

Species of *Ardeicola* (Insecta: Mallophaga) parasitic on birds of the family Threskiornithidae

K. P. HAJELA*

AND

B. K. TANDAN

Department of Zoology, University of Lucknow, India

Accepted for publication January 1970

Four new and six known species of *Ardeicola* (Phlopteridae) from the Threskiornithidae are described, the new species being from *Theristicus melanopis*, *Bostrychia carunculata*, *Pseudibis davisoni* and *Platibis flavipes*.

CONTENTS

	PAGE
Introduction	309
Species of <i>Ardeicola</i>	310
<i>Ardeicola melanopis</i> , sp. nov.	310
<i>A. epiphanes</i>	315
<i>A. theristicus</i>	315
<i>A. geronticorum</i>	315
<i>Ardeicola ababae</i> , sp. nov.	320
<i>A. dennelli</i>	323
<i>Ardeicola burmanus</i> , sp. nov.	324
<i>Ardeicola harrisoni</i> , sp. nov.	325
<i>A. smithersi</i>	328
<i>A. ajajae</i>	331
Acknowledgements	334
References	334

INTRODUCTION

This paper is the fifth in the series (Hajela, 1966; Hajela & Tandan, 1967a, b, 1968) dealing with species of *Ardeicola* Clay, 1935 parasitic on birds of the family Threskiornithidae. Names of the head setae are according to Clay (1951) using abbreviations as in figures 15 and 16. The abbreviations used in describing the length and position of important setae are those given in Tandan & Kumar (1969). For convenience, some setae on the terminalia have been designated as a, b, d, p₁ and p₂. Figures in parentheses denote the number of specimens studied and \bar{x} denotes the mean. The chaetotaxy in the figures agree with the specimens from which they were drawn. Most of the measurements have been corrected to two decimal places.

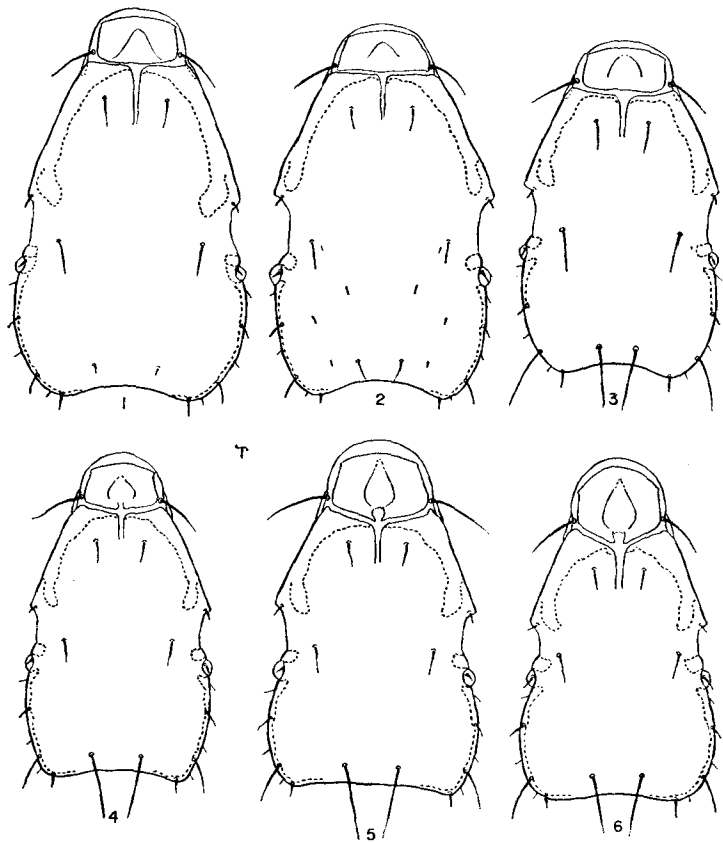
* Present address: Department of Zoology, D.A.V. College, University of Kanpur, Kanpur, U.P.

SPECIES OF *ARDEICOLA* CLAY, 1935*Ardeicola melanopsis* sp. nov.

(Figs 1, 2, 7, 9, 14, 18, 21 and 22; Tables 1 to 3)

Type host: *Theristicus melanopsis* (Gmelin).

This new species is related to *A. epiphanes* and *A. theristicus*, but more closely to the former; the females differ less and are therefore less easily separable than the males. Apparently a well sclerotized species, but mounted specimens suboptimal and



FIGURES 1 to 6. Heads of *Ardeicola*. 1, 2, *A. melanopsis*: 1, female; 2, male. 3, *A. geronticorum*, male. 4, *A. ababae*, male. 5, *A. dennelli*, male. 6, *A. burmanus*, male.

golden yellow in colour. Appreciable dimorphism in the length of the two sexes (Tables 1 and 2).

Male. Shape of head characteristic (Fig. 2). It is wider in the preantennal region than at temples; latter widest at level of first marginal temporal setae and progressively converge posteriorly due to which the lens of the eye is prominent. Dorsal carina

Table 1. Measurements (mm) of *Ardeicola* species. Number of specimens measured given in parenthesis

	<i>melanopsis</i>		Male <i>epiphanes</i>		<i>theristicus</i> (5)	
	Range	Mean	Range	Mean	Range	Mean
Head L	0.57-0.62	0.604 (7)	0.57-0.61	0.59 (5)	0.62-0.63	0.622
B ₁	0.37-0.41	0.39 (9)	0.34-0.37	0.36 (10)	0.38-0.41	0.39
B ₂	0.34-0.38	0.36 (9)	0.33-0.35	0.34 (10)	0.36-0.38	0.37
B ₃	0.014-0.034	0.026 (9)	0.007-0.028	0.016 (10)	0.007-0.034	0.025
Prothorax L	0.18-0.22	0.205 (7)	0.18-0.19	0.182 (5)	0.17-0.21	0.19
B	0.30-0.33	0.32 (7)	0.29-0.30	0.292 (5)	0.30-0.32	0.31
Pterothorax L	0.39-0.43	0.41 (7)	0.37-0.41	0.38 (5)	0.44-0.49	0.47
B	0.41-0.45	0.44 (7)	0.39-0.43	0.41 (5)	0.42-0.44	0.43
Abdomen L	1.41-1.60	1.52 (7)	1.50-1.60	1.56 (5)	1.66-1.78	1.73
B	0.49-0.56	0.52 (6)	0.45-0.50	0.48 (4)	0.34-0.45	0.40
T.I.	2.59-2.86	2.74 (7)	2.65-2.81	2.73 (5)	2.92-3.04	3.01
C.I.	0.58-0.63	0.60 (7)	0.57-0.59	0.58 (5)	0.58-0.62	0.59

L, Length; B, breadth; B₁, breadth at level of preantennal setae; B₂, Maximum width across temples; B₃, Difference between B₁ and B₂; T.I., total length.

Table 2. Measurements (mm) of *Ardeicola* species. Number of specimens measured given in parenthesis

	<i>melanopsis</i>		Female <i>epiphanes</i> (5)		<i>theristicus</i> (6)	
	Range	Mean	Range	Mean	Range	Mean
Head L	0.61-0.66	0.63 (8)	0.61-0.67	0.63	0.64-0.66	0.65
B ₁	0.36-0.41	0.39 (8)	0.34-0.36	0.35	0.36-0.38	0.37
B ₂	0.37-0.41	0.40 (8)	0.36-0.39	0.37	0.40-0.41	0.408
Prothorax L	0.16-0.18	0.17 (6)	0.15-0.17	0.16	0.18-0.19	0.185
B	0.30-0.33	0.31 (6)	0.29-0.31	0.302	0.30-0.32	0.314
Pterothorax L	0.36-0.41	0.39 (6)	0.37-0.41	0.38	0.43-0.46	0.44
B	0.43-0.47	0.44 (6)	0.41-0.45	0.44	0.44-0.47	0.45
Abdomen L	1.69-1.82	1.80 (6)	1.87-2.03	1.94	2.04-2.12	2.08
B	0.61-0.66	0.63 (3)	0.63-0.68	0.65	0.60-0.68	0.64
T.I.	2.90-3.21	3.00 (6)	3.00-3.20	3.11	3.30-3.44	3.36
C.I.	0.60-0.64	0.62 (8)	0.57-0.61	0.59	0.61-0.62	0.615

L, Length; B, breadth; B₁, breadth at level of preantennal setae; B₂, maximum width across temples; T.I., total length.

straight; preantennal suture narrow. Dorsal anterior plate much wider than long (Table 3), appearing rectangular in shape as its anterior margin is slightly curved and the posterior margin straight and uninterrupted; usually uniformly sclerotized, otherwise an incipient demarcation of a less sclerotized central area evident, the lines which demarcate falling much short of the posterior margin of the plate (as in Fig. 7). Ventral anterior plate narrow, with posterior margin straight or bulging medially, but always uninterrupted; its anterior thickenings inconspicuous, wide and not quite discrete. Premarginal carina short, dss. ml to lg, at its tip. Tip of gular plate joined to occipital carinae slightly posterior to their articulation with condyles of the mandibles; in four other species the gular plate is similarly modified: *A. epiphanes*, *A. theristicus*,

Table 3. Measurements (mm) of dorsal anterior plate of *Ardeicola* species. Number of specimens measured given in parenthesis

	<i>melanopsis</i>		<i>epiphanes</i>		<i>theristicus</i>	
	(9)		Male (8)		(6)	
Breadth	0.138-0.147	0.143	0.121-0.138	0.129	0.144-0.150	0.146
Length	0.060-0.074	0.065	0.057-0.067	0.062	0.080-0.085	0.081
Difference	0.074-0.083	0.078	0.060-0.070	0.067	0.060-0.070	0.065
Breadth	2.00-2.30	2.19	2.00-2.17	2.09	1.73-1.88	1.81
Length						
	(8)		Female (8)		(7)	
Breadth	0.134-0.150	0.141	0.128-0.138	0.131	0.138-0.154	0.147
Length	0.064-0.077	0.072	0.070-0.077	0.073	0.080-0.096	0.087
Difference	0.064-0.074	0.069	0.054-0.060	0.058	0.054-0.067	0.059
Breadth	1.83-2.10	1.96	1.71-1.86	1.81	1.60-1.84	1.67
Length						

A. emersoni and *A. meinertzhageni* (fig. 3 in Hajela, 1966). A stout peg-like dorsal seta on enlarged antennal segment I, its tip often filamentous. Important head setae as follows: Avs. 3 posterior to as. 1 and almost at same level as ads. Vsm. 1 posterior to vsm. 2. Ads., pns., pcs., and mds. sh to ml. Ocular sp, on edge of temple; pas. sp or sh basally thick; all 6 + 6 marginal temporals sp, fourth resembles sixth, which is stoutest. Pts. sh, does not cross the occiput.

Neck sclerite and pronotum continuous (Fig. 14). Pronotum undivided, inner posterior seta ml, outer sp and tends to be long. Pterothorax slightly wider than long; pteronotum entire, but its anterior margin slightly and posterior more indented medially (as in Fig. 12). Pteronotal setal count as in *A. nippon* and *A. emersoni* (see Hajela & Tandan, 1968). On meso- and meta-sternum 4-5 and 2 lg setae respectively.

Abdomen as in *A. emersonia* (see Hajela & Tandan, 1968). Normal in shape and proportions from segments II-VIII, but IX-XI modified. Anal lobes hidden. Terminal sternum (or margin of genital opening) thickened posteriorly; medially the anterior margin of thickening is raised and posterior margin is arched (Fig. 21). Genital opening terminal. External genitalia as shown in Fig. 9.

Abdominal chaetotaxy (13). Tergal. II, ant. tc 2 sh not on tergite proper. Posterior. II, 5-7; III-VI, 6 (10); VII, 5-6 (9); VIII, 2 tr (off tergite but in a notch thereof) and 2 tc + 2-4 tl (11) (2 tl stout, 1-2 tl fine); IX + X, ant. 2 sh, setae a 1 + 1 sh, fine, at about middle of segment; XI, ant. 2 sh, and post. 2 + 2 (2 sh to ml, 2 stout lg), anterior and outer to latter a short seta may occur on one or both sides; setae b, 1 + 1 (10), 0 + 1 (2) sh, fine, on tergum XI or its lateral sclerotized edge. Post-spiracular setae on terga II-VII, 1 + 1 (11); variation in 2; II, 1 + 2; III, 1 + 2 and III, 1 + 0. II, lg; III, IV, ml to lg; V-VII, lg. Of II equal to or slightly longer than of III and of both much thinner and shorter than the tergal setae; of IV equal to or slightly shorter than of III. Pleural. Count in 6 thus: II, 1 + 1; III, IV, 2 + 2; V, 3 + 3; VI-VIII, 4 + 4. This represents the normal count. Individual variation in 5 thus: VI, 1 + 4; VI, VIII, 2 + 4; VII, 4 + 5;

VII, VIII, 4 + 3; VIII, 3 + 3. Setae, p₁, 1 + 1 elg lateral and posterior to seta a. Sternal. II, 2 sc elg + 2 sl lg (1 + 1 m or sh may be present between sc and sl); III-V, 2 sc elg (usually m or sh sl also, on III 1 + 1, on IV, 1 + 0); VI, 4 (an important character), 2 sc elg + 2 sl ml to lg (occasionally 1 + 0 m also between sc and sl); VII, 2 sc elg + 4 sl (2 sl elg, 2 sh to ml); on II-VII slightly anterior to or level with the sc setae 1 + 1 m may also be present; VIII, 1 + 1 lg: all 3 + 3 anal setae marginal, inner slightly removed from other two, middle and outer almost contiguous, all sh, outermost longest and stoutest (Fig. 21).

Both setae a and p₁ are relatively posterior; setae homologous with p₂ and d of other species not identifiable.

Female. Shape of head differs from that (Fig. 1) of male; is widest across temples at about the level of marginal temporal setae 2 (Fig. 1). Dorsal anterior plate usually has a slightly less sclerotized central area, which is more extensive as the lines which demarcate it reach to the posterior margin of the plate (Figs 1 and 7.) Other characters including the ventral plate as in male. Gular plate normal anteriorly; antennae filiform. Same head setae are shorter and finer, but pts. are m, and avs. 3 may be very slightly posterior relative to ads. Thorax as in male, but inner prothoracic seta sh, and on meso- and meta-sternum respectively 4 (rarely 5) and 2 setae.

General characters of abdomen as in female of *A. emersoni* (see Hajela & Tandan, 1968). Segment III slightly longer than II; composite IX-XI and its tergite as in Fig. 22. Supra-vulval sclerites short (faint), posteriorly rounded.

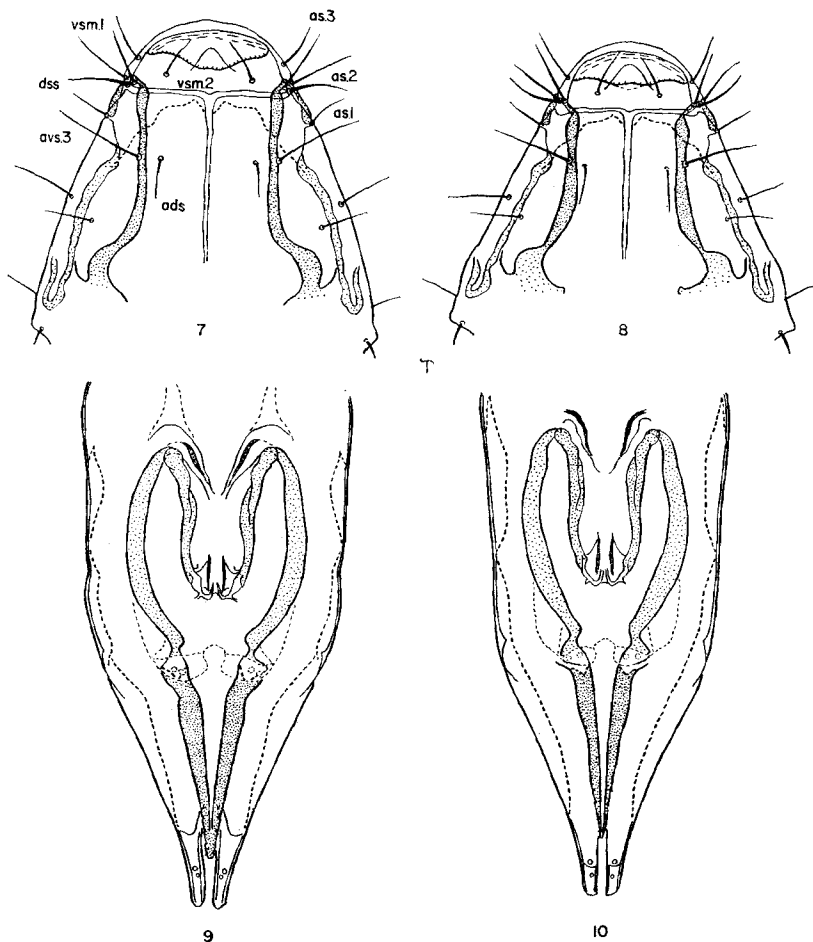
Abdominal chaetotaxy. Tergal (8). II, ant. tc 2 m or sh. Posterior. II, 6 (7); III, 4-6 (6); IV-VI, 6 (5-8); VII, 5-6 (7); VIII, 2 tr (in a notch of tergite but surrounded by secondary sclerotization) and 2 tc + 2-4 tl (tc longer than tl setae); IX-XI, ant. 2 sh, and post. 2 tc + 2 tl sh, tl on tergite or on its edge; setae a, 1 + 1 (7) sh submarginal, off tergite; setae b, 1 + 1 (6), 1 + 2 (1) sh, off tergite, rarely on its edge or on it (slightly anteriorly an identical seta may be present on one side). Post-spiracular setae on terga II-VII, 1 + 1 (12); in 1 on V, 1 + 0. II-IV, sh to ml; V, ml (rarely sh); VI, ml to lg (rarely sh); VII, lg (rarely ml). Of II and III either equal or of II significantly longer. Pleural (10). II-VIII, as in male (6). Variation in 4 thus: VII, 4 + 2 or 5 (2); VIII, 4 + 3 or 5 (2); setae, p₁, 1 + 1 lg; p₂, 1 + 1 sp, level with, anterior or posterior to p₁; marginal and submarginal, 3 + 3 sp. An important feature of the pleural count is the constant number, 2 + 2 on IV and 3 + 3 on V. Sternal (8). Of II-VIII basically as in the male; differences thus: III, sl sh; VI, 1 + 1 sh sl also between sc and normal sl; 4-6 sh to ml, fine setae between those of VII and VIII. Setae d, 2 + 2 ml or lg; anal setae, 3 + 3 (2 inner characteristic, 4 outer sp), their position as in Fig. 18. On vulval margin, 15-21 (11) m setae, 6 + 7 (1).

Material examined. 23♂ and 23♀ from *Theristicus melanopsis* (Gmelin), Chile (R. Meinertzhagen nos. 4836, 13494, 16143). Also 2♀ Dr. K. C. Emerson collection, 1 from *T. melanopsis* and the given host of the other wrong.

Holotype ♂, slide no. 13494a from *Theristicus melanopsis* in B.M. (N.H.). **Paratypes** 22 (2 dissected) ♂ and 23♀, with the above data.

Discussion. The following characters of *Ardeicola melanopsis* sp. nov. distinguish it from *A. epiphanes*. Both sexes: proportions of dorsal anterior plate (Table 3); slight differences in the position of as. 2, dss. and vsm. 1, relative to each other (Figs 7 and 8).

Male: shape of head, there being greater difference in its width in the preantennal region and width across temples (Table 1); post-spiracular setae are significantly longer and thicker; the terminalia are wider and the genitalia are stouter (compare Figs 9 and 21 respectively with 10 and 23). Female: the 2 inner tergo-lateral setae on VIII do not reach the posterior tergals on IX–XI, which they do in *A. epiphanes*; tergite IX–XI is wider at about the level of setae a (Figs 22 and 24); post-spiracular setae on II–IV are longer (sh to ml); pleural setae on III–V and sternal setae are slightly longer and finer. Slight differences in the shape of supra-vulval sclerites could not be confirmed due to their faintness.



FIGURES 7 TO 10. 7, 8, Preantennal region of head (same scale): 7, *A. melanopsis*, female; 8, *A. epiphanes*, male. ads, Anterior dorsal seta; as, anterior setae 1, 2, 3; avs, anterior ventral seta 3; dss, dorsal submarginal seta; vsm, ventral submarginal setae 1, 2. 9, 10, Male genitalia, posterior sclerites (same scale): 9, *A. melanopsis*; 10, *A. epiphanes*.

Ardeicola epiphanes (Kellogg & Paine, 1911)

(Figs 8, 10, 23 and 24; Tables 1 to 3)

Type host: *Theristicus branickii* Berlepsch & Stolzmann.

Lipeurus epiphanes Kellogg & Paine, 1911. *Ent. News*, 22: 21, fig. 2. Host: Desert curlew. Error.

Kellogg & Paine (1911) described *Lipeurus* (= *Ardeicola*) *epiphanes* from a 'desert curlew'. But Hopkins (1938) considered the given host to be incorrect, which it patently is, and established *Theristicus branickii* to be the true host of *L. epiphanes*.

The female is very similar to *A. melanopsis* but the male less so: the characters distinguishing the two species are given above under *A. melanopsis*.

Material examined. 20 (2 dissected) ♂, 20♀, from *Theristicus branickii* Berlepsch & Stolzmann, Peru and Ecuador (R. Meinertzhagen nos. 4835, 13493) B.M. (N.H.).

Ardeicola theristicus (Pessôa & Guimarães, 1935)

(Fig. 11; Tables 1 to 3)

Type host: *Theristicus caudatus* (Boddaert).

Esthiopterum theristicum Pessôa & Guimarães, 1935. *Ann. Fac. Med. S. Paulo*, 11: 311, figs 1–5. Host: *Theristicus caudatus*.

This species differs from *A. melanopsis* and *A. epiphanes* as follows:

Both sexes. Longer and narrower (Tables 1 and 2) proportions of dorsal anterior plate (Table 3). Avs. 3 posterior to as. 1, but distance between these setae significantly less; avs. 3 is just anterior relative to ads. (a diagnostic character), and the latter is relatively long as are also other head setae (Fig. 11). Thickenings of ventral anterior plate more conspicuous and less wide.

Male. The central modified area of the dorsal anterior plate is more extensive (as in *A. geronticum*); pterothorax longer than wide. Segment IX–XI narrower anteriorly and longer, and posterior margin of thickening of terminal sternum characteristically bilobed (fig. 14 in Hajela & Tandan, 1968). The 2 tergo-central and the tergo-lateral setae on VIII extend equally posteriorly; in *A. melanopsis* and *A. epiphanes* the tergo-central setae extend beyond the tergo-lateral setae. The following setae are significantly longer; a and b; anterior tergals on IX + X; those on tergum XI; anal setae. Components of external genitalia stouter and different in proportions.

Female. Post-spiracular setae on V–VII sh, the antero-posterior increase in their length usually less (rarely ml on V, ml to lg on VI, lg on VII). Tergite IX–XI feebly sclerotized (or apparently unsclerotized) around the posterior tergo-central setae, hence the posterior median emargination in the tergite appears wider at their level.

Material examined. 15 (2 dissected) ♂, 10♀ from Paraguay (R. Meinertzhagen nos. 4913, 13495, 14260) in B.M. (N.H.).

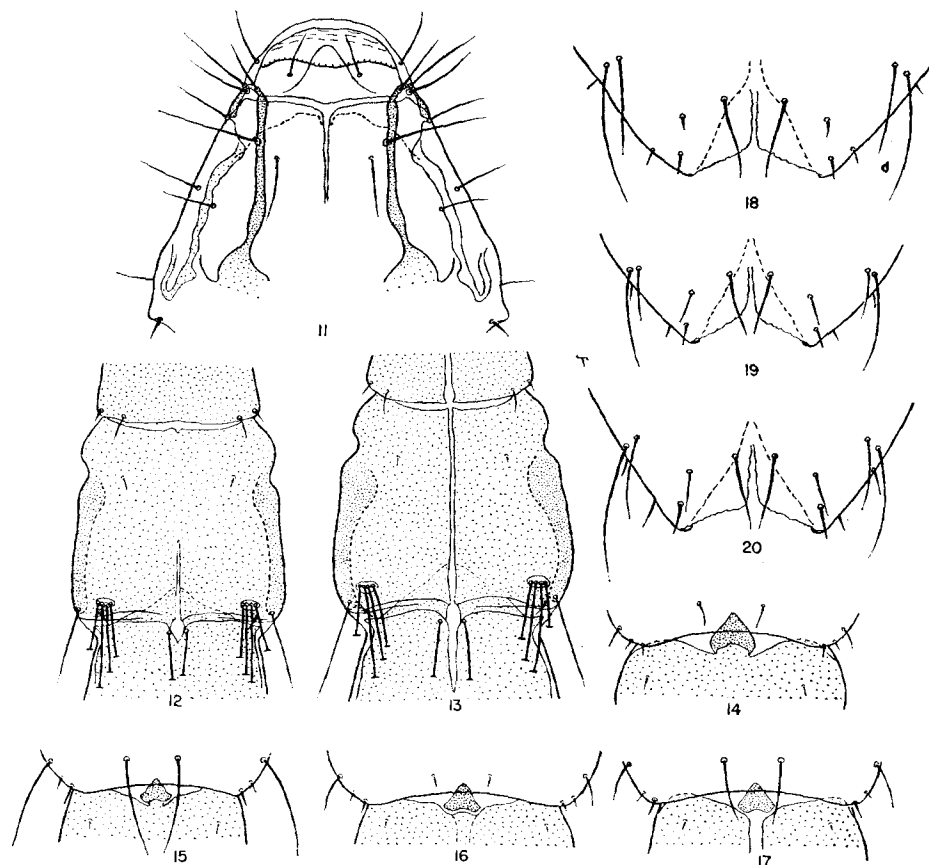
Ardeicola geronticum Brinck, 1955

(Figs 3, 15, 25, 29, 33 and 34; Tables 4 and 6)

Type host: *Geronticus calvus* (Boddaert).

Ardeicola geronticum Brinck, 1955. *S. Afr. Animal Life*, 2: 413, figs 5, 6.

The taxon *geronticum* was created for the *Ardeicola* species from *Geronticus calvus*



FIGURES 11 to 20. 11, *A. theristicus*, preantennal region of head, male. 12, 13, Male thorax (same scale): 12, *A. ababae*; 13, *A. dennelli*. 14-17, Neck sclerite and anterior half of pronotum (same scale): 14, *A. melanopis*, male; 15, *A. geronticorum*, male; 16, *A. ababae*, female; 17, *A. dennelli*, male. 18-20, Female, 2 + 2 setae d and 3 + 3 anal setae: 18, *A. melanopis*; 19, *A. ababae*; 20, *A. burmanus*.

and *G. eremita* (Linn.), and the single male collected from *G. calvus* in Basutoland was designated as the holotype. Specimens from *G. eremita* only have been available for study and the following description is based on them.

This is an interesting species. Its dorsal anterior plate resembles that of *A. theristicus*, but the ventral preantennal region resembles that of *A. ababae* sp. nov., to which it is most closely related. Only the important characters and differences from this latter species have been given. Body measurements differ and there is less dimorphism in the length of the two sexes (Tables 4 and 6).

Male. Shape of head (Fig. 3) similar to that of the three previous species, but temples are normally widest between marginal temporal setae 1 and 2. Dorsal carina usually

Table 4. Measurements (mm) of *Ardeicola* species. Number of specimens measured given in parenthesis

	Male				Female			
	<i>geronticorum</i> (6)		<i>ababae</i> (4)		<i>geronticorum</i> (6)		<i>ababae</i> (2)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Head L	0.51-0.54	0.52	0.53-0.57	0.55	0.58-0.59	0.588	0.61-0.62	0.615
B ₁	0.31-0.33	0.315	0.30-0.34	0.31	0.34-0.36	0.35	0.33-0.35	0.34
B ₂	0.32-0.34	0.33	0.32-0.34	0.325	0.38-0.39	0.388	0.37-0.39	0.38
Prothorax L	0.14-0.15	0.145	0.15-0.18	0.16	0.14-0.15	0.146	0.15-0.16	0.155
B	0.26-0.29	0.28	0.27-0.31	0.29	0.31-0.33	0.32	0.30-0.31	0.305
Pterothorax L	0.29-0.30	0.295	0.31-0.36	0.33	0.31-0.35	0.32	0.36-0.37	0.365
B	0.33-0.36	0.34	0.34-0.41	0.37	0.40-0.47	0.42	0.40-0.46	0.43
Abdomen L	1.21-1.30	1.26	1.22-1.39	1.32	1.66-1.79	1.73	1.89-1.97	1.93
B	0.36-0.41	0.39	0.34-0.43	0.38	0.50-0.59	0.55	0.58-0.59	0.585
T.L.	2.19-2.27	2.22	2.31-2.50	2.38	2.71-2.88	2.78	3.01-3.13	3.07
C.I.	0.62-0.64	0.63	0.59-0.61	0.60	0.64-0.66	0.65	0.60-0.62	0.61

L, Length; B, breadth; B₁, breadth at level of preantennal setae; B₂, maximum width across temples; T.L., total length.

Table 5. Measurements (mm) of *Ardeicola* species. Number of specimens measured given in parenthesis

	Male				Female			
	<i>dennelli</i> (7)		<i>burmanus</i> (3)		<i>dennelli</i> (7)		<i>burmanus</i> (7)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Head L	0.55-0.59	0.57	0.55-0.56	0.555	0.61-0.70	0.65	0.61-0.65	0.63
B ₁	0.34-0.36	0.345	0.30-0.32	0.31	0.37-0.41	0.39	0.36-0.37	0.365
B ₂	0.34-0.37	0.36	0.34-0.36	0.35	0.40-0.45	0.43	0.39-0.43	0.41
Prothorax L	0.15-0.17	0.16	0.15-0.16	0.156	0.17-0.18	0.17	0.15-0.18	0.16
B	0.28-0.32	0.29	0.28	0.28	0.32-0.37	0.34	0.30-0.33	0.32
Pterothorax L	0.30-0.34	0.32	0.32-0.33	0.325	0.32-0.40	0.36	0.33-0.37	0.35
B	0.36-0.43	0.39	0.34-0.36	0.35	0.43-0.54	0.47	0.41-0.44	0.42
Abdomen L	1.27-1.48	1.36	1.29 (1)		1.75-1.97	1.82	1.61-1.83	1.76
B	0.40-0.44	0.42	0.36 (1)		0.55-0.65	0.58	0.45-0.56	0.52
T.L.	2.29-2.57	2.43	2.36 (1)		2.95-3.21	3.20	2.73-3.02	2.92
C.I.	0.62-0.63	0.624	0.61-0.65	0.63	0.65-0.67	0.654	0.64-0.66	0.65

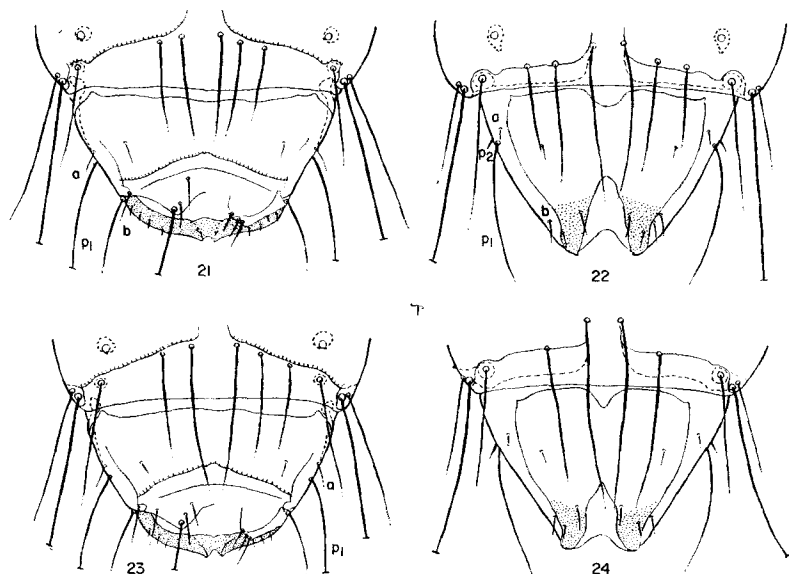
L, Length; B, breadth; B₁, Breadth at level of preantennal setae; B₂, maximum width across temples; T.L., total length.

straight, exceptionally slightly curved also. Dorsal anterior plate much wider than long (Table 6) with a distinctly less sclerotized central area; the lines which demarcate it diverge posteriorly and almost reach the posterior margin of the plate; the latter is uninterrupted (rarely nicked medially), straight or slightly curved, (as in Fig. 25). Posterior margin of ventral anterior plate emarginate, and anterior thickenings more in number and more distinct than in *A. theristicus*. Premarginal carina moderately long, dss. subapically on it. Tip of gular plate (apparently) not joined to occipital carinae.

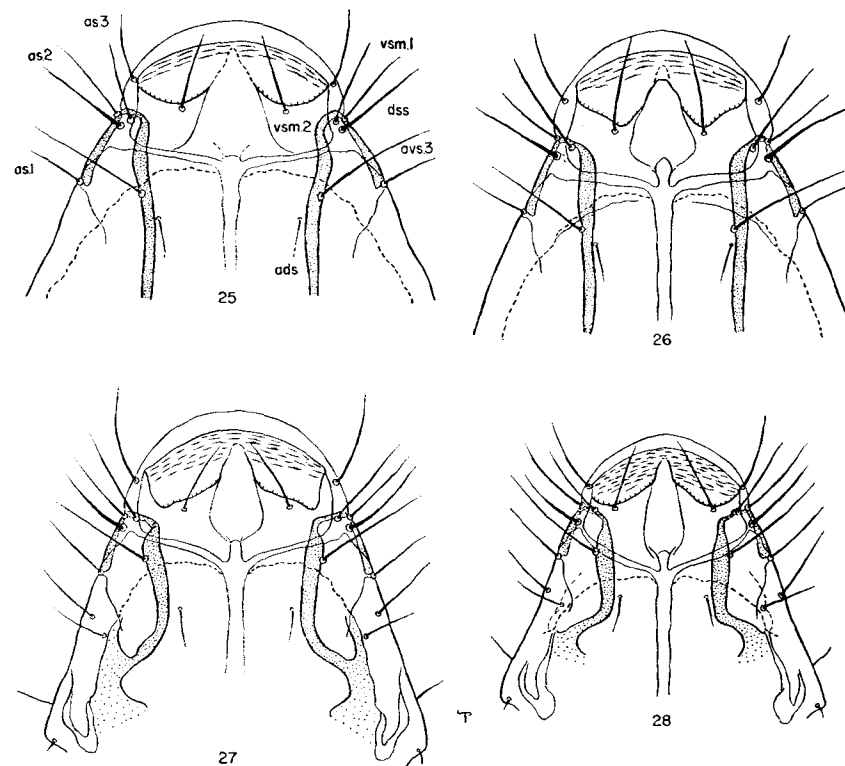
Avs. 3 slightly posterior to as. 1 and distinctly anterior relative to ads. Vsm. 1 posterior to vsm. 2. Same head setae longer than in *A. ababae*, especially pns., pts., mts. 4 (m1 to 1g).

Table 6. Measurements (mm) of dorsal anterior plate of *Ardeicola* species. Number of specimens measured given in parenthesis

		Male		Female	
		Range	Mean	Range	Mean
<i>geronticorum</i>	Breadth	0.124-0.134 (8)	0.128 (8)	0.134-0.150 (10)	0.143 (10)
	Length	0.064-0.072	0.068	0.070-0.086	0.080
	Difference	0.057-0.064	0.059	0.054-0.067	0.058
	Breadth	1.81-1.90	1.86	1.66-1.90	1.77
	Length				
<i>ababae</i>	Breadth	0.128-0.144 (4)	0.135 (4)	0.144-0.150 (4)	0.145 (4)
	Length	0.077-0.083	0.082	0.080-0.092	0.084
	Difference	0.051-0.060	0.055	0.050-0.067	0.060
	Breadth	1.64-1.73	1.68	1.55-1.80	1.71
	Length				
<i>dennelli</i>	Breadth	0.147-0.169 (20)	0.158 (20)	0.160-0.195 (19)	0.183 (19)
	Length	0.099-0.128	0.111	0.108-0.138	0.122
	Difference	0.030-0.050	0.047	0.044-0.057	0.050
	Breadth	1.31-1.56	1.41	1.34-1.50	1.40
	Length				
<i>burmanus</i>	Breadth	0.144-0.160 (3)	0.150 (3)	0.160-0.176 (10)	0.169 (10)
	Length	0.121-0.131	0.126	0.131-0.150	0.141
	Difference	0.022-0.028	0.024	0.022-0.032	0.027
	Breadth	1.17-1.21	1.19	1.15-1.24	1.19
	Length				

FIGURES 21 to 24. Terminalia, dorsal. 21, 22, *A. melanopis*: 21, male; 22, female. 23, 24, *A. epiphanes*: 23, male; 24, female. In 21 and 23 tergum XI omitted on right-hand side to show the anal setae.

Neck sclerite continuous with the pronotum (Fig. 15); latter normally undivided, otherwise an incipient division evident in its anterior and posterior margins medially. Pteronotum intermediate between *A. melanopis* and *A. ababae*. Longest pteronotal seta crosses the spiracle or even extends to posterior margin of III. On meso- and metasternum 4 and 3-5 lg setae respectively.

FIGURES 25 to 28. Preantennal region of head of female *Ardeicola*: 25, *A. geronticorum*; 26, *A. ababae*; 27, *A. dennelli*; 28, *A. burmanus*. ads, Anterior dorsal seta; as, anterior setae 1, 2, 3; avs, anterior ventral seta 3; dss, dorsal submarginal seta; vsm, ventral submarginal seta 1, 2.

Abdomen (Figs 29 and 30) shorter and wider, specially across segments II and III than in *A. ababae*. Segment IV shorter than II and III, hence its tergite also (appears) shorter. On VIII the tc and tl setae extend equally posteriorly or tc extend beyond tl, but both may reach the 2 anterior tergal setae on IX-XI but usually extend beyond them. The latter and pleural setae on II-IV longer than in *ababae*. Chaetotaxy of sternum II seems to differ, but the specimens are unsatisfactory for its study. Tergal setae and setae in the genital region significantly thicker and longer and in external genitalia the penis of the penial complex much wider posteriorly (Figs 34 and 35).

Tergal chaetotaxy (Fig. 29). II, ant. tc 2 lg, resemble the posterior tc in proportions, not on tergite proper. Posterior. II, 7-8, \bar{x} 7.66 (9); III, 7-8, \bar{x} 7.89 (9); IV, 7-8, \bar{x} 7.83 (6); V, 7-8, \bar{x} 7.62 (8); VI, 6-8, \bar{x} 7.11 (9); VII, 6-8, \bar{x} 7.22 (9); VIII, 2 tr and 2 tc + 2 tl; IX-XI, as in *A. ababae*. Post-spiracular setae absent on terga II-V or VI; VI, VII, sh, but irregular in 13 males; VI, VII both, 0 (5); VI, VII both, 0 + 1 (1); VII only, 0 + 1 or 1 + 0 (6), 1 + 1 (1).

Female. Shape of head very different from that of male and resembles the female head of the previous species. The important setae, and the dorsal and ventral anterior plate complex as in the male, but the lines which demarcate the central less sclerotized area occasionally converge towards each other posteriorly (Fig. 25). Thorax as in the male; on meso- and meta-sternum 4-5 lg setae respectively.

Abdominal segments II and III significantly shorter than in *A. ababae*; proportions of composite IX-XI as in Fig. 33, lateral margins of its tergite curved, specially posteriorly and posterior margin more arched (Figs 33 and 32).

Tergal chaetotaxy. II, ant tc 2 lg. Posterior. II, 7-8, \bar{x} 7.66 (3); III, 8 (6); IV, 7-8 \bar{x} 7.87 (8) (11 in 1); V, 7-8, \bar{x} 7.87 (8); VI, VII, 6-8, \bar{x} 7.22 (9); VIII-XI, as in *A. ababae*. Post-spiracular setae absent on terga II-V; VI, VII, sh, but irregular in 10 females; VI, VII both, 1 + 0 or 1 (5); VII only, 1 + 0 (2), 1 + 1 (1); VI, VII both 1 + 1 (1) and 1 + 1, 1 + 2 respectively (1).

Pleural and sternal chaetotaxy in both sexes much as in *A. ababae*.

Material examined. 13 (3 dissected) ♂ and 16 ♀ from *Geronticus eremita* (Linn.), Morocco, November, 1938 (R. Meinertzhagen nos. 12016 and 12124), B.M. (N.H.).

Ardeicola ababae sp. nov.

(Figs 4, 12, 16, 19, 26, 30-32 and 35; Tables 4 and 6)

Type host: *Bostrychia carunculata* (Rüppell).

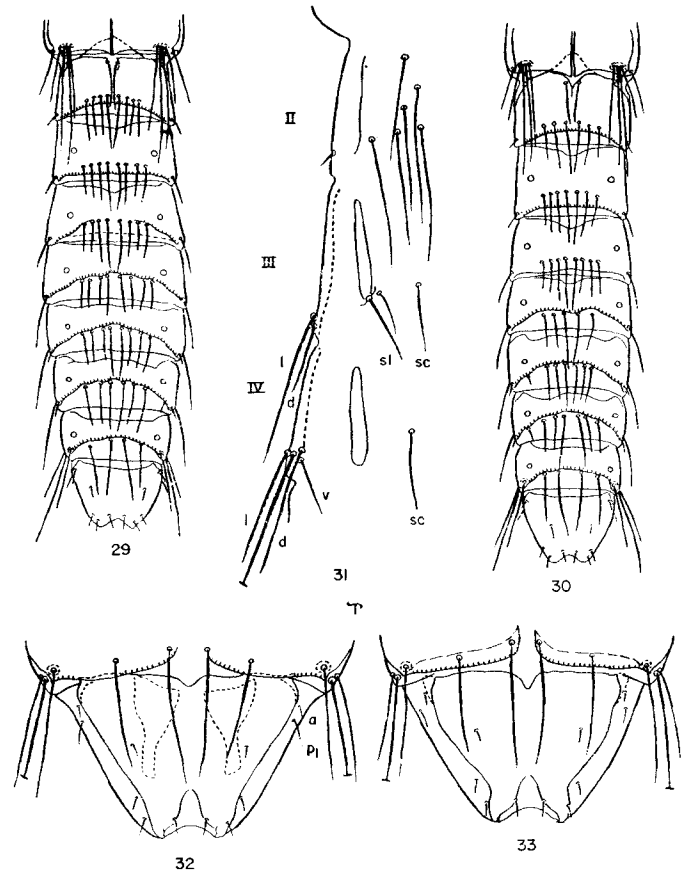
This species is related most closely to *A. geronticum* from which it can be distinguished in both sexes by the characters of the head; in the male by the penial complex of the genitalia, and in the female by the shape of the abdomen, especially of the terminalia.

A well sclerotized species; mounted specimens golden yellow in colour. No overlap in the length of the two sexes (Table 4).

Male. Head very slightly wider across temples than in the preantennal region; temples widest between marginal temporal setae 1 and 2 or 2 and 3 (Fig. 4). Dorsal carina very slightly curved. Dorsal anterior plate somewhat rectangular, appreciably wider than long (Table 6); its posterior margin deeply indented medially; the central modified area appreciably less sclerotized than the rest of the plate and the lines which demarcate it converge towards each other posteriorly. Normally these lines fall short of the median, marginal indentation, exceptionally meet it also and thus the indentation becomes continuous with the preantennal suture (as in Fig. 26). However, the posterior margin of the central, less sclerotized area is quite distinct. Premarginal carina and ventral anterior plate as in *A. geronticum* but anterior thickenings of latter prominent, more in number and significantly less wide.

Important head setae as follows. Dss. more subapically on premarginal carina than in

A. geronticum, but position of avs. 3 and vsm. 1 as in that species. Ads., pns., pcs., and mds. sh; ocular, on lens, and pas. sp; mts. 4 sh, remaining 5 + 5 sp, but sixth longest and stoutest; pts. ml to lg, extends to or crosses the m anterior pronotal setae.

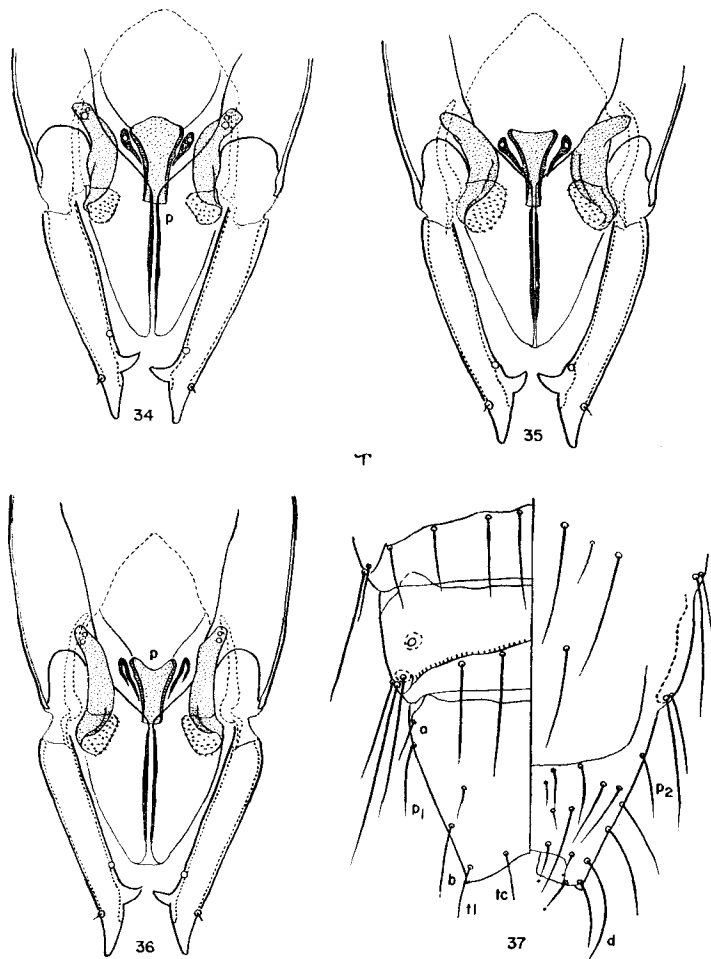


FIGURES 29 to 33. 29, 30, Male abdomen, dorsal (same scale): 29, *A. geronticum*; 30, *A. ababae*. 31, Female sternite II-IV of *A. ababae*; d, dorsal I, lateral; sc, sternocentral; sl, sterno-lateral; v, ventral. 32, 33, Female terminalia, dorsal: 32, *A. ababae* (supra-vulval sclerites shown by broken lines); 33, *A. geronticum*.

Neck sclerite normally separate from the pronotum but faint indication of continuity may also be evident (as in Fig. 16). Pronotum incipiently or completely divided, and pteronotum normally as in the previous species, exceptionally as in the following species (Fig. 12). On pronotum 1 + 1 anterior m and 2 + 2 posterior setae, outer sp and inner sh. Pterothorax wider than long. Pteronotal setal count normal and longest seta reaches to spiracle of III. On meso- and meta-sternum 4 and 3-4 lg setae respectively.

Abdomen not absolutely normal in shape and proportions, as segments II-IV have become longer (than in *A. geronticum*); composite segment IX-XI normal (Fig. 30).

Segments II and III almost equally long, but IV slightly shorter, and tergite IV appears almost equal to tergites II and III. Anal lobes project slightly beyond tergum XI. External genitalia as in Fig. 35.



FIGURES 34 to 37. 34-36, Male genitalia (same scale): 34, *A. geronticorum*; 35, *A. ababae*; 36, *A. burmanus*: p, penis. 37, *A. burmanus*, male terminalia, dorsal and ventral (anal setae indicated by a dot near their tips): tc, tergo-central; tl, tergo-lateral.

Abdominal chaetotaxy. Tergal (average of 4 given). II, ant. tc 2 lg, resemble the posterior tc in proportions, on tergite proper. Posterior. II, 5-6, 5.75; III, 7-8, 7.75; IV, 5-8, 7; V, 6-7, 6.25; VI, VII, 6; VIII, 2 tr on tergite, and 2 tc + 2 tl, tl at about the middle of tc and tr, tc slightly longer than tl, both reach to or fall short of anterior tergons on IX-XI; IX-XI, ant. 2 m to sh, post. 2 tc + 2 tl, tc slightly longer than tl; setae

a, 1 + 1 sh to ml, normally on edge of tergite; setae b, 1 + 1 or absent on 1 side, sh on tergite. Post-spiracular setae absent on terga II-V; on VI, VII, sh but irregular in 4 males; 1 + 1, 1 + 1; 0 + 1, 0 + 0; 1 + 0, 1 + 0; 0 + 0, 1 + 1. Pleural. II, 1 + 1 sp; III, 2 + 2, 2 sh, 2 ml; IV, 2 + 2, 2 ml, 2 lg; V, 3 + 3, 2 ml, 4 lg; VI, VII, 4 + 4, 2 sh, 2 ml, 2 lg; VIII, 4 + 4, 4 ml to lg, 2 lg, 2 elg; setae p₁, 1 + 1 sh; setae p₂, 1 + 1 ml, normally posterior, may be close or even anterior, to p₁; marginal setae, 3 + 3 ml to lg. Sternal. II, either only 2 sc + 2 sl, all elg, sc longer than sl, or these and 2 lg to elg ant. also; III, 2 sc lg + 2 sl sh to ml rarely lg also; IV, V, 2 sc lg: VI, 2 sc elg + 4 sl ml to elg: VII, 2 sc lg + 4 sl lg: VIII, 1 + 1 lg; setae d, 2 + 2 lg; anal setae, 3 + 3 (2 ant. sh to almost ml, 2 middle sh, 2 post. almost ml).

Female. Shape of head differs only slightly from that of male; other characters as in the male, except for the normal differences (Fig. 26). Pronotum either undivided or incipiently divided. Longest pteronotal seta extends to posterior margin of II. On meso- and metasternum 4-5 and 2-5 lg setae respectively. Composite segment IX-XI as in Fig. 32; lateral margins of its tergite not strongly curved (as they are in *geronticorum*, Fig. 33), and posterior margin only slightly arched. Supra-vulval sclerites somewhat triangular, having a posterior extension (Fig. 32).

Abdominal chaetotaxy. General disposition as in male. Tergal (average of 4 given). II, ant. tc 2 lg. Posterior. II, 7-8, 7.25; III, IV, 8; V, 7-8, 7.50; VI, 6-8, 6.75; VII, 6-7, 6.40; VIII, 2 tr on tergite, and 2 tc + 2 tl, tl closer to tc than to tr, tc longer than tl and cross well the anterior tergals on IX-XI, tl cross latter slightly; IX-XI, ant. 2 m to sh, post. 2 tc + 2 tl all sh, tc slightly longer than tl, tl on or off tergite. Setae a and b, 1 + 1 sh off tergite. Post-spiracular setae absent on terga II and III or II-IV; VII, 1 + 1 sh; IV-VI sh but irregular in 4 females; IV, 0 and V, VI, 1; IV, 0 and V, VI, 1 + 1; IV, V, 1 and VI, 1 + 1; IV, V, 0 and VI, 1 + 1. Pleural. Count as in male but on IV, 7-8, and on V, 6-8; proportions of those on III and IV much different. Sternal (Fig. 31). II, 11-12 lg, 5-7 ant. and 4 or 6 post.; III, 2 sc + 4 sl, sl near sternite and outer sl adjoins it (2-3 m or sh may also be present anteriorly). Setae d, 2 + 2, 2 sh to ml, 2 lg; anal setae, 3 + 3, 2 characteristic, 2 sh, 2 sp. (Fig. 19). Vulval marginal, 12-19 sp.

Material examined. 5♂ (1 dissected), 5♀ from *Bostrychia carunculata* (Rüppell) as follows: R. Meinertzhagen no. 4906 and O. Theodor 10. xi. 1958 no. 1959-234, Ethiopia all in B.M. (N.H.); 1♂, 1♀ in Emerson collection, no other data.

Holotype ♂, B.M. (N.H.), slide no 707 from *Bostrychia carunculata*, Ethiopia. **Paratypes:** 5♂ and 6♀ with data as given above.

The species is named after the capital of Ethiopia.

Ardeicola dennelli Hajela & Tandan, 1967

(Figs 5, 13, 17 and 27; Tables 5 and 6)

Type host: *Pseudibis papillosa* (Temminck).

Ardeicola dennelli Hajela & Tandan, 1967. *Proc. R. ent. Soc. Lond. (B)*, **36**: 73, figs 10-17.

Given below are characters essential for its comparison with related species, and not available in the original description.

Phylogenetically this species is nearest to *A. burmanus* sp. nov. The structure of its

head, especially the preantennal region, is intermediate, and such as to form a link, between *A. ababae* and *A. burmanus*. It is larger than *A. ababae* (Table 5) and the preantennal region of the head readily distinguishes the two species (Figs 27, 26 and 28); other distinguishing characters are the fourth marginal temporal seta, nature of pro- and ptero-notum, male external genitalia and female terminalia. Characters which distinguish it from *A. burmanus* are given under that species.

Male. Head widest at about level of marginal temporal setae 2 and not at level of preantennal setae (Fig. 5), hence quite different in shape from those of the previous species. Dorsal carina curved. Dorsal anterior plate somewhat wider than long, not rectangular as both its anterior and posterior margins are curved. Posterior margin of the plate deeply indented medially; its central modified area much less sclerotized than the plate elsewhere, and the lines which demarcate it meet the median indentation in the posterior margin (as in Fig. 27). The contrast in the degree of sclerotization of the plate centrally and elsewhere is a striking feature. Ventral anterior plate as in *A. geronticorum* and *A. ababae*, but the anterior thickenings are discrete, less wide, more numerous and more prominent. Premarginal carina moderately long, dss. slightly subapically on it. Avs. 3 anterior to as. 1 (in fact it is almost as much anterior as it is posterior to as. 1 in *A. theristicus*) and is much anterior relative to ads. Vsm. 1 slightly posterior to vsm. 2. Neck sclerite separate from the divided pronotum; pteronotum also divided (Figs 13 and 17).

Female. General characters of the head (except for the normal differences (Fig. 27) and thorax as in the male.

Ardeicola burmanus sp. nov.

(Figs 6, 20, 28, 36 and 37; Tables 5 and 6)

Type host: *Pseudibis davisoni* (Hume).

This species is most closely related to *A. dennelli*, which it resembles in general body characters. The two can be distinguished by the characters of the dorsal preantennal region of the head (Figs 28 and 27) and the body measurements (Tables 5 and 6). In the following description only the main differences from *A. dennelli* are given.

Smaller in size, about that of *A. ababae* (Table 4).

Male. Dorsal carina greatly curved (Fig. 6). Dorsal anterior plate longer, and anterior thickenings of ventral anterior plate more numerous and smaller. Vsm. 1 very slightly posterior to vsm. 2. Mts. 4 sh to ml; inner posterior prothoracic seta stouter and longer. On both meso- and meta-sternum 4 lg setae. Posterior margin of segment IX–XI as in Fig. 37, with setae, especially a, b and p₁, thicker and slightly longer. External genitalia as in Fig. 36.

Female. Lateral margins of tergite IX–XI somewhat less curved. Supra-vulval sclerites differ slightly in shape and proportions. On III sc setae significantly shorter.

Abdominal chaetotaxy. *Male*. Tergal (average of 3 given). II, ant. tc 2 lg, resemble the posterior tc in proportions, on tergite proper. Posterior. II, 6–8, 6.66; III, 7–8, 7.33; IV, 6–7, 6.66; V, 5–6, 5.66; (in 10 males of *A. dennelli*; II, 6–9, 7.50; III, 7–8, 7.60; IV, 5–7, 6.00; V, 6–7, 6.20) VI, 6; VII, 5–6; VIII, 2 tr and 2 tc + 2 tl; IX–XI, ant. 2 sh, post. 2 tc + 2 tl all sh, tc and tl almost equal; setae a, 1 + 1 sh; b, 1 + 1 ml. Post-spiracular setae on terga V–VII, 1 + 1 sh, show a slight antero-posterior increase in

length. Pleural. Count normal; p₁, ml; p₂, lg. Sternal. II, 2 sc + 2 sl, all lg but sc longer; III, as on II, but sc lg always longer than ml to lg sl; 1 or 2 anterior may also be present on II and III; IV, V, 2 sc; VI, VII, 2 sc + 4 sl; VIII, 1 + 1; setae, d, 2 + 2 lg; anal, 3 + 3.

Female. General disposition as in the male. Tergal. II, ant. tc 2, as in male. Posterior. II, 6–9, \bar{x} 7.66 (6); III, IV, 6–8, \bar{x} 7.50 (10); V, 6–8, \bar{x} 6.40 (10); VI, 5–6, \bar{x} 5.77 (9); VII, 5–6, \bar{x} 5.88 (9); (in 10 females of *A. dennelli*; III, 8–10, 8.40; VII, 4–7, 5.10) VIII, 2 tr and 2 tc + 2 tl; IX–XI, ant. 2 sh and post. 2 tc + 2 tl all sh to ml, usually tc slightly longer; setae a, 1 + 1 sh, off tergite; b, 1 + 1 sh, off tergite or on its edge (a seta identical to b may be present slightly anteriorly on one or both sides). Post-spiracular setae on terga IV–VII, 1 + 1 (in all 10); IV, V, m or sh; VI, sh; VII sh or ml. Pleural. IV, each side 3–6, total 7–12 (10) as follows; 7 (1); 8 (2); 9 (3); 10 (1); 11 (2); 12 (1). In 19 females of *A. dennelli* on IV, each side 2–6, total 6–11 as follows; 6 (1); 7 (4); 8 (7); 9 (4); 10 (2); 11 (1). Sternal. II, ant 4–7 and post 5–7; III, 2 sc + 4 (7), 5 (3) sl, and 1–2 sh to ml ant. to these. (In *A. dennelli* on III in 15 females thus; 2 sc + 4 (10), 5 (3), 6 (2) sl, and 2–3 ant. to these; setae on this sternum and also sterna IV, V longer also.) IV, V, 2 sc; VI, VII, 2 sc + 4 sl; VIII, 1 + 1; 3–4 sh to ml setae present between VII and VIII, of which 1 + 1 are usually at same level as sternal on VII. Anal setae as in Fig. 20.

Holotype ♂ from *Pseudibis davisoni* (Hume), Burma, October, 1930, slide no. 4905a (R. Meinertzhagen collection) in B.M. (N.H.), *Paratypes*: 2♂ (dissected) and 10♀, with the same data.

Ardeicola harrisoni sp. nov.

(Figs 38 to 42; Table 7)

Type host: *Platibis flavipes* (Gould).

This new species resembles *A. plataleae*, *A. ajajae* Carriker and *A. smithersi* Büttiker, in lacking the two anterior setae on composite tergum IX–XI in both sexes. However, it is not related to any of them and can be distinguished in the male by the fused tergites of segments III–V and in the female by the elongated segment II and compressed III.

Alkali treated specimens almost white, hence a feebly sclerotized species. No overlap in the length of the sexes (Table 7).

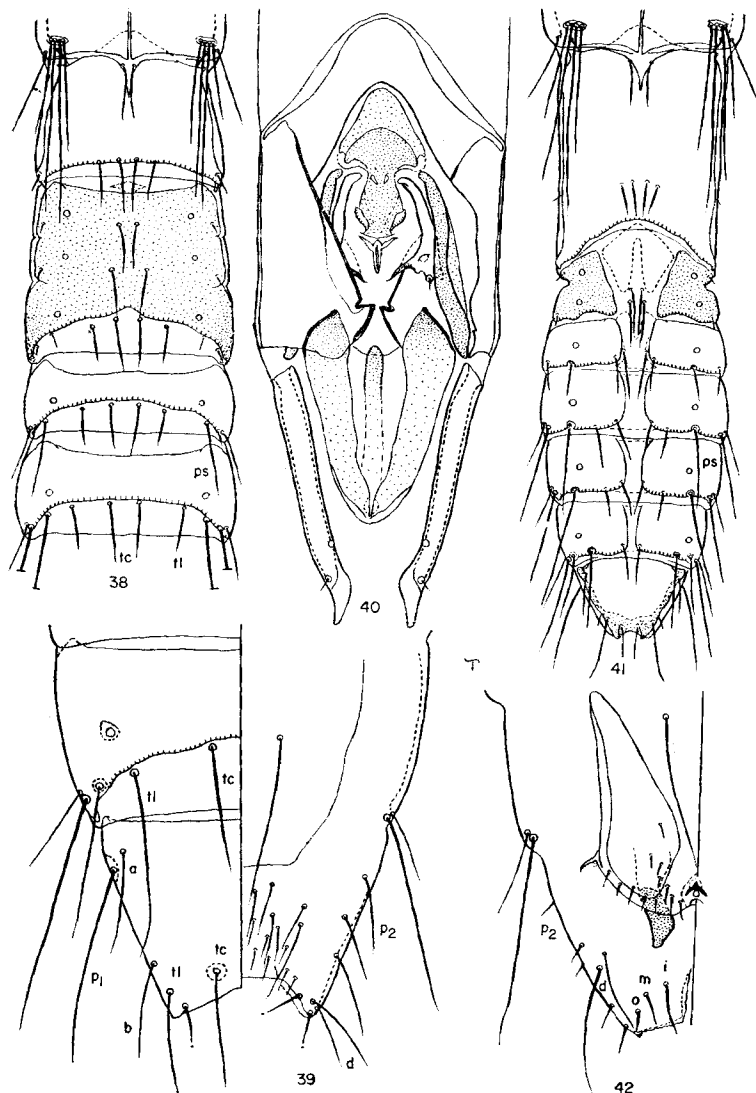
Table 7. Measurements (mm) of three males and five females of *A. harrisoni* mounted in Canada balsam

		Male			Female		
		Range	Mean	Allotype	Range	Mean	Holotype
Head	Length	0.59–0.63	0.61	0.63	0.61–0.66	0.63	0.66
	Breadth	*0.32–0.36	0.34	0.36	0.32–0.38	0.34	0.38
Prothorax	Length	†0.36–0.39	0.37	0.39	0.39–0.43	0.398	0.43
	Breadth	0.17–0.18	0.177	0.18	0.18–0.23	0.198	0.21
Pterothorax	Length	0.30–0.32	0.31	0.32	0.32–0.36	0.33	0.36
	Breadth	0.45–0.47	0.46	0.45	0.48–0.54	0.51	0.54
Abdomen	Length	0.39–0.41	0.402	0.41	0.43–0.52	0.45	0.52
	Breadth	1.46–1.64	1.53	1.64	1.67–1.88	1.76	1.88
Total length		0.39–0.47	0.43	0.47	0.47–0.59	0.51	0.59
Cephalic index		2.70–2.91	2.78	2.91	2.95–3.28	3.099	3.28
		0.60–0.61	0.605	0.61	0.61–0.64	0.63	0.64

* Breadth at level of preantennal setae.

† Breadth across temples.

Male. General characters of the head as in *A. burmanus*. Length of important setae as follows: dss. and ads. lg, latter of the two sides relatively close to each other; pns., pcs., and mds. ml; pas. and ocular sp, latter on edge of temporal margin; mts. 4 lg,



FIGURES 38 to 42. *A. harrisoni*: 38, male abdomen, dorsal, segments II-VII; 39, male terminalia, dorsal and ventral (anal setae indicated by a dot near their tips); 40, male genitalia, posterior sclerites; 41, female abdomen, dorsal; 42, female terminalia, one-half, ventral (supra-vulval sclerite stippled). i, Inner; m, middle; o, outer; ps, post-spiracular; tc, tergoventral; tl, tergo-lateral.

remaining 5 + 5 m and fine, but sixth slightly stouter than others. Pts. and others ml to lg and the former cross the occiput fairly.

General characters of thorax as in *A. melanopis*. Outer posterior prothoracic seta sh (not spiniform) and inner lg. Pterothorax longer than wide. The longest pteronotal seta may extend even beyond the spiracle of IV. On meso- and meta-sternum 4 and 2 lg setae respectively.

Abdomen as in Figs 38 and 39; widest across segment VII, stouter than in *A. ajajae*, *A. smithersi* and *A. plataleae* (see fig. 29, in Clay & Hopkins, 1950). Segments III, IV and V not separated by intersegmental sutures and the tergal thickenings of the three fused to form a large tergite (Fig. 38), a condition similar to that of segments IX-XI. Terga IX-XI emarginate posteriorly and the anal lobes not extending beyond it (Fig. 39) Sternites II-VIII as long and narrow lateral plates. Subgenital plate and chaetotaxy of genital region, and the external genitalia as in Figs 39 and 40. Margin of genital opening unhardened.

Female. General characters of head and thorax as in the male except for the normal differences. The same setae are shorter and finer, but posttemporal are m. Longest posterior pteronotal seta extends to about the middle of segment II. On meso- and meta-sternum 4-6 and 3-4 lg to elg setae respectively.

General characters of abdomen and relative lengths of segments as in Fig. 41; widest across segment V or VI. Segment II elongated and about one-third of the entire abdomen in length; III much reduced and IV short. No intersegmental suture between III and IV. Tergal thickening of II almost entire; of III-VIII as lateral tergites but those of III and IV of each side fused characteristically and the tergum between the two (as also between lateral tergites V-VII) is moderately hardened. Tergite IX-XI as in Fig. 41, posteriorly pigmented characteristically. Genital region (Fig. 42) with lateral supra-vulval sclerites elongated, irregular in shape and extending well posteriorly. Opening of the spermathecal duct strengthened anteriorly by a crescentic sclerite.

Abdominal chaetotaxy. Male. Tergal. II, ant. tc 2 lg, resemble the posterior tl setae more. Posterior. II, 2 tc + 1-2 tl; III, IV, 2 tc; V-VII, 2 tc + 2 tl; VIII, 2 tr, on tergite, and 2 tc + 2 tl, tl quite close to tr and much longer than tc setae; IX-XI, ant. setae absent (an important character), post. 2 tc ml to lg + 2 tl lg; setae a, 1 + 1 lg and b, 1 + 1 ml to lg, both well on tergite. Post-spiracular setae, without contiguous sensilli, present on terga V-VII, 1 + 1; V, sh; VI, lg; VII, elg, stout extend to or cross anterior margin of tergite IX-XI. Pleural. II, 1 + 1 sp or sh; III, IV, 2 + 2 sh fine; V, 3 + 3, 2 sh, 4 ml; VI, 4 + 4, 2 sh, 2 ml, 4 lg; VII, 4 + 4, 4 ml to lg, 4 lg to elg; VIII, 8-9, 4 lg, 4-5 elg; setae p₁, 1 + 1 elg and p₂, 1 + 1 ml to lg; marginal and submarginal, 5-6 ml to lg. Sternal. II, 2 sc lg + 2-4 sl, 2 lg, 0-2 sh, sc slightly longer than sl; III, IV, 2 sc lg + 1-2 sl sh; sc on II-IV wide apart; V, 2 sc lg + 0-2 sl sh; VI, VII, 2 sc + 4 sl; VIII, 1 + 1; setae d, 2 + 2, ml to lg; anal, 3 + 3, 4 sh, 2 ml, arrangement as in Fig. 39 (1 + 1 almost dorsal, on tergum XI).

Female. Tergal (Fig. 41). II, ant. tc 2. Posterior. II, 2 tc + 2 tl or 2 tc (apparently only); III, IV, 2 tc; position of setae on II-IV characteristic; V, 2 tc + 1-2 tl; VI, 2 tc + 2 tl; VII, 2 tc + 2-3 tl; VIII, 2 tr, on tergite, and 2 tc + 2 tl, as in male; IX-XI, ant. setae absent, post. 2 tc + 2 tl, all lg, tl anterior to and much longer than tc setae; setae a, 1 + 1 lg, fine and b, 1 + 1 ml, fine, off tergite. Post-spiracular setae on terga V-VII,

1 + 1; V, ml; VI, lg; VII, elg extend even to setae b. Pleural. II, 1 + 1 m, position almost at middle of segment important; III, 2 + 2, 2 sp, 2 ml fine; IV, 4-5 sh to ml; V, 4-6, 4 sh, 1-2 ml to lg; on III-V none thick and stout; VI, 8-9, 4 ml fine, 2-3 lg fine, 2 elg; VII, VIII, 4 + 4, as on VI; setae p_1 , 1 + 1 elg and p_2 , 1 + 1 sp; setae d, 2 + 2, 2 lg, 2 elg; marginal and submarginal, 4 + 4. Sternal. II, 2 ant. and 2 post., lg, between these 4-6 m or sh; III, IV, 2 sc m + 2 sl sh; V, 2 sc lg + 2 sl m or sh; VI, 2 sc m or sh + 4 sl, 2 lg, 2 ml; VII, as on VI but sc lg; VIII, 1 + 1 lg; setae d, 2 + 2, 2 lg, 2 elg; anal, 3 + 3, 2 characteristic ml, 4 sp or sh; on vulval margin, 8-9 each side.

Being based partly on material collected by the late L. Harrison, this new species is named after that eminent Mallophagologist. *Material examined*. 5♀, 3♂ from the type host from Australia (L. Harrison and R. Meinertzhagen no. 4987).

Holotype ♀, slide no. 4987a. *Paratypes*: 4♀ and 3♂ (1 on slide no 4987a designated as *allotype*) from *Platibis flavipes*, with data as above. All in B.M. (N.H.).

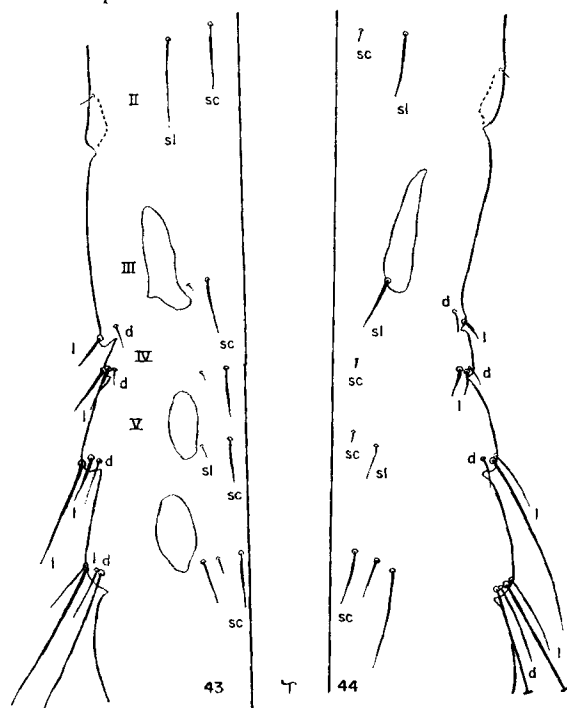
Ardeicola smithersi Büttiker, 1967

(Figs 43, 45, 48, 50, 52-54 and 56)

Type host: *Platalea alba* Scopoli.

Ardeicola smithersi Büttiker, 1967. *J. ent. Soc. sth. Afr.*, 30: 107 figs 1-3, 5, 7, 10.

Host: *Platalea alba* Scopoli.



FIGURES 43 and 44. Female sterna II-VI: 43, *A. smithersi*; 44, *A. ajajae*. d, Dorsal; l, lateral; sc, sternocentral; sl, sternolateral.

As the original description of *A. smithersi* lacks characters which distinguish it from *A. ajajae*, to which it is most closely related, its redescription has become necessary.

A feebly sclerotized species, hence the sclerites are faint. No overlap in the length of the sexes; male, 2.93-3.14, \bar{x} 3.04 (3) mm, and female, 3.22-3.56, \bar{x} 3.39 (3) mm.

General body characters as shown in figs 1 and 2 in Büttiker, 1967. General characters of head, especially the preantennal region, resemble those of *A. burmanus* and, to a little extent, of *A. dennelli*; there are fewer thickenings of the ventral anterior plate. In the male the gular plate is unmodified anteriorly.

Important head setae as follows. Ads. and dss. lg; pns. ml in male, slightly shorter in female; pts. m to sh in female, lg in male and reaches well beyond the occiput. Mts. 4 lg, remaining 5 + 5 sp, but sixth thickest and longest. Other head setae usually lg, except pas. (sp) and os. (sh, on edge of temporal margin).

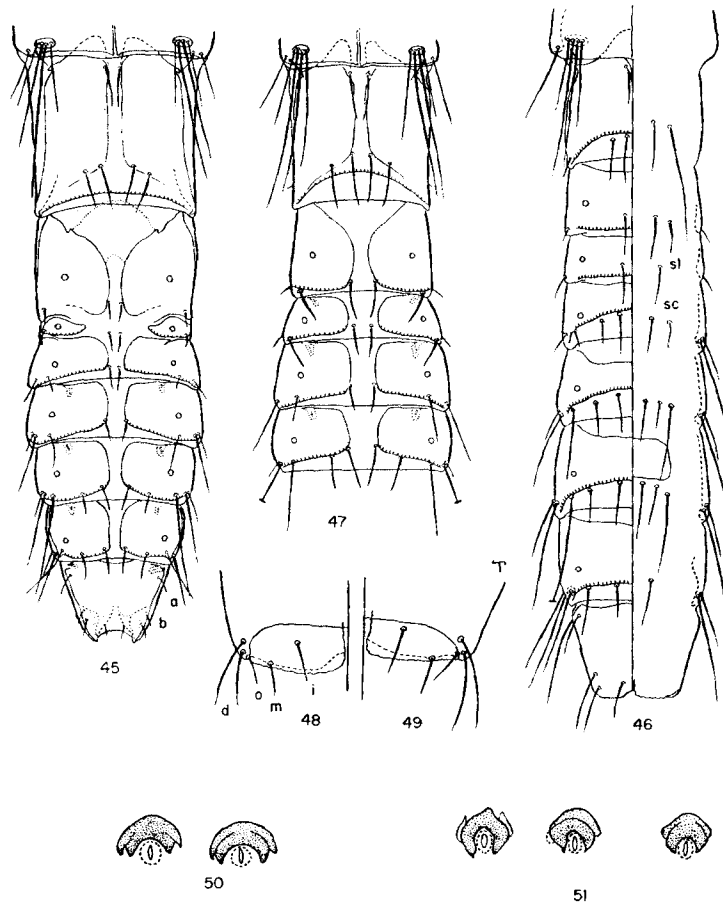
Nature of pro- and ptero-notum, and their chaetotaxy, (as also the neck sclerite) as in *A. melanopsis*. Outer posterior prothoracic seta sh, inner lg in male and ml in female. The longest pteronotal seta may reach to the spiracle of III in male and to posterior margin of II in female. On meso- and meta-sternum 2 + 2 and 1 + 1 setae respectively.

Female abdomen widest across segment V or VI and relative lengths of the segments as in Fig. 45, and fig. 1 in Büttiker, 1967. Segments II and III elongated, but II much longer than III; IV much reduced and characteristic. Tergite IX-XI falls considerably short of the lateral segmental margins. All sternal thickenings not discernible, but that of III distinct, characteristic lateral sternites (Fig. 43). Supra-vulval sclerites elongated, greatly variable in shape posteriorly (Fig. 53). Opening of the spermathecal duct strengthened by a crescentic sclerite (Fig. 50) with characteristic lateral ends.

In both sexes the terminal composite tergum characteristically pigmented. Male terminalia and external genitalia as in Figs 52, 54 and 56; margin of genital opening unhardened.

Abdominal chaetotaxy. Male (3). Tergal. II. ant. tc 2 almost lg, on tergite proper. Posterior. II 2 tc + 2 tl (2), 2 + 1 (1), tc slightly longer than tl; III, IV, 2 tc; V, 2 tc (2), 2 tc + 2 tl (1); VI, 2 tc + 2 tl (2), 1 + 2 (1); VII, 2 tc + 2 tl; tc setae on II-VII characteristic; VIII, 2 tr, on tergite, and 2 tc + 2 tl, tl setae reach slightly or somewhat beyond setae a and fall much short of b, and about 1½ to 2 times longer than tc setae; IX-XI, no anterior tergals (an important character) and only posterior 2 tc lg + 2 tl almost to lg, tc somewhat anterior to and very slightly or rather longer than tl setae; setae a, 1 + 0-1 lg; b, 1 + 1 ml to almost lg; a and b well on tergite. Post-spiracular setae on terga V-VII, 1 + 1; V, sh, just reach to or cross posterior margin of V; VI, ml to lg; VII, elg. Pleural. II, 1 + 1 sh fine, near posterior end of segment; III, IV, 2 + 2, 2 dorsal sh, 2 lateral sp; V, 3 + 2 or 3, 2 dorsal sh, 3-4 lateral lg to elg; VI-VIII, normally 4 + 4, variation 7 also; setae p_1 , 1 + 0-1 elg; p_2 , 1 + 1, lg, close to or well away from p_1 ; marginal and submarginal, 5-6 ml to lg. Sternal. II, 2 sc + 2 sl all lg, sl about 2½ times longer than sc setae; III, 2 sc lg (usually well apart) + 2 sl m or sh; IV, 2 sc lg + 2 sl (2) and 1 sl (1) m or sh; V, 2 sc lg + 2 sl (2) and 1 sl (1) sh; VI, 2 sc lg + 4 sl, 2 inner normally sh exceptionally lg and 2 outer sl elg; sc setae on II-VI characteristic; VII, 2 sc elg + 4 sl, 2 inner sl lg and 2 outer sl elg, sl equal to or slightly longer than sc setae; VIII, 1 + 1 lg; setae d, 2 + 2 lg; anal, 2 inner ml, 2 middle ml, 2 outer sh to ml (Fig. 48).

Female (3). Tergal (Fig. 45). II, ant. tc 2, as in male. Posterior. II, 2 tc + 2 tl, tl slightly longer than tc; III-V, 2 tc (no tl on V in any male); VI, 2 tc + 2 tl (2), 2 tc (1); VII, 2 tc + 2 tl; VIII, 2 tr, on tergite, and 2 tc ml + 2 tl lg, tl finer than tc; IX-XI, no anterior



FIGURES 45 TO 51. 45, *A. smithersi*, female abdomen, dorsal. 46, *A. ajajae*, male abdomen, dorsal and ventral (anal setae and setae in genital region omitted): sc, sternocentral; sl, sternolateral. 47, *A. plataleae*, abdominal segments II-VI of female, dorsal. 48, 49, Male, setae d and anal setae (i, inner; m, middle; o, outer) (margin of tergum XI shown by broken line): 48, *A. smithersi*; 49, *A. ajajae*. 50, 51, Sclerite anterior to opening of spermathecal duct: 50, *A. smithersi*; 51, *A. ajajae*.

tergals, only posterior 2 tc ml + 2 tl ml, tl slightly or rather more anterior to, and equal to or very slightly longer than, tc; setae a, 0-1 + 1 lg on tergite; b, 1 + 1 sh to ml, on or off tergite. Post-spiracular setae on terga V-VII; V, sh; VI, lg, fall slightly short of or cross spiracle of VII; VII, elg, reach to or fall short of setae b. Pleural (Fig. 43). II, 1 + 1 sp,

relatively more anterior than in male; III, 2 + 2, 2 dorsal ml, 2 lateral sp ml characteristic; IV, 3 + 3, 2 dorsal sh, 4 lateral sp ml to lg characteristic; V, 6, 2 dorsal almost lg, 2 lateral resemble laterals of III and IV, 2 lateral lg stout, or 7-8, as 1 + 0-1 lateral elg stout also present; VI-VIII, 4 + 4; setae p_1 , 1 + 1 elg; p_2 , 1 + 1 sp; marginal and submarginal, 6-9, 1 + 1 of these adjoining the outer anals (shown by arrow in Fig. 53) lg and remaining 4-7 sp. Sternal. II, 2 sc lg + 2 sl lg, sl equal to sc or very slightly longer; III, 2 sc (wide apart) ml to almost lg + 2 sl m to sh; IV, V, 2 sc ml to lg + 2 sl sh; VI, 2 sc ml to lg + 4 sl, 2 inner ml and 2 outer lg, sc usually slightly longer than sl setae; VII, 2 sc lg + 4 sl, 2 inner ml to lg and 2 outer lg, sc equal to or slightly longer than outer sl setae; VIII, 1 + 1 lg; setae d, 2 + 2 lg; anal, 2 inner characteristic ml, 2 middle sh, 2 outer sp; marginal vulval, 14-16 sp, and 10-11 m anteriorly in the genital region.

Material examined. 3♂, 3♀ from *Platalea alba* Scopoli, Bechuanaland, (now Botswana), Tsesebe (Dr F. Zumpt, 15. xii. 1955) in B.M. (N.H.).

Ardeicola ajajae Carriker, 1961

(Figs 44, 46, 49, 51, 55 and 57)

Type host: *Ajaja ajaja* (Linn.).

Ardeicola plataleae ajajae Carriker in Carriker & Diaz-Ungria, 1961. *Noved. cient. Mus. Hist. nat. La Salle*—(Zool.), No. 28: 50, figs 51-53.

Ardeicola ajajae described in Carriker & Diaz-Ungria (1961) from *Ajaja ajaja* as a new subspecies of *A. plataleae* (Linn.), was raised by Emerson (1962) to its deserved specific rank—an action which Tuff (1967) has also supported. While describing the new species *A. smithersi* from *Platalea alba*, Büttiker (1967) compared it with *A. plataleae*, and with this action *A. plataleae* was brought closer to two species with which its affinities are relatively less close. After a critical study of these three species it has been concluded that *A. ajajae* and *A. smithersi* are very closely related to each other. Further, each is related to an almost equal degree to *A. plataleae* also, but less closely than they are to each other.

Ardeicola ajajae is distinguished from the closely related *A. smithersi* as follows. In the male by the proportions of the sternal setae on II, III and VI and their number on sternum IV, and the components of the external genitalia. In the female by the proportions of the pleural setae on II-V and of the sternal setae on II, V and VI, but most of all by the characteristic (1 + 1) sl setae on sternum III, and the shape of the sclerite anterior to the opening of the spermathecal duct.

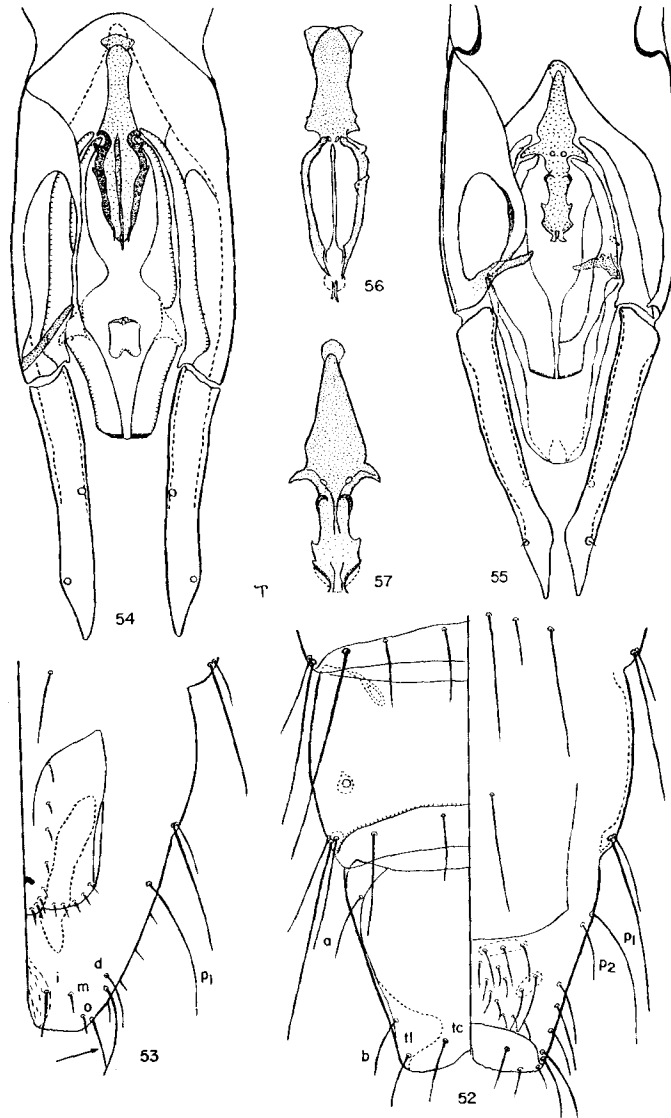
In combination some or all of the following characters distinguish *A. plataleae* from *A. smithersi* and *A. ajajae*.

Male. (1) On II the sc are slightly to rather longer than the sl setae; (2) post-spiracular setae on V are lg and cross well into VI, but falling short of the spiracle; (3) on VIII the tl setae fall short of or reach to setae b and are about $2\frac{1}{2}$ times longer than the tc setae; (4) on IX-XI the tc are very slightly anterior to tl setae, and tl are rather to much longer than the tc setae; (5) on V, 2 tc (3), 2 tc + 2 tl (1); (6) sclerites of external genitalia (see figs 29 & 30 in Clay & Hopkins, 1950).

Female. (1) Shape and proportions of abdominal segments, especially of IV (Figs 47, 43 to 45). (2) Pleural setae: proportions of III, 2 lateral ml, 2 lateral and ventral stout lg

and inwardly directed; count and proportions of IV, 2 + 2 (6), as on III but 2 lateral sp usually thinner and shorter, or 5 as 1 more sp lateral present; count of V, 3 + 3.

In its general characters *A. ajajae* resembles *A. smithersi* and its differences from the



FIGURES 52 to 57. 52, 53, *A. smithersi*: 52, male terminalia, dorsal and ventral (tc, tergoventral; tl, tergolateral); 53, female terminalia, one-half, ventral (i, inner; m, middle; o, outer). 54, 55, Male genitalia, posterior sclerites: 54, *A. smithersi*; 55, *A. ajajae*. 56, 57, Median sclerite of male genitalia: 56, *A. smithersi*; 57, *A. ajajae*.

latter have been described mostly in a comparative manner (see also figs 1, 2 & 3 in Tuff, 1967).

Slightly larger in size. Important head setae longer (pcs. ml to almost lg), except pts. which is shorter and in the male crosses the occiput slightly or to a greater extent. On mesosternum 4-6 lg setae and in female inner posterior prothoracic seta lg. Longest pteronotal seta reaches to or crosses posterior margin of III in male, and crosses posterior margin of II in female.

Male abdomen as in Fig. 46, and external genitalia as in Figs 55 and 57. In the female the characteristic segment IV is significantly larger (Fig. 44) and in proportions intermediate between *A. plataleae* and *A. smithersi*, but closer to that of the latter species in size. The sclerite anterior to the opening of the spermathecal duct (Fig. 51) surrounds almost three-quarters of the opening.

Abdominal chaetotaxy. Male. Tergal. Count basically as in *A. smithersi* but individual variation thus: II, 2 tc + 2 tl (7); V, 2 + 2 (5), 2 + 1 (1), 2 + 0 (1); VI, 2 + 2 (6), 2 + 1 (1); IX-XI, posterior 2 + 2 (4), 3 + 2 (2). Proportions: on III-VII tc setae and on V post-spiracular setae (ml to almost lg, cross slightly posterior margin of V) longer; on VIII tl setae reach slightly beyond setae a and are about $1\frac{1}{2}$ times longer than tc setae; on IX-XI tc setae very slightly anterior to tl setae and tl equal to or slightly longer than tc setae; setae a and b longer. Pleural (4). Count of all segments, p_1 and p_2 as in *A. smithersi*. Proportions: II, sp or sh; III, 2 lateral may be stouter; VI-VIII all may be longer; V, 2 dorsal sh to ml, 4 lateral may be longer. Sternal (7). Count of II, III and VI-VIII as in *A. smithersi* (in one 2 almost lg setae present anterior to sc setae on III); IV, only 2 sc lg; V, 2 sc lg + 2 sl (4), 1 sl (2), 0 sl (1), sl sh to ml. Proportions: II, sl even longer than sc setae; III, sc ml to lg, sl ml to almost lg and stout; VI, 2 inner sl ml to lg; anal longer and stouter (compare Figs 49 and 48).

Female. Tergal (3). Count of II-IV, VII and VIII as in *A. smithersi*. V, 2 tc + 2 tl (1), 2 tc (2); VI, 2 tc + 2 tl (3); IX-XI, posterior 2 + 2 (1), 2 + 4 (1), 2 + 1 (1), position of tc variable. Proportions. Anterior tc on II, tc on V, tc and tl setae on VII longer than in *A. smithersi*; VIII, tc and tl setae ml and similar in shape and proportions. Post-spiracular: V, sh to ml; VI, lg to elg, reach to post-spiracular or even cross posterior margin of VII; VII, elg, reach to b or tip of abdomen. Pleural (5) (Fig. 44). Count of II and III, and count and proportions of VI, VIII and p_1 as in *A. smithersi*. IV, 5-8, 2 dorsal sh, 3-6 lateral sp characteristic; V, 3 + 3, 2 dorsal sh, 2 lateral lg and 2 elg; marginal and submarginal, 5-7, 1 + 1 adjoining the outer anals sh or ml (never lg) and stout or just sp. All pleurals on II (m) and III (sh), and lateral ones on IV significantly shorter, while on V dorsal ones shorter and lateral longer and thinner than in *A. smithersi*. Sternal (5). Count of II, V, VI-VIII, d and anal setae as in *A. smithersi*. III, 2 sl ml to almost lg and characteristic (a diagnostic character); IV, 0 or 2 sc m. Proportions. II, sc sh, sl lg to elg; V, sc m to sh, sl sh to ml; VI, sc almost lg, 2 inner sl normally ml to lg (rarely sh also) and 2 outer lg to elg, outer sl much longer than sc setae; VII, sc lg, 2 inner sl almost to lg and 2 outer lg to elg, outer sl equal to or slightly longer than sc setae; setae d and anals longer and stouter.

Material examined. 7 ♂ (1 dissected) 6 ♀, from *Ajaja ajaja* (Linn.), Florida, R. Meinertzhagen no 4993; British Guiana, Rupununi, 18. ii. 1961, T. Clay no. 145; Bolivia, San Joaquin, Benni, 18. vi. 1963, no B₄ Maru 1170. K. C. Emerson collection.

ACKNOWLEDGEMENTS

We are most grateful to Dr Theresa Clay and Dr K. C. Emerson for the loan of *Ardeicola* from the collections of the British Museum (Natural History) and the U.S. National Museum respectively; to Dr Clay for reading the manuscript and for several valuable suggestions; to Dr M. B. Lal, F.N.I., and Prof. P. D. Gupta for their kind interest in our work and for departmental facilities. This research has been financed in part by grant, FG-In-179 (A7-ENT-28), made to B. K. Tandan by the United States Department of Agriculture under P.L. 480, and thanks are expressed to the authorities of the U.S.D.A., A.R.S., in New Delhi and Washington D.C., and to Dr. K. C. Emerson and Dr R. I. Sailer for sponsoring the grant and for much helpful co-operation.

REFERENCES

- BÜTTIKER, W., 1967. A new species of *Ardeicola* Clay (Mallophaga: Philopteridae). *J. ent. Soc. sth. Afr.* **30**: 107-110.
- CARRIKER, M. A., Jr. & DIAZ-UNGRIA, C., 1961. New and little known Mallophaga from Venezuelan birds (Part I). *Noved. cient. Mus. Hist. nat. La Salle (Zool.)*, No. 28: 3-60.
- CLAY, T., 1951. An introduction to a classification of the Avian Ischnocera (Mallophaga). Part I. *Trans. R. ent. Soc. Lond.*, **102**: 171-194.
- CLAY, T. & HOPKINS, G. H. E., 1950. The early literature on Mallophaga. Part I. *Bull. Br. Mus. nat. Hist. (Entom.)*, **1**: 221-272.
- EMERSON, K. C., 1962. *A tentative list of Mallophaga for North American birds (North of Mexico)*. Dugway Proving Ground, Dugway, Utah.
- HAJELA, K. P., 1966. A new species of Neotropical *Ardeicola* Clay, 1935 (Mallophaga, Ischnocera). *Ann. Mag. nat. Hist.*, (13) **9**: 551-556.
- HAJELA, K. P. & TANDAN, B. K., 1967a. New species of *Ardeicola* Clay, 1935 (Mallophaga: Ischnocera). *Proc. R. ent. Soc. Lond. (B)*, **36**: 71-78.
- HAJELA, K. P. & TANDAN, B. K., 1967b. Two new species of *Ardeicola* Clay, 1935 (Mallophaga, Ischnocera) from African ibises. *Parasitology*, **57**: 719-728.
- HAJELA, K. P. & TANDAN, B. K., 1968. Two new Mallophaga species of the genus *Ardeicola* Clay, 1935 (Ischnocera: Philopteridae). *Ann. ent. Soc. Am.*, **61**: 146-151.
- HOPKINS, G. H. E., 1938. Stray notes on Mallophaga. *Ann. Mag. nat. Hist.*, (11) **2**: 191-198.
- HOPKINS, G. H. E. & CLAY, T., 1952. *A check list of the genera and species of Mallophaga*. British Museum (Natural History).
- KELLOGG, V. L. & PAINE, J. H., 1911. Mallophaga from Bolivian birds. *Ent. News*, **22**: 19-24.
- TANDAN, B. K. & KUMAR, P., 1969. Mallophaga from birds of the Indian Subregion Part VII. *Ardeicola hardayali* sp. n. (Ischnocera, Philopteridae) from *Leptoptilos javanicus*. *Annl. Soc. ent. Fr.*, **5**: 145-154.
- TUFF, D. W., 1967. A review of North American *Ardeicola* (Mallophaga: Philopteridae). *J. Kansas ent. Soc.*, **40**: 241-263.