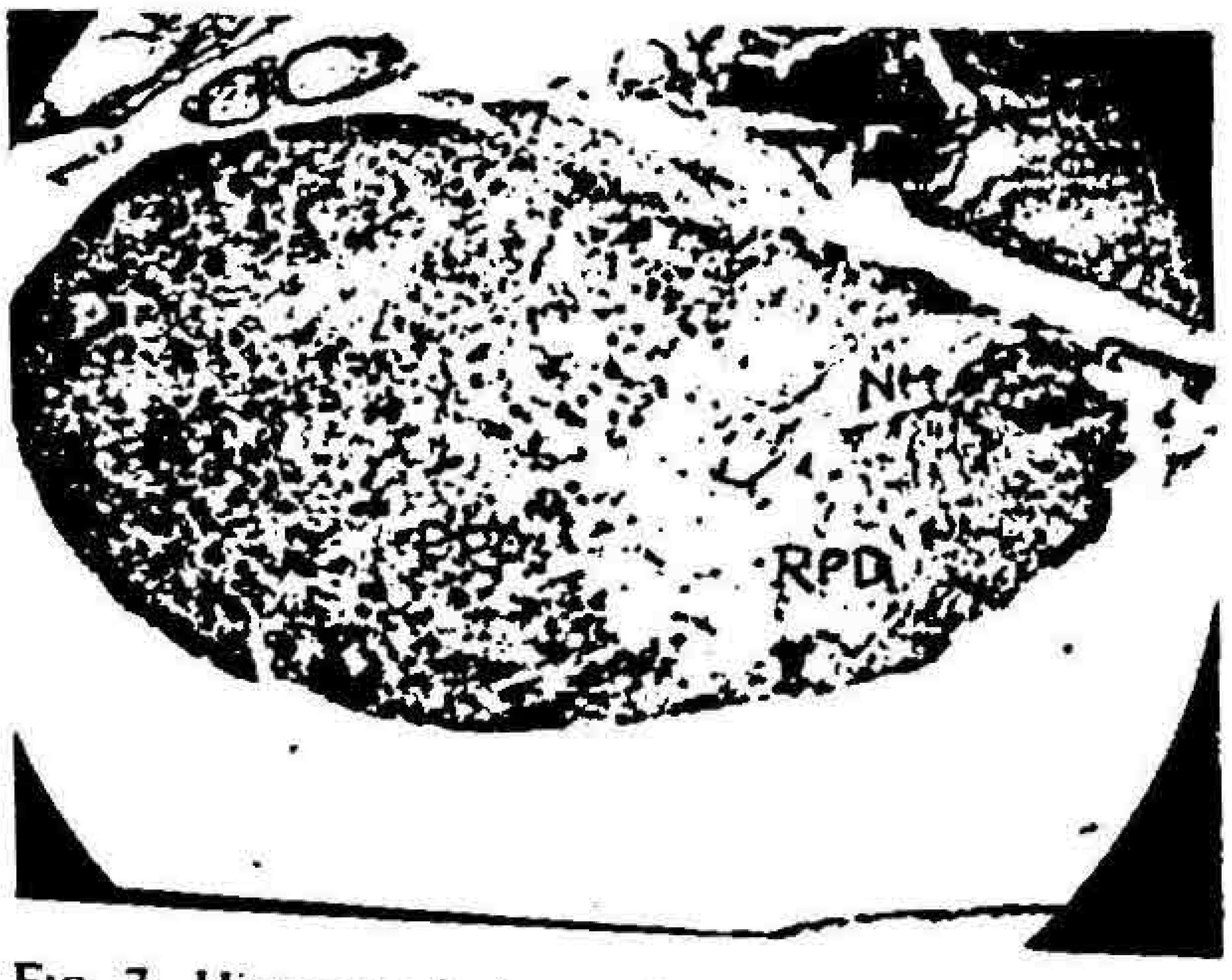

FIG. 7. Histomorphology of the pituitary gland of an immature adult female (stage 8) (× 145).

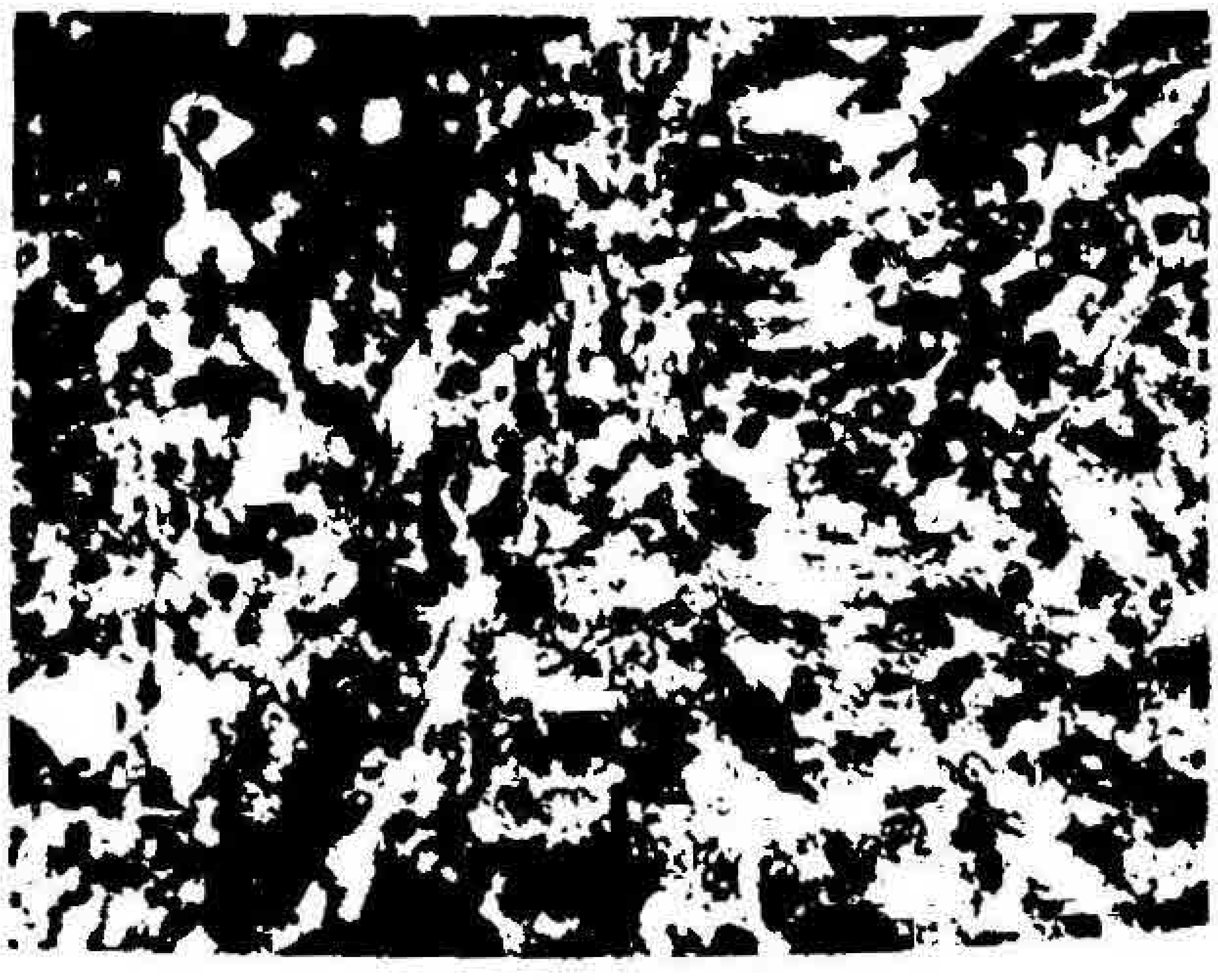

FIG. 8. Neurohypophyseal region of the pituitary of an immature adult (× 1030).

FIG. 9. Pituitary gland of an immature adult female in the region of the RPD. Note the arrangement of the prolactin-secreting cells in the form of prominent follicles (F) (× 1030).

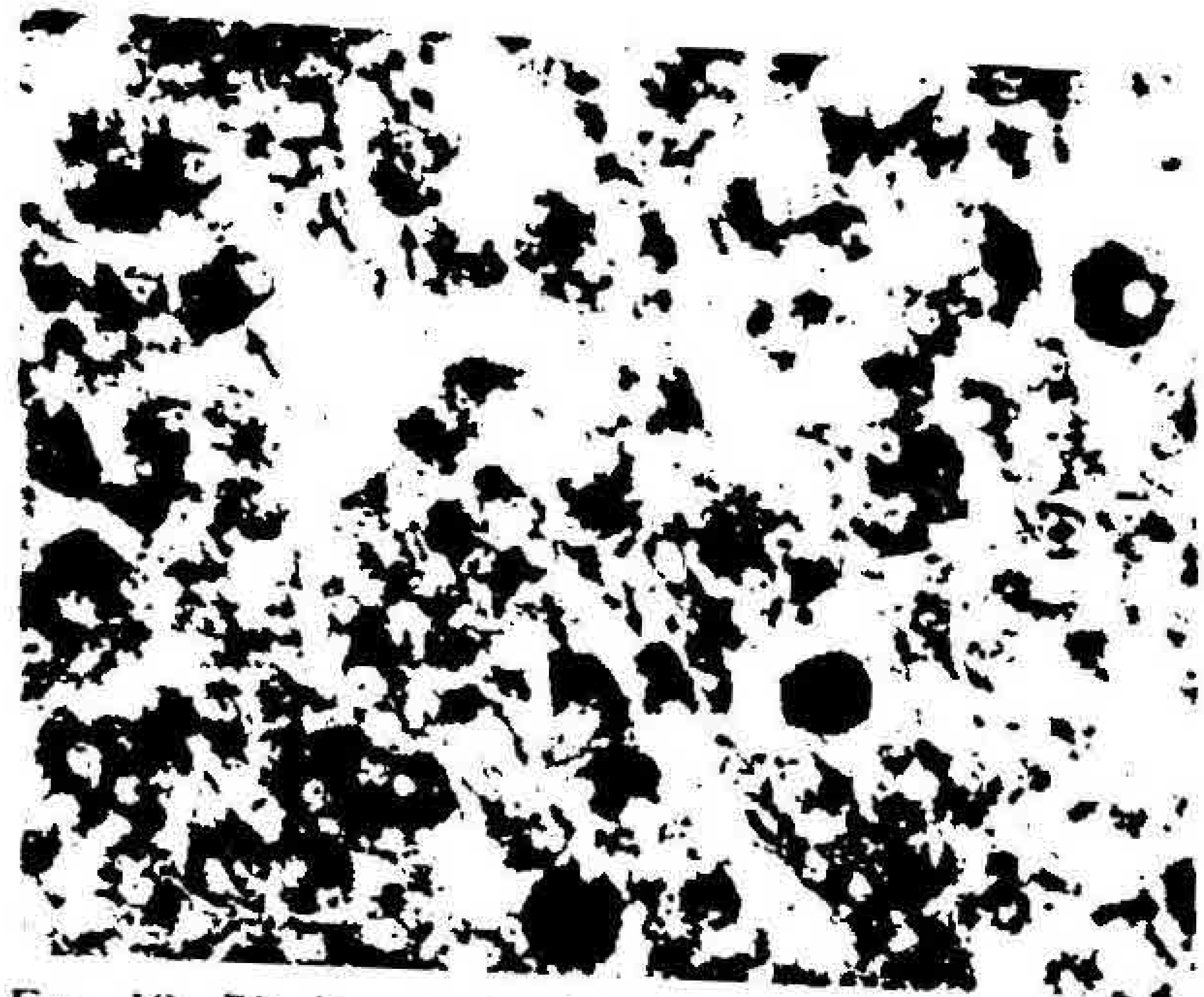

FIG. 10. Pituitary gland of an immature adult female in the region of the proximal pars distalis showing the gonadotrophs (× 1050).

The latter continues into the adenohypophysis as a great trunk — the neurohypophysis — which intimately interdigitates with the adenohypophyseal components. The neurohypophysis is composed of loosely arranged fibres among which, nuclei of neuroglial cells, droplets and irregular patches of colloid-like material are present (fig. 8).

The rostral pars distalis (RPD) is distinctly regionated and is largely composed of acidophilic cells, some basophilic and a few chromophobes. The acidophilic cells are arranged in follicles (fig. 9), which are not PAS positive. The cells are identified as prolactin-secreting cells. The chromophobe cells of the rostal pars distalis are not always refractory to stain and normally lie in the region between the prolactin cells and the neurohypophysis. These may be regarded as the ACTH cells. At this stage, the proximal pars distalis (PPD) of *C. catla* is also discernible as a distinct region of the adenohypophysis. It contains well-defined acidophils, but faintly stained basophils. The latter, regarded as the gonadotrophs, may also be differentiated into two cell types *i.e.*, smaller basophils which are usually round or oval, containing granular cytoplasm and peripheral basophils whose nuclei are large and round. The cells are found singly or in groups towards the periphery of the proximal pars distalis (fig. 10). In addition to these two well-defined types of cyanophilic cells, there are also smaller cells with contracted nuclei. Probably, these cells are the resting cells from which larger and active cells are recruited[12].

The pars intermedia (PI) is a cone-like region, with the apex directed anteriorly. This region contains a few faintly stained basophils resembling those of the PPD (probably, the gonadotrophs) and lying adjacent to the latter. The chromophobes appear like naked nuclei due to their scanty non-staining cytoplasm (fig. 11). These are the intermedial cells responsible for the elaboration of the melanophore-stimulating hormone[13]. The proximal pars distalis exhibits the presence of thyrotrophs and faintly basophilic gonadotrophs. The pars intermedia shows the presence of chromophobes which contain

FIG. 11. Pituitary gland of an immature adult in the region of the pars intermedia showing the intermedial cells (× 1050).

little cytoplasm and are regarded as the intermedial cells. That the pattern of the body surface as well as the pigmentation of the eyes of the fish get established early in the developmental period suggests that this is probably one of the first adenohypophyseal regions to become functionally established.

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