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# The Mid-Ventral Gland of the Indian Gerbil, Tatera indica and Soft-Furred Field Rat, Rattus meltada

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Kumari S. & Prakash I., 1983: The mid-ventral gland of the Indian gerbil, *Tatera indica* and soft-furred field rat, *Rattus meltada*. Acta theriol., 28, 28: 425—438 [With 3 Tables, 2 Figs. & Plates XIV—XV]

The ventral scent marking gland occurs in about 91 and 72 per cent male *Tatera indica* and *Rattus meltada* respectively. It is absent in the females of the latter species but is present in about 5.8 per cent female *T. indica* residing in urban areas and 10.3 per cent female residing in desert grasslands. The gland size is positively and significantly correlated with body weight. The growth of the gland is a continuous process throughout the life of the rodents. No relationship has been found between the gland size and the home range of the rodents. The sebaceous alveoli in the gland of both the species are of typical holocrine type and the epidermal stratified epithelium in *T. indica* is smooth whereas in *R. m. pallidior* it is papillaeform.

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## I. INTRODUCTION

Specialised cutaneous glands which produce odoriferous secretions are found in a number of mammals (Mykytowycz, 1970; Ewer, 1968; Quay, 1965). Usually, the scent producing glands occur in discrete patches or association in the skin at a number of locations in the body (Kumari, 1982). The secretion of such glands has been attributed a number of functions pertaining to olfactory communication among rodents (Thiessen & Yahr, 1977; Mykytowycz, 1970; Bronson, 1974; Stoddart, 1976; Whitten, 1966). We have been investigating the behavioural significance of scent marking in desert rodents. Out of 18 species inhabiting the Thar desert (Prakash, 1975), a mid-abdominal glandular pad has been discovered in the desert gerbil, *Meriones hurrianae* (Kumari, Cowan & Prakash, 1981), the Indian gerbil, *Tatera indica* and the soft-furred field-rat, *Rattus meltada pallidior*. It is being reported for the first time in the genus *Tatera* and in any of the *Rattus* found on the Indian sub-continent.

This report is concerned primarily with the gross morphology and histology of the mid-ventral scent-marking gland of the Indian gerbil, *T. indica* (Hardwicke, 1807) and the soft-furred field-rat or metad, *R. m. pallidior*

## II. MATERIAL & METHODS

*Tatera indica* and *Rattus meltada pallidior* were collected from typical desert habitat at Bikaner, Bisalpur and Jodhpur. Freshly captured animals were weighed to 1 g, then etherized and measured for total head and body length to 1 mm accuracy. Greatest width and length of the scent marking gland was determined to the nearest 0.1 mm with the help of a vernier callipers.

To examine the histological structure of the gland, the hair around it were removed, glandular area and surrounding skin excised, and mildly pressed between two glass slides to prevent curling. Glands were fixed for at least 48 ha in neutral buffer formalin-Bouin's solution. Transverse and longitudinal sections (8 μ) stained with hoematoxylin and eosin were microscopically examined.

## III. RESULTS

### 1. Occurrence and Gross Morphology

The ventral scent marking gland in the two species of rodents studied are situated on the mid ventral line of the abdomen. The gland pad can be readily seen by pushing aside the overlying lateral hairs of that region.

Out of 266 adult male *T. indica* examined, 243 (91.35%) possessed the scent marking gland. However, it was present only in 5.76% females (N=126) collected from an urban area (Bikaner) where they live in large social groups. The occurrence of gland in females collected from desert scrublands where gerbils live in pairs or singularly was more: 10.31% (N=104). The glandular pad is dirty white and elongate in shape in male *T. indica* (Fig. 1). However, it is not so prominent as in *R. meltada*. In females it appears as a thin line.

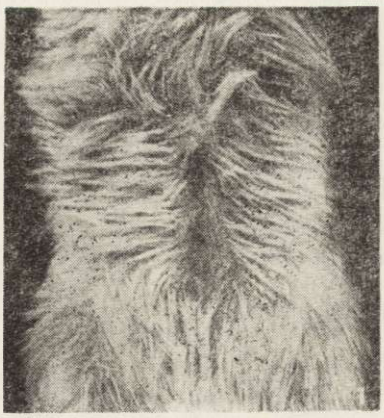

Fig. 1. Ventral scent marking gland in the male Indian desert gerbil (*Tatera indica*).

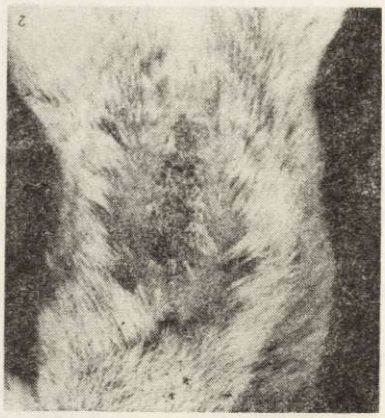

Fig. 2. Ventral scent marking gland in the male soft-furred field rat (*Rattus meltada pallidior*).

The gland, present only in male *Rattus meltada* (71.86%), is broad, relatively longer in size, dirty yellowish in colour and is fairly covered with hair (Fig. 2).

### 2. Gland Size

The glandular pad in male *T. indica* is found to be smaller as compared to *Rattus meltada pallidior* (Table 1). Among the few female in which the gland occurred, it was hardly 1—1.5 mm wide and about 3 mm in length.

Table 1

Gland measurements of two species of rodents, *T. indica* and *R. m. pallidior*.

| Body weight (g) | Head & Body length (mm) | Gland length (mm) | Gland width (mm) | Gland area ($mm^2$) |
|---|---|---|---|---|
| | | *T. indica*, Male | | |
| 123.2±3.01 | 162.4±3.16 | A 17.3±0.32 | 3.2±0.11 | 57.8± 2.16 |
| | | R 15.0±0.41 | 2.7±0.10 | 48.0± 1.82 |
| | | *R. m. pallidior*, Male | | |
| 65.4±1.66 | 129.9±2.16 | A 26.7±0.68 | 6.5±0.35 | 180.3± 9.68 |
| | | R 39.6±2.58 | 9.7±0.69 | 263.8±15.14 |

### 3. Gland Size and Body Measurements

The length, width and area of the scent marking ventral gland in male *T. indica* and *R. m. pallidior* are significantly and positively correlated with body weight ($r=+0.22$, $P<0.05$ to $r=+0.84$, $P<0.001$; Table 2). The correlation coefficient are also found to be significant in body species of rodents (Figs. 3, 4) at 5 per cent level.

Table 2

Correlation matrix (r) of gland and body measurements of *T. indica* and *R. m. pallidior*.

| GL/BW | GW/BW | GA/BW | GL/HW | HW/HB | GA/HB |
|---|---|---|---|---|---|
| | | *T. indica*, Male | | | |
| +0.8438*** | +0.8326*** | +0.7298** | +0.2403* | +0.1965$^{NS}$ | +0.3505* |
| | | *R. m. pallidior*, Male | | | |
| +0.4373* | +0.5572** | +0.2203* | +0.2572* | +0.5108** | +0.3201* |

GL=Gland length (mm), BW=Body weight, (g), GW=Gland width, (mm), GA=Gland area ($mm^2$), HB=Head & Body length (mm).

Level of significance: *=$P<0.005$, **=$P<0.01$, ***=$P<0.001$, NS=Not Significant.

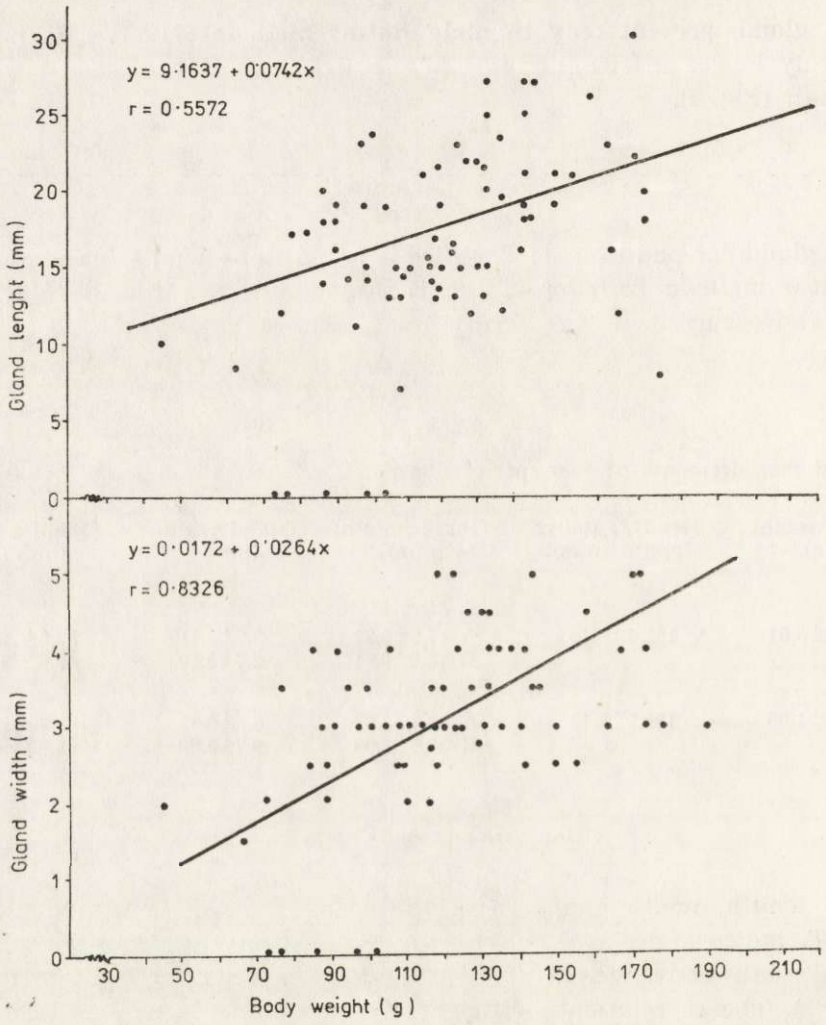


**Fig. 3.** Regression of gland length and gland width/body weight in male *T. indica indica.*

#### 4. Gland Size and Body Weight Classes

Comparison of the glandular size of male rodents (in which it is more developed) and the body weight classes, (Table 3), organised at 20 g interval in both the species, indicates that the growth of the gland is a continuous process through the age of these rodents. In *T. indica,* the body weight classes up to 80 g correspond with 4 month old animals, up to 140 g to 10 month age, and above this weight class growth curve so flattens that age could be from 1 to 1.5 years (Jain, 1970). From this

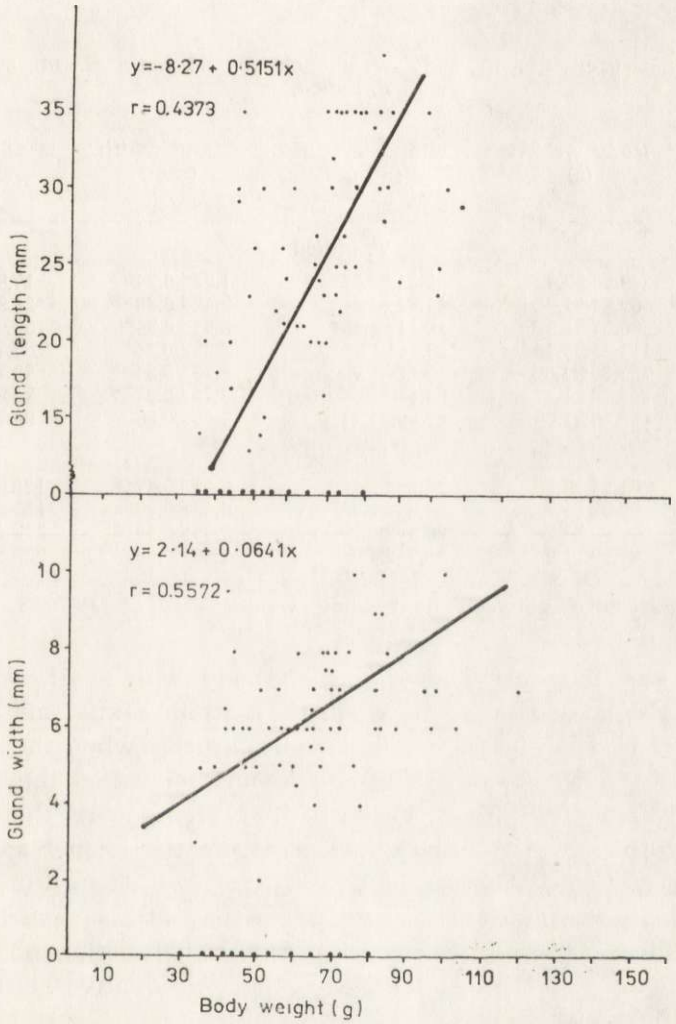


Fig. 4. Regression of gland length and gland width/body weigth in male *R. m. pallidior.*

analysis, it is further apparent that the growth of the gland does not cease at any stage in the life time of rodents. Such relationship between body weight classes and known-age *R. m. pallidior* is not, however, available. Nevertheless the trend of growth of gland measurements in the metad is also similar.

An interesting observation is made regarding the apparent spurts in relative growth rate of the gland in both the species. These occur when *T. indica* attain a body weight of 80 g and 160 g. However, in male *Rattus meltada* the sudden increase in the dimensions of the gland is

Table 3

Gland area measurements in body weight classes of male *R. m. pallidior* and *T. indica.*

| Body weight classes (g) | Body weight (g) | Gland length (mm) | Gland width (mm) | Gland area ($mm^2$) |
|---|---|---|---|---|
| | | *T. indica* | | |
| 40—60 | 49.90±2.6 | 9.33±0.95* | 1.83±0.24$^{NS}$ | 17.83± 0.86** |
| 61—80 | 69.94±1.64 | 11.64±1.44* | 2.42±0.35$^{NS}$ | 28.96± 5.20** |
| 81—100 | 90.83±1.5 | 16.11±1.38* | 3.07±0.34* | 50.03± 4.35* |
| 101—120 | 111.79±5.79 | 18.94±1.58$^{NS}$ | 3.33±0.34* | 57.65± 4.51** |
| 121—140 | 132.86±1.86 | 19.41±1.09$^{NS}$ | 3.76±0.34$^{NS}$ | 73.75± 8.47* |
| 141—160 | 148.29±1.97 | 20.54±2.54$^{NS}$ | 3.75±0.04$^{NS}$ | 76.95±10.04* |
| 161—180 | 168.16±1.29 | 22.09±1.41 | 4.08±0.36 | 90.27± 9.37 |
| | | *R. m. pallidior* | | |
| 30—50 | 41.25±3.28 | 21.9 ±2.8* | 5.95±0.47** | 139.0 ±23.4± |
| 51—70 | 62.82±1.09 | 24.6 ±1.0* | 6.05±0.26* | 155.3 ±12.2** |
| 71—90 | 79.06±1.2 | 29.5 ±3.1$^{NS}$ | 7.06±0.44$^{NS}$ | 223.40±16.42* |
| 91—110 | 97.50±1.0 | 30.7 ±4.0 | 7.50±0.087 | 239.50±57.9 |

Level of significance between next body weight class *=$P<0.05$, **=$P<0.01$, NS=Not Significant

observed when they are about 70 g in body weight. If we correlate these with the body weight at which they attain sexual maturity, it is revealed that male *T. indica* attain sexual maturity when they are about 105 g in body weight (Jain, 1970) and *R. meltada* when they are about 45 g in body weight (Rana & Prakash, 1982). It appears, therefore, that the spurt in the growth of the gland occurs in the former species prior to attaining maturity whereas in *R. meltada* it is afterwards. However, in *T. indica* the second spurt occurs after they attain sexual maturity. This may have a possible relationship with the function of the sebum odour of the scent marking gland with the reproductive activity.

### 5. Histology

The scent gland in a T. S. of ventral gland of *R. meltada* and *T. indica* shows distinct two regions; the outer one the epidermis and the inner one the dermis. The former is mostly composed of stratified epithelium in *T. indica* (Fig. 5, Plate XIV) but in *R. m. pallidior* the surface of the skin is highly papillated and folded (Fig. 6. Plate XIV). The epidermis and its corneous layer in the region of the glandular field attain somewhat greater thickness than in adjoining areas. The dermis consists of complexes of enlarged sebaceous alveoli of typical holocrine type, each with its own duct's, in both the rodent species. Gland masses fill the dermis and are responsible for the elevation of the gland. The sebaceous

gland units or alveoli of the mid-ventral gland area are the only glandular structure present and they are greatly anlarged. The follicular openings are enlarged, duct-like and are filled with glandular secretion (Figs. 7 & 8, Plates XIV, XV). The gland units are separated from each other by thin layer of connective tissue which supports the walls of the ducts. The lower end of each duct opens into several sebaceous alveoli. The basal alveolar cells are small, but as they develop they become progressively enlarged, their nuclei shrink, disappear and the cells break down in to fatty detritus within the lumen of the duct (Fig. 9, Plate XV) Many smaller undeveloped alveoli are also seen in the gland.

A comparison of the histological structure of the two species indicates some difference in the structure of the gland. Stratified epithelium is composed of many layers in *T. indica,* as also reported in both sexes of *M. hurrianae* (Kumari, Cowan & Prakash, 1981); whereas in *R. meltada* (Fig. 6) it is thinner than that of the former two species. Thickness of dermis in *R. meltada* is greater in comparison to *T. indica* and *M. hurrianae.* In *R. meltada* stratified epithelium is papillae form (Fig. 6) while in *T. indica* it is smooth (Fig. 5). Ventral gland in former species is fairly covered with hair, so the T. S. of gland also shows large number of hair follicles. In *T. indica,* however, the density of hair on the gland surface is not that high.

## IV. DISCUSSION

In certain species like *Meriones hurrianae* (Kumari, Cowan & Prakash, 1981) and *Meriones unguiculatus* (Thiessen & Yahr, 1977), the ventral scent marking gland is present in both the sexes whereas in other species like *Rattus meltada pollidior* it is present only in males. In another category, it is present among males but also in a very low proportion of females, like *Tatera indica.* In *M. hurrianae,* the gland is present in 100 per cent males and females but in male *T. indica* and *R. m. pallidior,* it is present only in 91 and 74 per cent respectively. The absence of the ventral marking gland from one set, usually the female, and from a certain proportion even in the males is rather perplexing. It is expected that a gland which has developed during the evolutionary process should have a definitive function. Then why it should be absent in 10 or 30 per cent of the male animals as it is so in *T. indica* and *R. m. pallidior.* We cannot relate the absence of gland to any age or body weight class because it is observed that in *R. m. pallidior* the gland is quite prominent in the body weight class 30 to 50 g but is absent in a number of animals in the 51—60 g category and in other classes. Question, therefore, remains

to be answered as to how the function of the gland is being performed in animlas which are devoid of it?

A comparison of the gland size in the three species in wich it occurs among the desert rodents reveals that it is largest in male *R. m. pallidior,* smallest in *T. indica* and that of *M. hurrianae* assumes a middle position. It is imperative to visualise that the size of the gland should be related to the magnitude of its function. The ventral scent marking gland among rodents has been attributed a number of functions: territorial (Thiessen, 1968; Mykytowycz, 1962); familiarization, denoting the home (Daly, 1977); reproduction (Mitchell, 1967); marking of pups and the general area (Wallace, Owen & Thiessen, 1973); phagostimulant (Kumari & Prakash, 1979); food reservation (Kumari & Prakash, 1981a); advertising ready-to-mate stage in females (Kumari & Prakash, 1981b); and social hierarchy (Kumari & Prakash, 1981c) and so on. If the function of the gland was only to scent mark its home range with its sebum exudation, indicating territoriality; the area of home range of a rodent should be proportional with the area of the gland since the requirement of sebum will be more in a species which has a larger home range. It is observed that the home range of male *T. indica* is 1875 $m^2$ that of *R. m. pallidior,* 1217 $m^2$ and of *M. hurrianae* 88.7 $m^2$ (Prakash, 1975). Considering the above conjecture these figures when compared with the gland size indicate an inverse relationship. The home range area of *T. indica* is larger but the gland size is smaller whereas the gland area of *R. m. pallidior* is almost 3 times that of *T. indica* but its home range is smaller than the latter. The variation in gland size of the two species does not suggest that scent marking in these two species has only territorial function. On the contrary, our result that the body weight and gland size are significantly and positively correlated (Table 2) indicates that the growth of the scent marking gland may be a function of body weight and age of animals.

The growth of the scent marking gland in these two species is a continuous process, it keeps on growing throughout the life time of the rodents but exhibit sporadically a significantly high growth rate at certain age. The correlation between the body weight (in a way indicating age) and the gland measurements also confirm our observations about the process of its continuous growth (Figs. 3, 4). The females of both the species show interest in the scent marks of the males (Idris & Prakash, 1981; Prakash & Idris, 1982) and therefore, it is quite probable that it may have a function related to reproduction. A number of ethological investigations are in progress to understand the role of scent marking among desert rodents in chemical communication (Kumari & Prakash, 1981a, b, c; Prakash & Idris, 1982), and more exhaustive work

may unveil the mystery of the role of this specialised odour producing gland present in a few rodents only.

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## GRUCZOŁY BRZUSZNE U *TATERA INDICA* i *RATTUS MELTADA*

Streszczenie

Bruszne gruczoły zapachowe występują u około 91% *Tatera indica* i 72% *Rattus meltada* (Ryc. 1, 2). Nie występują w ogóle u samic tego ostatniego gatunku. W 5,8% spotyka się je u samic *T. indica* zamieszkujących tereny miejskie, a w około 10,3% u samic zamieszkujących suche stepy. Wielkość gruczołów jest istotnie dodatnio skorelowana z ciężarem ciała (Tabela 1, 2; Ryc. 3, 4). Rosną one przez całe życie zwierzęcia (Tabela 3). Nie stwierdzono zależności między wielkością gruczołów a areałem osobniczym gryzoni. Pęcherzyki tłuszczowe w gruczołach u obu gatunków są typu holokrynowego. Zewnętrzny nabłonek warstwowy u *T. indica* jest gładki podczas gdy u *R. m. pallidior* jest typu brodawkowego (Ryc. 5—9, Tablica XIV).



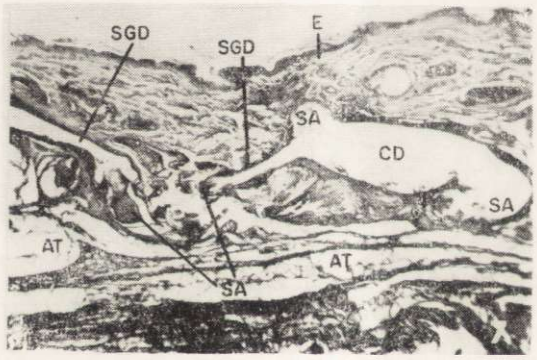


Plate XIV

Fig. 5. T. S. Ventral gland of male *T. indica* (×100).
SE=Stratified epithelium, SA=Sebaceous alveoli, CT=Connective tissue, CM=Common duct, S=Secretion.

Fig. 6. T. S. Ventral gland of male *R. m. pallidior* (×100).
E=Epidermis, EP=Epidermal papiliae, SA=Sebaceous alveoli, CD=Sebaceous gland duct, HF=Hair follicle, AT=Addipose tissue, PC=*Panniculus carnosus.*

Fig. 7. L. S. Ventral gland of male *T. indica* showing sebaceous alveolar complex feeding into the common duce (×100).
E=Epidermis, SA=Sebaceous alveloi, SGD=Sebaceous gland duct, AT=Adipose tissue, CD=Common duct.

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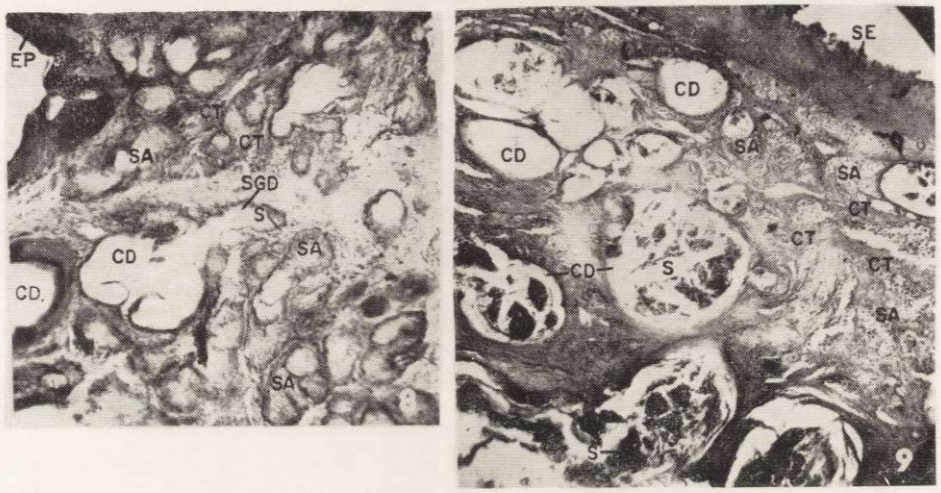


Plate XV

Fig. 8. S. Ventral gland of male *R. m. pallidior* showing sebaceous alveolar complex feeding into common duct (×100).

E=Epidermis, EP=Epidermal papillae, CD=Common duct, CT=Connective tissue, SA=Sebaceous alveoli, SGD=Sebaceous gland duct, S=Secretion.

Fig. 9. T. S. Ventral gland of male *T. indica* showing discharge of secretion from common duct (×100).

SE=Stratified epithelium, CT=Connective tissue, SA=Sebaceous alveoli, CD=Common duct, S=Secretion.