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# XV.—A NOTE ON THE VISCERAL HISTOLOGY OF *CERATOTHERIUM*

By F. J. Aumonier and A. J. E. Cave

(St. Bartholomew's Hospital Medical College)

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Two Plates

SYNOPSIS

Histological details concerning certain of the viscera of *Ceratotherium* are presented for the first time.

## Introduction

Considerations of body-size and of environmental and climatic factors impose upon the milieu intérieur of the larger mammals a variety of physiological problems upon the satisfactory solution of which depends an animal's individual well-being and its survival as a species. Few such problems are patient of direct experimental investigation: hence their nature and the means adopted for their natural solution have generally to be inferred from interpretation of the morphological adaptations inevitably established in response. Structure, because it is the organic expression of function, remains the key thereto. There is therefore need for continued exploration in the field of comparative morphology, with special attention to comparative histology. Because of the difficulties attendant upon the field collection of desirable histological material and because of the insufficient advantage taken to date of prosectorial material from menagerie sources, relatively little is known regarding the visceral histology of many mammalian forms, not least of those now approaching extinction. No apology, therefore, is tendered for this present submission of certain limited information concerning the visceral histology of the rare *Ceratotherium*.

## Material and Methods

An immature animal, injured by native poachers, was shot by official order in the West Nile District of Uganda. Immediately after its death, Dr. H. E. Williams, of Arua, secured specimens of the animal's skin, nuchal eminence, liver, kidney, gut wall, neck musculature and lymph nodes: these were immersed in a strong formalin solution which gave excellent fixation. This field material was despatched to the Anatomy Department of Makerere Medical College, Kampala, and there blocked and processed by Dr. D. B. Allbrook. Thereafter paraffin blocks were generously forwarded hither for cutting and staining.

## Observations

The accompanying photographic reproductions of the various micro-sections obtained obviate much textual description of *Ceratotherium* visceral histology. All the material examined was found to be healthy, to be extremely well fixed and to stain readily with haematoxylin and eosin, with Masson's triple stain and by Foot's silver technique for reticulum.

It is perhaps pertinent to mention that *Ceratotherium* subsists exclusively upon grass.

*The liver* (Pl. I, fig. 1) stains well with hæmatoxylin and eosin and by Foot's silver method for reticulum. The hepatic tissue is well preserved and all nuclei appear to be well formed and healthy. The liver lobule is nowise remarkable; it bears a close resemblance to that of *Equus*. The parenchymal cells are generally and considerably vacuolated and their appearance is suggestive of the former presence of intracellular stored material (?glycogen ?fat). The portal tract is surrounded by a relatively small amount of connective tissue: the branches of the hepatic artery show notably thick muscular walls: the bile ducts are abundant, well marked and extremely capacious and manifest a profusion of tributaries.

*Muscle tissue* from the posterior cervical region stains well with hæmatoxylin and eosin. Both in transverse and in longitudinal section the majority of the muscle fibres display large, coarse myofibrils, though a minority of fibres show finer fibrils. No admixture of elastic tissue is observable in the sections studied.

*Colon* (Pl. I, fig. 2). The field specimen of bowel wall is undoubtedly colon. Stained with hæmatoxylin and eosin it shows an epithelium comprising a single layer of columnar cells with goblet cells in great abundance. (Both the gross and the microscopic anatomy of the stomach of this exclusively grass-feeding form remain as yet unknown.)

*Lymph nodes* (Pl. I, figs. 3, 4; Pl. II, fig. 1) examined are from the superficial cervical, deep cervical and intercostal regions. The material stains well with hæmatoxylin and eosin and by Foot's silver method for reticulum. All the nodes prove to be hæmolymph nodes. Histologically they closely resemble splenic tissue, are extremely blood-engorged, present no demarcation into cortex and medulla and are characterized by huge sinusoids. It may well be that all the lymph nodes in this species are of the hæmolymph variety. The superficial cervical node manifests a greater relative proportion of fibrous tissue than do the deep cervical and intercostal nodes. Plasma cells are abundant in all the nodes. The secondary nodules contain numerous small "sheathed" arteries similar to those found in the white pulp of typical mammalian spleen, though these nodal vessels tend to be relatively more numerous and relatively smaller than those encountered in the spleen.

*The kidney* (Pl. II, figs. 2, 3, 4) stains excellently by Masson's triple stain. At its origin the renal tubule is somewhat "prolapsed" within Bowman's capsule. The proximal and distal convoluted tubules are less well fixed than the collecting tubules: the lumina of all tubules contain much débris, amounting in many instances to actual casts. In the deeper parts of the cortex the inner (juxta-luminal) portions of the cells are extremely granular and stain a green colour: in the more superficial cortical cells (especially in those near the renal capsule) most of this green-stained brush border is detached and occupies the tubule lumen. (A corresponding histological picture has been noted by one of us (F. J. A.) in the rabbit kidney.) In the renal medulla occasional large and obvious casts, and/or cell débris, are detectable within the tubule lumina.

Thus finely granular, albuminous material is present in most of the cortical tubules and in some of the medullary collecting tubules. The histological picture is suggestive of the production of a large volume of urine and of the passing of considerable quantities of albumen therein.

## Discussion

It is possible to correlate certain of the reported histological findings with what is known of the physiology of the species.

The suggested presence of stored material in the liver cells (as glycogen or fat) is

consonant with the relatively great quantity of subcutaneous fat characteristic of *Ceratotherium*. In the adult animal the panniculus adiposus may attain a thickness of some 5·0 cm. on the ventral, and some 2·5 cm. on the dorsal, aspect of the trunk.

The renal histology, which suggests a high and sustained degree of parenchymal activity with the production of considerable quantities of an albuminous urine, reflects morphologically what is known observationally concerning the mechanism of water-excretion in this animal. Cave and Allbrook (1959) have shown the skin to lack sweat glands of the usual type, but to possess comparatively few, though extremely large, sweat glands of apocrine type, lavishly provided with relatively enormous myoepithelial cells. These myoepithelial cells are the agency whereby sweat is discharged, suddenly and in great quantity, upon enforced and violent muscular activity. At other times, it would seem, the apocrine sweat glands remain quiescent and water is discharged from the body in the form of urine exclusively. Field observations show that micturition is not effected by a single total vesical contraction but by a discontinuous series of partial vesical contractions, whereby successive puffs or sprays of urine are emitted as the animal traverses its terrain. By this means the animal's pathways to its feeding grounds are blazed, along which it returns under olfactory guidance.

## REFERENCE

CAVE, A. J. E., and ALLBROOK, D. B. (1959).—The skin and nuchal eminence of the White Rhinoceros. *Proc. zool. Soc. Lond.*, 132, 99.

## DESCRIPTION OF PLATES

### PLATE I

**Fig. 1.**—Liver. Portal tract, showing the thick-walled hepatic artery and a bile duct with multiple tributaries. × 80.

**Fig. 2.**—Colon, showing striated border of the epithelium and goblet cells in the crypts of Lieberkühn. × 500.

**Fig. 3.**—Hæmolymph node (superficial cervical), showing structure and numerous erythrocytes lying in the nodal stroma: a sinusoid is also visible. × 500.

**Fig. 4.**—Hæmolymph node (intercostal), showing lymphatic sinusoid containing reticulo-endothelial cells. × 500.

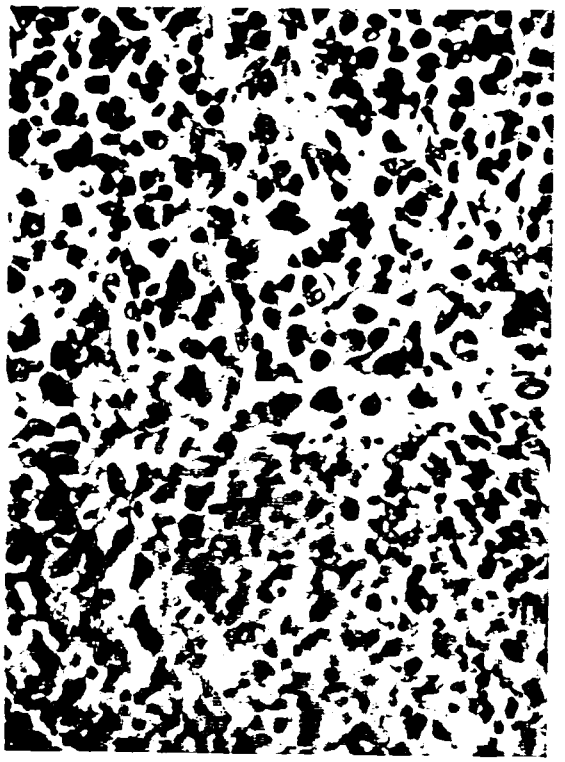
### PLATE II

**Fig. 1.**—Hæmolymph node (deep cervical), showing plasma cells. × 1000.

**Fig. 2.**—Kidney, showing casts in the tubules. × 13.

**Fig. 3.**—Kidney, subcapsular glomerulus, showing exit of a tubule from Bowman's capsule and loss of striated border in neighbouring tubules. × 350.

**Fig. 4.**—Kidney, juxta-medullary glomerulus, showing exit of tubule and the presence of a somewhat imperfect brush border. The "prolapse" of the tubule into Bowman's capsule is evident. × 350.



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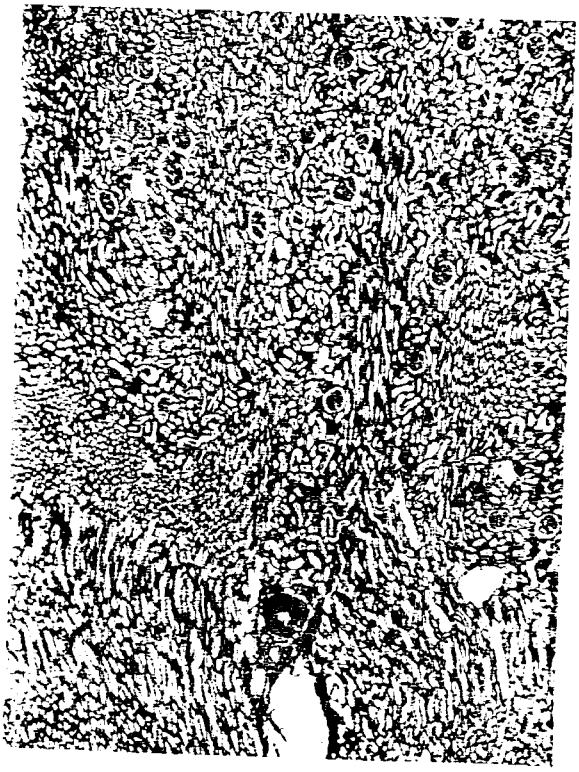

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