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THE PROCTODEUM — A NEW KEY CHARACTER FOR DEMODICIDS (DEMODICIDAE)

BY

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Several investigators (e.g. Banks, 1915; Berlese, 1925) have either reported or figured an anal opening for members of the genus *Demodex*. In every case this opening was alleged to be directly adjacent to the genitalia. Extensive examination of this area by Hirst, 1919, and many others since then (e.g., Lombardini, 1942) has led to the conclusion that the demodicid digestive tract ends as a bilobed midgut sac with no remaining elements of the proctodeum.

A proctodeal structure has been found (O'Dea) and is described below. Variations of this within the genus *Demodex* are reported followed by a brief account of the taxonomic utility and a suggestion of the probable function of this structure.

Proctodeum.

The proctodeum has so far only been found either in the adult females or adult males and females of a limited number of species of the genus *Demodex*. The opening of this structure lies midventrally in the posterior one-third of the opisthosoma. Under bright phase contrast the chitinous lining shows up clearly as confluent with the opisthosomal exoskeleton (Pl. I, A, B). Internally this lining passes dorsally for a short distance after which it courses in various directions and assumes various forms dependent upon the species or sex under examination.

In the female of *D. folliculorum* the proctodeum is 12.5 μm long by 1.5 μm wide as an attenuated tube and runs posteriorly in the opisthosoma ending in a closed tip (Pl. I, C). It is similar in the females of *D. canis* except that here it is shorter, 11.5 μm, and in the unexpanded condition (see below and Pl. I, A) it is thin (< 1.0μm) and curved whereas in the expanded condition it is thick (2.5 μm) and swells as it proceeds posteriorly (Pl. I, B) In *D. phylloides* female the proctodeum is at first a short tube which then expands anteriorly and posteriorly as a moderate sized dead-end sac.

Marked sexual dimorphism of this structure is found in several species. In *D. aurati* males the proctodeum runs as a thin attenuated tube anteriorly (Pl. I, D), whereas in the female it runs posteriorly and is thick and finger-like (Pl. I, E). In males of *D. phylloides* and *D. canis* this structure is either absent or so minute that we have been unable to distinguish it.

*Araneologia*, t. XII, fasc. 3. 1970.
PLATE 1: Proctodeal structures in various demodicids.

Stained (HaE) paraffin sections of several species (e.g., *D. canis, D. phylloides*) show no marked cellular development either around the shaft of the chitinous tube or at its tip. The latter is not apposed to any specific internal organ but seems to lie in the haemocoel.

Examination of stained sections, *in toto* stained (acid fuchsin) preparations, and *in toto* mounts in Hoyer's medium fail to show any granular excretory products in the lumen of this structure. The tip of the proctodeal tube has never been found closely apposed to the pigment (excretory) granules.

In one specimen of an undescribed demodicid from *Lepus californicus* the proctodeum was found everted (Pl. I, F) — this probably due to excessive pressure during slide preparation. On several occasions male specimens of *D. aurati* have been found with the proctodeum twisted dorsally. In every case the anterior portion of the mites have been distorted due to injury upon recovery. In the females of *D. canis*, however, we quite commonly find underanged specimens with a thin and others with a thickened tube as though this structure were expansible.

A list by sex of the described species in which the proctodeum has been found appears in Table I. Nine undescribed species have also been examined and these show a proctodeum in at least one sex of each.

**Table I : Status of the proctodeum in five species of demodicids with lengths and brief descriptions.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>Total Length µm</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>D. folliculorum</em></td>
<td>♂</td>
<td>12.5 × 1.5</td>
<td>tubular attenuated toward tip.</td>
</tr>
<tr>
<td></td>
<td>♀</td>
<td>wanting in 5</td>
<td>examined.</td>
</tr>
<tr>
<td><em>D. criceti</em></td>
<td>♂</td>
<td>4.8</td>
<td>V-shaped and terminal</td>
</tr>
<tr>
<td></td>
<td>♀</td>
<td>26.1</td>
<td>whip-like, sinuous</td>
</tr>
<tr>
<td><em>D. aurati</em></td>
<td>♂</td>
<td>11.6</td>
<td>finger-like posterior-directed.</td>
</tr>
<tr>
<td></td>
<td>♀</td>
<td>18.4</td>
<td>slender, anterior-directed.</td>
</tr>
<tr>
<td><em>D. canis</em></td>
<td>♂</td>
<td>11.5 × 1.0</td>
<td>slender, markedly attenuated toward tip</td>
</tr>
<tr>
<td></td>
<td>♀</td>
<td>wanting in 7</td>
<td>examined.</td>
</tr>
<tr>
<td><em>D. phylloides</em></td>
<td>♂</td>
<td>11.5 × 2.5</td>
<td>short stalk, expanded anteriorly and posteriorly as sac.</td>
</tr>
<tr>
<td></td>
<td>♀</td>
<td>wanting in 6</td>
<td>examined.</td>
</tr>
</tbody>
</table>

**Taxonomic Utility.**

The lining of the proctodeum, at least in the species recorded in Table I, is a very stable character. Examination of twenty specimens each of males and females of *D. aurati* shows that it varies only imperceptibly in size and shape being constant for the sex of each and markedly different from any of the other 15 species examined. Furthermore, the position of the proctodeal opening is constant. Counts of annulae (*D. aurati*) taken from the posterior of the opisthosoma to the proctodeal opening showed an average of 20 females to be 20.4 (19-24) and for 20 males 34.1 (30-38). The length of the proctodeum in the female is ca. 11.6 µm and in the male ca. 18.4 µm.

This structure proves especially useful in cases in which there are two species of demodicids parasitizing the same host. Examination of the two species, *D. aurati* and *D. criceti*, present on the golden hamster (see Nutting, 1965), shows that even markedly distorted specimens can readily be distinguished as to species and also as to sex. In *D. criceti* the proctodeum opens
ventrally and subterminally on the opisthosoma. The female structure when viewed ventrally is short, thickened (4.8 \mu m) and V-shaped (Fig. 1, A, B), whereas that in the male is slender, sinuous and long (26.1 \mu m) — in fact extending approximately one-half the length of the opisthosoma (Fig. 1, C). These structures differ remarkably from those discussed above for *D. aurati*.

**FIG. 1**: Proctodeum of male and female *D. criceti*.
A. — Female *D. criceti* in lateral view. B. — Female *D. criceti* in ventral view.
C. — Male *D. criceti* in lateral view.

In fact of the characters of use to demodicid taxonomy the proctodeum seems to be one of the most constant and useful key characters.

**DISCUSSION.**

It has long been known that the closely related cheyletids possess an excretory organ (Thor, 1904) apparently derived as a modification of the proctodeum. The excretory organ arises either ventrally, terminally or dorsally (see Hughes, 1959) and passes dorsal to the mid-gut. The proctodeum in the demodicids we have so far examined starts either ventrally or sub-terminally and runs anteriorly or posteriorly but never over the dorsal surface of the mid-gut. Excretory crystals are not found in this structure nor does this in any way connect with the pigment (excretory) granules which are thought to be eliminated by a different mechanism (see Stromberg and Nutting, in press). In view of the consistent termination of the proctodeum in the haemocoel and its apparent expansibility we suggest that it may be an hydrostatic organ.

It would seem appropriate since we have as yet no clear cellular detail associated with this structure and no assurance of its function that we provisionally designate it the proctodeum and its opening to the exterior the proctodeal pore!

**SUMMARY.**

A proctodeum has been found in several species of the genus *Demodex*. Although often differing between the sexes in the same species it is clearly defined, consistent in morphology within sex or species, and a valid structure for species discrimination. In view of the marked difficulties involved in distinguishing species in the genus *Demodex* it is evident that this structure will prove to be a cardinal key character for species separation.

Since this structure seems to end consistently in the haemocoel and is never associated with the pigment (excretory) granules, it is suggested that it may function as a hydrostatic organ. It is proposed that this structure be called provisionally the proctodeum and its opening the proctodeal pore.
ACKNOWLEDGEMENTS

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REFERENCES


Author's note: Since this manuscript was submitted, "A Manual of Acarology" by G. W. Krantz has been published. This has an illustration (p. 184, 56-3) of an unlabelled structure of an unnamed demodicid which is undoubtedly a proétodeum.