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THE PREPUTIAL GLANDS OF *CERATOTHERIUM*

by

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L'auteur donne la première description des glandes préputiales chez *Ceratotherium simum*. Chaque glande préputiale est en forme de papille cutanée, avec centre ombiliqué où débouche une crypte dans laquelle s'ouvrent les ductules d'une glande sudoripare, enfoncée elle-même par une masse de tissu lymphoïde. Ces glandes préputiales sont fort remarquables extérieurement chez *Ceratotherium* : elles manquent chez *Diceros*.

INTRODUCTION

The mammalian skin manifests an impressive faculty for the production of specialized glandular adnexa in almost any region of the body surface. One such specialization is that of a macroscopically recognizable diverticulum representing an invagination of the (usually hairless) skin, the modified sebaceous glands of which manufacture a pungent oily or waxy secretion, of olfactory significance to other individuals of the same species. Such cutaneous diverticula are independent of both total body size and taxonomic relationship and in magnitude they vary from pits just recognizable by the naked eye to sacs of dissectable proportions.

Examples of such sacciform glandular diverticula include the antorbital of Cervidae, the facial of *Phacochoerus*, the post-cornual of *Rupricapra*, the temporal of *Elephas* and *Loxodonta*, the occipital of Camelidae, the dorsal of *Dicotyles* and *Dendrohyrax*, the caudal of *Capra* and *Moschus*, the perineal of various carnivores and rodents, the inguinal of some ungulates, the metatarsal of *Lama*, the carpal of *Sus scrofa*, the unguiculate of *Tetraceros*, the pedal of *Rhinoceros*, the sternal of *Hylobates*, *Ateles* and various marsupials, and the gular of *Pithecia*. In the preputial skin diverticula of this nature have been described by Pocock (1910, 1916) for *Moschus moschiferus*, *Sus scrofa* and *Nototragus melanotis*, in

which last form the cutaneous sac, some 37 mm long by 25 mm broad, yielded a strongly odorous, dark green, waxy secretion. The preputial diverticula of the mouse and rat have been described by Schaffer (1933) and figured for the white rat by Greene (1955).

Apart altogether from the possible presence of such macroscopic diverticula, the preputial skin of probably all mammals manifests a rich development of cutaneous (sebaceous, sweat) glands, primarily to ensure the necessary lubrication during extrusion and retraction of the penis, and secondarily to provide a secretion of potent, sexually significant odour : a familiar example is that of the preputial glands of *Equus*, whose secretion, mixed with desquamated epithelial cells, constitutes the unpleasantly odorous smegma.

Attention is here directed to the presence of certain hitherto undescribed and histologically peculiar glands which occur in the preputial skin of *Ceratotherium* and which constitute a most conspicuous external feature of the penile integument.

Preputial glands in *Ceratotherium*

In colour the skin of the penis of a 3 years old specimen of *Ceratotherium simum* is elephant grey with mauve undertones. Against this background certain white papillae stand out markedly. These papillae are encountered either singly, or in confluent

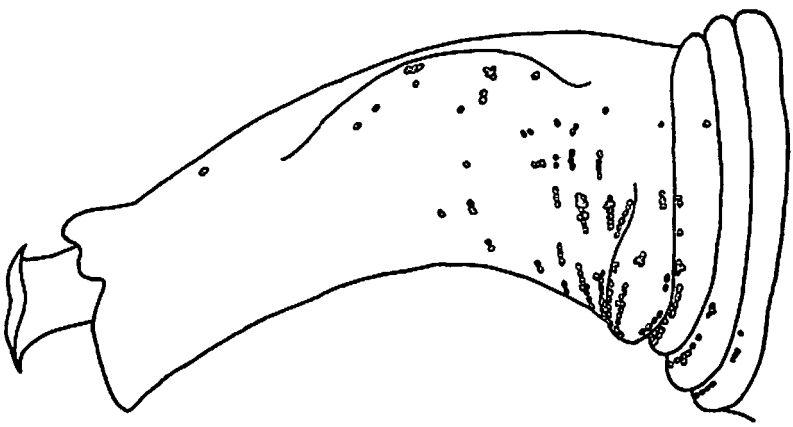

Fig. 1. — *Ceratotherium*. Glans penis and prepuce, to show distribution of preputial papillae.

clusters or short rows, upon the preputial skin adjacent to the glans penis, as also upon the glans itself and upon the outer surface of its lateral processes (fig. 1). Each papilla has the form of a low, flat-topped elevation, oval or circular in outline, and some 2 mm in maximum diameter, whose crateriform free surface presents centrally the dark ostium of a largish crypt (Fig. 2). The naked eye appearance of such a papilla recalls (though on more diminutive scale) that of the smallest of the carpal glands present in *Sus scrofa*.

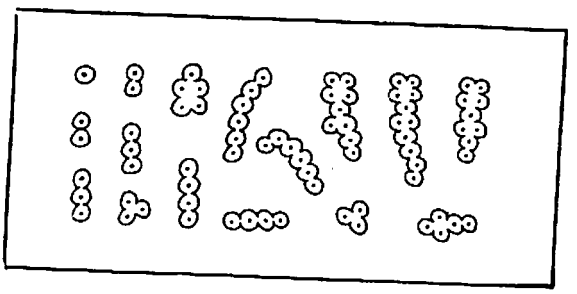

Fig. 2. — *Ceratotherium*. External appearance and groupings of preputial papillae.

Structurally each papilla is a cutaneous elevation related to a central crypt and to a more deeply situate eccrine sweat gland, associated, like the papillary skin itself, with a relatively enormous quantity of dense lymphoid tissue (Fig. 3). The papillary epidermis reveals a relatively thin stratum corneum, which is everywhere much infiltrated by lymphocytes and which lines the central crypt : dermal papillae are here shorter, more rounded and more widely spaced than in the surrounding preputial skin, where they are notably tall, slender and closely packed. The crypt is surrounded by an obtrusive mass of dense lymphoid tissue, which shows secondary nodules and extends towards, and into, the epidermis. Embedded in this lymphoid tissue, deep to the crypt, is a typically eccrine sweat gland, associated with myoepithelial cells, whose duct discharges into the crypt lumen. The dark-staining lymphoid tissue is strikingly obvious upon mere naked eye inspection of histological sections of the papillae. The presence of this lymphoid tissue must account for the formation of the papillae, since otherwise the ducts of the sweat glands could without hindrance open, through the crypts, flush with a non-elevated cutaneous surface.

This intimate association of lymphoid tissue with an eccrine sweat gland constitutes a most unusual histological finding, for which, seemingly, a parallel is not discernible elsewhere.

The eccrine sweat gland itself shows nothing histologically remarkable : all traces of mucin are absent from its secretion, which is obviously of a watery nature : but whether this secretion is odorous or otherwise cannot be determined on mere microscopical evidence.

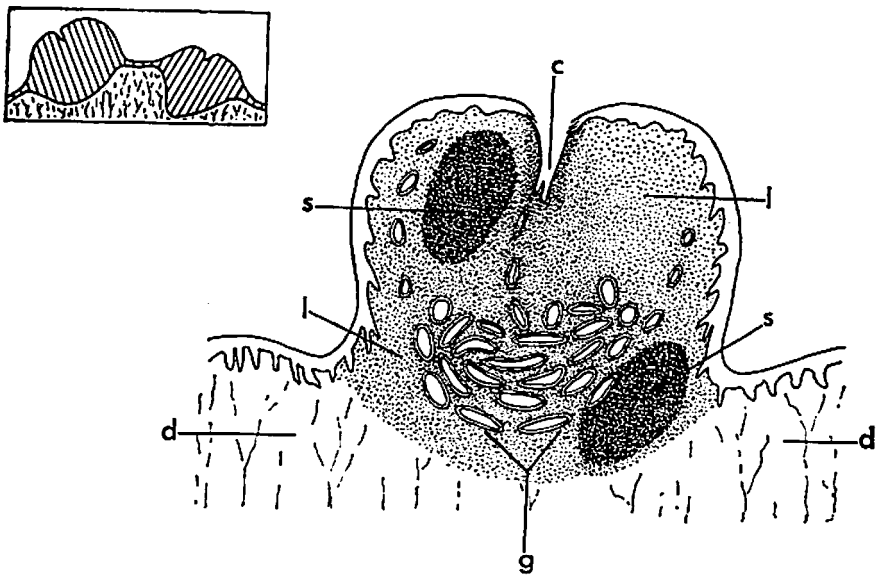

Fig. 3. — *Ceratotherium*. Preputial papilla, sectioned, low power magnification (diagrammatic). c = crypt ; d = dermis ; g = eccrine sweat gland ; l = lymphoid tissue ; s = secondary nodule. Inset = outline of two sectioned papillae.

In *Ceratotherium* preputial skin apocrine sweat glands, sebaceous glands and hair follicles are present. In the skin elsewhere (neck, flanks, limbs) the apocrine gland is the only variety of sweat gland encountered, and is invariably attended by numerous, well developed myoepithelial cells. This finding harmonizes with the histological pattern of the body skin of non-Primate mammals generally. It might therefore be expected that the specialized preputial glands of *Ceratotherium* would prove to be of the apocrine variety and it is somewhat surprising to discover that the glands associated with the preputial papillae are unequivocally of eccrine

type. The intimate association of active lymphoid tissue with these glands is also surprising and is not easy of explanation. The periglandular lymphoid tissue which characterizes the mucous glands of the alimentary and respiratory tracts is generally — and reasonably — credited with a protective role against bacterial invasion. It is however difficult to understand why the *Ceratotherium* preputial glands should be particularly vulnerable to infection and should thus require the protection afforded by the presence of lymphoid tissue.

Discussion

The presence of apocrine sweat glands in the *Ceratotherium* preputial skin is not unexpected since this variety of sweat gland predominantes in the skin elsewhere ; it is commonly associated with the production of an odorous type of sweat, and the *Ceratotherium* penile region can be observed to exercise an olfactory attraction for the female of the species.

The presence of eccrine sweat glands in the *Ceratotherium* prepuce and glans is in agreement with the occurrence of such glands in the non-hairy skin regions (e. g. rhinarium, foot pads, genitalia) of other mammals. The intimate association of such eccrine glands with dense masses of active lymphoid tissue is, however, an altogether exceptional finding. It is common enough (e. g. in the lingual, faucial and pharyngeal mucosa) to encounter mucus-secreting glands discharging into a central crypt and surrounded by abundant lymphoid tissue : it is, apparently, unknown elsewhere for an eccrine sweat gland to manifest any comparable association with lymphoid tissue. Histological methods alone afford no clue to the chemical nature of the secretion of these peculiarly specialized eccrine glands of the *Ceratotherium* penis, which are probably best interpreted as scent glands of sexual significance.

In *Diceros bicornis,* the form closest to *Ceratotherium,* preputial papillae comparable to those obtaining in *Ceratotherium* are not present. Lönnberg (1912) reported no such structures in his specimen of adult *Diceros* penis, nor could the writer detect any in the spirit-preserved penis of a 4 years old animal specially examined. The preputial skin of *Diceros* is of a uniform clove-brown colour, and is nowhere studded by white (or other) papillae. His-

tologically this skin manifests very numerous sweat glands, all of apocrine type, associated with an abundance of well developed myoepithelial cells, but a complete absence of eccrine sweat glands and of lymphoid tissue. The preputial apocrine sweat glands of *Diceros* contain a relatively large quantity of solid protein precipitate, which may be responsible for the odorous nature of the region. (The sebaceous glands present appear to manufacture a partly protein, partly lipoid, secretion, which may act both as a lubricant and as a sexual attraction). The glans penis and its lateral processes in *Diceros* are wholly devoid of recognizable gland orifices : the more proximal preputial skin (that alongside the ventral frenum) displays, in short rows, a limited number of orifices of pinpoint size, which open flush with the surface and are the mouths of hair follicles into which open the local apocrine sweat glands.

Nothing has been recorded either in the standard zoological treatises (e. g. Grassé, 1955 ; Ottow, 1955) or in particular monographs regarding the occurence of specialized preputial glands in the Asian rhinoceroses. Thus Owen (1862) and Freund (1930) make no mention of such structures in *Rhinoceros unicornis*, neither do Beddard and Treves (1887) concerning *Rhinoceros sondaicus* nor Forbes (1881) concerning *Didermocerus sumatrensis*.

So far as is known, therefore, the distinctive preputial glands described herein for *Ceratotherium* are without counterpart among the remaining members of the Rhinocerotidae.

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SUMMARY

A description is given of certain preputial glands present in *Ceratotherium* but wanting in *Diceros*. Each such gland consists essentially of a large eccrine sweat gland, embedded within a dense mass of lymphoid tissue, which results in the formation of a cutaneous papilla. The ostium of the gland duct lies in a central depression on the papilla.

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