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PARASITIC ON KIWIS (*APTERYX*)

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Summary

One new species of *Rallicola* (Phloptoridae) from *Apteryx owenii* is described and the known species parasitic on *Apteryx* are discussed.

INTRODUCTION

Harrison (1915) described three species of *Ishnocera*, associated with the New Zealand kiwi, *Apteryx*, which he placed in *Aptericola*, his subgenus of *Rallicola*. Clay (1953) in a revision of the *Rallicola*-complex did not recognise the subgenus *Aptericola*, but accepted Harrison's three species on the basis of the characters used by that author. Since then it has been possible to examine a greater number of specimens and to reassess the characters on which the species were separated.

In the original paper Harrison (1915:88) states that the material on which his new species were based was collected from kiwi skins in the Cambridge University Museum. Some at least of this material is now in the British Museum (Natural History) and a male and female of each of *Rallicola gadowi* and *novaezealandiae* and the single female of *gracilentus* (= *gracilis*) have at some time been labelled as "types". As the females are more easily separated than the males, the female specimen labelled "type" of each of these species will here be designated as lectotype.

TAXONOMIC CHARACTERS OF *Rallicola*

Among the characters which have proved to be of specific value in *Rallicola* the following have been used here: proportions of the head and mesosome, the characters in the male associated with the last apparent sternite (VIII or IX) and those of the terminal sterna of the female.

In the male the posterior margins of sternites V and VI are convex and flaplike (observation with the scanning electron microscope, SEM); this is also the case with the last apparent sternite, the posterior margin of which may provide characters of taxonomic importance in the species of *Rallicola* (Clay, 1953). Examination with the SEM shows that in *gadowi*

(Fig. 1) there is a groove below the margin of this sternite passing to the posterior margin of the abdomen; this groove has various thickened areas and when viewed with transmitted light at some angles these areas may appear to be underneath the edge of the sclerite.

In female *Rallicola* there is a tubercle each side of the last sternum bearing anteriorly on its inner margin one or more elongate processes (Figs 3, 4). The presence of these tubercles is a generic character in *Rallicola* and the number of processes has been used as a specific character. Examination with transmitted light of a typical process of *R. gadowi* shows that it does not have the surface socket usually associated with the body setae of the Ischnocera. However, it does have internally a base similar to that of a normal seta, the articulating setal membrane appearing to be reduced to a greater or lesser extent (Fig. 2). Examination with the SEM shows that externally some of these setae have the appearance of a simple outgrowth of the body wall (Figs 5, 6, a), some have an indication of a line of demarcation (Fig. 4, b), and others arise from a cavity in the body wall (Fig. 5, c). Evidence from the optical and scanning electron microscopes shows that this cavity leads to the true base of the seta. When the process appears as a simple outgrowth it seems that the body wall has fused with the outside of the seta so that it is no longer possible to say where one begins and the other ends. Thus, although these processes superficially appear to be morphologically dissimilar, they are all true setae. Rothschild (*in* Traub, 1968) has shown that some of the "spines" found in the fleas are non-articulated setae. The species parasitic on *Apteryx* may show intra-specific variation of the type of setae on the tubercle not only between individuals but from side to side of the same individual, for purposes of description therefore no distinction between the different types has been made, the total number only being given.

Measurements are given in millimetres and the number of specimens examined is shown in brackets.

***Rallicola gadowi* Harrison, 1915**

(Figs 1, 2, 3, 5, 6, 7, 10, 13)

Type host: *Apteryx australis* = *Apteryx a. australis* Shaw

Rallicola gadowi Harrison, 1915, Parasitology 8: 90, figs 1, 2.

Rallicola novaezealandiae Harrison, 1915, op. cit. :92, figs 3-5. Type host:

Apteryx lawryi = *Apteryx australis lawryi* Rothschild. Syn. n.

Rallicola gadowi Harrison. Clay, 1953, Proc. zool. Soc. Lond. 123: 568 figs 9-11.

Rallicola novaezealandiae Harrison. Clay, 1953, op. cit. :579.

MATERIAL EXAMINED from *Apteryx a. australis*, NEW ZEALAND: Lectotype ♀ and paralectotype ♂; 10 ♂, 3 ♀ from skins; 4 ♂, 2 ♀, Lake Te Anau South Island (E. Melland). 2 ♂, 2 ♀ said to have been taken from *Apteryx, haasti*, Takahe Valley, South Island, do not belong to the species usually

found on that host, but resemble *gadowi*, although the measurements are not typical of specimens from *Apteryx a. australis*.

LECTOTYPE here designated: ♀ in BMNH (slide no. 744) from *Apteryx australis*, skin in Cambridge Museum (L. Harrison).

PARALECTOTYPE: ♂ in BMNH (slide no. 745), data as for lectotype.

MATERIAL EXAMINED from *Apteryx a. lawryi*, NEW ZEALAND: Lectotype ♀ and paralectotype ♂; 32 ♂, 16 ♀ from Stewart Island, 27.ii.1968 (J. McBurney); 3 ♂, 1 ♀ from Stewart Island; 1 ♂ from type host (no other data).

LECTOTYPE here designated: ♀ in BMNH (slide no. 746) from *Apteryx lawryi*, skin in Cambridge Museum (L. Harrison).

PARALECTOTYPE: ♂ in BMNH (slide no. 747), data as for lectotype.

The difficulty in studying the species parasitic on *Apteryx* has been the lack of good series of authenticated material. Much has been taken from skins, often originating from birds in zoological gardens and perhaps not always correctly identified, thus an atypical specimen may be showing intraspecific variation or have originated from a different host. I am fortunate therefore in having the opportunity, through the kindness of Dr J. C. Watt of Department of Scientific and Industrial Research, Nelson, of examining the large number of specimens collected by Mr McBurney from *Apteryx a. lawryi*. For convenience these specimens and others from the same host are referred to as *R. novaezealandiae*.

Harrison separated *gadowi* from *novaezealandiae* by its more robust form, the shape of the anterior margin of the head, the proportions of the male genitalia and the presence of a median emargination of the vulval margin.

In a number of measurements *gadowi* averages larger, but there is sufficient overlap to make identification of all specimens uncertain. If the breadth of the head at the temples is taken as an example, the range of male *gadowi* is 0.55–0.64, mean (16) 0.61; *novaezealandiae* is 0.48–0.57, mean (15) 0.55. The males parasitic on *Apteryx a. mantelli* are somewhat intermediate: range 0.54–0.62, mean (12) 0.58. In the female, the range in *gadowi* is 0.58–0.71, mean (8) 0.66; *novaezealandiae*, 0.58–0.66, mean (26) 0.62, and from *A. a. mantelli*, 0.59–0.71, mean (16) 0.64. If heads of a similar size belonging to individuals from the three hosts are compared or the projection method as described in Clay & Hopkins (1954:230) is used, the differences given by Harrison are not apparent. Comparison of similar-sized specimens again does not show differences in the proportions of the mesosome or differences in the length of the parameres or basal

apodeme. Clay (1953:579) used the shape of the parameres as a distinguishing character, but examination of more material shows the absence of constant differences. The median indentation of the vulval margin in the lectotype of *gadowi* as shown in Harrison (1915, fig. 2) and in Clay (1953, fig. 46) appears to be an artefact, as also is that shown in Fig. 7 of the present paper. Other specimens from the type host may or may not show a slight indentation so that this character cannot be used to separate specimens from these hosts.

The chaetotaxy of the specimens from *australis* and *lawryi* shows some differences: in the male for instance, the range of tergoventral setae on II (the first apparent segment) is 4–9, mean (15) 6.6 in *gadowi*; 6–8, mean (27) 7.6 in *novaezealandiae*, and 6–10, mean (16) 6.8 in specimens from *A. a. mantelli*. In 13 males from *australis*, 12 have 2 setae on sternum VII and 1 has 3; 16 males from *mantelli* have 2, and in 38 males from *lawryi* the range is 2–4, mean 3.38. There is a tendency in female *novaezealandiae* to have a larger number of setae in the group each side of sterna VII–VIII (4+4) instead of the more usual 3+3 as found in *gadowi*; however, there are specimens which cannot be separated on this character. Anterior setae on female ventral tubercles vary from 2 to 4 each side. Seven females from *australis* all had 3+3; of 16 from *mantelli*, 8 had 3+3 and 8 had various numbers (3+4, 4+4, 3+2, 2+2), and of 16 from *lawryi*, 10 had 3+3 and 6 had various number (3+4, 4+4, 4+2, 3+2). Only 1 specimen of the 39 examined from the three subspecies of *australis* resembled the condition in *gracilentus* and *pilgrimi* n.sp. in having 2 setae on both sides.

It is apparent from a study of the measurements and chaetotaxy that the populations on *australis* and *lawryi* show some divergence, with specimens from *mantelli* being more similar to those from *australis*. However, as all individuals from one host subspecies cannot be assigned to a population characteristic of that host, it seems more satisfactory to include all the populations from the three subspecies of *australis* under the name *gadowi*.

MATERIAL EXAMINED from *Apteryx australis mantelli*, NEW ZEALAND: 2 ♂, 6 ♀, Manawatu, 7.iv.1965 (G. Singh); 18 ♂, 10 ♀, skins (R. Meinerzhagen); 1 ♂, 5 ♀, skins (L. Harrison).

***Rallicola gracilentus* Clay, 1953**
(Figs 8, 11, 14)

Type host: *Apteryx haastii* Potts

Rallicola gracilis Harrison, 1915, Parasitology 8: 93, fig. 6 nec Piaget, 1871.

Rallicola gracilentus Clay, 1953, Proc. zool. Soc. Lond. 123: 584. Nomen novum for *gracilis* Harrison.

MATERIAL EXAMINED from *Apteryx haastii*, NEW ZEALAND: Lectotype,

♀; 1 ♂, 1 ♀, Goulard Downs, Nelson, 6.ii.1924 (E. S. Gourlay); 18 ♂, 15 ♀ from skins; 47 ♂, 41 ♀ from the Zoological Gardens, London.

LECTOTYPE here designated: ♀ in BMNH (slide no. 748) from *Apteryx haasti*, skin in Cambridge Museum (L. Harrison).

This species is distinguished from other known species parasitic on *Apteryx* in the female by the shape of the terminal segments of the abdomen and the vulval margin (Fig. 8) and in the male by the proportions of the head (Fig. 11) and of the mesosome (Fig. 14).

It resembles *pilgrimi* in having a sclerotised ring round the opening of the spermathecal tube and in having 2+2 anterior setae on the female tubercles. These setae are shorter than those of *gadowi* and constant in number, only one of the 32 females examined having an extra seta on one side.

Breadth of head at temples: ♀ (20), 0.57-0.61, mean 0.59; ♂ (16), 0.52-0.57, mean 0.55.

Rallicola pilgrimi Clay, n. sp.

(Figs 9, 12, 15)

Type host: *Apteryx owenii* Gould

MATERIAL EXAMINED from skins of *Apteryx owenii*, NEW ZEALAND: 6 ♂, 5 ♀, Collingwood, South Island; 7 ♂, 5 ♀, South Island (no other data); 4 ♂, 4 ♀, Mt Hector, Tararua Range, North Island. These last specimens were taken from the skin of the only known preserved specimen of *owenii* from North Island (see Buller, 1876:193).

HOLOTYPE: ♀ in BMNH (slide no. 749) from *Apteryx owenii*, NEW ZEALAND, Mt Hector, Tararua Range, North Island.

PARATYPES: 17 ♂, 13 ♀ with data as given above under material examined, BMNH and Entomology Division, Nelson.

This species is distinguished by the chaetotaxy and other characters of the vulval region in the female and by the proportions of the head and mesosome and by the form of the margin of the last sternite in the male.

FEMALE AND MALE: General characters as in Clay, 1953, figs 9, 10; shape of head as in Fig. 12. Marginal temporal seta 4, the only elongate temporal seta, reaches beyond the end of the pterothorax. Meso- and metathorax each with two long central setae. Shape of terminal segment of female abdomen as in Fig. 9; a well marked crescentic sclerite each side of vulval margin and with a sclerotised ring round the opening of the spermathecal duct as in *gracilentus*. Shape of mesosome as in Fig. 15; margin of last sclerite with central indentation.

ABDOMINAL CHAETOTAXY: Tergocentral, ♀ (10): II, 6-9, mean 7.4; III, 8-12, mean 10.3; IV, 7-10, mean 9.1; V, 8-10, mean 8.5; VI, 6-8, mean 7.0; VII, 5-6, mean 5.8; VIII, 3-4. ♂ (12): II, 6-8, mean 6.8; III, 8-11, mean 9.0; IV, 8-10, mean 8.4; V, 6-9, mean 7.3; VI, 4-6, mean 5.0; VII, 4-5, normally 4; VIII, 2-5, normally 4. Sternal, ♀ (10): II, 5-8, mean 6.6; III, 11-15, mean 13.0; IV, 11-15, mean 13.3; V, 10-14, mean 12.3; VI, 6-11, mean 9.5; VII-VIII, 3+3. ♂ (10): II, 5-7, mean 6.3; III, 12-15, mean 13.4; IV, 10-16, mean 12.8; V, 8-13, mean 10.7; VI, 6-9, mean 7.5; VII, 2; VIII, 2. Pleural in male and female (as in the previous two species): II, 1; III-V, 2; VI-VIII, 3 each side. In the female IX has 2 each side and the male 4. The female tends to have fewer spiniform setae on the vulval margin than in the other species: 5-10 each side, range of total: 13-19, mean (10) 15.8; in 10 specimens from *A. a. lawryi* the range was 17-22, mean 19.6. The anterior setae of the lateral tubercle of the female were 2+2 in the 14 specimens examined, both setae being shorter than those of *gadowi*.

MEASUREMENTS: Length of head, ♀ holotype 0.55, male paratype 0.50; total length, holotype 1.72; paratype 1.57; breadth of head at temples, holotype 0.49, paratype ♂ 0.43, range of ♀ (10) 0.48-0.51, mean 0.49, range of ♂ (10) 0.43-0.47, mean 0.45; prothorax breadth, holotype 0.34, paratype ♂ 0.33; breadth of abdomen, holotype 0.70, paratype ♂ 0.61.

KEY TO THE SPECIES OF *Rallicola* PARASITIC ON *Apteryx*

FEMALES

1. Opening of spermathecal duct with sclerotised ring; anterior inner margin of lateral tubercle each with 2 setae.....2
Opening of spermathecal duct without sclerotised ring; anterior inner margin of lateral tubercle with 3-4 setae on at least one side.....**gadowi**
2. Terminal segment truncate; vulval margin prolonged posteriorly (Fig. 8).....**gracilentus**
Terminal segment not truncate; vulval margin flattened (Fig. 9).....**pilgrimi**

MALES

1. Posterior margin of last segment with central nick.....**pilgrimi**
Posterior margin of last sternite without central nick.....2
2. Proportions of head as in Fig. 10 and of mesosome as in Fig. 13.....**gadowi**
Proportions of head as in Fig. 11 and of mesosome as in Fig. 14.....**gracilentus**

HOST-PARASITE RELATIONS

The distribution of the species of *Rallicola* on *Apteryx* agrees with the classification of the hosts, that is, a single species on the three subspecies of *Apteryx australis* and a distinct species on each of the other two species, *A. haasti* and *A. owenii*; the last two species of *Rallicola* are perhaps more nearly related to each other than to the first.

This is quite different from the situation found in the distribution of the Menoponidae genus *Apteryx* as shown by Tandan (1972). The species of this genus show affinities either between the parasites of *Apteryx haasti* and *A. australis mantelli*, or as favoured by Dr Tandan, between those of *A. haasti* and *A. a. lawryi*. This conclusion may partly be due to the difficulty of interpreting relationships between the species of *Apteryx*; specimens of this genus from the two hosts not represented (*Apteryx a. australis* and *A. owenii*) might also help elucidate the problem.

The species of *Rallicola* parasitic on *Apteryx australis* differs from many ischnoceran parasites in that it does not conform to Harrison's rule that the individuals of populations parasitic on larger forms of a group of related birds average larger. Available specimens of *R. gadowi* from *Apteryx a. australis* average larger than those from *australis lawryi*, although according to Oliver (1955) *lawryi* is the larger bird. However, there is no explanation of the direct cause of Harrison's rule (Clay, 1951) and it is possible that the relation between body size and feather size is different in a flightless bird; nor is it known what criteria were used in judging the size of the forms of *Apteryx*. The other two species of *Rallicola* do conform to Harrison's rule, the larger (*gracilentus*) being found on the larger bird, *A. haastii*, and the smaller (*pilgrimi*) on the smaller *A. owenii*.

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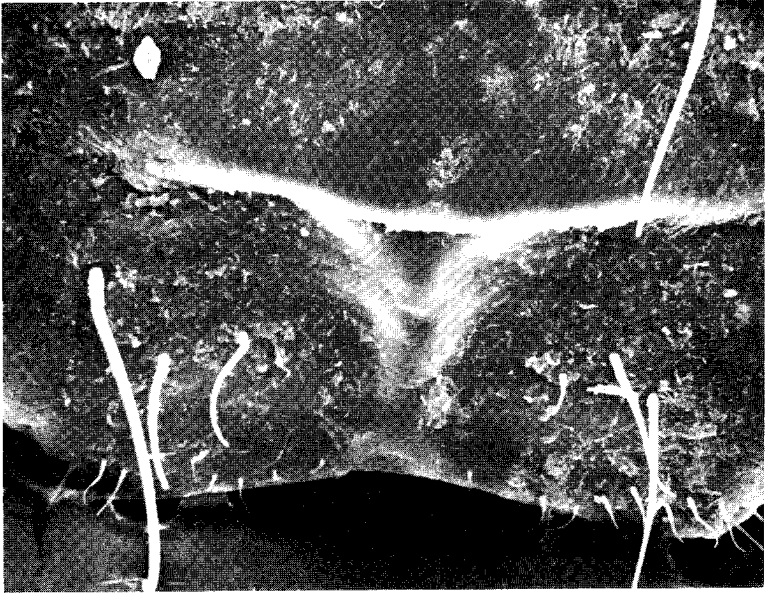


FIG. 1—Terminal sterna of male abdomen, *R. gadowi*. SEM

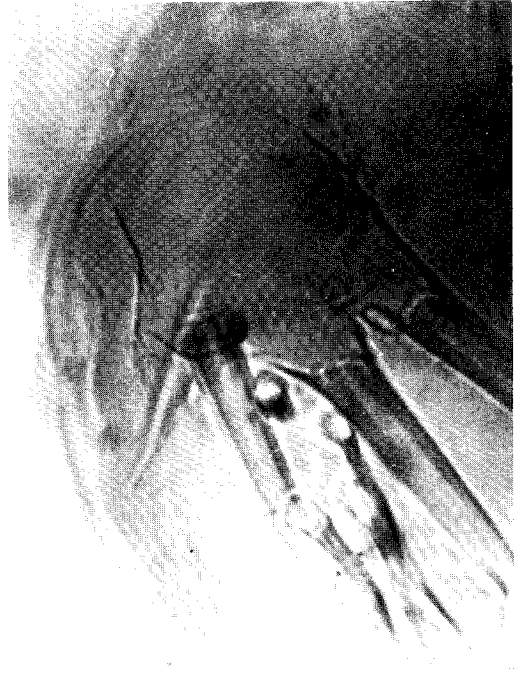
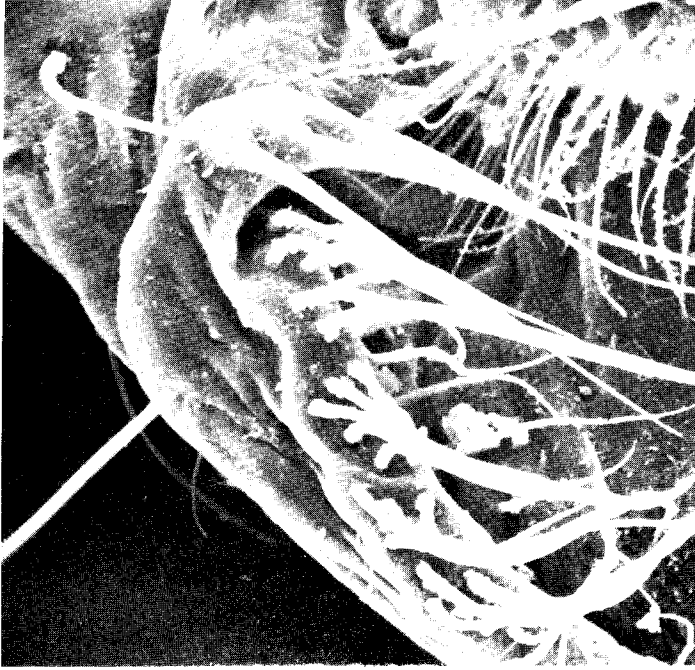
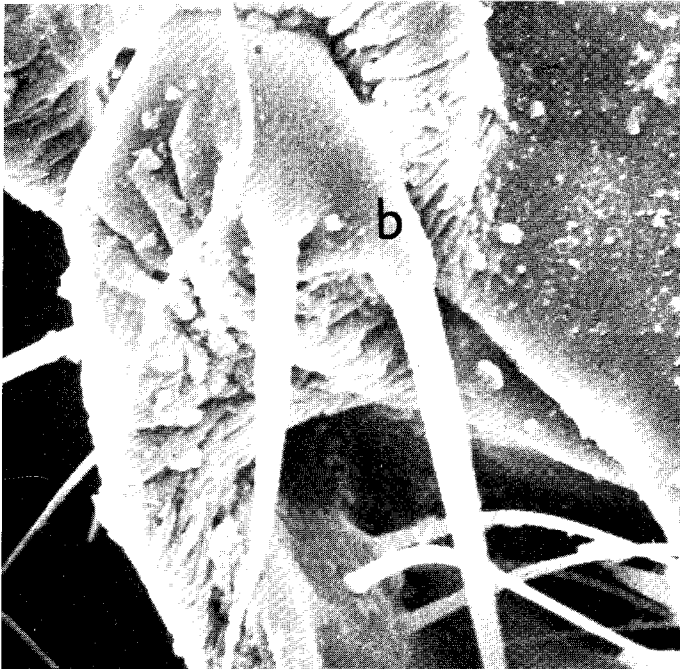


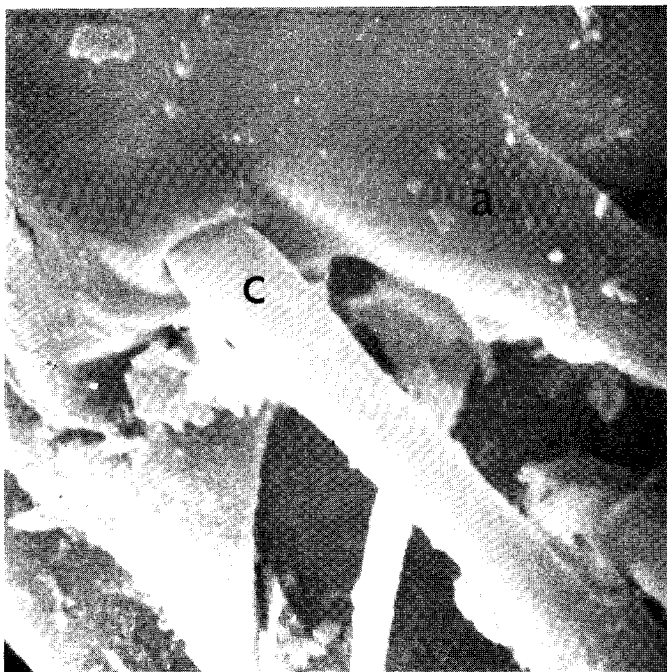
FIG. 2—Anterior part of female tubercle of *R. gadowi* from *Apteryx a. lawryi*. Phase contrast.



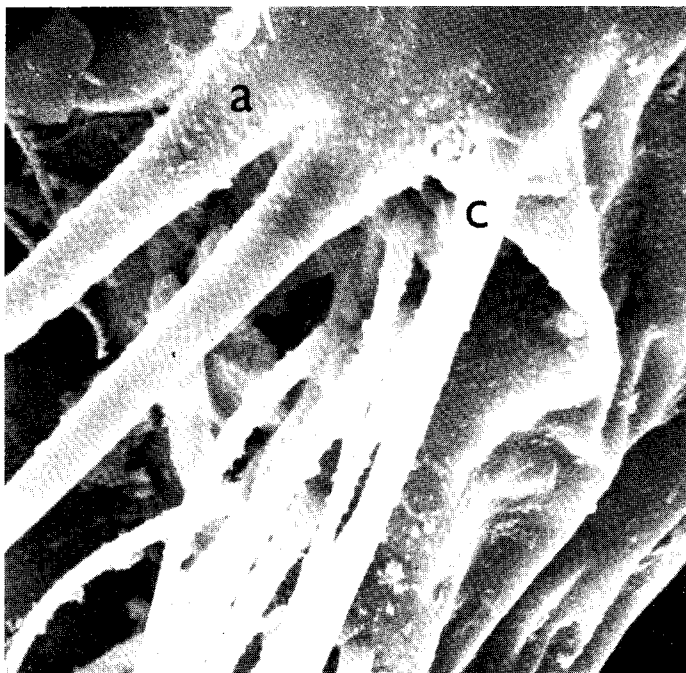
3. Complete tubercle of *R. galowi*



4. Anterior part of tubercle of *Rallicola* from *Porphyrio melanotus*

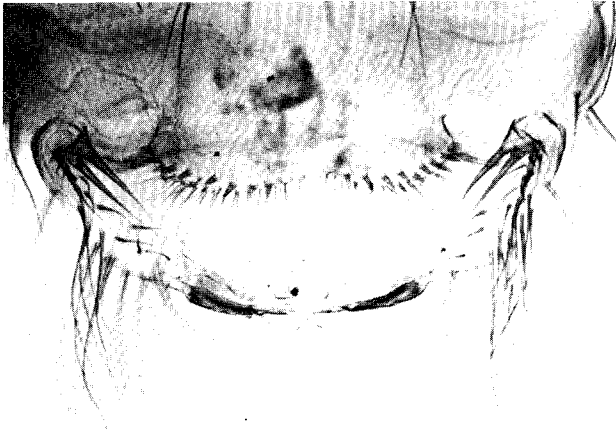


5. Parts of tubercle of *R. gadawi*

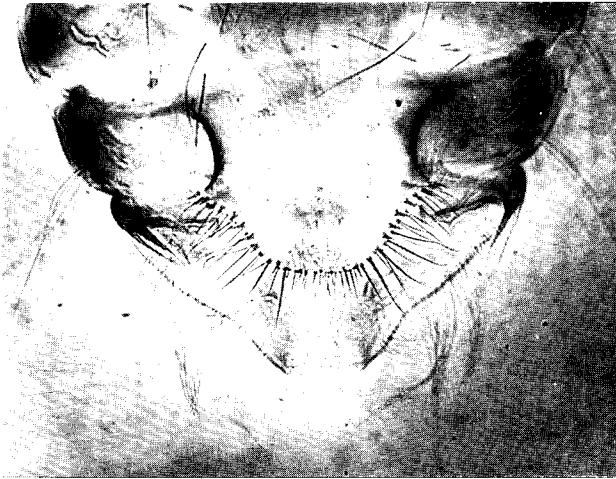


6. Parts of tubercle of *R. gadawi*

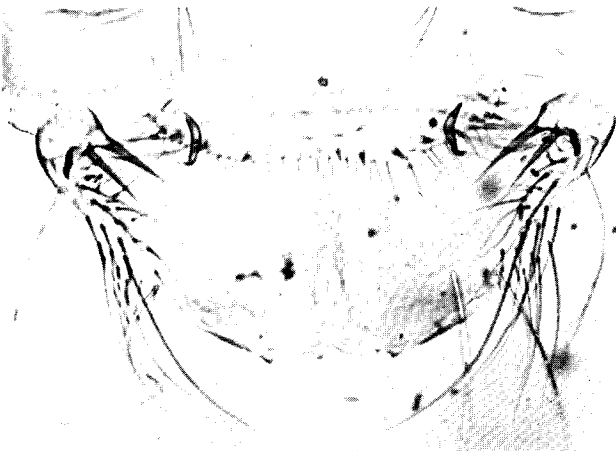
Figs 3-6--Female tubercle of *Rallicola* spp. For explanation of a c see text, SEM



7. *R. gadowi*

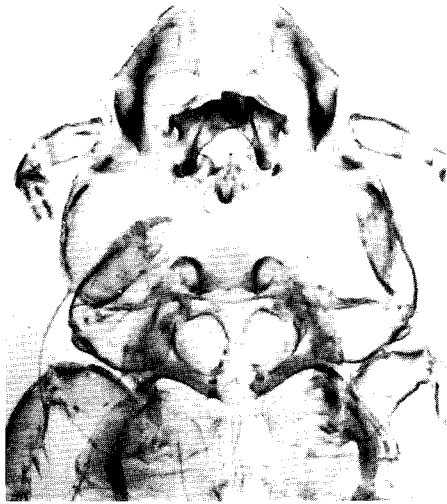


8. *R. gracilentus*

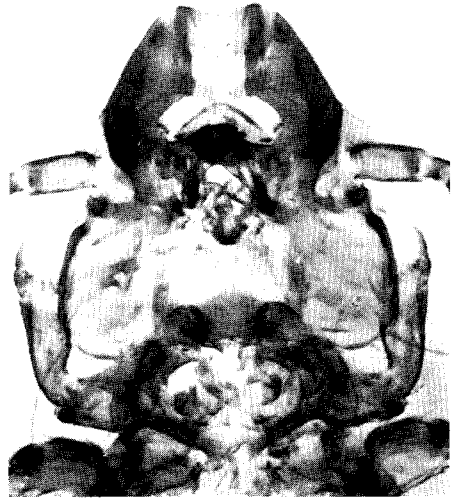


9. *R. pilgerimi*

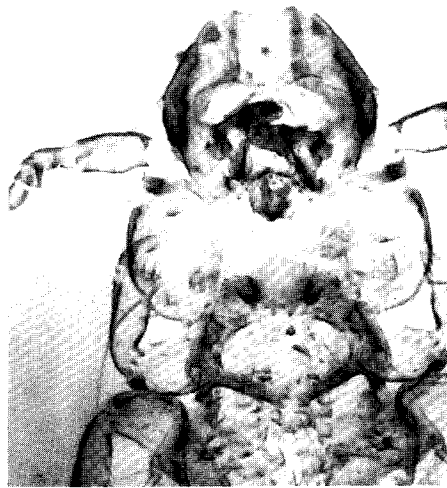
FIGS 7-9. Vulval region of female abdomen of *Rallicola* spp.



10. *R. gadowi*



11. *R. gracilentus*

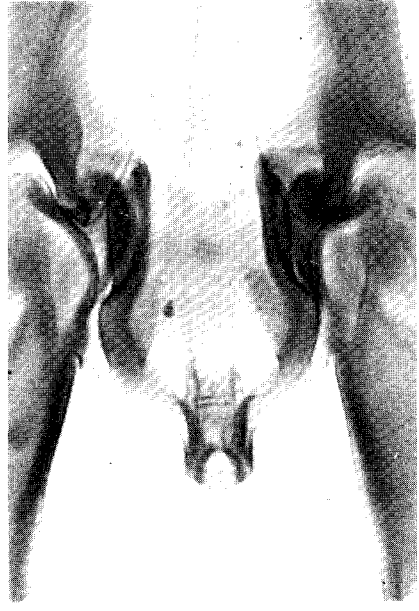


12. *R. pilgrimi*

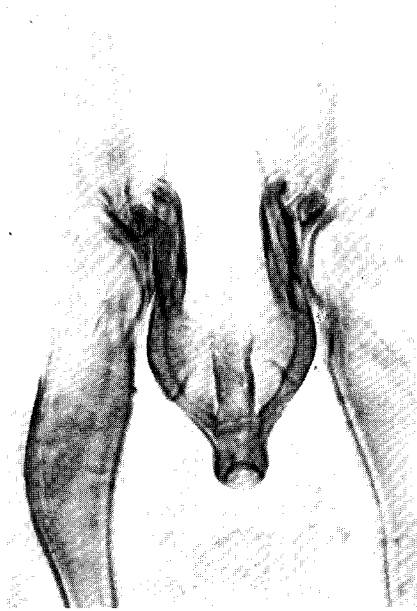
FIGS 10-12 - Male heads of *Rallicola* spp.



13. *R. gadowi* Harrison



14. *R. gracilentus* Clay



15. *R. pilgrimi* n.sp.

FIGS 13-15 Mesosome of male *Rallicola* spp.