HISTOLOGICAL AND HISTOCHEMICAL STUDIES ON PITUITARY GLAND OF INDIAN BUFFALO (Bos Bubalis)

By

ARVIND GANGULI, *B. V. Sc. and A. H. (Magadh)*

A THESIS

Submitted to the faculty of Veterinary Science, Magadh University, in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE (VET.)

POST-GRADUATE DEPARTMENT OF ANATOMY

BIHAR VETERINARY COLLEGE,

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P A T N A

Dated 14th November,1969.

Certified that the word described in this Thesis entitled " HISTOLOGICAL AND HISTOCHEMICAL STUDIES ON PITUITARY GLAND OF INDIAN BUFFALO" is the bonafide work of Shri Arvind Ganguli, carried out under my guidance and supervision.

(R. C. P. YADAVA)

A B S T R A C T S

This study was undertaken to provide a more or less complete and upto-date description of the histological and histochemical structures of the pituitary gland of Indian buffalo (Bos bubalis).

Studies were made on 12 Indian buffaloes, out of which six were young male (due to non-availability of adult male animal the studies were made on young male animal only) and six adult female.

The pituitary gland in this species was elongated and narrow. The colour of the pituitary gland appeared to be light brown. The neurohypophysis part was whiter than the adenohypophysis part. The gland was found to be lodged in the sella turcica of the sphenoid bone.

The approximate weight of the pituitary gland of young male animal was 555.0 mg. and that of adult female animal was 855.5 mg.

The average length, breadth and thickness of the pituitary gland of young male animal were 1.3 cm., 0.4 cm. and 0.5 cm. respectively. In adult female buffalo these were 1.6 cm., 0.7 cm. and 0.9 cm. respectively.

The pars distalis was brown in colour whereas pars nervosa was white. The pars nervosa was smaller than the pars distalis.

The pars intermedia was closely fused with the pars nervosa. It remained all around the pars nervosa. The cells were basophilic in nature and smaller than the basophil cells of pars distalis.

The pars tuberalis encircled the infundibulum in a collar like fashion. The cells were basophilic in nature.

The capsule of pituitary gland of Indian buffalo was made up of fine reticular and collagenous fibres. No muscle fibres were found.

The pars distalis in this species was composed of tortuous and branching cell cords and clusters, surrounded by sinusoids and mesh work of reticular fibres.

The cell cords had three main types of cell in this species - acidophils, basophils and chromophobes or cheif cells. Among the three main type of cells, the basophil cells were largest in size and their average diameter was 24.04 microns in the young animal and 25.41 microns in adult animal. Some of these cells were circular and some of them were triangular in outline. The average diameter of the nucleus was 4.2 micron in both the cases. Basophil cells were evenly distributed in pars distalis. Three types of basophil cells were distinguished in this species by P.a.s. and alcian blue stain- gonadotrophic I cells (follicle stimulating hormone secreting cells), gonadotrophic II cells (leuteinising hormone secreting cells) and thyrotrophic cells (thyroid stimulating hormone secreting cells). The

acidophil cells were smaller than the basophil cells but larger than the chromophobe cells in this species. Their average diameter was 13.07 microns in young animals and 13.85 microns in adult animals. Acidophil cells were circular to oval in outline. The average diameter of nucleus of acidophil cells was 4.2 microns in both the cases.

Two types of acidophil cells were found in this species by orange G and aniline blue stain- alpha or A_1 cells (growth hormone secreting cells) and epsilon-eta or A_2 cells (prolactin hormone secreting cells).

The chromophobe or reserve or cheif cells were found in groups in pars distalis of this species. The average diameter of the chromophobe cells was 6.45 micron in young animal and 8.86 micron in adult animal and that of nucleus was 4.2 micron in both the cases.

The infundibulum of pituitary gland of Indian buffalo was composed of mainly of nervous tissue.

The pars nervosa was smaller in size than the pars distalis in this species. The nerve fibres in this region were arranged in unoriented fashion. The glia cells were found to be present at certain regions of pars nervosa. The pituicytes had short branching processes and a distinct cell membrane. The Herring bodies were also found in this part. They appeared circular and oval in outline.

Various special stains had been used to demonstrate

glycogen, phospholipid, ascorbic acid, ferric chloride and calcium.

The glycogen was appeared to be present in the basophil cells in the pars distalis, capsule of the gland and colloid material of the hypophyseal cavity.

The phospholipid was appeared to be present in the pars distalis of the pituitary gland of Indian buffalo. The ascorbic acid was present in the pars distalis of the gland.

Calcium and ferric chloride were appeared to be absent from the pituitary gland of Indian buffalo.

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Dedicated to my revered Professor Dr. R.C.P.Yadava, M.S.,Ph.D.(Mich) Director,Livestock Research Station,Bihar, Patna and Head of the Postgraduate Department of Anatomy Bihar Veterinary College, Patna , whose unfothomable knowledge and timely inculcations have been the paramount and immense source of inspiration.

A C K N O W L E D G M E N T S

The author wishes to express his deep sense of gratitude and sincere reverence to Dr. R.C.P.Yadava, M.S., Ph.D.(U.S.A.), Professor & Head of the Postgraduate Deptt. of Anatomy, Bihar Veterinary College, Patna and Director, Livestock Research Station, Bihar, for his invaluable suggestions, guidance and supervision during the tenure of this investigation.

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The author is also very thankful to Arts and Photosection of Bihar Veterinary College, Patna for preparing the gross photographs and photo micrographs needed to elucidate the various points.

V I T A

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Candidate for the Degree
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Final examination :-	December, 1969, Bihar Veterinary College, Patna.
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Outline of studies:-	Major subject - Anatomy Minor subjects- Surgery (including radiology), Gynaecology and Obstetrics (including Artificial insemination).
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INTRODUCTION

This investigation deals with a histological and histochemical studies on pituitary gland of Indian buffalo (Bos bubalis). The capsule, adenohypophysis, neurohypophysis and hypophyseal cavity of pituitary gland of Indian buffalo are studied histologically and histochemically in this present study.

The buffalo has been chosen for this investigation on account of its great economic value. The total population of buffalo in the world is 95.4 million out of which 51 million is present in India alone (Year Book, 1964). Indian buffaloes are heavy milker than Indian cows. The fat content of Indian buffalo milk is 1½ time more than Indian cows' milk. So, Indian buffalo milk is more valuable in ghee and butter production. Buffaloes' meat, hide, horn and hoof also form a major part in the production than any other farm animal. This undoubtedly symbolises the role which this animal is playing for the economic development of the country.

Pituitary gland is the master endocrine gland of the body. The anterior pituitary consists of the pars distalis and the pars tuberalis. The posterior pituitary consists of the pars intermedia and the pars nervosa. The hypophyseal stalk consists primarily of the neural stalk which connects the posterior pituitary with the hypothalamus (Greep,1954).

The pars distalis forms the major portion of the anterior lobe and contains the hormone producing cells (Zarrow,1962) which secretes Somatotrophic hormone, Adrenocorticotrophic hormone, Thyroid stimulating hormone, Follicle stimulating hormone, Luteinising hormone and Prolactin(Leuteotrophic hormone). The secretion of both Somatotrophic hormone and Prolactin take place from the acidophil cells of the anterior pituitary, and all rest hormones are secreted from basophil cells. Follicle stimulating hormone, Luteinising hormone and Leuteotrophic hormone are of major significance in regulating the ovaries and testes both with regard to production of ova and sperm and the release of specific gonadal hormones. In addition, Leuteotrophic hormone has a direct effect on peripheral tissues such as the mammary gland so this hormone is directly concerned with the milk secretion. Adrenocorticotrophic hormone and Thyroid stimulating hormone are concerned with the functioning of the adrenal cortex and the thyroid gland.

The posterior pituitary secretes oxytocin and vasopressin hormones. Oxytocin hormone is directly concerned with the contraction of uterus and let down of milk. Vasopressin hormone is concerned with the blood pressure raising and antidiuretic action (Bloom,1957).

The Melanophore stimulating hormone is also secreted by the pituitary gland. This hormone is concerned with the colouring of the skin (Ham, 1957).

Hence, the pituitary gland is of great importance on account of producing valuable hormones.

Trautman (1957) gave a brief comparative account of histological structures of the pituitary gland of the various domesticated animals excepting buffalo.

Serber (1958) described the cell types in the pars distalis of the hamster pituitary gland.

William (1961) described the histochemical aspect of the human pituitary gland.

Mazzocchi (1967) described the different cell types, intercellular spaces and follicles in the adenohypophysis of pig.

Bugnon (1967) observed six different type of cells in the pars distalis of fox pituitary gland.

Carlon (1967) noted in detail the six cell types in the adenohypophysis of the dog.

Nayar (1968) investigated the growth hormone and prolactin secreting cells in the pituitary gland of ox.

Reviewing the work of various research workers, the author has not found any literature regarding the histology and histochemistry of the hypophysis cerebri of the Indian buffalo.

The present research embraces the realm of both histology and histochemistry of the hypophysis cerebri of the Indian buffalo (Bos bubalis). A brief account of its gross structures has also been made. The author hopes this paper will serve as a reference to the physiologist, anatomist, biologist and other research workers.

Microscopic studies were made under light microscope and as such ultramicroscopic structures have not found place in this work. Moreover, the structures of the Golgi-complex, mitochondria, pattern of blood vessels and nerve terminations, requiring special cytological and histological techniques have not been carried out. Nowhere in the literature has there been found a complete description of an up-to-date study of the pituitary gland of buffalo.

Hence this investigation was undertaken to contribute something towards this aspect of the science.

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REVIEW OF LITERATURE

GROSS ANATOMY

Jonston & Willis (1938) described the pituitary gland in man as a reddish grey, ovoid body, measuring about 12 mm. in its transverse and 8 mm. in its antero-posterior diameter. The gland was attached to the end of infundibulum and lodged in the hypophyseal fossa of sphenoid bone. The gland had two lobes - anterior and posterior. The anterior lobe was kidney shaped and larger than the posterior lobe.

Herbert & Herbert (1947) observed the hypophysis cerebri of man as a flattened oval body, longest diameter averaging 10 to 12 mm. They were situated at the base of the brain near optic chiasma. The major parts of the gland were a larger anterior glandular lobe and a smaller nervous lobe. The pars intermedia and pars tuberalis, the two smaller glandular masses were situated in between the two major lobes.

Greep (1954) pointed out that in human hypophysis the average measurement was 1.3 cm. (transverse) by 1 cm. (sagittal) by 0.5 cm. (vertical). Its weight was 0.5 to 0.6 gms. in adult. The female pituitary was larger than male. During pregnancy the size of hypophysis cerebri was more and it might go upto 1 gm. in multipara. The hypophysis had

two lobes, the anterior lobe was pinkish in colour and composed of soft, pliable glandular tissue, the posterior lobe was whiter, more fibrous and of firmer consistency.

Dukes (1955) described that the hypophysis cerebri occurred throughout the vertebrate series. Its place of occurrence was hypophyseal fossa of sphenoid bone in higher animals. Grossly it had two lobes anterior and posterior in all higher animals.

Sisson & Grossman (1956) presented a comparative description of pituitary gland of horse, ox, dog and fowl. In horse, the pituitary gland was a yellowish brown discoidal structure which was connected with the base of the cerebrum by a delicate tube, the infundibulum. In ox it was much more narrower than that of horse. The infundibulum was relatively long and slopes downwards and backwards. In dog it was circular and rather small. In fowl the hypophysis was a small brown mass situated at the same place like mammals.

Trautman (1957) stated that in domestic animals, the hypophysis cerebri had embryologically two parts, pars buccalis and pars nervosa, histologically four parts, pars tuberalis, pars distalis, pars intermedia and pars nervosa and grossly anterior lobe and posterior lobe.

Bloom (1957) described that human pituitary gland measured about 1 cm. in length, 1 to 1.5 cm. in width and

about 0.5 cm. in height. Its weight was about 0.5 gm. in male and slightly more in female. The anterior lobe formed about ¾th of the gland, the neural lobe the most remainder, the pars intermedia and pars tuberalis each about 2 %.

Turner (1961) described the pituitary gland of vertebrates. The pituitary gland was a compound gland, located in the sella turcica, a concavity in the sphenoid bone. Pituitary gland had two parts - adenohypophysis and neurohypophysis. In human infants, the pars intermedia was conspicuous but in adults it merges with the neural lobe and tend to become obscure. In birds, whale, Indian elephant and armadilla this lobe was absent.

Copenhaver & Wilfred (1964) described the human pituitary gland. It measured about 1.2 to 1.5 cm. in transverse plane about 1 cm. in sagittal plane and about 0.5 cm. in height. Its average weight in male was 0.6 gm., in multipara the weight of the gland might be upto 1 gm.

Keever (1964) noted that the pituitary gland in adult male white-footed mouse was larger than females. Sexually active males had larger pituitaries than non-active males. In lactating animals, the pituitary gland was larger than that of pregnant animals.

Anand (1967) observed the pituitary gland of Slender Loris loris. In it he found that hypophyseal axis directed antero-posteriorly, pars tuberalis encircled the

infundibular stalk and did not extend rostrally to the region of the optic chiasma. The pars intermedia lined the ventral and antero-lateral surfaces of the pars nervosa. The pars distalis laid immediately below the hypothalamus.

MICROSCOPIC ANATOMY

The Capsule:

Greep (1954) found a fibrous connective tissue capsule in the pituitary gland of mammals.

Bloom (1957) described that the capsule of pituitary gland of human was made up of dense collagenous fibers and separated from the periosteum of the sphenoid bone by a looser layer of connective tissue containing numerous veins.

Tarmas (1960) observed the capsule of human hypophysis cerebri composed of connective tissue.

Adenohypophysis:

Greep (1954) presented a systematic classification of adenohypophysis into three sub-divisions. The subdivisions of the adenohypophysis were pars distalis or anterior lobe, pars tuberalis and pars intermedia.

Trautman (1957) used the term pars buccalis in place of adenohypophysis due to its embryological development from the dorsal evagination of stomodeum. He had divided this part into three sub-divisions - pars tuberalis, pars distalis and pars intermedia.

Copenhaver & Wilfred (1958) divided adenohypophysis which was originated from oral ectoderm into three components - pars tuberalis, pars anterior or pars distalis and pars intermedia.

Pars distalis :

Herbert & Herbert (1947) described in human pituitary gland that the pars distalis had cords of epithelial cells interspersed among numerous blood and lymph spaces. The acidophilic and basophilic cells were present in this part.

Serber (1958) noted in hamster pituitary gland that the acidophil cells were round to ellipsoid in shape, smaller in size than basophil cells, the cells had a large spherical granules. The cell nuclei were light staining and vesicular. The acidophil cells were distributed in scattered fashion and appeared in cluster. The basophil cells were largest cell types in both the sexes. The nuclei had the same size to that of acidophil cells. Two types of basophil cells were observed in this species, one type of moderate size and the other of large size, the latter being of rounded cells. Chromophobe cells were smaller and situated towards periphery.

Herlant (1959) investigated in the pars distalis of

mole that during mating the second type of gonadotrophic cells appeared. In the female, the lactation cells appeared in the course of gestation and hypertrophy took place after littering.

Herlant (1959) noted in the pars distalis of mice, cat, mole and lemur two different types of gonadotrophic cells. He described that first of these cells were actual basophilic and other one had acidophilic properties.

Eletman (1959) noted in the anterior pituitary of dwarf mouse that the acidophil cells were more prominant, cytoplasm had a broad rim around the nucleus. The cytoplasm of the cell contained a special type of granules (Spherules). The thyrotrophic cells were completely absent in dwarf but isolated thyrotrophic cells were observed by him.

Muto (1959) described castration cells of pars distalis of male albino rat. He observed that castration cells were spherical Beta cells enclosing an expanding signet ring.

Miraglia (1960) noted in the pituitary gland of tein (a reptile) that the pars glandularis had the same type of cells to other reptiles.

Muto (1960) observed that changes took place in cells of adenohypophysis after castration in male rats. He noted that Beta cells were increased in number after castration.

Parteds (1960) investigated five types of chromophilic cells in the pituitary of pleurodeles waltlii - classical acidophil (alpha), Erythrosianophilic, thyrotrophic, gonadotrophic (beta), P.a.s. positive, which remained negative with alcian blue at PH 0.2 (Y).

Yamada (1960) noted the cellular changes in the mouse anterior pituitary gland from maturity to senility. He observed that the acidophil cells slightly changed in granulation and number, Beta cells remained same. Chromophobe cells gradually increased in number.

Herlant (1960) noted Beta and Gamma cells in the pars distalis of both sexes of mole. In sexual active period the Gamma cells were very active. He observed the classic cells which secrete prolactin hormone, and which were quite different from the acidophilic and Gamma cells.

Goegg (1960) investigated increased number of vesiculate chromophobe cells in pars distalis of critinoid dwarf.

Dodd (1960) described in Petromyzon fluviatilis that the anterior lobe contained acidophilic and basophilic cells arranged in vertical columns.

Peyne (1961) investigated large masses in the anterior lobe of castrated, ovariectomized and old fowls. He described these masses as fusion of secretory vesicles.

Turner (1961) described the presence of irregular masses and cords of epithelial cells separated by sinusoids and supported by connective tissue frame work in the pars distalis of vertebrate pituitary gland. Further he noted two types of acidophilic cells, three types of basophilic cells and chromophobe cells.

Vanoos (1961) noted four types of chromophilic cells in the pars distalis of common frog, the cells were acidophils, Beta cells or amphiphils type I, Y cells or amphiphils type II, and Delta cells or cyanophils. He found that the Beta cells were absent from the pituitary gland of Juvenile Rana temporaria. One year after castration the hyperactivity of Beta cells were noted by him.

Barnes (1961) investigated the ciliated secretory cells in pars distalis of mouse hypophysis cerebri.

Tavares (1961) investigated in pars distalis of cat two types of gonadotrophic cells in addition to thyrotrophic cells which were P.a.s. positive.

Ortman (1961) investigated the cell types in anterior lobe of Rana pipiens and he found Acid fuchsin cells P.a.s. positive, Aniline blue cells (type 1 and type 2) P.a.s.positive, orange G cells P.a.s. negative, Purple cells P.a.s.positive and Chromophobe cells P.a.s. negative.

Gabe (1962) stated five types of cells - the alpha, beta, gamma, delta and epsilon - eta in the anterior pituitary

gland of mammals.

Girons (1962) observed in Crocodiles, turtles, lizards and snakes in anterior lobe the presence of solid structure which contained various cell types with a constant mode of distribution.

Oliverean (1962) noted 6 types of cells in the adenohypophysis of teleosts - two types of acidophiles, two types of gonadotrophic cells - P.a.s. positive and thyrotrophic cells - P.a.s. positive. Further, he identified 5 types of cells in the adenohypophysis of reptiles - alpha cells, gonadotrophic cells (beta and gamma) and Delta cells and finally epsilon cells.

Tixier (1962) stated 6 distinct cellular types in the anterior hypophysis of male peking duck, 5 of these cells were identical to other vertebrates, but the sixth cellular type noted and named Kappa cell and described as peculior to birds.

Tixier & Vidal (1962) observed six cell types in the anterior pituitary of duck. They noted two types of acidophil cells (A_1 cell or alpha cells and the A_2 cells or epsilon cells), and three quite distinct types of glycoprotein cells.

Bugnon and Racadot (1963) observed six types of cells in the anterior lobe of pig pituitary gland.

Yamada (1963) investigated five types of cells in

mouse. The cells were Acidophils, Basophil, Chromophobe, Theta cell, and cells without any kind of granules. He further stated that Theta cells or specific chromophobe cells were noted during pregnancy and lactation.

Wilfred & Copenhaver (1964) described that in human the parenchyma of pars anterior was formed by anastomosing cords of cells between which the sinusoids situated. Acidophil, Basophil and chromophobe cells formed the cell types of parenchyma. As many as 6 types of cells were described by them in this part.

Srebro (1964) stated the following types of cells in the pars distalis of Xenopus laenis. Alpha cells (classical acidophil), Delta cells (Thyrotrophs) and Beta and Gamma cells (Gonadotrophs) were observed by him.

Charnot & Racadot (1964) observed six different type of cells in the anterior lobe of dromedary.

Uchida (1967) observed six different type of cells in the pars distalis of mouse pituitary gland. He investigated two types of acidophils - one growth hormone secreting cells and other prolacting secreting cells, three types of basophils and chromophobe cells.

Carlon (1967) investigated six different catagories of cells in the pars distalis of dog pituitary gland. According to him cell types were same to other mammals.

Bugnon & Lenys (1967) described six different type of cells in the pars distalis of fox pituitary gland.

Mazzocchi (1967) noted in adenohypophysis of pig the intercellular spaces and follicles. According to him thise follicles were made up of non-secreting cells, and the follicles control the quantity of hormone entering the blood.

Anand (1967) stated in the adenohypophysis of slender loris loris, that five type of cells were present in this part. Four type of basophil cells and one type of acidophil cell were present in this part.

Repeine & Bratu (1968) observed gomeri positive cells in the pars distalis of human pituitary gland. According to them the gomeri positive cells were same to Beta cells.

Pars intermedia:

Herbert & Herbert (1947) found in the pars intermedia of human pituitary gland the colloid filled follicles among the cell cords.

Trautman (1957) observed in the pars intermedia of domestic animals a connective tissue frame work occupied by basophilic cells which were in the form of dense masses. In the ox islands of well differentiated tissues of the pars distalis type were also observed by him.

Bloom (1957) stated that pars intermedia in human pituitary gland formed about two percent of the pars distalis.

Sano (1959) found argyrophil cells (barrier cells) in dog's and cat's intermediate lobe. He found that the cells had parikaryon at various levels in the intermediate lobe and extent bipolar or unipolar processes ending in a cone like enlargements on the walls of the hypophyseal cavity and in the connective tissue between the intermediate and posterior lobes. The argyrophilic cells were neither a connective tissue element nor a nerve cells. He stated that possibly the argyrophilic cells were neuroglia cells that took part in the mutual functions between the intermediate and posterior lobes.

Oliverean (1960) observed that the intermediate lobe of pituitary gland of EEL contained mainly chromophobe cells.

Towarnicki (1962) found that the intermediate lobe of pituitary gland of Pike had very poor vascularization.

Zarrow (1962) described that the intermediate lobe of farm animals was a narrow strip of tissue between the pars nervosa and pars distalis and not present in certain birds and mammals.

Kurosunik (1963) investigated two parts in the pars intermedia of rat pituitary gland, One part the marginal zone facing the residual lumen of Rathke's pouch and the pars intermedia proper situated dorsal to the former. In a few cases he found ciliated cells among the epithelial cells lining Rathke's lumen or in the walls of cysts and in the pars intermedia proper goblet cells were present intermingled with

the ciliated cells. He found two types of glandular cells in this part, dark and light cells, the cytoplasm of the dark cells were P.a.s. positive and sudanophilic. The colloid substances in the lumen of the Rathke's and in the cyst were also P.a.s. positive.

Lagait and Lagait (1963) noted that the blood sucking animals had larger intermediate lobe and the aquatic animals had the small intermediate lobe. He further found that the intermediate lobe of Carnivora penetrate deeply into the nervous lobe.

Copenhaver (1964) described the pars intermedia of mammals. He found that in mammals the pars intermedia was formed by well developed epithelial stratum lining the vestigial lumen dorsally. The cells were polygonal in outline and took basic dye and secretary granules were present. In man and ape, he found the pars intermedia rudimentary. The small vesicles were present and they contained colloid. Cellular prolongations from it extended into the neural lobe for variable distances. Some of these cells became filled with colloid and formed cysts. Mucous and ciliated cells were also found.

Anand (1967) found in pars intermedia of slender loris loris that it lined the ventral and antero lateral surfaces of the pars nervosa.

Pars tuberalis:

Turner (1949) described that the pars tuberalis of vertebrates composed of columns of chromophobic cells which remained in follicular patterns. In many animals pars tuberalis not only surrounded the infundibular stalk but also spreaded out under the brain for considerable distance.

Ham (1957) described that the pars tuberalis of man was an upward extension of the pars anterior. The cells it contained were roughly cuboidal in shape and devoid of cytoplasmic granules. The cell cytoplasm was diffused and mildly basophilic. This part was fairly vascular.

Maximow & Bloom (1957) described that the pars tuberalis of man had thickness of 25 to 60 microns and the thickest portion was on the anterior surface of the stalk. The epithelial cells in this region were mainly small alpha and beta cells. The cells were cuboidal columnar in nature and measured about 12 to 18 microns in size and contained numerous small granules. The cells contained large amount of glycogen. Some of the cells were arranged in follicle like structure. Islands measuring 50 to 70 microns in extent of squamous epithelial cells were also found.

Carleton (1961) described the pars tuberalis of mammals. It connected the pituitary gland with the base of the brain and third ventricle. In man it contained solid strands of epithelial cells. In ox and cat it exhibited a

vesicular structure. The vesicles being lined by cuboidal epithelium and occupied by colloid like material. The pars tuberalis was extraordinarily vascular in all animals including man.

Copenhaver (1964) described a specialized area in the anterior lobe of cat and rabbit which he termed as Zona tuberalis. This area was devoid of alpha cells.

Foster (1964) noted an early effect of castraction on the cytology of the Zona tuberalis of rabbit. He found hyperplasia of the mucoid cells in this part. A depletion of the mucoid cells in the Zona tuberalis took place after four months of castration.

Anand (1967) noted the pars tuberalis of slender loris loris. He found that pars tuberalis encircled the infundibular stalk but did not extend rostrally to the region of the optic chiasma.

Neurohypophysis :

Greep (1954) presented a systematic classification of neurohypophysis into two subdivisions. The subdivisions of the neurohypophysis were lobus nervosus or pars nervosa and infundibulum.

Trautman (1957) termed the neurohypophysis as pars nervosa.

Copenhaver & Wilfred (1958) divided neurohypophysis which was originated from neural ectoderm into two parts - Pars nervosa or infundibular process or neural lobe and infundibulum or neural stalk.

Pars nervosa :

Gray (1930) described the pars nervosa of man that it was developed as a down growth from the floor of the embryonic brain, and during early foetal life it contained a cavity continuous with that of the third ventricle. In cat this cavity remained throughout the life. This part was composed of neuroglia cells and fibers, and was invaded by cell columns which grew into it from the pars intermedia. This region was embedded by scattered masses of a colloid substance which was similar to that found in the thyroid gland. In fishes this part was larger and composed of nervous structures. This part had limited blood supply from the internal carotid artery.

Herbert & Herbert (1947) described the pars nervosa of man. It was composed of connective tissue fibers frame work and neuroglia cells. This part was originated from the floor of the brain.

Turner (1949) stated the pars nervosa of the vertebrates that this portion of the pituitary gland was composed of branching cells called pituicytes and many non-myelinated nerve fibers. The pituicytes were not only present in the

pars nervosa, but also extended into the infundibular stalk. The pituicytes looked like neuroglia but cytologically they were not same. The pituicytes did not contain Nissl bodies.

Theodese et al. (1953) described the pars nervosa of mammals. In ox, this part contained glia cells. These glia cells were described as pituicytes. The pituicytes were connected with the nerve fibers of this region, and the same nerve fibers were end at the blood vessels of this part. In pig, the developing stages of pituicytes had marked similarity with the astrocytes. Like astrocytes the pituicytes contained vascular processes and foot plates.

Ham (1957) stated the pars nervosa of opossum that this part contained lobules which were divided by septa. The septa contained blood vessels. The centre part of each lobule contained a hilus. The hilus was made up of chiefly bundles of hypothalamo hypophyseal tract. The fibers were diverged from the region of hilus to approach the septum that surrounded the lobule. Near their termination each fiber existed as a central core of cylinders of neurosecretory material which remained in contact with septa more or less at right angles to them. This zone consisted of cylinders that abut on the septa and this zone was called Palisade zone of the lobule. In the hilus of each lobule the pituicytes were found. Pituicytes were a type of neuroglia cells probably worked as a supporting function. Their cytoplasmic processes (fibers) might extend between the cylinders of neurosecretory materials

in the Palisade zone. Granules were found in pars nervosa. Herring bodies were also found in pars nervosa. They were terminal bulb of nerve fibers of the hypothalamo hypophyseal tract that ended within the substance of the pars nervosa.

Maximow & Bloom (1957) described the pars nervosa of man. The cell pituicytes had four types - reticulo pituicytes, micropituicytes, fibropituicytes and adenopituicytes. The pituicytes varied considerably in size and shape, and had processes more than 100 microns in length. They were modified glia cells and appeared singly or in small or large groups. In man, the pituicytes contained pigment granules. Some of these silver granules contained iron. Glia cells with typical fibers of the central nervous system were also found in this region.

Trautman (1957) described the pars nervosa of the domestic animals. The vascular connective tissue frame work of the pars nervosa contained neuroglia like cells with interwoven processes. Some of the pituicytes had fine granules and droplets which indicated the secretory activity. The basophilic cells and spheroid hyaline capsule might also be found in this part. In addition to this, he described a net like plexus of nerve fibers. These fibers arose from the nuclei of hypothalamus and reached the pars nervosa via infundibulum. The nerve cell bodies were not found in this

region. The pars nervosa got very few blood vessels.

Wilfred & Copenhaver (1958) described the pars nervosa of mammals. They stated that the pituicytes had resemblance to the neuroglia cells in some respects. The pituicytes were small cells with ramifying process but without the distinctive features of nerve cells. Many of the pituicytes contained variable numbers of refractile droplets or granules in their cytoplasm. The nuclei of the pituicytes were round to oval in shape with a fine chromatin network. The cytoplasm of the pituicytes were drawn out into a variable number of processes which ended either on the walls of the blood vessels or on the connective tissue septa of the gland. They described four types of pituicytes - reticulopituicytes, micropituicytes, fibropituicytes and adenopituicytes. Herring bodies were present in the pars nervosa. They were present near the terminals of the nerve fibers and in intercellular spaces. Granules were present in pars nervosa.

Holmes (1959) noted in the ferret the agglomeration of nerve cells between stalk and main neural process. The cells were small or medium sized, no neurosecretory materials were found in the cells.

Miraglia (1960) noted in the pars nervosa of the tein (a reptile) that this part was consisted of lobules and into each of lobule a branch of infundibular recess

penetrated.

Carleton & Short (1961) stated the pars nervosa of mammals that this part was composed of the neuroglia elements and ependyma fibers. The neuroglia elements were described as pituicytes.

Zarrow (1962) stated that pars nervosa of mammals contained many nerve fibers, and from this part the secretion of oxytocin and vasopressin hormones took place.

Infundibulum:

Vanghan (1907) described infundibulum of vertebrate as a conical process of reddish colour to the summit of which the pituitary gland was attached. It contained a funnel shaped cavity, which communicated superiorly with the third ventricle of the brain.

Gray (1930) described infundibulum of man. It was directed downwards and forwards and contained a funnel shaped recess from the cavity of the third ventricle. It was surrounded by an upward extension from the anterior lobe of the pituitary gland.

Jonston & Whillis (1938) stated that the infundibulum of pituitary gland of man directed downward and forward. The pituitary gland was attached to it.

Turner (1949) stated that the infundibulum of mammals contained pituicytes.

Hence, the pituitary gland is of great importance on account of producing valuable hormones.

Trautman (1957) gave a brief comparative account of histological structures of the pituitary gland of the various domesticated animals excepting buffalo.

Serber (1958) described the cell types in the pars distalis of the hamster pituitary gland.

William (1961) described the histochemical aspect of the human pituitary gland.

Mazzocchi (1967) described the different cell types, intercellular spaces and follicles in the adenohypophysis of pig.

Bugnon (1967) observed six different type of cells in the pars distalis of fox pituitary gland.

Carlon (1967) noted in detail the six cell types in the adenohypophysis of the dog.

Nayar (1968) investigated the growth hormone and prolactin secreting cells in the pituitary gland of ox.

Reviewing the work of various research workers, the author has not found any literature regarding the histology and histochemistry of the hypophysis cerebri of the Indian buffalo.

HISTOCHEMISTRY

Pars distalis:

Trautman (1957) stated that Ascorbic acid was found in the pars distalis of the pituitary gland of domestic animals. It possibly played a role in the secretory process.

Serber (1958) found more P.a.s. positive materials in the gonadectomized hamester pituitary gland than the normal.

Fujimori (1959) noted in pars distalis of male mouse that P.a.s. positive cells were increased in number with age.

Graumaun & Hinrichsen (1960) observed that basophil cells of pituitary gland did not contain acid lipid and acid mucopolysaccharides. The content of R.N.A. in basophil cells was very less in amount than acidophil cells.

Brown (1960) investigated that the thyroid stimulating hormone was found in the mitochondria of the cell, prolactin and somatotrophic hormone found in the acidophilic granules, follicle stimulating hormone was distributed over several fractions and adrenocorticotrophic hormone was found in the microsomes.

Ortman (1961) noted that in Rana pipiens all the

chromophilic cells were negative for alkaline phosphatase.

Tavares (1961) observed in cat pituitary gland that gonadotrophic I cells secreted follicle stimulating hormone, gonadotrophic II cells secreted luteinising hormone and thyrotrophic cells secreted thyroid stimulating hormone.

Gabe (1962) found that the delta cells secreted thyroid stimulating hormone, beta cells secreted follicle stimulating hormone, gamma cells secreted luteinising hormone, alpha cells secreted somatotrophic hormone, alpha or epsilon-eta secreted adrenocorticotrophic hormone and epsilon-eta secreted prolactin hormone.

Oliverean (1962) noted in fishes that the alpha cells were responsible for the secretion of somatotrophic hormone and adrenocorticotrophic hormone, gonadotrophic cells (beta and gamma) were responsible for the follicle stimulating hormone and luteinising hormone, thyrotrophic cells secreted thyroid stimulating hormone and epsilon cells secreted prolactin hormone.

Emmartman et al.(1963) demonstrated prolactin hormone in cat and rat pituitary gland in the cytoplasm of acidophilic (alpha) cells of pars distalis.

Anand (1967) noted in pituitary gland of slender loris loris five types of chromophilic cells. The basophilic cells were responsible for the secretion of follicle stimulating hormone, luteinising hormone and thyroid stimulating

hormone. The acidophilic cells were responsible for the secretion of growth hormone and prolactin hormone.

Kietz & Gospodinow (1967) noted phospholipid in the adenohypophysis of Bos Taurus.

Carlon (1967) identified six different cells in the anterior lobe of dog pituitary gland. Luteinising hormone, adrenocorticotrophic hormone producing cells were identified by him.

Nayar et al. (1968) observed in bovine species that the pars distalis contained two types of acidophilic cells - One secreted growth hormone and other prolactin hormone. The acidophil cells in this species were P.a.s. positive.

Pars intermedia:

William & Mary (1961) found in pars intermedia that colloid material contained two types of materials - one an acid mucopolysacharide as found in the gland and the other, a mucoprotein or protein combined with the mucopolysacharide.

Pars tuberalis:

Foster & Cameron (1964) found hyperplasia of mucoid cells of zona tuberalis in rabbit after castration but recovary took place after four months.

Pars nervosa :

Wilfred & Copenhaver (1958) described that the

pituicytes of the neurohypophysis of man contained granules and they were composed of neutral, unsaturated fat.

William & Nary (1961) found P.a.s. positive materials in pars nervosa. Further stated that glycogen was the possible source for P.a.s. reaction.

Infundibulum :

Seitz (1964) noted protein in the infundibulum of pig pituitary gland.

Hypophyseal cavity:

Rondell (1960) observed R.N.A. and alkaline phosphatase in the hypophyseal cavity of the developing urodele. The percentage of cells active for alkaline phosphatase was greater than R.N.A.

William & Nary (1961) observed that colloid material of the hypophyseal cavity was made up of two materials. The colloid was P.a.s.positive.

Kurasunik et al.(1963) noted that in human a colloid of the lumen of Rathke's pouch was P.a.s. positive, sudanophilic and protein containing.

Copenhaver (1964) described colloid material in the hypophyseal cavity of ox pituitary gland. He stated that the colloid material was P.a.s. positive.

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MATERIALS AND METHODS

Source of Animals:

The present investigation included observations on twelve pituitary glands of Indian buffalo (Bos bubalis), out of which six were adult female and six young male. All the young animals were from two to three years of age and adult animals were from ten to thirteen years of age. The pituitary glands of young animal were collected from the department of Anatomy, Bihar Veterinary College, Patna, which were killed by bleeding through the common carotid artery and embalmed with ten percent formalin solution. The adult animal pituitary glands were collected from slaughter house, Sahganj, Patna.

The animals were in good nutritional condition and appeared to be free from disease.

Techniques

The pituitary glands were weighed with the aid of physical balance. The greatest length, breadth and thickness of the pituitary glands were measured separately with slide calipers.

Fixation:

The pituitary glands which obtained from slaughter house were immediately put at the site into ten percent formaldehyde (one part commercial formalin and nine parts water). The materials of department of Anatomy were collected from embalmed animals meant for dissection. However, they were fixed, upon their removal from carcasses in ten percent formaldehyde solution. Special fixatives were used for histochemical works.

Preparation of blocks:

The entire pituitary gland was used as one block.

Water and alcoholic wash:

The glands were washed in running tap water for three to twelve hours and were then put into 70 percent ethyl alcohol for 12 to 16 hours.

As glycogen was to be demonstrated, the pituitary glands were transferred from the formol saline to 70 percent alcohol for alcoholic wash for at least twenty four hours.

Dehydration:

The tissues were then passed through the three jars for dehydration as follows:-

1) Jar I - Normal butyl alcohol and 95 percent ethyl alcohol(equal parts) - 4 hours.

2) Jar II - Normal butyl alcohol No.I - 4 hours

3) Jar III- Normal butyl alcohol No.II-16 hours.

Clearing and infiltration:

After dehydration the tissues were made to pass through the four jars containing the following chemicals and kept inside the paraffin oven at 60°C.

1) Jar I - containing half normal butyl alcohol and half 52°C paraffin - 2 hours.
2) Jar II - containing 52°C paraffin - 2 hours.
3) Jar III- containing 52°C paraffin - 2 hours.
4) Jar IV - containing 56°C paraffin - 18 hours.

Embedding:

The tissues were then embedded in hard paraffin(62°C) as the work was done during summer season.

Sectioning:

Longitudinal and transverse sections were cut at 5 microns, 7 microns and 10 microns respectively. They were collected on albuminised slides.

Staining:

Nearly four hundred slides were stained with the following different stains.

I. Harris alum haemotoxylin and counter stain ethyl eosin were used as a routine method of staining. The majority of the slides were stained with these stains.

II. Weigert and Van Gieson's stains were used for elastic, collagenous fibres and muscle fibres (Mallory,1942).

III. Foot's silver impregnation method for Reticular fibres (Rubb - Smith's modification) (Culling, 1957).

IV. Fast Green - Van Gieson's staining for acidophilic and basophilic granules (Lillie,).

V. The Von Kossa method for calcium deposits(Pearse'60).

VI. Perl's method for Ferric Iron (Pearse'60).

VII. Periodic-Acid-Schiff reaction without digestion for demonstration of glycogen,mucin (McManus,1949).

VIII. P.a.s. alcian blue staining for identification of thyrotrophic cells, gonadotrophic I cells and gonadotrophic II cells (Tavares,1961).

IX. Orange G and aniline blue staining for two types of acidophil cells.(Francis,1946).

X. P.a.s. stain for phospholipid after oxidised with par acetic acid (Pearse'60).

XI. Stain for Ascorbic Acid (Gomori,1952).

Mounting:

The mounting of the sections were done with D.P.X., Canada balsam and glycerin jelly, as the ocassion demanded.

Methods of measurement(Micrometry):

Diameters of acidophil, basophil and chromophobe cells and their nuclei and the cells of intermediate lobe were measured with the aid of 'Ocular micrometer', which was standarised against a 'Stage micrometer'. As the average of six measurements were considered statistically sufficient, so six slides from all the twelve buffaloes were taken and the structures were measured under light microscope. Thus the average of six measurements from each animal gave the measurement of the particular structure of that animal. Further, the mean of the average of all the measurements in different animals of the same age group gave the final average measurement of the particular structure in the animals of that age group.

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RESULTS AND DISCUSSION

Gross :

The hypophysis cerebri structurally and functionally is the most complex of the endocrine glands. It is derived in part from oral ectoderm and in part from the brain with which it maintains its connection in the adults. The major parts of the gland (anterior and posterior lobes) lies, in most forms, in a bony fossa, the sella turcica, a depression in sphenoid bone. This part is ensheathed by the dura, an extension of which, the diaphragm sellae, roofs over the sella turcica. There is a small aperture in the diaphragma through which the pituitary stalk passes. The suprasellar portion of the gland includes the pituitary stalk and the portion of the hypothalamus known as median eminence of the tuber cinereum. The infundibular stem forms the bulk of the pituitary stalk. The smaller component, the pars tuberalis, surrounds the infundibular stem and flares out onto the median eminence.

The pars nervosa and pars intermedia are intimately fused. Except at the periphery pars intermedia is separated, in most species, from the pars anterior by a cleft like cavity, the vestigial lumen or hypophyseal cavity. In man, only ramnants of this cleft are present. In birds, armadillo, whales the pars intermedia is not

present and there is no vestigial lumen.

The hypophysis is divided into following parts:-

Derivation	Divisions	Components
Oral ectoderm	Adenohypophysis	Pars tuberalis.
		Pars anterior or pars distalis.
		Pars intermedia.
Neural ectoderm	Neurohypophysis	Pars nervosa.
		Infundibulum.

In Indian buffalo, the hypophysis was found to be brown in colour. The adenohypophysis part had some black spots externally. The neurohypophysis part was whiter than the adenohypophysis. The gland was encapsulated by a capsule.

The shape of the hypophysis was elongated and narrow (Plate no.1). The infundibulum was directed downward and forward.

The average weight of the pituitary gland of Indian buffalo were 555.0 mg. in young male animal and 855.5 mg. in adult female animal (Table no.I & II).

The average length, breadth and thickness were 1.3 cm., 0.4 cm. and 0.5 cm. respectively in young

male animal and in female animal 1.6 cm., 0.7 cm. and 0.9 cm. respectively.(Table no.I & II).

The vestigial lumen or hypophyseal cavity was present in this species. It was present in between the pars distalis and pars intermedia. It was more prominant in younger animals than in the adults.

The lumen of the infundibulum was not visible with nacked eyes in Indian buffaloes. Similarly the pars tuberalis and pars intermedia were not well demarkated under nacket eyes.

Our observations were similar to describe by Greep (1954) in man, Trautman (1957) in domestic animals and Wilfred and Copenhaver (1958) in mammals.

Table no.I

Weight and measurement of Pituitary gland of Indian buffalo (Male young)

Animal no.	Age in years	Weight	Length	Thickness	Breadth
1	2	480 mg.	1.2 cm.	0.5 cm.	0.4 cm.
2	3	650 mg.	1.4 cm.	0.7 cm.	0.5 cm.
3	2½	510 mg.	1.2 cm.	0.5 cm.	0.4 cm.
4	2	495 mg.	1.4 cm.	0.6 cm.	0.4 cm.
5	2½	590 mg.	1.1 cm.	0.5 cm.	0.4 cm.
6	3	605 mg.	1.5 cm.	0.6 cm.	0.5 cm.
Total		3330 mg.	7.8 cm.	3.4 cm.	2.6 cm.
Mean		555 mg.	1.3 cm.	.5 cm.	.4 cm.

Table no.II

Weight and measurement of Pituitary gland of Indian buffalo (Female adult)

Animal no.	Age in years	Weight	Length	Thickness	Breadth
7	10	900 mg.	1.7 cm.	0.8 cm.	0.7 cm.
8	11	857 mg.	1.4 cm.	0.7 cm.	0.6 cm.
9	10½	950 mg.	1.6 cm.	1.0 cm.	0.8 cm.
10	13	998 mg.	1.6 cm.	1.0 cm.	0.8 cm.
11	11½	850 mg.	1.8 cm.	1.0 cm.	0.8 cm.
12	13	858 mg.	1.7 cm.	0.9 cm.	0.7 cm.
T o t a l		5313 mg.	9.8 cm.	5.4 cm.	4.4 cm.
Mean		885.5 mg.	1.6 cm.	.9 cm.	.7 cm.

Microscopic Anatomy

The Capsule:

The pituitary gland is enveloped by a connective tissue fibre capsule. The connective tissue fibres are collagenous in nature.

In Indian buffalo the pituitary gland was enveloped by a connective tissue fibres capsule which was not easily removable in normal condition. The capsule contained mostly collagenous fibres. They ran parallel to the outer surface of the hypophysis. The fibres took red stain by Weigert and Van Geison's stain (Plate no.2). The muscle fibres were found absent.

Fine reticular fibres were also present besides the collagenous fibres. The reticular fibres also ran parallel to the outer surface of the hypophysis. The reticular fibres took black stain with Foot's silver impregnation method for reticular fibres (Rubb & Smith modification) (Plate no.3).

No histological difference was found between the capsule of the pituitary gland of young male animals and adult female animals.

Greep (1954), Bloom (1957) and Tarmas (1960)

also described that capsule of hypophysis was made up of collagenous fibres in man.

Adenohypophysis:

The adenohypophysis or glandular parts of the pituitary gland has three subdivisions - Pars distalis, Pars tuberalis and Pars intermedia.

In Indian buffalo also similar type of subdivisions of adenohypophysis were noted.

Pars distalis:

The parenchyma of this lobe is formed by anastomosing cords of cells between which the large capillaries (Sinusoids) are situated. In microscopic sections, irregularities in cell arrangements are always evident. Some cells appear to be in clusters, others in twisted cords, and still others form small well defined follicles, the lumen of which may contain colloid. There is very little connective tissue in any part of hypophysis, and in the pars distalis only a light mesh work of reticular fibres is present. These are encircled around the cell cords and sinusoids, the walls of which they strengthen.

The parenchyma of the pars distalis is composed of three main types of cells.- acidophils, basophils and

chromophobes. The acidophil cells and basophil cells are collectively spoken of as chromophiles.

The parenchyma of the pars distalis of pituitary gland of Indian buffalo was made up of mesh work of reticular connective tissue fibres and cell-cords. The cell-cords were tortuous and branching. They were surrounded by well developed large sinusoids and reticular fibres. The reticular fibres were arranged in circles(Plate 3). Mostly they were fine in nature but coarser fibres were also present. The sinusoids were well developed, branched and distributed throughout this part(Plate no.3).

The colloid materials were present in the alveoli formed by the cell-cords of pars distalis(Plate 4).

The cell-cords of pars distalis of Indian buffalo pituitary gland contained three main types of epithelial cells - acidophil cells, basophil cells and chromophobe cells(Plate no.4).

Acidophil cells:

In most preparations the acidophil cells are the outstanding cell type because they are numerous and generally stain intensely. In pars distalis of man, the acidophil cells make upto 37 percent of the parenchymal cell population. The acidophil cells are oval to rectangular

in shape. They vary in size. They remain in groups. They are smaller than basophil cells. The granules of acidophil cells are spherical in shape, uneven in size and vary greatly in number and distribution within a cell. The acidophil cells stain in all gradations of intensity from hyperchromatic to pale due to variation in granules content. The basophil cells display a similar characteristic. The cytoplasm of the acidophil cells stain weekly and contain mitochondria, a Golgi net at one pole of nucleus and a centriole.

There are two types of acidophil cells. One type is classic acidophil cells (alpha cells) secretes growth hormone and they are situated towards periphery of the pars distalis and the second type is Epsilon-eta situated centrally and secretes prolactin hormone.

In Indian buffalo the acidophil cells were smaller than the basophil cells but larger than the chromophobe cells (Plate 4). Their shape was circular to oval. These were distributed in scattered fashion in pars distalis. They were arranged in groups.

The nuclei of the acidophil cells of Indian buffalo pituitary gland were eccentric. They were circular in out line. They had chromatin net work. The nucliolus was placed centrally in the nucleus (Plate 4).

The average diameter of acidophil cells in young

male animal was 13.07 micron and that of in adult female animal was 13.85 micron. The average diameter of nucleus was 4.2 micron in both(Table 3 & 4).

The granules of the acidophil cells were uniform and spherical and took green stain with fast green and Van Gelson stain(Plate 5).

Two types of acidophil cells (A_1 and A_2) were found in this species by orange G and Aniline blue staining. By this staining one type of cell took orange stain with bluish tinge and second type of cell took lighter orange stain. The lighter orange stain cells were classic acidophil cells (A_1 or alpha cells) and were situated towards periphery more in pars distalis. The orange stain with bluish tinge acidophil cells (A_2 or epsilon-eta) were situated more towards centre of the pars distalis (Plate 6).

Probably acidophil A_1 or alpha cells were responsible for the secretion of growth hormone and acidophil A_2 or epsilon-eta for the secretion of prolactin hormone, in this species.

Francis et al.(1946) noted similar two types of acidophil cells (acidophil classic and epsilon-eta) in dog by staining with orange G and Aniline blue.

Copenhaver (1946) stated that in cat,dog and monkey two types of acidophil cells were present. In some

species growth hormone and prolactin hormone secreted separately from each type of cell.

Basophil cells:

The basophil cells are clearly the largest of the parenchymal cells in the pars distalis. They are mostly round to oval in shape, but angular outlines are also seen. They constitute an average of 11 percent of the cell population in the pars distalis. The granules stain with basic dye. The basophil cell granules are similar in size to those in acidophil cell granules and are subject to as much variation in number and distribution. The basophil cells have a more prominent Golgi net than do the acidophil cells. The mitochondria are numerous and vary in shape from spherulus to rodlets.

There are three types of basophil cells present in pars distalis- Two types of gonadotrophic cells and one thyrotrophic cell. The gonadotrophic I cells are situated towards periphery and secrete follicle stimulating hormone and gonadotrophic II cells remain centrally in pars distalis and secrete leutainising hormone. The thyrotrophic cells secrete thyroid stimulating hormone and are situated centrally in the pars distalis.

In Indian buffalo the basophil cells were larger than the acidophil and chromophobe cells. The average diameter of the basophil cells in young male animal was 24.04

micron and in adult female animal was 25.41 micron. The size of nucleus was 4.2 micron.(Table 5 & 6). The nucleus was circular in outline and had chromatin net work. The nucleus was placed centrally in basophil cell. The nucleolus was placed centrally in the nucleus(Plate no.4).

The cytoplasmic granules of basophil cells were coarser and took brownish red stain by Fast Green and Van Geison stain(Plate no.5).

Basophil cells were present at all parts of pars distalis in Indian buffalo pituitary gland. Basophil cells were circular to oval in shape but angular outlines were also found(Plate 7).

By P.a.s. and alcian blue staining two types of gonadotrophic cells (Gonadotrophic I and Gonadotrophic II) and thyrotrophic cells were distinguished in pars distalis of Indian buffalo pituitary gland. By this staining gonadotrophic I cells (Probably responsible for the secretion of follicle stimulating hormone) took red to violet colour and were situated towards periphery of the pars distalis. Gonadotrophic II cells(probably responsible for the secretion of leuteinising hormone) took blue colour and were situated centrally more in the pars distalis. Gonadotrophic I and gonadotrophic II cells were oval to round in shape(Plate 7). With the same stain the thyrotrophic cells took deep violet colour and were situated more centrally in the pars distalis.

Probably thyrotrophic cells of pars distalis were responsible for the secretion of thyroid stimulating hormone in pituitary gland of Indian buffalo (Plate no.7).

Tavares (1961) noted similar three types of basophil cells (Gonadotrophic I responsible for the secretion of follicle stimulating hormone, Gonadotrophic II cells responsible for the secretion of leuteinising hormone and Thyrotrophic cells responsible for the secretion of thyroid stimulating hormone) by P.a.s. and alcian blue staining.

Herlant (1961) found two types of Gonadotrophic cells by P.a.s. and alcian blue stain in mole.

Zarrow (1962) stated that the thyrotrophic cells secreted thyroid stimulating hormone. Peripherally located gonadotrophic cells secreted follicle stimulating hommone and centrally located gonadotrophic ~~a~~ cells in pars distalis secreted leuteinising hormone.

Chromophobe cells:

The distinctive characteristic of these cells, as seen in sections, is that they are essentially unstained and agranular. The chromophobes are smallest of the three cell types of pars distalis. They are rounded or polygonal in outline and have an indistinct walls. The cytoplasm of the chromophobe cells is free of alpha or beta granules.

Other light-staining granules that are possibly of mitochondrial nature have been described in chromophobe cells. The chromophobes cells often appear in groups in the centre of cell cords of pars distalis. The chromophobe cells make up approximately 52 percent of the cell population in the pars distalis of man.

In Romeis' classification of pituitary cells the chromophobe cells are the gamma cells.

In Indian buffalo chromophobe cells of pars distalis of pituitary gland were the smallest cell types. They were mostly circular in outline. The nuclei were present centrally in the cell. They were round in outline. They had chromatin net work. The nucleolus was present in the centre of the nucleus of chromophobe cells(Plate 4).

The average diameter of chromophobe cells in Indian buffalo pituitary gland were 6.45 micron in male young animal and 8.86 micron in adult female animal. The average diameter of nucleus was 4.2 micron in both(Table 7 & 8).

The chromophobe cells were in this species present in group near the centre of the cell cords of pars distalis. They were agranular cells.

Similar observations of chromophobe cells of pars distalis of pituitary gland were described by Greep(1954)

in man, Trautman (1957) in domestic animals, Serber (1958) in hamester, Wilfred & Copenhaver (1958) in mammals.

Pars Intermedia:

Pars intermedia consists of a connective tissue frame work occupied by basophilic cells, which often forms dense masses. The basophilic cells are smaller than the basophil cells of pars distalis. The nucleus of the cells of pars intermedia are round in outline and placed eccentric in the cell. The gland like follicles are often occurred in pars intermedia. They are lined with epithelium and contain a colloidal substance.

The pars intermedia remains in close contact with pars nervosa. It is separated from pars distalis by hypophyseal cavity except periphery.

In Indian buffalo pars intermedia was well developed. It almost covered the pars nervosa of pituitary gland of Indian buffalo. In young male animal and adult female animal in both cases the pars intermedia was found all around pars nervosa. It remained in close contact with pars nervosa. It was attached to the pars distalis at its superior and inferior parts where above and below the hypophyseal cavity was absent(Plate no.9, 10).

The pars intermedia was formed by well developed epithelial cells lining the hypophyseal cavity dorsally and

connective tissue frame work of reticular fibres. The reticular fibres were lesser in amount than the pars distalis (Plate no.12).

The cells of the pars intermedia were basophilic in nature. They were oval to circular in outline. The nucleus was placed eccentric in the cell. The nucleus was oval to round in shape. From one to four nucleolus were present in a nucleus of cells of pars intermedia. The chromatin net work was observed in the nucleus(Plate 8).

The average diameter of the cells of pars intermedia in young male animal was 19.35 micron and that of in adult female animal was 20.14 micron. The average diameter of nucleus was 4.2 micron (Table 9 & 10).

Pars Tuberalis:

The pars tuberalis contains many sinusoidal blood vessels and cellular tubes with stratified epithelial lining and colloidal masses in their lumina. The parenchymal cells contain fine, weekly basophilic gramules.

The pars tuberalis remains around the infundibulum of pituitary gland.

In Indian buffalo, the pars tuberalis was present around the infundibulum in a collar like fashion. It contained many sinusoidal blood vessels. The cells of this region

Table no.I

Weight and measurement of Pituitary gland of Indian buffalo (Male young)

Animal no.	Age in years	Weight	Length	Thickness	Breadth
1	2	480 mg.	1.2 cm.	0.5 cm.	0.4 cm.
2	3	650 mg.	1.4 cm.	0.7 cm.	0.5 cm.
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Total		3330 mg.	7.8 cm.	3.4 cm.	2.6 cm.
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Table no.II

Weight and measurement of Pituitary gland of Indian buffalo (Female adult)

Animal no.	Age in years	Weight	Length	Thickness	Breadth
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8	11	857 mg.	1.4 cm.	0.7 cm.	0.6 cm.
9	10½	950 mg.	1.6 cm.	1.0 cm.	0.8 cm.
10	13	998 mg.	1.6 cm.	1.0 cm.	0.8 cm.
11	11½	850 mg.	1.8 cm.	1.0 cm.	0.8 cm.
12	13	858 mg.	1.7 cm.	0.9 cm.	0.7 cm.
T o t a l		5313 mg.	9.8 cm.	5.4 cm.	4.4 cm.
Mean		885.5 mg.	1.6 cm.	.9 cm.	.7 cm.

Microscopic Anatomy

The Capsule:

The pituitary gland is enveloped by a connective tissue fibre capsule. The connective tissue fibres are collagenous in nature.

In Indian buffalo the pituitary gland was enveloped by a connective tissue fibres capsule which was not easily removable in normal condition. The capsule contained mostly collagenous fibres. They ran parallel to the outer surface of the hypophysis. The fibres took red stain by Weigert and Van Geison's stain (Plate no.2). The muscle fibres were found absent.

Fine reticular fibres were also present besides the collagenous fibres. The reticular fibres also ran parallel to the outer surface of the hypophysis. The reticular fibres took black stain with Foot's silver impregnation method for reticular fibres (Rubb & Smith modification) (Plate no.3).

No histological difference was found between the capsule of the pituitary gland of young male animals and adult female animals.

Greep (1954), Bloom (1957) and Tarmas (1960)

also described that capsule of hypophysis was made up of collagenous fibres in man.

Adenohypophysis:

The adenohypophysis or glandular parts of the pituitary gland has three subdivisions - Pars distalis, Pars tuberalis and Pars intermedia.

In Indian buffalo also similar type of subdivisions of adenohypophysis were noted.

Pars distalis:

The parenchyma of this lobe is formed by anastomosing cords of cells between which the large capillaries (Sinusoids) are situated. In microscopic sections, irregularities in cell arrangements are always evident. Some cells appear to be in clusters, others in twisted cords, and still others form small well defined follicles, the lumen of which may contain colloid. There is very little connective tissue in any part of hypophysis, and in the pars distalis only a light mesh work of reticular fibres is present. These are encircled around the cell cords and simusoids, the walls of which they strengthen.

The parenchyma of the pars distalis is composed of three main types of cells.- acidophils, basophils and

chromophobes. The acidophil cells and basophil cells are collectively spoken of as chromophiles.

The parenchyma of the pars distalis of pituitary gland of Indian buffalo was made up of mesh work of reticular connective tissue fibres and cell-cords. The cell-cords were tortuous and branching. They were surrounded by well developed large simusoids and reticular fibres. The reticular fibres were arranged in circles(Plate 3). Mostly they were fine in nature but coarser fibres were also present. The sinusoids were well developed, branched and distributed throughout this part(Plate no.3).

The colloid materials were present in the alveoli formed by the cell-cords of pars distalis(Plate 4).

The cell-cords of pars distalis of Indian buffalo pituitary gland contained three main types of epithelial cells - acidophil cells, basophil cells and chromophobe cells(Plate no.4).

Acidophil cells:

In most preparations the acidophil cells are the outstanding cell type because they are numerous and generally stain intensely. In pars distalis of man, the acidophil cells make upto 37 percent of the parenchymal cell population. The acidophil cells are oval to rectangular

in shape. They vary in size. They remain in groups. They are smaller than basophil cells. The granules of acidophil cells are spherical in shape, uneven in size and vary greatly in number and distribution within a cell. The acidophil cells stain in all gradations of intensity from hyperchromatic to pale due to variation in granules content. The basophil cells display a similar characteristic. The cytoplasm of the acidophil cells stain weekly and contain mitochondria, a Golgi net at one pole of nucleus and a centriole.

There are two types of acidophil cells. One type is classic acidophil cells (alpha cells) secretes growth hormone and they are situated towards periphery of the pars distalis and the second type is Epsilon-eta situated centrally and secretes prolactin hormone.

In Indian buffalo the acidophil cells were smaller than the basophil cells but larger than the chromophobe cells (Plate 4). Their shape was circular to oval. These were distributed in scattered fashion in pars distalis. They were arranged in groups.

The nuclei of the acidophil cells of Indian buffalo pituitary gland were eccentric. They were circular in out line. They had chromatin net work. The nucliolus was placed centrally in the nucleus (Plate 4).

The average diameter of acidophil cells in young

male animal was 13.07 micron and that of in adult female animal was 13.85 micron. The average diameter of nucleus was 4.2 micron in both(Table 3 & 4).

The granules of the acidophil cells were uniform and spherical and took green stain with fast green and Van Gelson stain(Plate 5).

Two types of acidophil cells (A_1 and A_2) were found in this species by orange G and Aniline blue staining. By this staining one type of cell took orange stain with bluish tinge and second type of cell took lighter orange stain. The lighter orange stain cells were classic acidophil cells (A_1 or alpha cells) and were situated towards periphery more in pars distalis. The orange stain with bluish tinge acidophil cells (A_2 or epsilon-eta) were situated more towards centre of the pars distalis (Plate 6).

Probably acidophil A_1 or alpha cells were responsible for the secretion of growth hormone and acidophil A_2 or epsilon-eta for the secretion of prolactin hormone, in this species.

Francis et al.(1946) noted similar two types of acidophil cells (acidophil classic and epsilon-eta) in dog by staining with orange G and Aniline blue.

Copenhaver (1946) stated that in cat,dog and monkey two types of acidophil cells were present. In some

species growth hormone and prolactin hormone secreted separately from each type of cell.

Basophil cells:

The basophil cells are clearly the largest of the parenchymal cells in the pars distalis. They are mostly round to oval in shape, but angular outlines are also seen. They constitute an average of 11 percent of the cell population in the pars distalis. The granules stain with basic dye. The basophil cell granules are similar in size to those in acidophil cell granules and are subject to as much variation in number and distribution. The basophil cells have a more prominent Golgi net than do the acidophil cells. The mitochondria are numerous and vary in shape from spherulus to rodlets.

There are three types of basophil cells present in pars distalis. Two types of gonadotrophic cells and one thyrotrophic cell. The gonadotrophic I cells are situated towards periphery and secrete follicle stimulating hormone and gonadotrophic II cells remain centrally in pars distalis and secrete leutenising hormone. The thyrotrophic cells secrete thyroid stimulating hormone and are situated centrally in the pars distalis.

In Indian buffalo the basophil cells were larger than the acidophil and chromophobe cells. The average diameter of the basophil cells in young male animal was 24.04

micron and in adult female animal was 25.41 micron. The size of nucleus was 4.2 micron.(Table 5 & 6). The nucleus was circular in outline and had chromatin net work. The nucleus was placed centrally in basophil cell. The nucleolus was placed centrally in the nucleus(Plate no.4).

The cytoplasmic granules of basophil cells were coarser and took brownish red stain by Fast Green and Van Geison stain(Plate no.5).

Basophil cells were present at all parts of pars distalis in Indian buffalo pituitary gland. Basophil cells were circular to oval in shape but angular outlines were also found(Plate 7).

By P.a.s. and alcian blue staining two types of gonadotrophic cells (Gonadotrophic I and Gonadotrophic II) and thyrotrophic cells were distinguished in pars distalis of Indian buffalo pituitary gland. By this staining gonadotrophic I cells (Probably responsible for the secretion of follicle stimulating hormone) took red to violet colour and were situated towards periphery of the pars distalis. Gonadotrophic II cells(probably responsible for the secretion of leuteinising hormone) took blue colour and were situated centrally more in the pars distalis. Gonadotrophic I and gonadotrophic II cells were oval to round in shape(Plate 7). With the same stain the thyrotrophic cells took deep violet colour and were situated more centrally in the pars distalis.

Probably thyrotrophic cells of pars distalis were responsible for the secretion of thyroid stimulating hormone in pituitary gland of Indian buffalo (Plate no.7).

Tavares (1961) noted similar three types of basophil cells (Gonadotrophic I responsible for the secretion of follicle stimulating hormone, Gonadotrophic II cells responsible for the secretion of leuteinising hormone and Thyrotrophic cells responsible for the secretion of thyroid stimulating hormone) by P.a.s. and alcian blue staining.

Herlant (1961) found two types of Gonadotrophic cells by P.a.s. and alcian blue stain in mole.

Zarrow (1962) stated that the thyrotrophic cells secreted thyroid stimulating hormone. Peripherally located gonadotrophic cells secreted follicle stimulating hormone and centrally located gonadotrophic ∝ cells in pars distalis secreted leuteinising hormone.

Chromophobe cells:

The distinctive characteristic of these cells, as seen in sections, is that they are essentially unstained and agranular. The chromophobes are smallest of the three cell types of pars distalis. They are rounded or polygonal in outline and have an indistinct walls. The cytoplasm of the chromophobe cells is free of alpha or beta granules.

Other light-staining granules that are possibly of mitochondrial nature have been described in chromophobe cells. The chromophobes cells often appear in groups in the centre of cell cords of pars distalis. The chromophobe cells make up approximately 52 percent of the cell population in the pars distalis of man.

In Romeis' classification of pituitary cells the chromophobe cells are the gamma cells.

In Indian buffalo chromophobe cells of pars distalis of pituitary gland were the smallest cell types. They were mostly circular in outline. The nuclei were present centrally in the cell. They were round in outline. They had chromatin net work. The nucleolus was present in the centre of the nucleus of chromophobe cells(Plate 4).

The average diameter of chromophobe cells in Indian buffalo pituitary gland were 6.45 micron in male young animal and 8.86 micron in adult female animal. The average diameter of nucleus was 4.2 micron in both(Table 7 & 8).

The chromophobe cells were in this species present in group near the centre of the cell cords of pars distalis. They were agranular cells.

Similar observations of chromophobe cells of pars distalis of pituitary gland were described by Greep(1954)

in man, Trautman (1957) in domestic animals, Serber (1958) in hamester, Wilfred & Copenhaver (1958) in mammals.

Pars Intermedia:

Pars intermedia consists of a connective tissue frame work occupied by basophilic cells, which often forms dense masses. The basophilic cells are smaller than the basophil cells of pars distalis. The nucleus of the cells of pars intermedia are round in outline and placed eccentric in the cell. The gland like follicles are often occurred in pars intermedia. They are lined with epithelium and contain a colloidal substance.

The pars intermedia remains in close contact with pars nervosa. It is separated from pars distalis by hypophyseal cavity except periphery.

In Indian buffalo pars intermedia was well developed. It almost covered the pars nervosa of pituitary gland of Indian buffalo. In young male animal and adult female animal in both cases the pars intermedia was found all around pars nervosa. It remained in close contact with pars nervosa. It was attached to the pars distalis at its superior and inferior parts where above and below the hypophyseal cavity was absent(Plate no.9, 10).

The pars intermedia was formed by well developed epithelial cells lining the hypophyseal cavity dorsally and

connective tissue frame work of reticular fibres. The reticular fibres were lesser in amount than the pars distalis (Plate no.12).

The cells of the pars intermedia were basophilic in nature. They were oval to circular in outline. The nucleus was placed eccentric in the cell. The nucleus was oval to round in shape. From one to four nucleolus were present in a nucleus of cells of pars intermedia. The chromatin net work was observed in the nucleus(Plate 8).

The average diameter of the cells of pars intermedia in young male animal was 19.35 micron and that of in adult female animal was 20.14 micron. The average diameter of nucleus was 4.2 micron (Table 9 & 10).

Pars Tuberalis:

The pars tuberalis contains many sinusoidal blood vessels and cellular tubes with stratified epithelial lining and colloidal masses in their lumina. The parenchymal cells contain fine, weekly basophilic granules.

The pars tuberalis remains around the infundibulum of pituitary gland.

In Indian buffalo, the pars tuberalis was present around the infundibulum in a collar like fashion. It contained many sinusoidal blood vessels. The cells of this region

were basophilic in nature. They were circular in shape. The nucleus was present centrally.

The pars tuberalis contained colloid material, and connective tissue frame work.

Similar observations of pars tuberalis were described by Greep (1954) in man, Trautman (1957) in domestic animal, Wilfred & Copenhaver (1958) in mammals.

Neurohypophysis:

The neurohypophysis of the hypophysis is a down growth from the hypothalamic region of the brain. The neurohypophysis includes neural lobe and the infundibulum. The infundibulum includes infundibular stem and the median eminence of the tuber cinerum. These regions are similar in that they possess the same type of cell, the same nerve and blood supply and yield the same active substances upon extraction.

In Indian buffalo the neurohypophysis contained pars nervosa and infundibulum.

Pars Nervosa:

The pars nervosa is made up of vascular connective tissue frame work which houses neuroglia like cells with interoven processes. Certain of the cellular elements, the pituicytes, show fine gramules and droplets indicative of

secretory activity. The pars nervosa contains intra and extra cellular pigments, which increases in amount with the age. Basophilic cells and spheroid hyaline capsule may also be present. In addition to this, there is a net like plexus of nerve fibres which arise in the nuclei of the hypothalamus and reach the pars nervosa via infundibulum. True nerve cell bodies are lacking in this part.

The cytoplasm of pituicytes are drawn out into a variable number of processes which end either on the walls of the blood vessels or on connective tissue frame work of this part. There are four types of pituicytes - reticulopituicytes, micropituicytes, fibropituicytes and adenopituicytes.

In normal pars nervosa, there may frequently be found masses of a rather homogenous material which are known as Herring bodies. They are interpreted as accumulations of the stored secretory material surrounding the nerve fibre terminals or in the intercellular spaces or as expanded portions of the nerve fibres showing increased concentration of the secretory material.

In Indian buffalo, the pars nervosa contained vascular connective tissue frame work. The nerve fibres in this region were arranged in an unoriented fashion. Some of the nerve fibres were terminated in whorls (Plate 13).

In Indian buffalo pituitary gland, the pars nervosa was found to be surrounded by pars intermedia from both the sides (Plate 10). It remained in close contact with the pars intermedia. Pars nervosa was found smaller than pars distalis in this species.

By silver stain the following type of cells were located in the pars nervosa of Indian buffalo.

A few glia cells were observed at certain parts of pars nervosa (Plate 14). They had several cytoplasmic processes.

The pituicytes which were first identified by Bucy (1940,1942), were also found in this part. The pituicytes had short branching processes and a distinct cell membrane(Plate 15). They were present at all parts of pars nervosa.

The Herring bodies were also found in pars nervosa of Indian buffalo. They were intercellular homogenous material and were situated near the termination of nerve fibres. They appeared circular to oval in outline (Plate 16).

Similar observations of pars nervosa were described by Greep (1954) in man, Trautman (1957) described that in certain species of domestic animal the pars nervosa was found to be surrounded by pars intermedia, Maximow & Bloom (1957) in man, Wilfred & Copenhaver(1958) in mammals.

Infundibulum:

The suprasellar portion of the pituitary gland includes pituitary stalk and the portion of the hypothalamus known as median eminence of the tuber cinereum. The infundibular stem forms the bulk of the pituitary stalk.

The infundibulum contains a funnel shaped cavity known as infundibular cavity. The infundibular cavity communicates with the third ventricle of the brain. The infundibulum is composed of nerve fibres. Some glia cells and pituicytes may also be found in this region. The infundibular cavity is lined by ependyma.

In Indian buffalo, the infundibulum of pituitary gland was found to be made up of mostly nervous tissue. In the posterior part of the stalk numerous multipolar neurons showing their argentophilic nature of cytoplasm had also been found. Certain axis cylinders had also been observed in the preparation showing clear cut neurofibrilae extending length wise in the structure. The nerve fibres were arranged in parallel rows. Glia cells were also found to be present in this part of the pituitary gland.

Similar observations on infundibulum of pituitary gland were described by Greep (1954) in man, Trautman(1957) in domestic animals, Maximow & Bloom (1957) in man, Wilfred & Copenhaver(1958) in mammals.

Hypophyseal cavity:

The hypophyseal cavity is the embryological remnant of the Rathke's pouch. It separates the pars distalis from the pars intermedia. In certain species it is not present. In ox, it contains colloid material. The colloid material is more in adult than young.

In Indian buffalo, the hypophyseal cavity was present in between pars distalis and pars intermedia (Plate 3). It was more prominent in young male animals than the adult female animals(Plate 3 &13). It contained P.a.s. positive colloid material. The colloid material was found to be present more in adult female animals than the young male animals.

Greep (1954) described that ox hypophyseal cavity contained P.a.s. positive colloid material. Trautman (1957) described in domestic animal the same thing about hypophyseal cavity.

Infundibular cavity:

Infundibular cavity was found to be present in Indian buffalo pituitary gland. It was reached upto the gland(vide diagram 1).

Table - III

Diameter of the acidophil cells and nucleus of Pars distalis of the pituitary gland of Indian buffalo in microns.

(Young male animals)

Animal no.	Age in years	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
1	2	12.75	11.50	12.12	4.2	4.2	4.2
2	3	12.75	12.00	12.37	4.2	4.2	4.2
3	2½	17.00	12.75	14.87	4.2	4.2	4.2
4	2	12.50	11.25	11.87	4.2	4.2	4.2
5	2½	17.00	12.75	14.87	4.2	4.2	4.2
6	3	12.75	12.00	12.37	4.2	4.2	4.2
Total				78.04			25.2
Mean				13.07			4.2

Table - IV

Diameter of the acidophil cells and nucleus of Pars distalis of the pituitary gland of Indian buffalo in microns.

(Adult female animals)

Animal no.	Age in years	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
7	10	16.00	13.75	14.87	4.2	4.2	4.2
8	11	12.75	12.00	12.37	4.2	4.2	4.2
9	10½	17.75	13.75	15.75	4.2	4.2	4.2
10	13	14.00	12.50	13.25	4.2	4.2	4.2
11	11½	17.00	12.75	14.87	4.2	4.2	4.2
12	13	12.75	11.25	12.00	4.2	4.2	4.2
Total				83.11			25.2
Mean				13.85			4.2

Table - V

Diameter of the basophil cells and nucleus of Pars distalis of the pituitary gland of Indian buffalo, in microns.
(Young male animals)

Animal no.	Age in years	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
1	2	25.50	21.25	23.37	4.2	4.2	4.2
2	3	29.75	25.50	27.62	4.2	4.2	4.2
3	2½	21.25	17.00	19.12	4.2	4.2	4.2
4	2	25.50	21.25	23.37	4.2	4.2	4.2
5	2½	25.50	21.25	23.37	4.2	4.2	4.2
6	3	29.75	25.50	27.62	4.2	4.2	4.2
Total				144.27			25.2
Mean				24.04			4.2

Table - VI

Diameter of the basophil cells and nucleus of Pars distalis of the Pituitary gland of Indian buffalo, in microns.
(Adult female animals)

Animal no.	Age in years	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
7	10	29.75	25.50	27.62	4.2	4.2	4.2
8	11	36.00	29.75	32.87	4.2	4.2	4.2
9	10½	25.50	29.75	27.62	4.2	4.2	4.2
10	13	25.50	21.25	23.37	4.2	4.2	4.2
11	11½	29.75	25.50	27.62	4.2	4.2	4.2
12	13	14.75	12.00	13.37	4.2	4.2	4.2
Total				152.47			25.2
Mean				25.41			4.2

Table - VII

Diameter of the chromophobe cells and nucleus of Pars distalis of the pituitary gland of Indian buffalo, in mrcrons.
(Young male animals)

Animal no.	Age in years.	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
1.	2	6.45	6.45	6.45	4.2	4.2	4.2
2	3	6.67	6.33	6.45	4.2	4.2	4.2
3	2½	6.45	6.45	6.45	4.2	4.2	4.2
4	2	6.70	6.30	6.45	4.2	4.2	4.2
5	2½	6.45	6.45	6.45	4.2	4.2	4.2
6	3	6.67	6.33	6.45	4.2	4.2	4.2
T o t a l				38.70			25.2
Mean				6.45			4.2

Table - VIII

Diameter of the chromophobe cells and nucleus of Pars distalis of the pituitary glad of Indian buffalo, in microns.
(Adult female animals)

Animal no.	Age in years	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
7	10	8.86	8.86	8.86	4.2	4.2	4.2
8	11	9.01	8.71	8.86	4.2	4.2	4.2
9	10½	8.98	8.74	8.86	4.2	4.2	4.2
10	13	8.86	8.86	8.86	4.2	4.2	4.2
11	11½	9.01	8.71	8.86	4.2	4.2	4.2
12	13	8.86	8.86	8.86	4.2	4.2	4.2
Total				53.16			25.2
Mean				8.86			4.2

Table - IX

Diameter of cells and nucleus of Pars intermedia of the Pituitary gland of Indian buffalo, in microns.
(Young male animals)

Animal no.	Age in years.	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
1	2	25.50	21.25	23.37	4.2	4.2	4.2
2	3	21.25	16.00	18.62	4.2	4.2	4.2
3	2½	16.00	13.50	14.75	4.2	4.2	4.2
4	2	25.50	21.25	23.37	4.2	4.2	4.2
5	2½	21.25	16.00	18.62	4.2	4.2	4.2
6	3	21.25	13.50	17.37	4.2	4.2	4.2
Total				116.10			25.2
Mean				19.35			4.2

Table - X

Diameter of cells and nucleus of Pars intermedia of the pituitary gland of Indian buffalo, in microns.
(Adult female animals)

Animal no.	Age in years.	Cell diameter			Nucleus diameter		
		Greatest	Smallest	Mean	Greatest	Smallest	Mean
7	10	16.00	13.50	14.75	4.2	4.2	4.2
8	11	21.25	16.00	18.62	4.2	4.2	4.2
9	10½	25.50	21.25	23.37	4.2	4.2	4.2
10	13	21.25	13.50	17.37	4.2	4.2	4.2
11	11 ½	25.50	21.25	23.37	4.2	4.2	4.2
12	13	25.50	21.25	23.37	4.2	4.2	4.2
Total				120.85			25.2
mean				20.14			4.2

Histochemistry

Pars distalis:

Ascorbic acid is present in the pars distalis of the pituitary gland of domestic animals. It is probably played a role in the secretory process.

P.a.s. positive materials are more in amount in castrated animal pituitary gland than the normal. The P.a.s. positive materials in the pars distalis increase in number with age.

The basophil cells of pars distalis do not contain acid lipid and acid mucopholysaccharides. The content of R.N.A. in basophil cells is very less in amount than acidophil cells.

The chromophobe cells do not contain alkaline phosphatase.

Pars distalis contains phospholipid. In bovine the acidophil cells are P.a.s.positive but in other species the P.a.s. positive cells are basophil cells.

The colloid material of pars intermedia contains two types of material - one an acid mucopolysaccharide, and the other, a mucoprotein of protein combined with the mucopolysaccharide.

Pituicytes of the neurohypophysis of man contains granules and they are composed of neutral, unsaturated fat. P.a.s. positive materials are present in pars nervosa and P.a.s. positive reaction is due to the presence of glycogen.

The infundibulum of the pituitary gland contains protein in case of pig.

The hypophyseal cavity contains R.N.A. and alkaline phosphatase in the hypophyseal cavity of the developing urodele. The percentage of cells active for alkaline phosphatase are greater than R.N.A. The colloid material present in the hypophyseal cavity is P.a.s. positive, sudanophilic and protein containing.

In Indian buffalo the capsule of the pituitary gland was found to be P.a.s. positive for glycogen.

The pars distalis of Indian buffalo pituitary gland contained ascorbic acid. The phospholipid was also found to be present in the pars distalis of Indian buffalo pituitary gland. The P.a.s. positive material (for glycogen only) were the basophilic cells of the pars distalis.

Calcium deposits and ferric iron were found to be absent from the pars distalis of Indian buffalo pituitary gland. T

The colloid material of the hypophyseal cavity of the pituitary gland of Indian buffalo was found to be posi-

positive for P.a.s. reaction (for glycogen only).

Trautman (1957) described the presence of ascorbic acid in the pars distalis of pituitary gland of domestic animals.

Kietz & Gospodinow (1967) noted phospholipid in the adenohypophysis of Bos Taurus.

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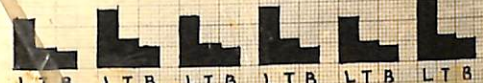
LENTH(L), THICKNESS(T) & BREADTH(B) OF PITUITARY GLAND OF INDIAN BUFFALO CALVES IN CM.



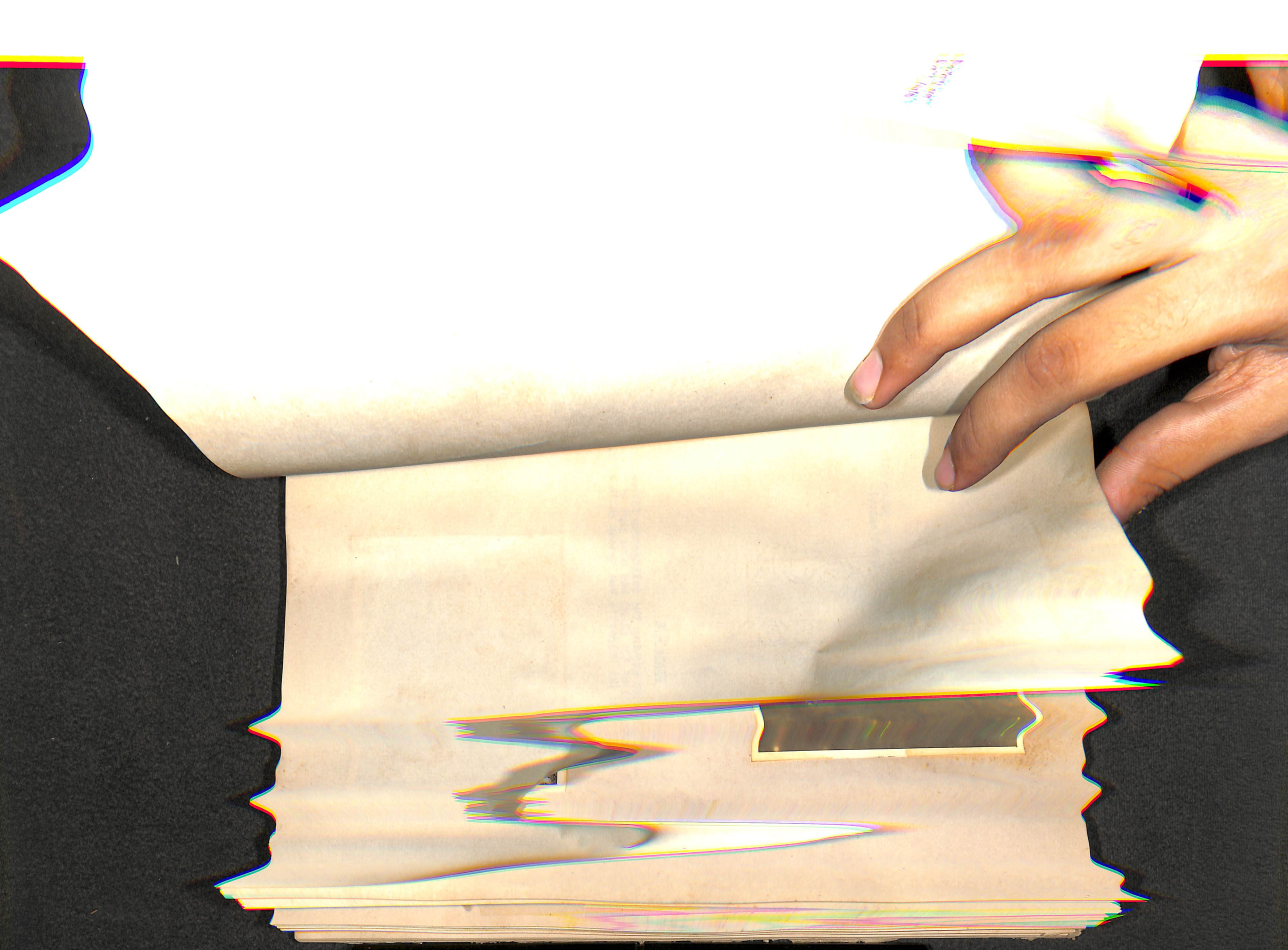
	L	T	B	L	T	B	L	T	B	L	T	B	L	T	B	L	T	B
AGE OF ANIMAL IN YEARS	2			3			2½			2			2½			3		

1 DIVISION = .1 CM.

LENGTH(L), THICKNESS(T) & BREADTH(B) OF PITUITARY GLAND OF INDIAN BUFFALO(ADULT) IN CM.

	L	T	B	L	T	B	L	T	B	L	T	B	L	T	B	L	T	B
AGE OF ANIMAL IN YEARS	10			11			10½			13			11½			13		

1 DIVISION = .1 CM.



SUMMARY AND CONCLUSION

Gross, histological and histochemical studies were made on the pituitary glands of 12 Indian buffalo. Six of them were young male animals (due to non-availability of adult male buffalo the work was done on the young male buffalo only) and other six were adult female animals. The tissues were fixed in 10 percent formaline solution. Special fixatives were used for histochemical works. Paraffin embedded sections were cut at 5,7 and 10 microns. Haematoxiline and eosin stains were used as routine stains. Besides, ten special stains were employed for special histological and histochemical studies. Stained sections of the pituitary glands were studied under light microscope.

1. In Indian buffalo, the hypophysis was brown in colour. Its shape was elongated and narrow. It was encapsulated by a capsule. The infundibulum was directed downward and forward. The average weight of the pituitary gland of Indian buffalo was 555.0 mg. in young male and 855.5 mg. in adult female animals. The average length, breadth and thickness were 1.3 cm., 0.4 cm. and 0.5 cm. respectively in young male animal and in female adult animal 1.6 cm. , 0.7 cm. and 0.9 cm. respectively. The hypophyseal cavity was present in this species. It separated

the pars distalis from the pars intermedia. The gland was situated in the sella turcica of the sphenoid bone.

2. The pituitary gland of Indian buffalo was enveloped by a capsule. The capsule was made up of collagenous and reticular fibres. No muscle fibre was found.

3. The adenohypophysis part of the pituitary gland contained three sub-divisions in this species - pars distalis, pars tuberalis and pars intermedia.

4. The pars distalis of the pituitary gland in this species contained mesh work of reticular fibres and cell cords. The cell cords were tortuous and branching. They were surrounded by well developed large sinusoids and reticular fibres. The reticular fibres were found arranged in circles. The colloid materials were present in the alveoli formed by the cell cords of the pars distalis.

The cell cords of the pars distalis of Indian buffalo contained three main type of cells - acidophil cells, basophil cells and chromophobe cells.

5. In this species acidophil cells were smaller than basophil cells but larger than chromophobe cells. They were distributed in scattered fashion in pars distalis but more near the centre. They were arranged in groups. They were circular to oval in outline. The nuclei of acidophil cell were eccentric. The nucleolus was placed centrally in

each cell nucleus. Chromatine net work was present in the nucleus.

The average diameter of acidophil cells in young male animal was 13.07 microns and that of in adult female animal was 13.85 microns. The average diameter of nucleus was 4.2 micron in both cases.

Two types of acidophil cells (A_1 or alpha and A_2 or epsilon-eta) were present in this species. They were distinguished from one another by orange G and aniline blue staining. Probably A_1 cells or alpha cells were responsible for the secretion of growth hormone whereas A_2 cells or epsilon-eta cells were for prolactin hormone. A_1 cells or alpha cells were present more towards periphery of pars distalis. A_2 or epsilon-eta cells were more towards the centre of the pars distalis.

6. In Indian buffalo, the basophil cells were larger than the acidophil cells and chromophobe cells. The average diameter of the basophil cells in young male animal was 24.04 microns and in adult female animals was 25.41 micron. The size of nucleus was 4.2 micron in both the cases. The basophil cells were found at all parts of the pars distalis but more towards periphery. They were oval to circular in outline but angular outline was also noted in this species.

Three types of basophil cells were present in this

species. They were distinguished by P.a.s. and alcian blue staining. Two types of gonadotrophic cells (I & II) and thyrotrophic cells were found in this species. The gonadotrophic I cells responsible for the secretion of follicle stimulating hormone were situated more towards periphery of the pars distalis. The gonadotrophic II cells responsible for the secretion of leuteinising hormone were situated more centrally in the pars distalis. Both were oval to round in shape. The thyrotrophic cells responsible for thyroid stimulating hormone were situated centrally in the pars distalis.

7. In Indian buffalo, chromophobe cells were found to be the smallest cell types in pars distalis. The average diameter of chromophobe cells in male young animal was 6.45 microns and in adult female animal was 8.86 microns. The average diameter of nucleus was 4.2 microns in both the cases. Chromophobe cells were agranular in this species. They remained in groups near the centre of the cell cords of pars distalis.

8. The pars intermedia was well developed in Indian buffalo. It was present all around the pars nervosa. It was formed by well developed epithelial cells lining the hypophyseal cavity posteriorly. It was attached to the pars distalis at its superior and inferior parts above and below the hypophyseal cavity. It was extended upto the infundibular stalk. It contained connective tissue frame work of reticular

fibres. The reticular fibres were lesser than the pars distalis. The cells were basophilic in nature and their average diameter was 19.35 microns in young male animal and 20.14 microns in adult female animal.

9. In Indian buffalo pars tuberalis encircled the infundibular stalk in a collar like fashion. It had many sinusoidal blood vessels. The pars tuberalis was made up of connective tissue frame work and basophilic ß cells among them were situated.

10. The neurohypophysis part of Indian buffalo pituitary gland contained - the pars nervosa and the infundibulum.

11. The pars nervosa of Indian buffalo pituitary gland contained a connective tissue frame work. The nerve fibres were arranged in an unoriented fashion. Some of the nerve fibres were arranged in whorls. The glia cells were present at certain parts of pars nervosa. The pituicytes were also present. They had short branching cytoplasmic processes. They were present throughout the neurohypophysis. Herring bodies were also present in this part. They were intercellular homogenous material and were situated near the termination of nerve fibres. They appeared circular to oval in outline.

12. In Indian buffalo pituitary gland the infundibulum was made up of mostly nervous tissue. The nerve fibres

were arranged in parallel rows in this part of the hypophysis. In posterior part of the stalk numerous multipolar nurons showing their argentophilic nature of cytoplasm had also been found. Certain axis cylinders were also present in this part. The neurofibrilae were extending length wise in the structure were found.

13. The hypophyseal cavity in the Indian buffalo was situated in between pars distalis and pars intermedia. It was more prominent in young male animals than the adult female animals. The hypophyseal cavity in this species contained colloid material. The colloid material was found to be more in adult animals than young animals. The colloid materials were P.a.s.positive.

14. In Indian buffalo, ascorbic acid was found to be present in the pars distalis of the pituitary gland.

The phospholipid was found to be present in the pars distalis of the pituitary gland.

The P.a.s.positive materials (for glycogen only) were the basophilic cells of pars distalis. Colloid material of hypophyseal cavity and capsule of the pituitary gland were also positive for P.a.s. reaction(for glycogen only).

Calcium deposits and Ferric iron were found absent from the pars distalis of Indian buffalo.

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