their ovaries and become egg-layers. It must be noted that dominance status is not correlated with age of the animal. For example, OA, the subordinate individual is older than SP and SH. Thus a dominant individual can conserve its energy from a very early age before its ovaries become irreversibly atrophied.

ACKNOWLEDGEMENTS

I am grateful to Madhav Gadgil, Indian Institute of Science, and Mary Jane West-Eberhard, University of Costa Rica, for initiating me into this study.

1. Altmann, *J. Behaviour*, 1974, **49**, 227.
2. Kramer, L., Pliner, P. and Alloway, T., *Aggression, Dominance and Individual Spacing*, Plenum Publishing Corporation, 1978.
3. Gadagkar, R. R., Gadgil, M. and Mahabal, A. S., *Proc. Symp. Ecol. Anim. Pop. Zoological Survey of India*, Calcutta, 1978.
4. Gadgil, M. and Mahabal, A. S., *Curr. Sci.*, 1974, **43**, 482.
5. Hermann, H. R. and Dirks, T. F., *Psyche*, 1975, **82**, 97.
6. Pardi, L., *Physiol. Zool.*, 1948, **21**, 1.
7. Schein, M. W., *Social Hierarchy and Dominance*, Dowden, Hutchinson and Ross, Inc., Pennsylvania, 1975.
8. Spradbery, J. P., *Wasps*, University of Washington Press, Seattle, 1973.
9. West, M. J. *Science*, 1967, **157**, 1584.
10. West-Eberhard, M. J., *Misc. Publ. Mus. Zool.*, University of Michigan, 1969.
11. Wilson, E. O., *Sociobiology, The New Synthesis*, Harvard University Press, Cambridge, Massachusetts, 1975.

THE STRUCTURE OF THE PITUITARY GLAND AND THE SEASONAL NUMERICAL VARIATIONS IN THE GONADOTROPHS IN *ROUSETTUS LESCHENAULTI* (DESMAREST)

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ABSTRACT

Numerical changes in the gonadotrophs from the pars anterior of megachiropteran bat, *Rousettus leschenaulti* have been correlated with its unique breeding habits. The pituitary gland is club shaped. The hypophyseal stalk has a proximal hollow segment and a distal solid segment. The neural lobe is recognised into a dorsal and a ventral component. The pars tuberalis is identified. The hypophyseal cleft is absent in the specimens whereas it is present as a distinct cavity in the juvenile forms. The pars intermedia is histologically identified from the pars anterior. Five distinct cell types in addition to the chromophobes have been identified in the pars anterior. There is a regional distribution of these cells in the pars anterior. Cell counts of the gonadotrophs from the pars anterior during different phases of the sexual activity of this bat indicate a close correlation with the unique breeding habits.

CHIROPTERA is one of the largest orders of mammals with eight of the seventeen extent families being represented in India. *Rousettus leschenaulti* is one of the typical metachiropteran species in which all the adult females experience a second pregnancy within a short time after the first conceptus is delivered in March/April. Hence, it was felt that a detailed investigation of the numerical changes in the gonadotrophs from the anterior pituitary gland in this species of bats during different phases of sexual activity would be of interest.

MATERIAL AND METHODS

For the present investigations female specimens of *Rousettus leschenaulti* were collected from Aurangabad, Maharashtra State. Transverse and sagittal sections of the pituitary of several specimens at the same reproductive stage were cut and stained with a battery of cytochemical techniques for identifying various cell types and their distribution in different regions of the gland[1,6,8,12,20,25,29]. Different cell types were identified tinctorially supplemented by their size, shape and location. These cells are numbered following the recommendations of the eleventh international committee for the nomenclature of the adenohypophysis[36]. Different gonadotrophs from the pars anterior were counted from every tenth section with the help of a 10^2 mm. ATAGO gadget and a hand tally counter. From these counts an average number of gonadotrophs per section was calculated by multiplying the average with the total number of sections of the pituitary. From these counts the percentages of the different gonadotrophs were calculated.

Observations

The pituitary gland of *Rousettus leschenaulti* is club-shaped. The III ventricle of the brain opens as a recessus hypophyseus into the proximal segment of the hypophyseal stalk (Fig. 1). The anatomy of the neurohypophysis of this bat consists of two distinct components—a dorsal component which is the continuation of the hypophyseal stalk and which becomes progressively thin caudally and loses its identity at about the middle of the length of the neural lobe, and a ventral component which extends from the region a little caudal to the end of the recessus hypophyseus and becomes progressively enlarged towards the caudal end to form the main bulk of the neural lobe (Figs. 4–8). The pars tuberalis is present. The pars intermedia envelops the caudal third of the hypophyseal stalk and the cranial half of the neural lobe except for a narrow region on the dorsal side where the two lateral moieties of the pars intermedia are separated by a narrow cleft (Figs. 1, 3–4). The pituitary of unweaned young one reveals the presence of a distinct hypophyseal cleft lined by cuboidal epithelium and the neural lobe is not distinguished into the dorsal and the ventral components (Figs. 9–10). The three types of gonadotrophs exhibit a regional distribution in the pars anterior. Details of the reproductive habits of *Rousettus leschenaulti* have been studied[9,10].

ROUSETTUS LESCHENAULTI

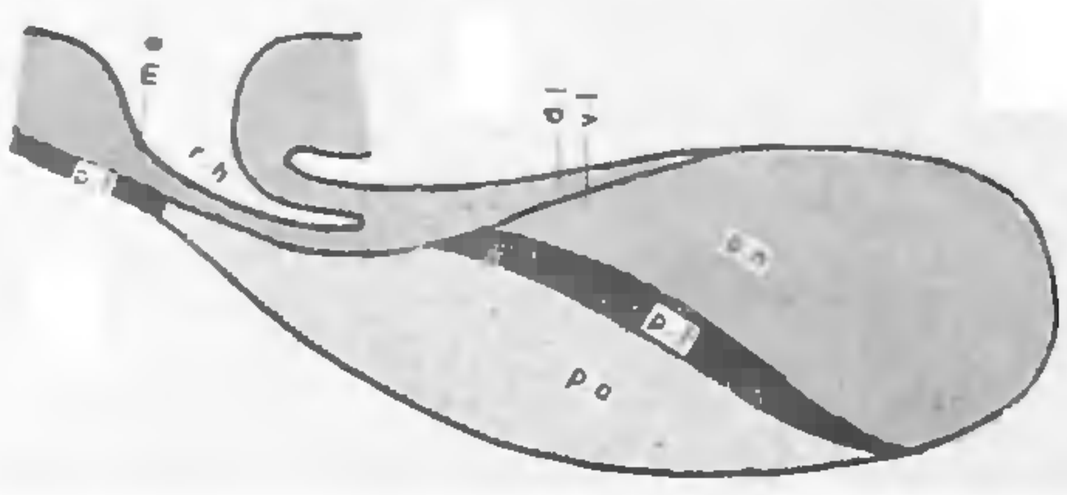


FIG. 1. Semischematic representation of the sagittal section of the pituitary gland of *Rousettus leschenaulti.* (r.h., recessus hypophyseus; m.e., median eminence; h.st., hypophyseal stalk; pn., neural lobe; p.a., pars anterior; p.i., pars intermedia; p.t., pars tuberalis; d.l., dorsal lobe; v.l., ventral lobe.)

Table I shows the changes in the percentages of these gonadotrophs during different seasons of the year. The breeding behaviour and the pregnancy cycles of this species of bats are reflected in these changes of the percentages of gonadotrophs.

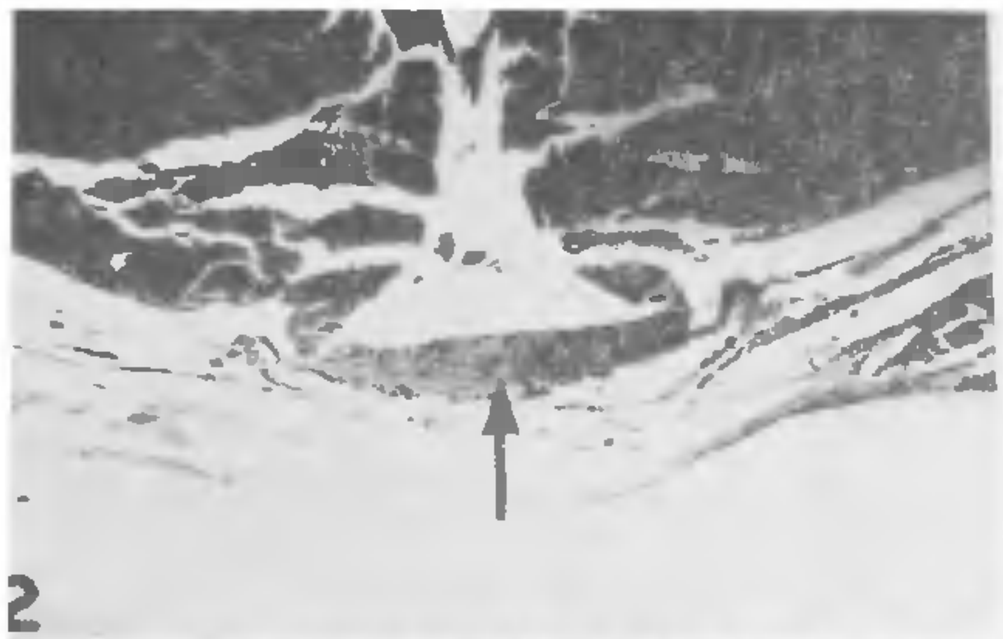
Discussion

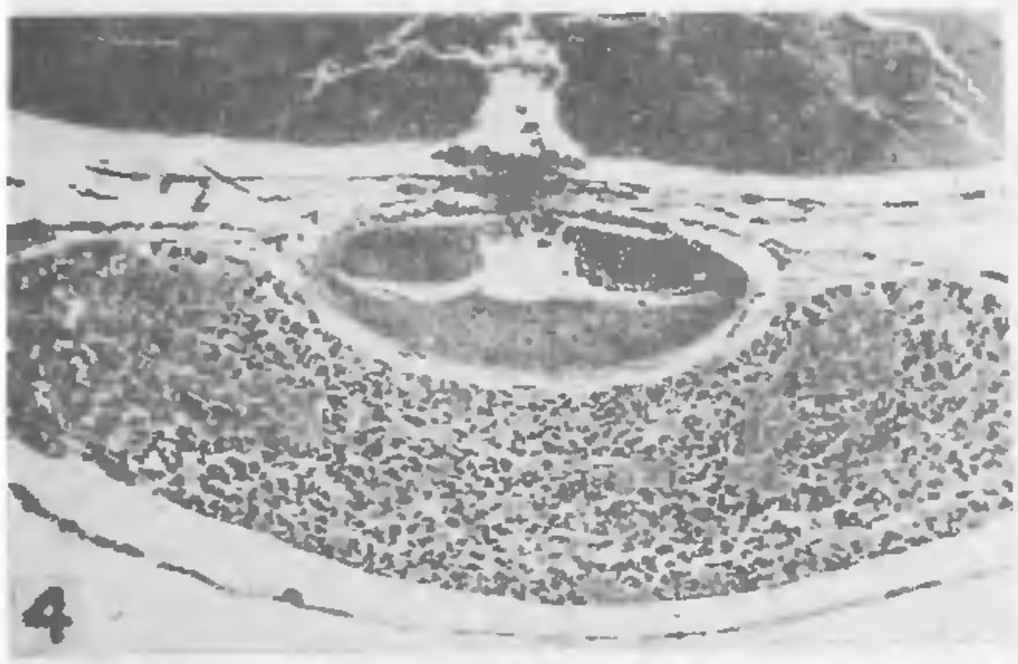
Studies on the structure of the pituitary gland in different mammals[2,11,13–18,27–28] have revealed that the structure of the pituitary gland is dependent upon several factors. The juvenile forms of *Rousettus leschenaulti* indicate the presence of distinct hypophyseal cleft and no demarcation between the dorsal and the ventral lobe of the neurohypophysis. However, the present studies do not indicate as to the stage of the growth at which the cleft obliterated and the demarcation between the dorsal and the ventral lobes of the neurohypophysis developed. The presence of two kinds of cells, poor vascularity and the plexus intermediatus in the pars intermedia have been reported[5,19,26]. The same is true of *Rousettus leschenaulti.* Diversity of cell types in the pars anterior has been known since it was reported[3,7,20,22,21-30,33,33,35]. The present studies on the pars anterior of *Rousettus leschenaulti* indicate that the differences in the intensity of staining of the cell types in different regions of the pars anterior during a given phase of the sex cycle probably reflect the differences in the physiological status of these cells. Five distinct tinctorially differentiated cell types have been identified in the pars anterior of cat, bat, mole and badger[20–22]. However, the precise changes in the cytological picture of the hypophysis have been known in none of these species. This is perhaps either due to the wild nature of the animals with different reproductive habits or to the non-availability of the details of the sex cycle. In *Rousettus leschenaulti* the numerical variations in the FSH and the LH cells closely follow the different periods of sexual activity. However, it is not possible to explain the erratic beahviour of the LTH cells; perhaps the cyclical aetivities of these cells are controlled by many faetors about which little is known. There is yet no satisfactory explanation for the mechanism by which increase and decrease in the number of these cells is brought. Mitotic divisions have been reported by a few workers[4,23,31], in alpha cells of the post partum pituitary of rats. Sawyer[34] did not notice any mitotic figures in the male bat *Myotis lucifugus lucifugus.* During the present investigations mitoses were not noticed in any cell types, at any

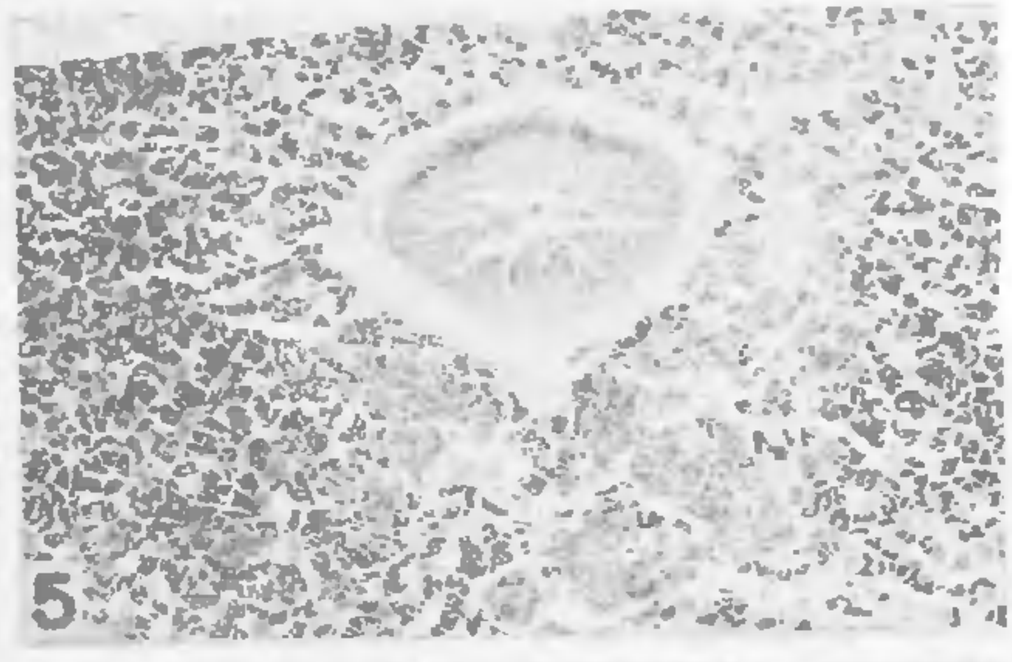
TABLE I

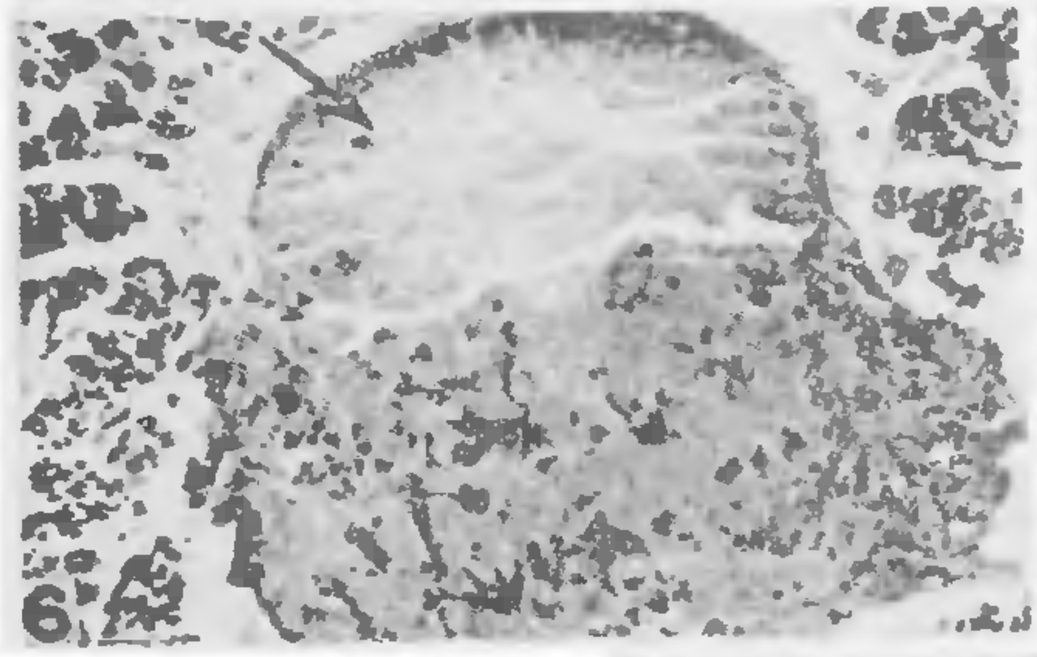
Table giving the percentages of the three types of gonadotrophs during different phases of the sexual activity in Rousettus leschenaulti

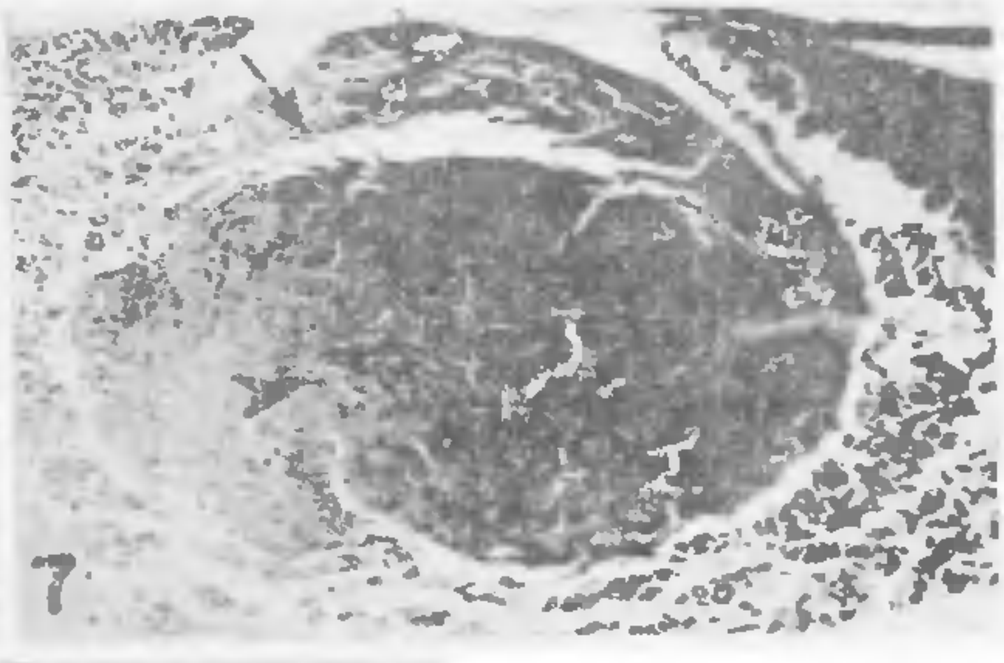
Months	FSH	LH	LTH
January	43·2	45·5	11·3
March	28·0	66·4	05·6
	41·0	56·5	02·5
April	37·0	60·7	02·3
July	45·5	..	54·5
	50·00	..	50·0

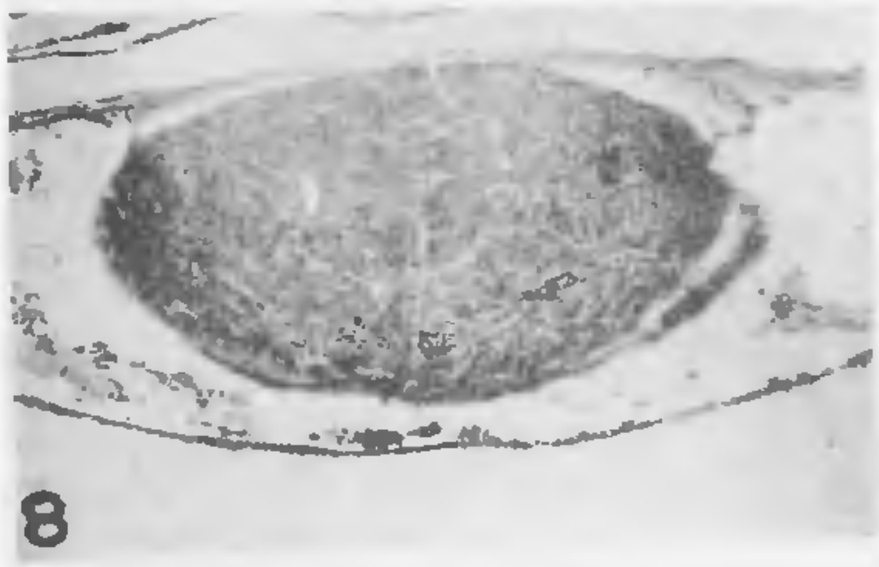




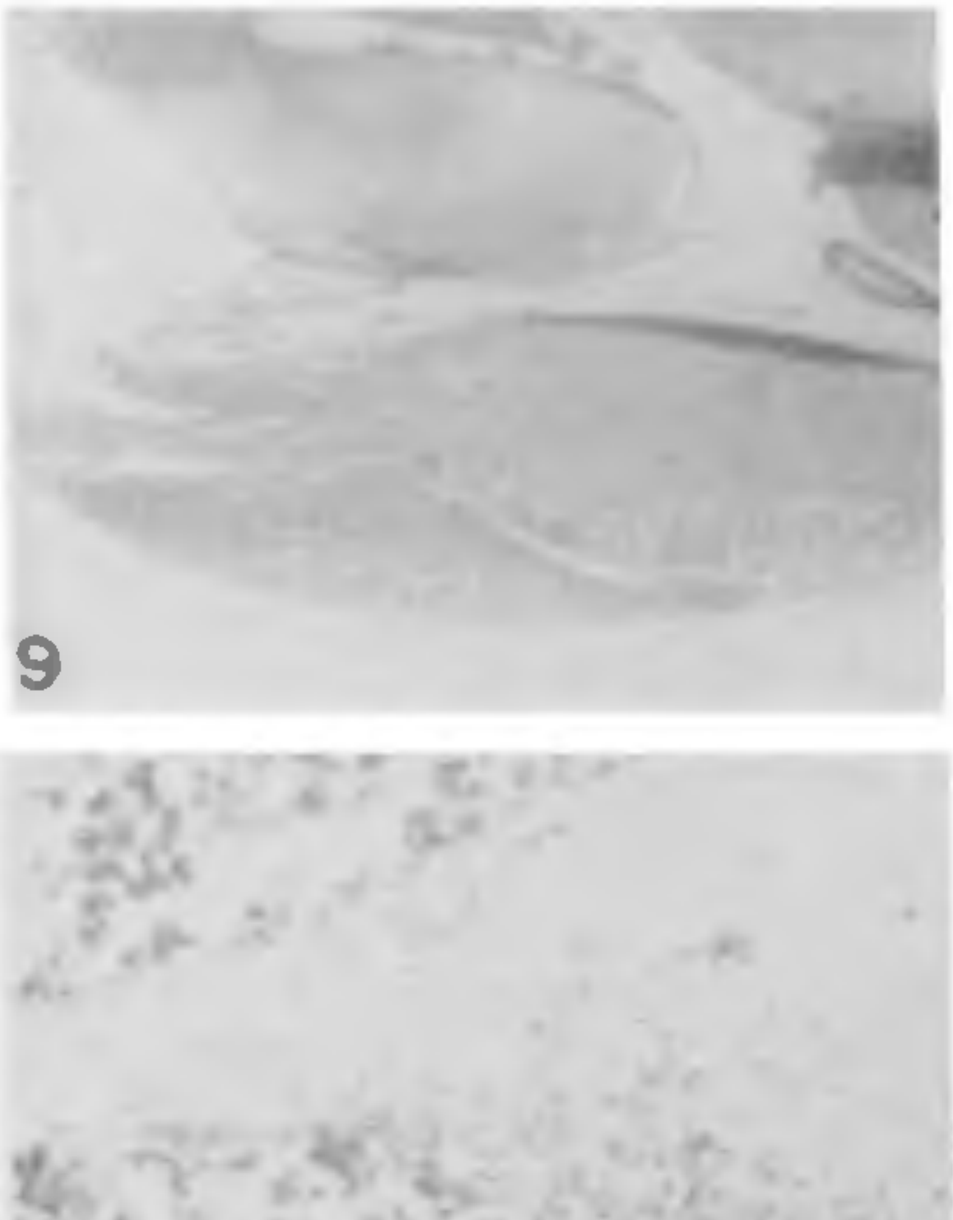








FIGS. 2–8. Figs. 2–5. Selected serial transverse sections of the pituitary gland of *Rousettus leschenaulti*. Please note the presence of the pars tuberalis (arrow) and the absence of the hypophyseal cleft (Figs. 3–5). Figs. 6–8. Selected serial transverse sections of the pituitary gland of *Rousettus leschenaulti* in the cranial region of the gland. Please note the dorsal and the ventral components (arrow and arrow head) of the neural lobe. The dorsal component decreases in size and the ventral component enlarges so that the ventral component forms the caudal part of the neural lobe, × 60. H.E. Stain.



FIGS. 9–10. Fig. 9. Sagittal section of the pituitary gland of unweaned young one. Please note the presence of definite hypophyseal cleft and no demarcation of the ventral and the dorsal component of the neural lobe as seen in the adult, × 38. H. E. Stain. Fig. 10. Magnified portion of the Fig. 9. Please note the presence of definite hypophyseal cleft, × 110.

phase of the reproductive activity. Interconversions of one type of gonadotropha into another is ruled out because the total number of gonadotrophs is constant during all the months. Hence, it leads to the only conclusion that perhaps chromophobes become periodically converted into different types of gonadotrophs depending upon the physiological status of the animal and after chromophobes. There are, however, no data at present if this actually happen since the progressive stages of conversions of chromophobes into the different gonadotrophs and *vice versa* are not available.

ACKNOWLEDGEMENTS

The author is grateful to Dr. A. Gopalakrishna, D Sc., Director, Institute of Science, Nagpur, for not only suggesting the problem but also for constant encouragement during the progress of this work.

1. Adams, C. W. M., *J. Histochem. Cytochem.*, 1956, 4, 23.
2. Barnes, B. G., *J. Endocrinology*, 1962, **71**, 618.
3. Basset, T. E. G., *Ibid.*, 1951, 7, 215.
4. Baer, P., *Acta Nerel. Morph.*, 1940, 3, 87.
5. Benda, C., *Zbl. Path. Reg. M.*, 1927, 40, 185, and 211.
6. Cason, J. E., *Stain Technology*, 1950, **25**, 225.
7. Dawson, A. B., *Anat. Rec.*, 1954, **120**, 810.
8. Elftman, H., *J. Histochem. Cytochem.*, 1959, 7, 98.
9. Gopalakrishna, A., *Curr. Sci.*, 1964, 33, 558.
10. —, *Ibid.*, 1969, 38, 338.
11. Green, J. D., *Am. J. Anat.*, 1951, 88, 225.
12. Halmi, N. S., *Stain Technology*, 1952, 27, 61.
13. Henstrom, I ., *Acta Zool.*, 1944, 25, 1.
14. —, *Acta Univ. Lund. N.F. AVD* 2, 1950, 40 (3), 1.
15. —, *Ark. Zool. Ser.* 2, 1953, 6, 97.
16. —, *Gunma J. Med. Sci.*, 1959, 3, 207.
17. —, *The Pituitary Gland*, eds. G. W. Harris and B. T. Denovan, 1966, p. 1.
18. — and Wingstrand, K. G., *Lunds Univ. Arsakr. N.F. Avd.*, 2, 1951, 47 (6), 1.
19. Herring, P. T., *Quart. J. Exp. Physiol.*, 1908, 1, 121.
20. Herlant, M., *Arch. Biol.*, 1956, 67, 89.
21. — and Connivence, R., *C.R. Acad. Sci., Paris*, 1961, 250, 606.
22. — and Racadot, J., *Arch. Biol.*, 1957, 68, 127.
23. Hunte, T. E., *Anat. Rec.*, 1946, 94, 519.
24. Kirkman, H., *Am. J. Anat.*, 1937, 61 (2), 223.
25. Koneff, A. A., *Stain Technology*, 1938, 25, 225.
26. Lothringer, B., *Arch. Nuke Anat.*, 1886, 28, 257.
27. Oboussier, H., *Arch. Entw. Mech. Org.*, 1948, 143, 192.
28. Patil, G. R., *J. Anat.*, 1974, 118 (1), 33.
29. Pearse, A. G. E., *Histochemistery—Theoretical and Applied*, 3rd edn., J. A. Churchill Ltd., London, 1968.
30. Purves, H. D. and Griesbach, W. E., *J. Endocr.*, 1957, 14 (4), 361.
31. Racadot, J., *Compt. Revd. Assoc. Anat.*, 1959, 41 (87), 1049.
32. Rasmussen, A. T., *Proc. Ass. Res. Nerv. Dis.*, 1936, 17, 118.
33. — and Herrick, R., *Proc. Soc. Exp. biol., N.Y.*, 1922, 19, 416.
34. Sawyer, E. L., *J. Morph.*, 1936, 2, 127.
35. Schonemann, A., *Arch. Path. Anat.*, 1892, 129, 310.
36. Van Oordt, P. G. W. J., *General and Comparative Endocrinology*, 1965, 5, 131.