Cytology of the Hypophysis in the Adrenalectomized Golden Hamster (Mesocricetus auratus)[1]

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The cytology of the hypophyseal pars distalis in the normal hamster has been studied by Koneff, Simpson and Evans ('46), Hanke and Charipper ('48), and Spagnoli and Charipper ('55). These authors employed neither the aldehyde fuchsin nor periodic acid-Schiff (PAS) staining procedures and were thus unable to subdivide the basophils into beta and delta types. Since completion of my study, Serber ('58) published the results of a study on the hypophysis of the normal hamster in which these procedures were utilized. However, several significant differences exist between my observations and those of Serber.

Differentiation of the types of basophils in the hamster is important because in the rat this achievement (Purves and Griesbach, '51a; '51b; Halmi, '50) has made possible a significant advance in the correlation of pituitary cytology with cellular function. Since in some respects the endocrinology of the hamster is unusual, a more precise analysis of the basophils in this species offers promise of providing additional useful information. Also, other aspects of cytology in the pars distalis, the neurohypophysis and pars intermedia in the hamster have received little attention.

This investigation had two objectives: (a) to study the cytology of the hypophysis in the nonadrenalectomized hamster and (b) to observe the influence of adrenalectomy on the hypophysis.

MATERIALS AND METHODS

At the beginning of the experiment young adult golden hamsters (*Mesocricetus auratus*) were paired by weight, the maximum difference in weight between the individuals of each pair being 11 gm. The average body weight with a standard deviation was 109 ± 3 gm for the males and 122 ± 3 gm for the females. One member of 44 pairs of males and of 4 pairs of females were adrenalectomized. The other member served as a control and was sham-operated. Subsequently, the sham-operated animal was pair-fed against its adrenalectomized mate. For two days before death the adrenalectomized hamster ate little or no food, so that pair-feeding resulted in severe restriction of food intake in the sham-operated control animal for that period. Although ad libitum-fed animals were not included in this study, it is unlikely that the food deprivation of the control animal had a significant effect on the cytology of the pars distalis since the numbers of chromophobes, acidophils and total basophils observed were similar to those found by Serber ('58) in normal hamsters. All animals received fresh water ad libitum.

Except for 4 pairs, the hamsters were killed by decapitation when the adrenalectomized member exhibited symptoms of adrenal insufficiency so severe as to preclude survival. These symptoms included extreme weakness or coma, decreased body temperature, dyspnea and frequently muscular tremor. Two pairs were killed 24 hours, two others 48 hours, and the remainder 2–9 days after the operation. The success of adrenal ablation was checked

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visually at autopsy and by microscopic examination of doubtful tissues. If adrenal tissue remained, the animal was eliminated.

Hypophyses were fixed in Bouin's fluid, formol-saline, or formol-calcium. Those fixed in formol-calcium were stained with the method of Baker ('46) for phospholipid as modified by Rennels ('53).

The Bouin-fixed tissues were stained with aldehyde fuchsin (Gomori, '50) with a Masson counterstain (light green being substituted for aniline blue) or with protargol (Bodian, '36). Staining of basophils[3] in the pars distalis with aldehyde fuchsin proved to be a capricious procedure, although many modifications were tried. When successful, beautiful differentiation of cell types was obtained. The procedure was successful with or without prior oxidation, performic acid, Lugol's solution, or 0.03% $KMnO_4$ in 0.3% H_2SO_4 being used for this purpose. It is believed that the variable staining with aldehyde fuchsin arose from the inability to control consistently the quality of fixation due to the natural thinness of the gland. Polysaccharides were demonstrated in sections of formol-saline-fixed glands with the periodic acid-Schiff (PAS) technic of Purves and Griesbach ('51a), followed by counterstaining with methylene blue in a citric acid-sodium diphosphate buffer (pH 5.6).

As a means of evaluating the adequacy of the stain and to serve as a basis for comparing pituitary cytology of the hamster with that of the rat, sections of hypophyses from normal rats were placed on the same slide with sections from the adrenalectomized and sham-operated control hamster of each pair.

Three sections of the hypophysis from male hamsters, approximately one-quarter, one-half, and three-quarters of the way through the gland were used for differential cell counts. On each section studied, either every other microscopic field, or up to every sixth field, was counted, with a minimum of 1,918 or an average of 2,489 cells being counted per gland. Identification of cell types was based solely on the presence of differentially stained cytoplasmic granules.

OBSERVATIONS

The gland in sham-operated controls

Pars distalis

General histology. Frequently, parenchymal cells of the pars distalis were arranged around masses of colloid which stained intensely with light green or aldehyde fuchsin and were PAS-positive. These colloidal masses varied in diameter from 3 to 20 μ.

A peculiarity of the hamster pars distalis was the variable presence of extensive areas of large "chromophobic spaces" (Hanke and Charipper, '48) upon the origin of which there is no agreement (Koneff et al., '46; Kirkman, '49; Hanke and Charipper, '48; and Spagnoli and Charipper, '55). These spaces were large, measuring as much as 30 μ in diameter (fig. 9). None of the technics used in this study revealed the presence of material within them except for occasional large, sparse, fuchsinophilic granules, delicate fibrils and nuclei in varied states of degeneration. Information was obtained regarding their origin. Irregularly-shaped clear spaces of variable size were observed within the cytoplasm of certain cells. These spaces appeared to enlarge by coalescence of smaller ones and by liquefaction of adjacent cells. Precise identification of the cell type(s) in which this process began was difficult. Nevertheless, parenchymal degeneration appeared first in chromophobes and probably involved light green-staining basophils (LGB) as well (fig. 17). Aldehyde fuchsin-staining basophils (AFB), and particularly alpha cells, seemed more resistant. Alpha cells often constituted the only type which could be identified in areas of extensive vacuolation, indicating that they were the last to

[3] Because of the present impossibility of establishing the identity of basophilic types in the pars distalis with those of other species, it is impossible to apply fully to the hamster the desirable classification of Romeis ('40). Therefore, the various cells will be designated as chromophobes, alpha cells (acidophils), light green-staining basophils (LGB) and acid fuchsin-staining basophils (AFB). This terminology for basophils is based on the use of both light green and aldehyde fuchsin on the same preparation since both types stain with light green in the absence of aldehyde fuchsin. In turn the LGB cells are divisible into subgroups LGB_1 and LGB_2.

be overcome. As the formation of a clear space spread through a nest of parenchymal cells, its border was indistinct. When it reached the reticulum at the periphery of a cell cluster, its border was then sharply defined (fig. 9).

Alpha cell (acidophil). Of all chromophils, alpha cells were most numerous and were more prevalent in the female than in the male. They were distributed throughout the gland, but reached their greatest frequency in the peripheral region. They also tended to be located peripherally in the individual cords and nests where they were adjacent to sinusoids (fig. 8).

The alpha cell appeared to exist in two forms. One form was spherical (fig. 7), and distinguished by exceedingly bright red granules when stained with acid fuchsin. The granules were spherical and large. The second form was elongate or polyhedral, the shape seeming to be determined by the pressure exerted on it by contiguous cells. Its granules were finer than those of the spherical alpha cells and usually not distinguishable as individual elements. When acid fuchsin was used after aldehyde fuchsin, the granules were often stained a pale red to orange color. Alpha cells in general contained a great deal of phospholipid (fig. 3).

The nucleus of the alpha cell after Bouin fixation was vesicular and distinguished by the presence of one or more large, fuchsinophilic nucleoli and large chromatin bodies, many of the latter being attached to the nuclear membrane. The nucleus was usually eccentrically located in the portion of the cell away from sinusoids.

Aldehyde fuchsin-staining basophil. After staining with aldehyde fuchsin, the AFB was most conspicuous, being the largest type present. AFB cells were distributed throughout the pars distalis (fig. 19) and showed a definite tendency to be aligned along sinusoids (figs. 1, 8). Also, they were aggregated alongside the largest vessels found in the pars distalis many of which were probably portal vessels. The AFB was generally spherical.

The cytoplasmic granules stained intensely with aldehyde fuchsin (fig. 1) and PAS (fig. 4). The affinity for aldehyde fuchsin was rather marked in the male but weak in the female. After Bouin fixation and staining with aldehyde fuchsin it was difficult to be certain of the size and form of granules, since the cytoplasm was filled with densely arranged flocculent masses which might have been aggregates of finer granules. After PAS staining of formol-saline fixed glands the cytoplasm appeared more homogeneous. Vacuoles of varied sizes were present (fig. 8). Although no substance was stained in these vacuoles with aldehyde fuchsin, some material which was colored faintly appeared after PAS. With acid fuchsin after Bouin fixation, sparse large red globular masses were present. In every respect these vacuoles resembled those seen in castration cells of the rat. The Golgi area was occasionally visible (fig. 1). When AFB's were stained with light green without aldehyde fuchsin they were still distinguishable because of their dense cytoplasm and typical shape. In this instance the granules did not appear as irregular masses but were more uniform in size and distribution.

The nucleus of the AFB was unique. It was ovoid in shape. The nuclear membrane was thick. Chromatin was rather uniformly distributed. The nucleoplasm, when stained with aldehyde fuchsin, gave the nucleus such density that differentiation of nuclear structure was often difficult (fig. 1). Nucleoli were present but were not as prominent as in the alpha cell. Degenerating AFB's were quite common. Inclusion bodies of varied forms were frequent in these cells.

Light green staining basophil. The LGB appeared to exist in two forms. The first form (LGB_1) corresponded to the "basophil" as described by earlier workers. In size, it was approximately that of the AFB and was spherical or polygonal in shape (fig. 1). After staining of Bouin-fixed glands with aldehyde fuchsin and Masson, the LGB_1 was strikingly different from the AFB in all other respects. The cytoplasmic granules were finer and less densely arranged. They were usually rather uniformly distributed. The granules were aldehyde fuchsin-negative but stained with light green. With PAS and counterstaining with methylene blue, one could not

differentiate sharply between the AFB and LGB. If identification of cell types was made on the basis of difference in nuclear structure (to be described subsequently) the cytoplasm of the LGB_1 was PAS-positive but much less so than that of the AFB. However, on the basis of this criterion one could not positively differentiate all LGB_1 cells from chromophobes. The LGB_1 frequently cupped around an alpha cell (fig. 7).

The nucleus of the LGB_1 was strikingly different from that of the AFB (fig. 1). It was larger and often possessed an irregularly indented membrane. The interior of the nucleus was less compactly arranged with the linin network being rather clearly delineated. A nucleolus was usually visible. Chromatin particles were generally fine, with larger masses being found along the nuclear membrane.

The LGB_2 was rare (fig. 6), constituting 1.6% of the cells in sham-operated male hamsters (table 2). One side of the cell was invariably in contact with the wall of a sinusoid. It was usually a sprawling cell and, also, often cupped around an alpha cell. It differed from LGB_1's in that the cytoplasmic granules were larger and stained more intensely with light green. My preparations did not reveal clearly the possible interrelationship of the two forms of basophils which stained with light green.

Chromophobe. The chromophobe, which was generally the smallest cell in the gland, was located in the center of cell cords away from the blood vessels. It possessed little cytoplasm and appeared to be inactive.

Finally, a number of cytological observations were made which could not be related directly to any particular cell type. In view of the secretion of protein hormones by the pars distalis, the exceedingly small amount of cytoplasmic ribonucleic acid revealed by staining of formol-saline-fixed glands with methylene blue was striking. In no cell type was distinctive cytoplasmic basophilia observed.

Following use of the protargol procedure many cells were filled with silver-stained granules (fig. 5). For the most part, they were polygonal in shape. Identification of these cells with the previously designated cell types was impossible, although adjacent sections stained with protargol and the Masson procedure were compared directly cell for cell. Among the chromophils, the shape of the silver-stained cells resembled most closely that of alpha cells.

Pars intermedia

The pars intermedia was separated from the pars distalis by an incomplete residual lumen. The pars intermedia was poorly vascularized and penetrated by little connective tissue (fig. 16). Occasional cystic structures were observed which contained a dense aldehyde fuchsin-staining colloid; others were empty.

The parenchyma proper was compactly arranged and consisted of a single cell type. However, the cells differed in the degree of cytoplasmic granulation. With aldehyde fuchsin and Masson, some cells were filled with fine purple granules whereas the cytoplasm of others stained only with light green. With PAS staining of formol-fixed glands, fine granules were present which varied greatly in number from cell to cell. Scattered in the parenchyma were elongate cells in which the cytoplasm stained intensely with PAS. Their nuclei were of irregular shape. It was not determined whether these cells were connective tissue elements or exhausted parenchymal cells.

Pars tuberalis

From the junction of pars intermedia and pars distalis at the periphery of the residual cleft the pars tuberalis extended up around the infundibular stem to the eminentia medialis. This part was quite thick inferiorly but was reduced to a thickness of only a few cells at the hypothalamus. Many blood vessels coursed through the tuberalis and the periphery of the stem just within it. Inferiorly, the pars tuberalis was distinguished by the predominance of large cells which were intensely stained with aldehyde fuchsin and PAS (fig. 15). Morphologically these cells were identical to AFB cells of the pars distalis. Some LGB_1 cells and chromophobes were observed also. Superiorly, the parenchymal cells were smaller and less granular.

Neurohypophysis

As revealed by staining with aldehyde fuchsin after oxidation with performic acid, neurosecretory material (NSM) had accumulated in the pars nervosa in great quantity (fig. 12), as observed previously by Eichner ('54). The densest concentrations were found in the vicinity of sinusoids. With the PAS procedure, less NSM was revealed but the distribution was the same. No NSM was observed in the absence of prior oxidation. The technics used rarely permitted clear differentiation of pituicytes from glial cells.

The infundibular stem was not as highly vascularized as the pars nervosa and did not exhibit accumulations of NSM.

The effect of adrenalectomy

Body weights

Following adrenalectomy, the mean weight of male hamsters was 93 ± 2.8 gm as contrasted to 112.5 ± 3.9 gm prior to the operation (table 1). This loss was significant at the 0.1% level. The sham-operated animals lost weight also because of the restriction in food intake imposed by pair-feeding. There was no significant difference in either sex between the mean weights of adrenalectomized and sham-operated animals at the end of the experiment.

Pars distalis

After adrenalectomy, there was no change in the stainability and distribution of colloid, nor in the frequency of "chromophobic" spaces.

Alpha cell. Adrenalectomy affected the alpha cells differently in the sexes. As determined by general observation of the slides, the 4 pairs of female hamsters studied revealed no change in number of alpha cells. However, in males they were reduced from a mean percentage of 19.6 ± 2.9 for sham-operated controls to 10.9 ± 2.1 for adrenalectomized animals, this difference being significant at less than the 5% level (table 2, figs. 8, 9). This re-

TABLE 1

The effect of surgical procedures on body weight

Treatment	No. of animals		Mean body weight			
			Male		Female	
	Male	Female	Before operation	After operation	Before operation	After operation
			gm	*gm*	*gm*	*gm*
Sham-operation	17	4	112.8 ± 4.4[1]	86.4 ± 3.2	121.2 ± 3.9	99.3 ± 3.0
			$P < 0.001$[2]		$P < 0.01$[2]	
Adrenalectomy	17	4	112.5 ± 3.9	93.0 ± 2.8	123.5 ± 6.2	94.0 ± 3.8
			$P < 0.001$[2]		$P < 0.01$[2]	
			$P > 0.90$[3]	$P > 0.10$[3]	$P > 0.70$[3]	$P > 0.30$[3]

[1] Standard deviation.
[2] Significance of difference between the means for body weights before and after operation.
[3] Significance of difference between the mean weights for sham-operated and adrenalectomized animals.

TABLE 2

The effect of adrenalectomy on the relative numbers of cell types in the pars distalis of male hamsters

Treatment	No. of hamsters	Mean per cent of cell types				
		Alpha	AFB	LGB_1	LGB_2	Chromophobes
Sham-operation	6	19.6 ± 2.9[1]	13.7 ± 1.2	12.3 ± 1.0	1.6 ± 0.3	52.8 ± 2.6
Adrenalectomy	6	10.9 ± 2.1	12.4 ± 1.2	15.5 ± 1.5	1.6 ± 0.3	59.6 ± 2.6
		$P < 0.05$[2]	> 0.40	> 0.10	> 0.9	> 0.10

[1] Standard error of the mean.
[2] Student-Fisher t-test.

duction was accompanied by degranulation which affected chiefly the polyhedral form. In some cases, the remaining alpha cells were almost entirely of the spherical form.

Adrenalectomy induced striking changes in alpha cells of the female. In all cases numerous nuclei were altered to give a hydropic appearance (figs. 18, 20). Fuchsinophilic intranuclear material was aggregated into a mass which was usually attached to the nuclear membrane. Other alpha cells were shrunken into compact bodies which subsequently fragmented (fig. 20).

AFB_1. Adrenalectomy did not alter the relative number of AFB cells (table 2). Cytological alterations were variable from animal to animal and, therefore, of questionable significance. In most cases the cells were smaller and partially degranulated (figs. 8, 9).

LGB. The slight increase in relative percentage of LGB_1 cells (table 2) was not statistically significant. However, the LGB_1 was generally hypertrophied after adrenalectomy with an increase in cytoplasmic granulation (figs. 8, 9). This was one of the most significant changes observed. Insofar as could be determined in the face of their low incidence, LGB_2 cells were not altered (table 2).

No significant changes were observed in the pars intermedia and pars tuberalis.

Neurohypophysis

Although no changes were observed in the infundibular stem, NSM as revealed by aldehyde fuchsin staining was depleted in the pars nervosa of hamsters in which this region was studied (figs. 12 and 13). This observation is in agreement with that of Rothballer ('56) and Malandra ('57) in the rat.

DISCUSSION

Differentiation of types of basophils in the hamster. Although there are many points of agreement between my observations and those of Serber ('58), the following significant differences exist. First, she reported a peripheral distribution of AFB's but in my preparations they were rather uniformly distributed throughout the pars distalis. Only when the aldehyde fuchsin stain was not entirely successful and AFB cells were stained weakly was a peripheral distribution observed. This occurrence was felt to be due to an obscure uncontrolled technical factor. Resolution of this problem is impossible because Serber's paper does not contain illustrations of glands stained with aldehyde fuchsin.

Second, Serber subdivided the basophils as seen in Masson preparations into "light" and "dark" subtypes. The former contained a vesicular nucleus, light cytoplasm, and stained with aldehyde fuchsin; the dark type had a small compact nucleus, dense cytoplasm, and was not stained with aldehyde fuchsin. The same distinction was made in my Masson-stained preparations but with aldehyde fuchsin the dark type (AFB) stained and the light (LGB) type did not. These structural and tinctorial characteristics are clearly revealed in figure 1. In this connection it is pertinent that Serber reported percentages for normal females of 3.7 for aldehyde fuchsin-stained cells and 3.6 for the "dark" basophil. The closeness of these figures suggests their identity.

The beautiful differentiation of AFB and LGB which was obtained with aldehyde fuchsin and Masson is in contradiction to the conclusion of Knigge ('57b) that staining of the hamster hypophysis with aldehyde fuchsin "does not permit consistent and precise differentiation of the two types of basophils."

Comparison of pituitary cytology in the hamster and rat. Vasquez-Lopez ('44) stated that, "The anatomy and histology of the normal pituitary gland are the same in the hamster as in the rat and mouse." In view of the current tendency to generalize from observations made in the rat regarding the cellular localization of hormone secretion in the pars distalis, the differences in pituitary cytology between the rat and hamster assume significance. These are of such magnitude as to raise doubt concerning the identity of the aldehyde fuchsin-staining cells in the two species. The beta cell of the rat, which is regarded as the source of thyrotropin (Halmi, '52), tends to be polygonal in shape (fig. 10) and is rarely located near blood vessels (Purves and Griesbach, '51a). In contrast, the AFB of the hamster is usually exceedingly large, nearly spherical and

generally located alongside the larger blood vessels and sinusoids. Whereas beta cells of the rat predominate in the central area of the gland, in the hamster AFB cells seem to be rather uniformly distributed throughout the gland. In relative number, beta cells constitute 2.43% of the cells in the normal female rat (Halmi, '50) while in the control hamsters of this study AFB cells made up 13.7% of the total. Serber reported a percentage of only 3.7 for aldehyde fuchsin staining cells in normal female hamsters. However, her total count for basophils was 24.7%, which compares favorbaly with my total of 27.6% for the sham-operated controls. These percentages are remarkably close when one considers the difficulty inherent in differentiating small basophils from chromophobes.

Further, signet ring cells of castration appeared in delta cells of the rat (Purves and Griesbach, '51a). In my preparations such vacuolation occurred only in AFB cells in the hamster. Serber ('58) also noted gonadectomy-like vacuolated basophils in the normal male hamster which "appeared to be principally but not exclusively basophils of the dark variety." My observations showed that these are AFB cells. Recognition of the differences between the staining properties of basophils in rat and hamster led Serber ('58) also to question the identity of the types in the two species when differentiated on this basis. Until aldehyde fuchsin-staining basophils have been studied in a variety of species under different endocrine states, it seems unwise to regard affinity for aldehyde fuchsin as being generally characteristic of the cell type which secretes thyrotropin. Indeed, a synthesis of Serber's and my observations indicates that the differentiation of beta and delta cells in the rat by aldehyde fuchsin-Masson staining is reversed in the hamster.

The effect of adrenalectomy. The reduction in size and number of alpha cells in the hamster agrees with the observations made by many others in the rat after bilateral adrenalectomy and in human patients with Addison's disease (table 3). Others have uniformly described a reduction in number and usually in size of basophils but most of these investigators did not divide the basophils into subtypes. Although in my study the AFB cells were insignificantly reduced in relative number, a clear reduction in size was seen in many cases. It is probable that if a longer survival time had been possible after adrenalectomy of the hamster, a reduction in number of AFB's would have been demonstrable. In the rat, Knigge ('57a) observed a 50% reduction of aldehyde fuchsin-staining basophils at 100 days after adrenalectomy.

In contrast to other species (table 3), a small increase in number of LGB cells occurred which was accompanied in the hamster by a rather striking hypertrophy of them. The identity of these cells was not conclusively proven. Their cytoplasm after adrenalectomy was more uniformly dense than in the controls but did retain the property of staining with light green. It was chiefly on the basis of staining affinity that they were classified as LGB cells. However, the hypertrophied LGB_1 cell resembled the amphophil which Mellgren ('48) and Russfield ('55) reported to be increased by adrenal insufficiency in the rat and man, respectively. Other workers (table 3) may also have considered these cells as chromophobes, although in the hamster, chromophobes were increased in relative number even when the LGB cells were excluded from this category during the counting procedure. In view of the augmented concentration of corticotropin which develops in the hypophysis of the rat (Gemzell et al., '51), and probably also in the hamster, after adrenalectomy, it is possible that the LGB is the source of corticotropin. Thus, in the hamster, more general cytologic changes were demonstrated in the chromophils after adrenalectomy than has been possible with the rat. There were two probable reasons for this outcome. First, use of the aldehyde fuchsin stain in my study permitted a more critical subdivision of the basophil category of cells. This procedure has not been employed in any previous study of the hamster hypophysis after adrenalectomy. Second, the hamster reacts more adversely to adrenalectomy than do most other species.

TABLE 3

The effect of adrenal insufficiency on the relative number and size of cellular types in the pars distalis

Author	Species	Acidophil		Basophil		Chromophobe	
		No.	Size	No.	Size	No.	Size
		Bilateral adrenalectomy					
Oka, '37	Rat	—	—	0	+	+	+
Lehmann, '29	Rat	—	0			+	
Martin, '32	Rat		—	0	0		
Grollman and Firor, '35	Dog, Rat			—			
Reese et al., '39	Rat	—	—	—	—	+	
Koneff, '44	Rat	—	—		—	+	
Mellgren, '48	Rat	—		1,2		+	
Halmi, '50	Rat	0	0	0	0		
Tuchmann-Duplessis, '51	Rat	—	—	—	—	+	+
Bachrach, et al., '54	Rat	0		—		+	+
Russfield, '55	Man	—		1,2			
Knigge,'57a	Rat	0		1,3	4	0	
Field, '58	Rat						
		Addison's disease					
Kraus, '23	Man	—	—	—	—	+	—
Terplan and Sanes, '32	Man	0		—	+		
Crooke and Russell, '35	Man	—		—		+	+
Hawking, '36	Man	—	—	—	0	+	+
Nicholson, '36	Man	0	0	—		0	0
Laqueur and Bernstein, '48	Man	—		0			
Sloper, '55	Man	—		—			

—, Decreased; +, increased; 0, indicates that no effect was reported to be present.
1, Basophils decreased; 2, amphophils increased; 3, delta basophils not changed; 4, delta basophils increased.

SUMMARY

Alpha cells, aldehyde fuchsin-staining basophils (AFB), light green-staining basophils (LGB) and chromophobic cells were identified in the pars distalis. AFB cells were evenly distributed throughout the pars distalis. The structural differences between the cells which stain with aldehyde fuchsin in the hamster as compared with those of the rat make it unwise to assign a definite physiological significance to staining with aldehyde fuchsin. The inferior portion of the pars tuberalis consisted chiefly of PAS-staining cells. The pars nervosa contained much neurosecretory material which was aggregated around sinusoids.

Adrenalectomy of the male hamster caused a decrease in size and number of alpha cells, a moderate degranulation and reduction in size of AFB cells, a striking increase in size of LGB_1 cells, and a small increase in relative number of chromophobes. Neurosecretory material was depleted from the pars nervosa.

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ber's manuscript on cytology of the hamster hypophysis before its publication.

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PLATE 1

EXPLANATION OF FIGURES

Abbreviations: A, alpha; B, AFB; L_1, LGB_1; L_2, LGB_2; C, colloid; CV, chromophobic vacuole; S, sinusoid; P. Int., pars intermedia. The letters for cell types are located at the left of the cell indicated.

Figures 1–7 are of the pars distalis from hamsters.

1 Sham-operated male. Five AFB cells are stained intensely. Note the density of nuclear structure, coarseness of granules in the cytoplasm and the dark cytocentrum or Golgi area near the nucleus. The LGB_1 cell shows fine, diffusely distributed granulation and a large vesicular nucleus with indented membrane. The alpha cell is polygonal. Bouin fixation; aldehyde fuchsin and Masson. 4 μ. $\times$ 1230.

2 Sham-operated male. A number of colloid masses are stained with aldehyde fuchsin. The arrow points to a vacuole in an AFB which is of the castration type. AFB cells are arranged along sinusoids. Fixation in Bouin's fluid; aldehyde fuchsin after performic acid oxidation and Masson. 3 μ. $\times$ 700.

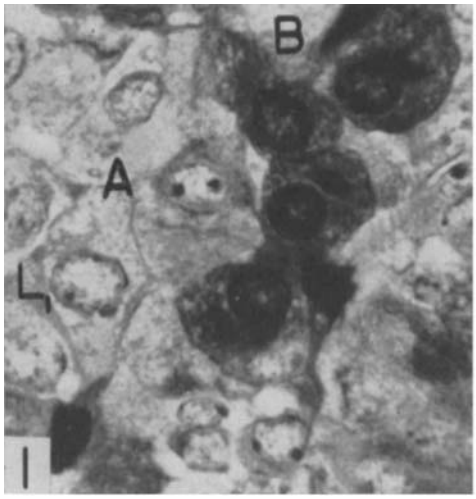
3 Sham-operated male. Phospholipid (black) is shown in alpha cells. Fixation in formol-calcium; Baker's acid hematein. 4 μ. $\times$ 644.

4 Sham-operated male. A number of AFB cells are intensely PAS-positive. At the arrow are vacuoles of the castration type containing faintly stained material. Fixation in formol-saline; PAS and methylene blue. 4 μ. $\times$ 740.

5 Sham-operated male. Polygonal cells are filled with protargol-stained granules. Fixation in Bouin's fluid; Bodian protargol. 3 μ. $\times$ 660.

6 Sham-operated male. Contrast between LGB_1 and LGB_2 is shown. Note large granules in the latter and relation of cell to the sinusoid. Fixation in Bouin's fluid; aldehyde fuchsin and Masson after performic acid oxidation. 3 μ. $\times$ 1230.

7 Female 7 days after adrenalectomy. A spherical form of the alpha cell is cupped in an LGB_1. Many alpha cells are present. Fixation in Bouin's fluid; Masson. 4 μ. $\times$ 1230.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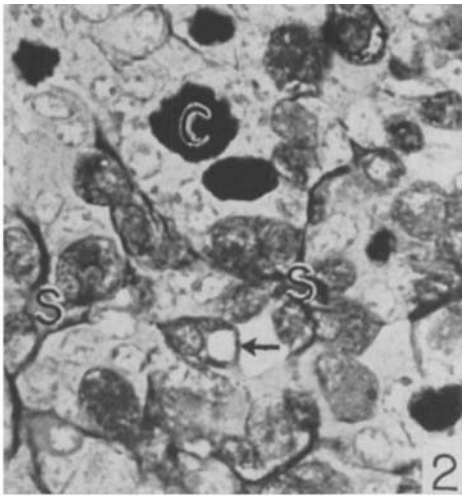
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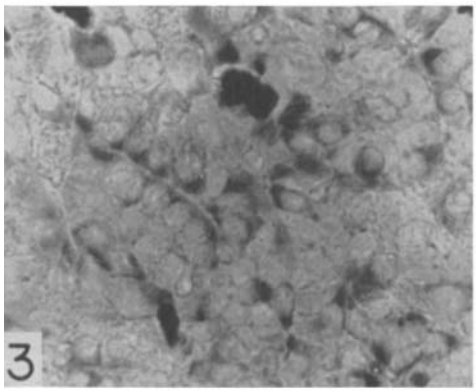
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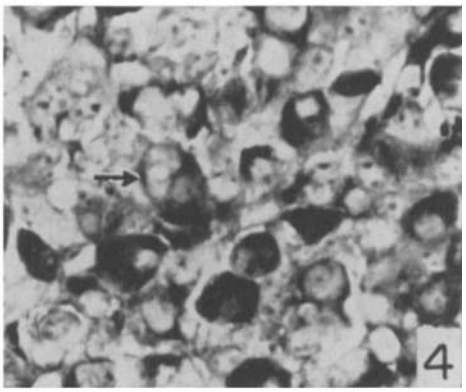
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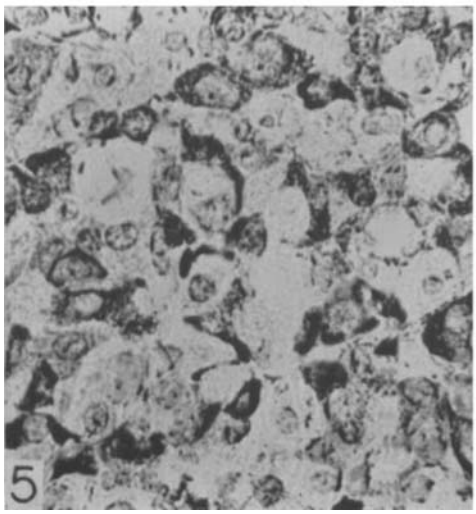
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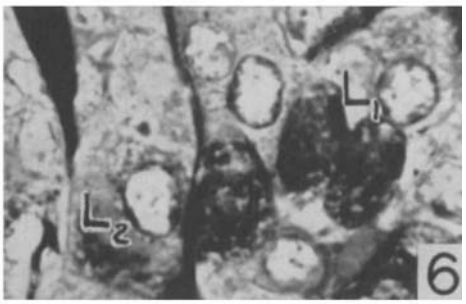
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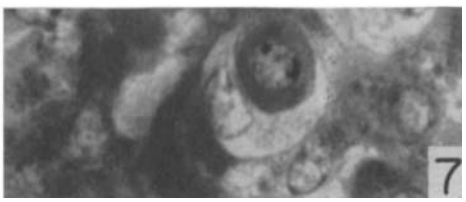
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PLATE 2

EXPLANATION OF FIGURES

The glands shown in figures 8–11 were fixed in Bouin's fluid and stained with aldehyde fuchsin and Masson after performic acid oxidation except that for figure 10 which was not oxidized.

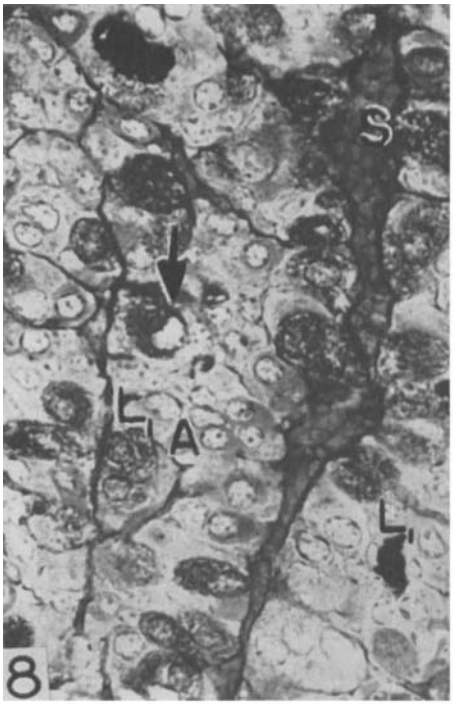
Figures 8–10 are of the pars distalis.

8 Sham-operated male hamster, control for hamster illustrated in figure 9. AFB and alpha cells are arranged along sinusoids. Few LGB_1 cells are visible (at the lower right, they are on both sides of the L_1). 3 μ. $\times$ 590.

9 Male hamster, 6 days after adrenalectomy. LGB_1 cells are markedly hypertrophied. AFB's on the left of B are reduced in size. Alpha cells are reduced. Chromophobic vacuoles appear at the top. 3 μ. $\times$ 590.

10 Male rat. AFB's are polygonal and do not show a consistent positional relationship to sinusoids. 4 μ. $\times$ 640.

11 Pars nervosa of a sham-operated male hamster. Neurosecretory material is concentrated in the vicinity of a sinusoid. Bouin fixation; aldehyde fuchsin and Masson, performic acid oxidation. 4 μ. $\times$ 350.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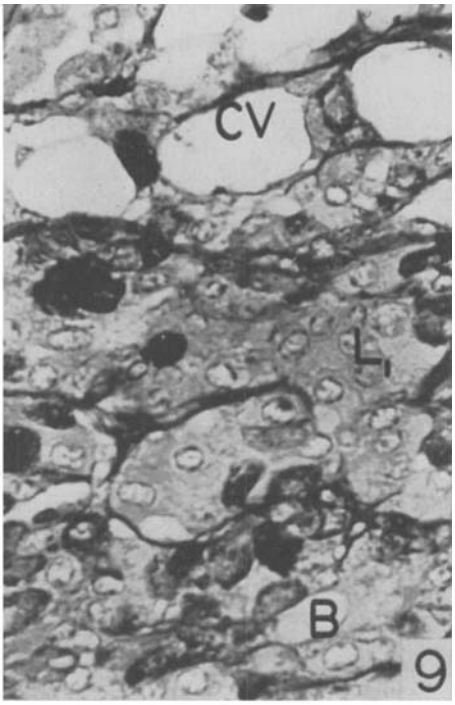
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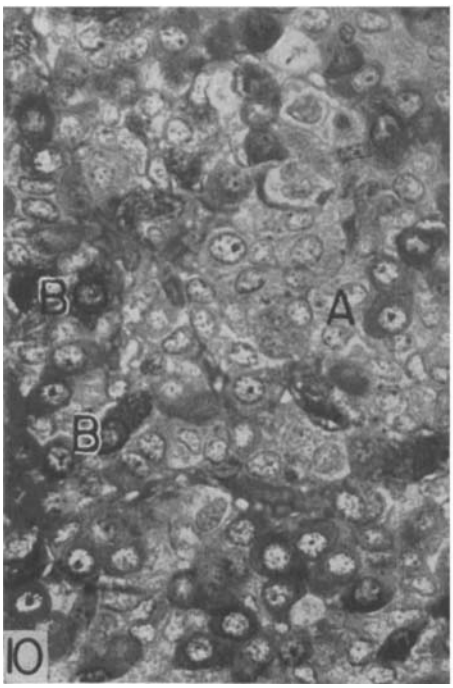
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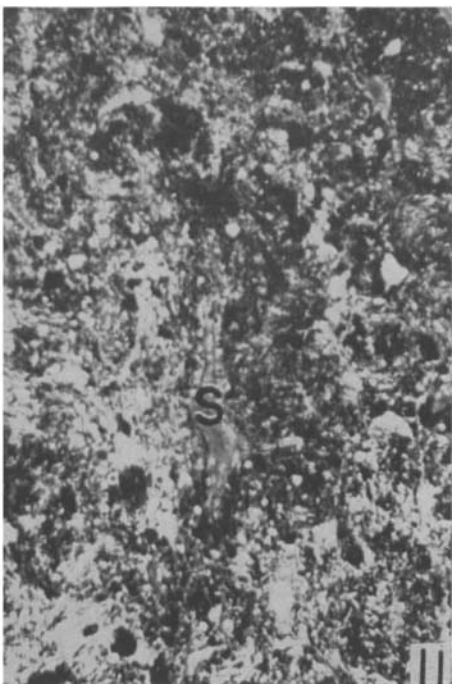
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PLATE 3

EXPLANATION OF FIGURES

Figures 12 and 13 are of hamster hypophyses fixed in Bouin's fluid and stained with aldehyde fuchsin and Masson after performic acid oxidation. The glands illustrated in figures 14–16 were fixed in formol-saline and stained with PAS and methylene blue.

12 Pars nervosa of a sham-operated hamster, control for figure 13. Neurosecretory material is densely concentrated in the pars nervosa. 4 μ. $\times$ 150.

13 Pars nervosa of a male hamster, 6 1/3 days after adrenalectomy. Neurosecretory material is depleted. 4 μ. $\times$ 150.

14 Pars nervosa of a sham-operated male, showing neurosecretory material stained with PAS concentrated near sinusoids. 4 μ. $\times$ 350.

15 Pars tuberalis above and infundibular stem below from a sham-operated hamster. The pars tuberalis at this location is composed mainly of spheroid cells which stain intensely with PAS. Neurosecretory material has not accumulated in the infundibular stem. 4 μ. $\times$ 330.

16 Pars intermedia of a sham-operated hamster. The parenchymal cells are filled with fine granules which stain with moderate intensity with PAS. 4 μ. $\times$ 680.

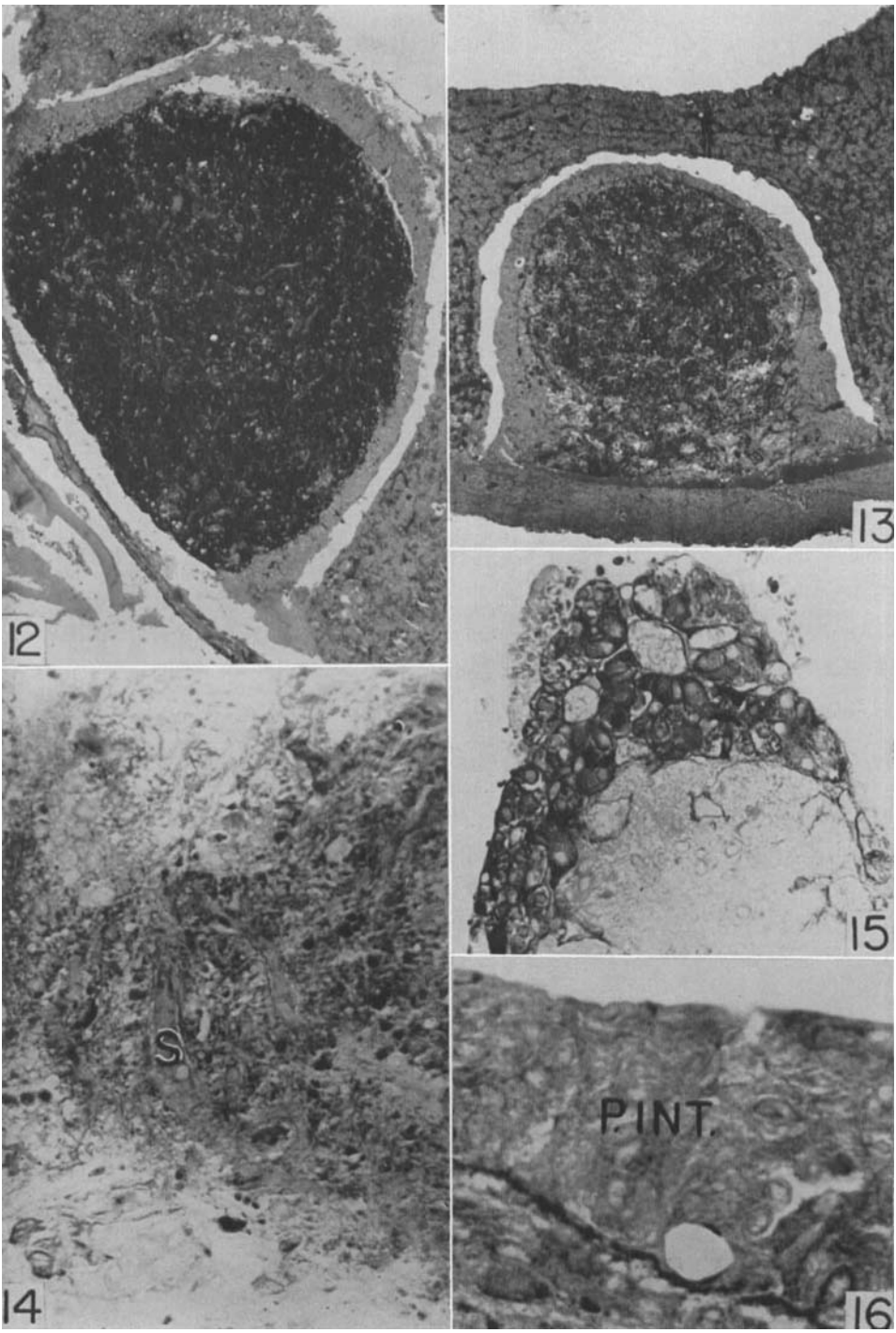
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PLATE 4

EXPLANATION OF FIGURES

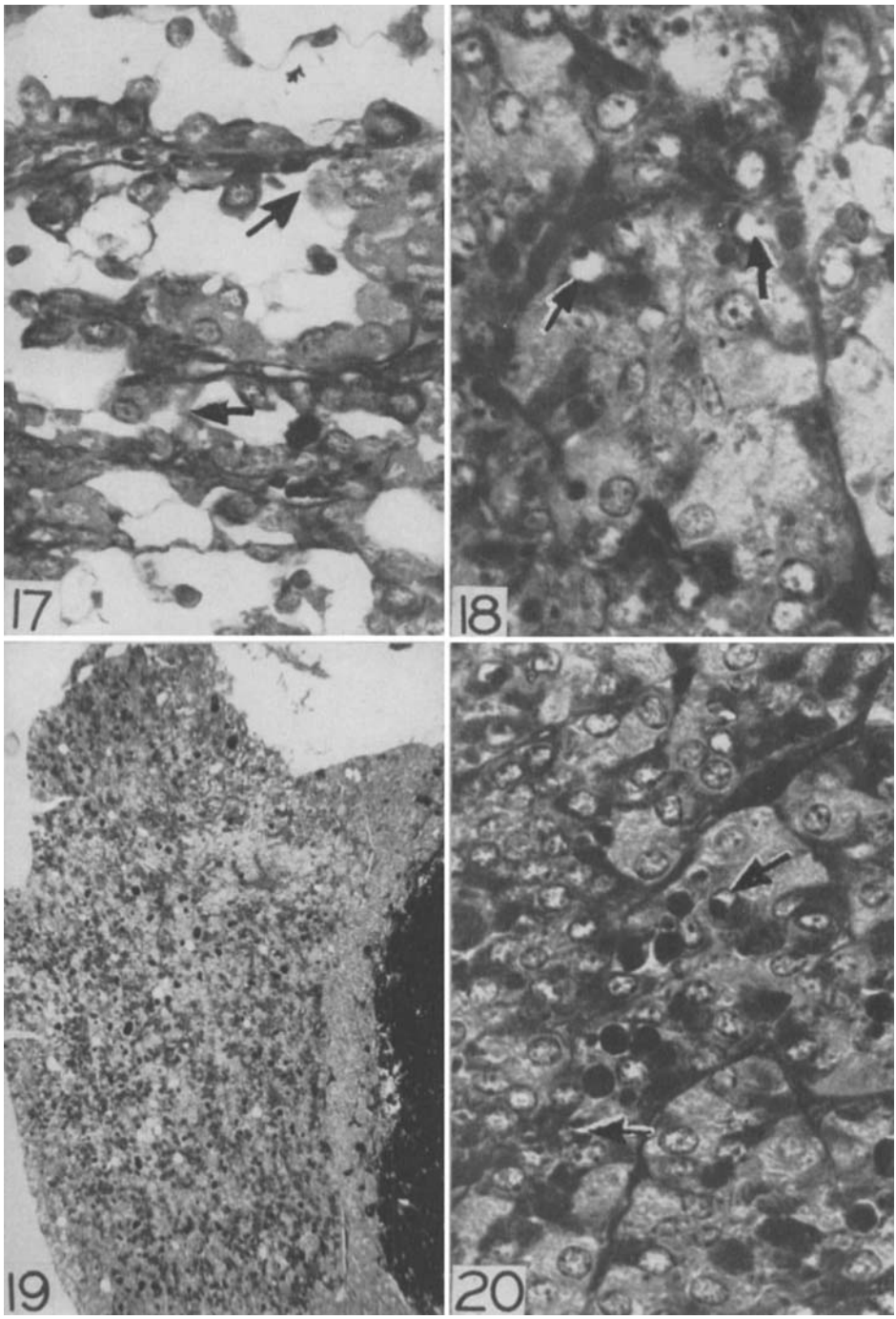
Figures 17 and 19 are of hamster hypophyses fixed in Bouin's fluid, and stained with aldehyde fuchsin and Masson; those for figures 18 and 20 were stained with Masson.

17 Pars distalis 6 days after adrenalectomy showing the development of chromophobic spaces. The arrows point to the indistinct edges of cells which seem to be undergoing liquefaction. Elsewhere pycnotic nuclei of degenerated cells are present. × 780.

18 Pars distalis of a female hamster 7½ days after adrenalectomy. The arrows point to two clear nuclei in alpha cells. Dense fuchsinophilic masses are attached to the nuclear membrane. × 920.

19 Pars distalis on the left and pars nervosa (black) on the right with the narrow pars intermedia intervening. In the pars distalis colloid is black; the gray to black cells are AFB's stained with aldehyde fuchsin. They are rather uniformly distributed. × 70.

20 Pars distalis of a female hamster 8 days after adrenalectomy. The round, dark bodies in the center are modified alpha cells. At the arrows are clear nuclei with compact fuchsinophilic bodies. × 720.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