

The genus *Esthiopterum* (Phthiraptera: Ischnocera)

B. K. TANDAN

Department of Zoology, University of Lucknow, Lucknow, India

SYNOPSIS

An account is given of eight species of *Esthiopterum* parasitic on cranes, and the three species-groups into which they are divided are characterised. Four of the species are described as new, redescriptions are given of the remainder, and a key for their separation is included. The affinities of the genus and host-parasite relationships are discussed.

INTRODUCTION

Harrison (1916: 26) erected the genus *Esthiopterum* for species of *Lipeurus* not possessing a circumfasciate head (or, according to Clay (1951: 184), not having the marginal carina complete), designating *E.(Lipeurus) ebraeum* Burmeister from *Grus communis* (= *Grus g. grus*) as the type species. Later, however, due to a misconception he changed the name to *Esthiopterella* (Harrison, 1937), which according to Hopkins & Clay (1952) was unnecessary. Among the numerous species included under *Esthiopterum* in Harrison's (1916) list are the two other large-bodied ischnoceran species then known from cranes: *E. giganteum* (Le Souëf & Bullen, 1902), was recognised as valid, but the other, *E. maximum* (Rudow, 1869), was made a synonym of *E. gruis* (L.). All the other species in that list have since been assigned to at least thirty-four genera, only six of which (*Lipeurus*, *Oxylipeurus*, *Pectinopygus*, *Pseudonirmus*, *Psittaconirmus* and *Rallicola*) were described at the time of its publication.

Under *Esthiopterum* in the Check List of Mallophaga (Hopkins & Clay, 1952) five species are recognised as valid, and the generic position of one species, *E. tataupa* Carriker, 1936, is said to be doubtful. Although the figure in Carriker (1936: Text-plate I, figure 3) is inadequate for the generic placing of this louse, it is sufficiently adequate to show that it does not represent an *Esthiopterum*. Thus, so far only four valid species of *Esthiopterum* are known from four of the fourteen species of cranes (family Gruidae) (Peters, 1934).

This study is based on material in the collections of the British Museum (Natural History) (BMNH) and Dr K.C. Emerson (EC). The chaetotaxy in the figures agrees with that of the specimens from which these were drawn; broken or missing setae have been completed either from the other side of the same specimen or from another specimen. Figures in parentheses indicate the number of specimens examined; \bar{x} denotes the mean of setal counts and measurements given in millimetres. Nomenclature as in Hopkins & Clay (1952).

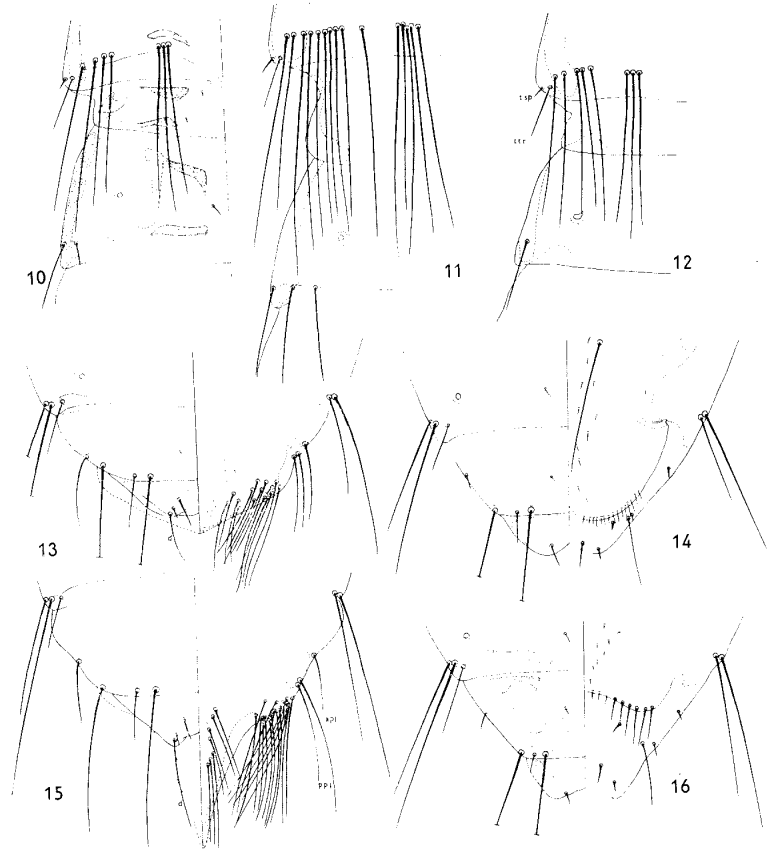
Esthiopterum Harrison, 1916

Predominantly white to light brown, with or without a pigmentation pattern of dark brown colour.

General characters of head as shown in figures 1, 2; marginal carina interrupted medially and laterally into pre- and postmarginal carinae; hyaline margin absent; a dorsal anterior and smaller ventral plate present. Ventral carina interrupted medially and passing anteriorly to fuse with anterior end of premarginal carina; pulvinus with lobes attached to flattened, thickened parallel edges of ventral carina; temporal carina absent or incipient; occipital carina well developed. Gular plate distinct or not apparent; hypopharynx normal. Antenna filiform in the female, strongly modified in the male; segment I greatly enlarged, having a dorsal appendage, II slightly enlarged, antero-lateral margin of III produced into a prominent hook at base of which is a tubercle, IV and V normal (figs. 3, 7). All head setae normal for Ischnocera are present (see Clay,



Figs. 1-9. *Esthiopterum* spp. (1, 2) Preantennal region of female head: (1) *E. giganteum*; (2) *E. indicum*. (3-7) Male antenna. (3) *E. paradiseum*; (4, 5) dorsal appendage on segment I: (4) *E. gruis*; (5) *E. indicum*. (6, 7) Tubercle at base of hook on segment III (indicated in fig. 3 by arrow): (6) *E. maximum*; (7) *E. indicum*. (8, 9) Basal apodeme: (8) *E. maximum*; (9) *E. gruis*.



Figs. 10-16. *Esthiopterum* spp. (10-12) Metanotum and abdominal segments II and III: (10) *E. elbeli*, male; (11) *E. indicum*, female; (12) *E. brevicapalum*, female. (13-16) Terminal segments of abdomen: (13) male and (14) female, *E. giganteum*; (15) *E. indicum*, male; (16) *E. africanum*, female. In figures 13 and 15 all three anal setae of the left-hand side have been shown dorsally. a. pl., p. pl., anterior and posterior pleural setae respectively on IX + X; d, dorsal anal seta; t. sp., t. tr., thoracic spiniform seta and thoracic trichobothrium respectively.

1951); additionally present are 2 + 2 temporal setae, and, in the male only, 1 + 1 setae inner to postnodal setae, here called posterior dorsals. Ocular seta on temporal margin; of the six marginal temporal setae each side, the fourth long to very long and all remain-

ing five (1-3, 5 and 6) spiniform or stout and of medium length; post-temporal seta minute.

Prothorax with moderately divergent sides, of characteristic shape. Pronotum apparently divided medially, with two posterior, marginal setae each side, outer stout and of medium length, inner medium to long and finer in the female. A well developed postnotum. Pteronotum divided medially in posterior half, without anterior setae; marginal pteronotal setae of three types as in *Ardeicola* (see Kumar & Tandan, 1971: 119): 1 + 1 spiniform, 1 + 1 trichobothria and a variable number of long or very long setae. The spiniform seta is outer and slightly anterior relative to the thoracic trichobothrium and the posterior and outer position of these two setae relative to the long setae is constant and diagnostic (figs. 10-12). Pterosternal plate not always apparent; on meso- and metasternum normally 1 + 1 long setae.

Abdomen with nine apparent segments, the first (probably representing I and II fused, but referred to as II) reduced. Tergal thickening II-XI as lateral tergites having faint or distinct contours, with or without a pigmentation pattern. Sternal thickening II either a median plate or apparently absent; on sterna III-VIII in the male and III-VII in the female in the form of lateral plates pigmented uniformly or differentially or merely as pigmented areas. Male and female genital region variable; male genital opening ventro-terminal.

Abdominal chaetotaxy, except for genital region, remarkably constant. Tergal: II-VIII, 2 between tergites, short on anterior and short to medium on posterior segments, with 2 anterior additionally on II that may be asymmetrically placed; IX + X, anterior, 2 short to medium, posterior 3 + 3 (figs. 13-16), outer and inner very long, middle medium to long (the outer seta interpreted as tergal could equally well be a pleural seta). Post-spiracular seta on VII only (1 + 1); abdominal trichobothrium on VIII (1 + 1). Pleural: II, absent; III, variable; IV, V, 3 + 3 (1 + 1 dorsal and inner, 1 + 1 dorsal and outer, 1 + 1 dorsolateral or lateral); VI-VIII, 4 + 4; IX + X, anterior 2 + 2 long in the male, spiniform or short in the female, and 2 + 2 posterior long, present in male only or absent (figs. 13-20). (In an occasional specimen the number of posterior tergal setae on IX + X and pleural setae on IV-VIII may deviate from the normal count.) Sternal: II-V, 2 short sternocentral; VI, VII, 2 very long sternocentral + 2 long sternolateral; VIII, 2 very long; anal setae as in figures 13, 14, 26. Chaetotaxy of genital region variable but in female 1 + 1 inner spiniform and 2 + 2 outer (each side one spiniform or short, one very long) setae always present (figs. 14, 16, 28).

The eight species have been divided into three species-groups.

The gruis species-group

(1) Body almost white to light brown, with a pigmentation pattern; lateral sternal thickening present on segments III-VIII in male and III-VII in female, variable in shape and pigmentation pattern. (2) Head setae relatively shorter and finer than in *giganteum*-group, the important setae being: dorsal submarginal long, preantennal short, postnodal medium, ocular short or spiniform, marginal temporal 4 long, in male, temporal 1 and posterior dorsal medium; anal setae, particularly d, relatively short in male (fig. 26). (3) Normally 7 very long marginal pteronotal setae each side arranged in four groups consisting of 1, 1, 2 and 3 setae, respectively (fig. 10). (4) In male dorsal appendage of antennal segment I relatively small and conical (fig. 4). (5) Tubercle at

base of hook on antennal segment III without prominent ridges (fig. 6). (6) Position of inner and middle posterior tergal setae on IX + X as in figures 25, 31. (7) Male segment IX + X without posterior pleural setae (fig. 26). (8) Terminal sternum curved in male (figs. 25, 26). (9) Vulval margin not enlarged (fig. 16). (10) Vulva with only marginal setae (fig. 16). (11) Vulval marginal setae medium to long, on each side forming continuous row and separated by a small median gap; central setae shorter and finer than lateral setae (fig. 16).

This group includes *E.gruis* (L.), *E.maximum* (Rudow), *E.elbeli* sp. n., *E.paradiseum* sp. n., *E.africanum* sp. n. and one new species, parasitic on *Grus monacha* Temminck, which is not described here.

Esthiopterum gruis (L., 1758)

(figs. 4, 9, 17, 20, 21, 26 and 33)

On the basis of evidence in the literature Clay & Hopkins (1950) restricted this name to the *Esthiopterum* species of *Grus g.gruis* and designated a neotype.

This species has a pigmentation pattern of dark brown areas on an extremely faint amber general background. Although the intensity of pigmentation is the same in both sexes, the areas on the antenna and abdomen, particularly the lateral ones on the abdominal venter, show marked sexual dimorphism, being more extensive in the male.

Male and female. General characters as in figures 38 and 40 in Clay & Hopkins (1950). Pigmentation of gular plate similar to that of *elbeli*. Contours of abdominal tergites extremely faint; abdominal pigmentation pattern as in figures 17, 20 and 33. In both sexes each lateral tergite IX + X with two separate pigmented patches (fig. 26). (In one male of 21 examined, the two areas are continuous on the tergite of one side, but no specimen of either sex has the two areas continuous on both lateral tergites, which is the normal condition in *paradiseum* and probably *elbeli* also.) Lateral tergites XI faintly pigmented posteriorly in the female; in the male pigmentation even less intense or apparently absent. Lateral sternites simply as curved dark brown areas, the elongate or ovoidal plates (of which in *maximum* the pigmented areas represent the inner margins) not being apparent (fig. 20); subgenital plate not apparent. Lateral sternite VIII in male as in figure 21. Basal apodeme unpigmented (fig. 9). (The female shown in figure 33 has the remains of an adult *Heleonomus macilentus* (Nitzsch) in its crop; it would be interesting to know whether it was living or dead when devoured.)

Chaetotaxy. Elongate pteronotal marginal setae: ♂ normal (7), 13 (1), 15 (1), 8 + 9 (1), \bar{x} 14.30 (10); ♀ normal (8), 8 + 6 (1), 15 (1). Pleural setae on segment III: ♂ 1 + 1 (8), 2 + 1 (1), 1 + 2 (1), long; ♀ 1 + 1 (8), 1 + 2 (2), long. Setae in genital region, ♂ (fig. 26): central, each side 4-9, \bar{x} 7.05 (20 sides), total 9-18 (10); lateral, each side 11-20, \bar{x} 14.70 (20 sides), total 24-36 (10); of the lateral setae one inner seta (x) on each side stouter and about 1.5-2 times longer than the other setae (fig. 26). (The central and lateral setae tend to merge with each other, so that in some specimens it is difficult to assign a seta occurring between these groups on one or both sides, and this therefore has been excluded from the count.) Vulval marginal: 17-27, \bar{x} 22.40 (10); 8-12, \bar{x} 9.80 fine and short to medium, 9-15, \bar{x} 12.60 stouter and medium to long.

Material examined. Neotype ♂, neallotype ♀, 24 ♂ (2 dissected) and 28 ♀ neoparatypes of *Esthiopterum gruis* (L.) from the type host, *Grus g.gruis* (L.), designated by Clay & Hopkins (1950: 250) (BMNH).

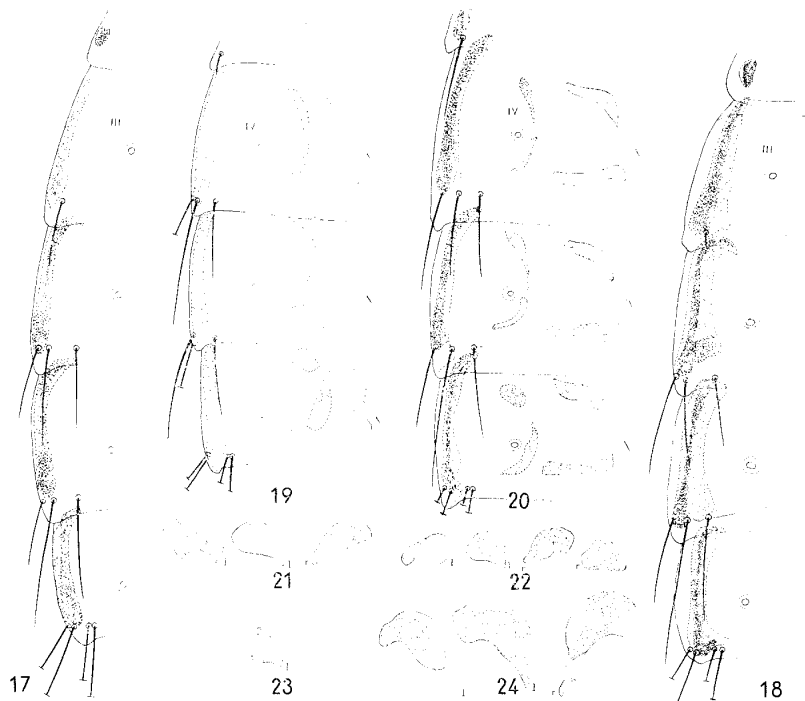
Esthiopterum maximum (Rudow, 1869)

(figs. 6, 8, 18, 19, 23, 29, 33 and 34)

Type-host: *Balearica pavonina gibbericeps* Reichenow.*Lipeurus maximus* Rudow, 1869: 37. Host: *Balearica pavonina*.

The single female from *Balearica pavonina* in the collection in the Hamburg Museum examined by Clay & Hopkins (1955: 63) was considered by them to be Rudow's type of this species and therefore designated as the lectotype.

On discovering that *Heleonomus* from subspecies of *B. pavonina* from East and West



Figs. 17-24. *Esthiopterum* spp. (17-20) Abdominal segments for pigmentation and chaetotaxy, in figures 19 and 20 the sternites have also been shown by broken lines: (17) *E. gruis*, male, segments II-VI; (18) *E. maximum*, male, segments II-VI; (19) *E. maximum*, female, segments III-VI; (20) *E. gruis*, female, segments III-VI. (21-24) Sternite VIII of male: (21) *E. gruis*, 3 individuals; (22) *E. elbeli*, 4 individuals; (23) *E. maximum*; (24) *E. paradiscum*, 3 individuals. l, sternite of left-hand side; r, sternite of right-hand side.

Africa differed specifically, Price (1970) decided to apply the name *Colpocephalum cornutum* Rudow, 1866 (= *H. cornutus*) to the Amblyceran parasitic on the East African subspecies, designating *B. pavonina gibbericeps* as the type host. Rudow (1869: 37) described *Lipeurus maximus* from the same species of crane, citing "Aus Afrika" as the geographical origin of the host and thus giving no clue to its subspecific identity. Since there is no reason to believe the provenance of this Ischnoceran and of the amblyceran *C. cornutum*, both described by Rudow, to be different, and as the restriction of the name of the type-host of the amblyceran species by Price is based on sound considerations, *B. p. gibbericeps* Reichenow is herewith designated as the type-host of *L. maximus* also.

This species is distinguished from *gruis* by details of the pigmentation pattern and in the male by the characters of the genitalia. Like *gruis*, it has a sexually dimorphic pigmentation pattern of dark brown areas; in the specimens examined, however, the contrast between the brown areas and the colour of the general cuticle is somewhat less marked in the male than in the female, because of the distinct amber coloration of the body, and on the abdominal dorsum there is less contrast than in *gruis* between the dark areas and the colour of the general cuticle (fig. 34).

Male and female. Contours of abdominal tergites distinct. Pigmentation pattern of lateral tergites IX + X (fig. 31) differs from that of *gruis* in the male; female with two separate pigmented areas, somewhat as in *gruis* (fig. 29). In the male pleurites III-VII or VIII more extensively pigmented than in *gruis* (figs. 17, 18), *elbeli* and *paradiscum*. Lateral sternites III-VII feebly sclerotised plates, elongated on III and IV, ovoidal on V-VII, with approximately one-third of their inner portion characteristically pigmented and brown to dark brown (fig. 19). Pigmented area on sterna III-VI usually uninterrupted and relatively more extensive than in *gruis*, the difference being more marked in the female. Posterior to lateral sternites VII is the median subgenital plate, of faint contours, particularly in the female (the two lateral pigmented areas on sternum VIII in the male are in fact on the anterolateral corners of this plate (fig. 23)). Basal apodeme of characteristic shape and well pigmented (fig. 8).

Chaetotaxy. Elongate pteronotal marginal setae: ♂ normal (7), 13 (3), 15 (4), \bar{x} 14.07 (14); ♀ normal (7), 13 (3), 15 (1), 8 + 8 (1), \bar{x} 14 (12). Pleural setae on segment III: ♂ 1 + 1 (10), long, range spiniform to long; ♀ 1 + 1 (9), 2 + 1 (1), slightly longer than in the male. Setae in genital region, ♂: central, each side 7-12, \bar{x} 9.20 (16 sides), total 14-22; lateral, each side, 13-19, \bar{x} 16.44 (16 sides), total 28-37 (8); one inner lateral seta (x) on each side stoutest and longest, as in *gruis*. Vulval marginal: 21-32, \bar{x} 23.30 (10); 9-15, \bar{x} 10.70 fine and short to medium (these tend to be slightly more than in *gruis*, *elbeli* and *paradiscum*), 8-17, \bar{x} 12.60 stouter and medium to long.

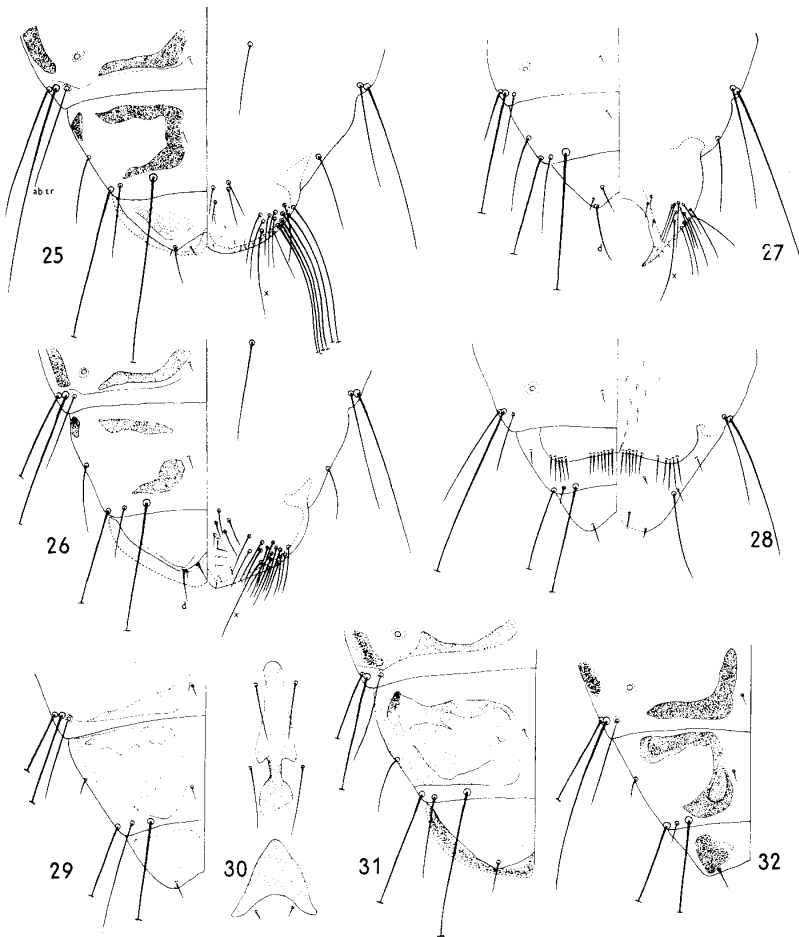
Material examined (all in BMNH). 3 ♂ (1 dissected), 3 ♀ (one compared with lectotype of *E. maximum*), Kenya: iii. 1936 (*R. Meinertzhagen*, 7322). 6 ♂ (1 dissected), 2 ♀, Kenya: Victoria Nyanza, Nairobi, ii. 1956 (*R. Meinertzhagen*, 2044, 20538); 5 ♂, 6 ♀, slides no. 1958-686, Uganda: Kampala, 17. ix. 1933 (*T. W. Chorley*); all from *Balearica pavonina gibbericeps*. 1 ♂, 1 ♀, from grey-crowned crane, Chicago Zoo, 9. vii. 1956 (EC).

Esthiopterum elbeli sp. n.

(figs. 10, 22 and 35)

Type-host: *Anthropoides virgo* (L.)

The pleural chaetotaxy of segment III readily distinguishes this from all other species



Figs. 25-32. *Esthiopterum* spp. (25-29, 31 and 32) Terminal segments of abdomen: (25) *E. paradiseum*, male; (26) *E. gruis*, neotype, male (pigmentation pattern of VIII-XI superimposed from a neoparatype); (27) *E. brevicephalum*, male; (28) *E. brevicephalum*, female, vulval margin shown completely; (29) *E. maximum*, female; (31) *E. maximum*, male; (32) *E. paradiseum*, female. In figures 25-27 all three anal setae of the left-hand side have been shown dorsally. (30) *E. africanum*, pterosternal plate and sternite 11, female.

of the *gruis* group, other distinguishing characters are the pigmentation pattern and the details of the male external genitalia.

Male and female. General sclerotisation and pigmentation as in *gruis* but dark brown areas on lateral tergites II-X and some sternites (fig. 10) slightly less extensive in both sexes (figs. 33, 35). In the 20 males and 16 females examined the curved pigmented area on each lateral tergite IX + X shows considerable variation: 9 individuals of each sex have one pigmented area on both lateral tergites (as in *paradiseum*); in 8 males and 4 females pigmented area of one side interrupted by a small to medium gap so that two areas are present (which is the condition in *gruis*), that of other side uninterrupted; one female has pigmented area of both tergites interrupted; in 3 males and 2 females faecal matter in rectum prevented determination of its nature. Although it can be concluded that each lateral tergite IX + X has normally one curved pigmented area, to some extent the state of this area is intermediate between that in *gruis* and *paradiseum*. Lateral tergites XI slightly more extensively pigmented than in *gruis*; these and the gular plate being less extensively so than in *paradiseum*. Lateral sternite VIII in male as in figure 22.

Chaetotaxy. Elongate pteronotal marginal setae: ♂ normal (23), 15 (1); ♀ normal (12), 13 (1), 15 (2), \bar{x} 14 (15). Pleural setae on segment III: ♂ 2 + 2 (17), 1 + 2 (1), 2 + 3 (1), ? + 2 (5); ♀ 2 + 2 (10), 3 + 2 (1), ? + 2 (2); 1 + 1 dorsal, short and spiniform to long and stout, 1 + 1 ventral or lateral, long to very long (this seta is absent in *paradiseum*). Setae in genital region, ♂: central, each side 2-5, \bar{x} 4.12 (16 sides), total 6-10 (8) medium to long; lateral, each side 9-12, \bar{x} 9.83 (18 sides), total 18-22 (9); of the lateral setae, one inner seta (x) on each side very long, 1-4 setae on each side, \bar{x} 3 (20 sides), total 4-8, \bar{x} 5.77 (9), much longer and stouter than seta x (unlike *gruis* and *maximum*), remaining setae much shorter and slightly thinner than seta x. These setae and the anal setae in male significantly thinner than in *paradiseum*. Vulval marginal: 18-26, \bar{x} 20.60 (10); 5-10, \bar{x} 7.70 fine and short to medium (these tend to be fewer than in *gruis* and *paradiseum*), 10-17, \bar{x} 12.90 stouter and medium to long.

Measurements. Head: total length—♂ 0.85-0.94, \bar{x} 0.89 (4); ♀ 0.91-0.97, \bar{x} 0.95 (4); preantennal length—♂ 0.40 (4); ♀ 0.40-0.43, \bar{x} 0.41 (4); breadth at temples—♂ 0.70-0.80, \bar{x} 0.74 (6); ♀ 0.76-0.82, \bar{x} 0.80 (6). Length of abdomen: ♂ 2.40-2.55, \bar{x} 2.48 (5); ♀ 2.66-2.75, \bar{x} 2.70 (4). Total length: ♂ 4.06-4.41, \bar{x} 4.22 (5); ♀ 4.34-4.70, \bar{x} 4.52 (5).

Holotype ♂, slide no. 8842a from *Anthropoides virgo*, India: Hyderabad (now Andhra Pradesh), ii.1937 (*R. Meinertzhagen*) (BMNH). **Paratypes.** From *A. virgo*: 17 ♂ (2 dissected), 10 ♀, with data as given for holotype (*R. Meinertzhagen*, 8841, 8842); 4 ♂, 1 ♀, Nepal: x.1919 and Egypt: (*R. Meinertzhagen*, 2210, 4595); 1 ♂ from captive crane, S. African Museum (*G.H.E. Hopkins*); 1 ♂, 2 ♀, Europe: (*L. Harrison*); (all BMNH). 1 ♂, 1 ♀, from captive crane, Quebec Zoo, 10.x.1943 (EC).

The species has been named in honour of Dr Robert E. Elbel.

Esthiopterum paradiseum sp. n.

(figs. 3, 24, 25, 32 and 36)

Type-host: *Anthropoides paradisea* (Lichtenstein)

This species is closely related to *elbeli*, from which it is distinguished in both sexes by: (1) the pigmentation pattern, (2) shape of the head and (3) pleural chaetotaxy of segment

III; in the male by (4) the chaetotaxy of the genital region and (5) proportions of the posterior components of the external genitalia, more particularly of the mesosome. Characters 1, 2, 4 and 5 in the male and 1 in the female separate it from *gruis* and *maximum*.

Male and female. Slightly larger than *elbeli*. General sclerotisation and pigmentation as in *gruis* and *elbeli*, except dark brown areas on gular plate and tergites III–XI in both sexes, sterna III–VIII in male and III–VII in female more extensive, the difference from *elbeli* being considerable (figs. 33, 35, 36). In both sexes (figs. 25, 32) each lateral tergite IX + X with one curved pigmented area; in one specimen only of each sex, of 20 males and 18 females examined, is the pigmented area on tergite of one side interrupted by a narrow gap. In some specimens of both sexes the lateral sternal thickening resembles that of *aximum*, except for a somewhat larger inner area of the plate being pigmented; in others only the pigmented area is evident, as in *gruis* and *elbeli*. Lateral sternite VIII in male (fig. 24) significantly larger than in other species of the *gruis*-group.

Chaetotaxy. Elongate pteronotal setae: ♂ normal (20), 13 (3), 15 (5), 16 (1), \bar{x} 14.14 (29); ♀ normal (14), 15 (5), \bar{x} 14.26 (19). Pleural setae on segment III: ♂ 1 + 1 (10) normally spiniform, range short to medium; ♀ 1 + 1 (8), 2 + 1 (2) normally spiniform, range short to long. Setae in genital region, ♂: central, each side 3–6, \bar{x} 4.05 (20 sides), total 6–11 (10), medium to long; lateral, each side 9–15, \bar{x} 12.50 (20 sides), total 21–30 (10) (these average more than in *elbeli*); of lateral setae, one inner seta (x) on each side very long, 3–9 setae on each side, \bar{x} 5.55 (20 sides), total 9–15 (10), much longer and stouter, remaining setae much shorter and slightly thinner, than seta x (fig. 25). Vulval marginal: 20–27, \bar{x} 22.90 (10); 8–12, \bar{x} 10 fine and short to medium, 10–18, \bar{x} 12.90 stouter and medium to long.

Measurements (5 ♂, 6 ♀). Head: total length—♂ 0.99–1.04, \bar{x} 1.01; ♀ 1.02–1.10, \bar{x} 1.05; preantennal length—♂ 0.43–0.46, \bar{x} 0.45; ♀ 0.45–0.48, \bar{x} 0.46; breadth at temples—♂ 0.84–0.88, \bar{x} 0.86; ♀ 0.90–0.94, \bar{x} 0.91. Length of abdomen: ♂ 2.44–2.62, \bar{x} 2.56; ♀ 2.48–2.84, \bar{x} 2.62. Total length: ♂ 4.30–4.49, \bar{x} 4.45; ♀ 4.38–4.77, \bar{x} 4.53.

From *Anthropoides paradisea*, mostly captive in various Zoos. **Holotype** ♂, slide no. 755, from captive bird in Durban Zoo, 9.ii.1954 (BMNH). **Paratypes**. 20 ♂ (2 dissected), 15 ♀, London Zoo, xi.1935; Cape Colony Zoo, xii.1936 and S. African Zoo (*R.Meinertzhagen*, 4463, 8154, 13325); 6 ♂, 6 ♀, S. Africa: Blomfoentein, v.1905 and Knysna, 7.ix.1909 (*G.H.E.Hopkins*); 5 ♂ (1 dissected), 3 ♀, Dudley Zoo, x.1937; 1 ♂, 1 ♀, Durban Zoo, 18.x.1953; 4 ♂, 12 ♀ (1 ♂, 7 ♀ in spirit), London Zoo, 4.vi.1971; 1 ♂, 1 ♀, no data, 27.ii.1952; (all BMNH).

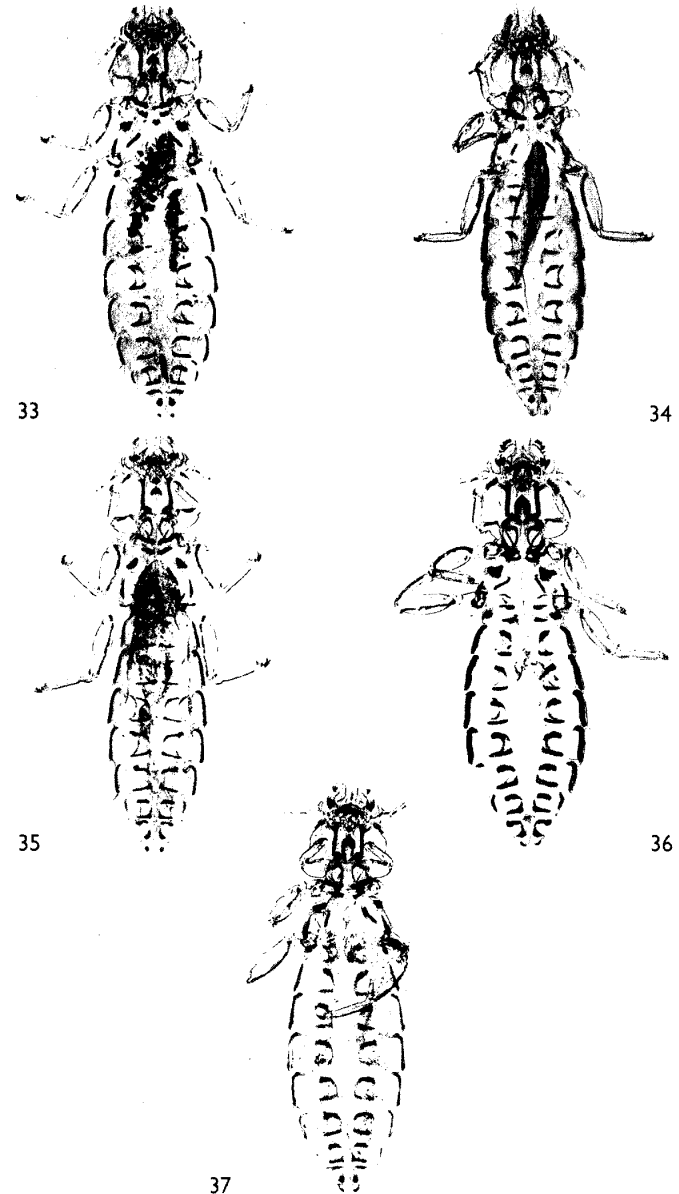
Esthiopterum africanum sp. n.

(figs. 16, 30 and 37)

Type-host: *Bugeranus carunculatus* (Gmelin)

This new taxon, based on four females, has been included in the *gruis*-group owing to the similarity of the vulval marginal chaetotaxy with species of that group. Whether or not this placing is correct can be decided only when a larger series of both sexes is available to determine not only the normal arrangement and number of marginal pteronotal setae but other characters also.

The pigmentation pattern and, to a lesser extent, the pteronotal chaetotaxy are the only known characters distinguishing the female from those of other species of the *gruis*-group.



Figs. 33–37. *Esthiopterum* spp., females: (33) *E.gruis* (L.); (34) *E.maximum* (Rudow); (35) *E.elbeli* sp. n.; (36) *E.paradisicum* sp. n.; (37) *E.africanum* sp. n.

Female. Slightly more heavily sclerotised (fig. 37) than females of all other species of *gruis*-group. Contrast between brown pigmentation pattern of lateral tergites II–VIII, which have distinct contours, and general background less marked even than in male of *maximum*, because of light brown colour of general cuticle. Pterosternal plate and sternite II as in figure 30, there being considerable individual variation in their shape. Lateral sternites III–VII as in *maximum*, but plates darker and colour more uniform because of apparent lack of differential pigmentation of their inner margins.

Chaetotaxy. Elongate pteronotal marginal setae: total 15–18, each side 7–9, \bar{x} 8.12 (8 sides), arranged in four groups, break-up of the eight sides being: 1 (outer group), 1, 2 and 3 (inner group) (2 sides); 1, 1, 2 and 4 (3 sides); 1, 1, 3 and 4 (1 side); 1, 1, 2 and 5 (2 sides). Although, because of individual variation no normal count and pattern are discernible, the range is intermediate between that in the *gruis* species-group and in *brevicephalum*. Pleural setae on segment III: 1 + 1 (3), 2 + 1 (1). Vulval marginal: 22–23 (4); 7–12, \bar{x} 9.75 fine and short to medium (their range only being smaller than in *maximum*), 10–15, \bar{x} 12.75 stouter and medium to long (fig. 16).

Measurements (4 ♀). Head: total length—1.13–1.16, \bar{x} 1.145; preantennal length—0.495–0.53, \bar{x} 0.51; breadth at temples—1.00–1.02, \bar{x} 1.01. Length of abdomen: 3.12–3.55, \bar{x} 3.30. Total length: 5.35–5.50, \bar{x} 5.42.

Holotype ♀, slide no. 1958–686, from skin (no. 17760 in S. African Museum) of *Bugeranus carunculatus*, BECHUANALAND (NOW BOTSWANA): Ngamiland, 21.v.1920 (G.H.E.Hopkins) (BMNH). *Paratypes*. 3 ♀ with data as given for holotype.

The *brevicephalum* species-group

(1) Body virtually white, without a pigmentation pattern; sternal thickening not apparent. (3) Normally 8 very long marginal pteronotal setae each side arranged in four groups of 1, 1, 3 and 3 setae, respectively (fig. 12). (8) Terminal sternum in the male produced into characteristic lateral, pointed processes, pigmented at the tip (fig. 27). (11) Vulval marginal setae medium to long, similar in proportions, and those of each side arranged in two groups separated by a prominent gap (fig. 28). Characters 2, 4, 6, 7, 9 and 10 as in the *gruis*-group; 5 as in the *giganteum*-group.

This group includes *E. brevicephalum* (McGregor) and an undetermined form parasitic on *Grus americana*.

Esthiopterus brevicephalum (McGregor, 1917)

(figs. 12, 27 and 28)

Type-host: *Grus canadensis tabida* (Peters)

The characters that delimit the species group distinguish *brevicephalum* from other known species.

Male and female chaetotaxy. Elongate pteronotal marginal setae: ♂ total 16–21, \bar{x} 17.83 (6), each side 8–12, arranged as follows in the 6 males: normal on both sides (2), normal on one side, deviation on other (2), deviation on both sides (2); ♀ total 13–19, \bar{x} 16.50 (20), each side 6–10, arranged as follows in the 20 females: normal on both sides (8), normal on one side, deviation on other (7), deviation on both sides (5). The deviation from norm may be in number or arrangement or in both. Pleural setae on segment III: ♂ 1 + 1 (6);

♀ 1 + 1 (18), 1 + 2 (1), 1 + ? (1); long to very long in both sexes. Setae in genital region, ♂: (3), central 3 + 3 and lateral 14 + 13 (1), 4 + 2 and 13 + 12 (1), 3 + 3 and 11 + 11 (1); these are present on lateral processes of terminal sternum. In each lateral cluster only one inner seta (x) is stouter and about 1.5–2 times longer than remaining setae, as in *gruis* and *maximum*.

Material examined. From *Grus c. canadensis* (L.), U.S.A.: 4 ♂ (1 pharate, 1 damaged, 1 dissected), 19 ♀, California (*R. Meinertzhagen*, 12609); 1 ♂, 1 ♀, St Michael, Alaska, slides no. 1949–507, 3.vi.1915 (*R.L. Edwards*) (all BMNH). From *Grus canadensis pratensis* F.A.A.Meyer, U.S.A.: Palmdale, Florida, 1 ♂ and 1 ♀, 15.xii.1970 (*D.J. Forrester*, SHC-22) (EC).

One female and one pharate male, both in poor condition, have been examined from *Grus americana* (L.) (U.S.A.: Aransas Pass, Texas, 25.iii.1948, *R.P. Allen*) (EC). These possess the characters of this species group but are inadequate for determining the specific status of the population on this host.

The *giganteum* species-group

(1) As in the *brevicephalum*-group. (2) Head setae relatively longer and stouter than in the *gruis*-group, the important ones being: dorsal submarginal very long, preantennal medium, postnodal and ocular long, marginal temporal 4 very long, in the male temporal 1 and posterior dorsal long; anal setae, particularly d, relatively long in the male (figs. 13, 15). (3) 27–35 very long marginal pteronotal setae (fig. 11). (4) In the male dorsal appendage of antennal segment I large and somewhat cylindrical (fig. 5). (5) Tubercle at base of hook on antennal segment III with several prominent ridges (fig. 7). (6) Position of inner and middle posterior tergal setae on IX + X as in figures 13–15. (7) Male segment IX + X with 2 + 2 posterior pleural setae (figs. 13, 15). (8) Terminal sternum in the male normal or modified. (9) Vulval margin enlarged (fig. 14). (10) Vulva with marginal and anterior setae (fig. 14). (11) Vulval marginal setae fine, short to medium, not strikingly different in proportions, and on each side forming a continuous row (fig. 14).

This group includes two species, *E. giganteum* (Le Souëff & Bullen) and *E. indicum* sp. n.

Esthiopterus giganteum (Le Souëff & Bullen, 1902)

(figs. 1, 13 and 14)

Type host: *Grus rubicunda rubicunda* (Perry)

The characters that distinguish this form from *indicum* are given under that species.

Male and female. Preantennal region of head as shown in figure 1. Measurements of head. Total length—♂ (2) 1.20; ♀ (1) 1.29; preantennal, ♂ 0.41, 0.45; ♀ 0.43. Breadth: temples, ♂ 1.17, 1.22; ♀ 1.31. Terminal sternum in the male normal (fig. 13).

Chaetotaxy. Elongate pteronotal marginal setae: ♂ each side 13–15, total 28 (2); ♀ each side 13–16, total 29 (1), 32 (1). Pleural setae on segment III: ♂ 2 + 2 (2); ♀ 2 + 2 (1), 2 + 3 (1). Setae in genital region, ♂: (1); central 7 + 4, relatively more lateral than in *gruis*-group; lateral 12 + 11, all more or less of similar proportions. Vulval marginal: (2), 17 + 15, 14 + 15, moderately long.

Material examined. From *Grus rubicunda* (Perry), Australia: 2 ♂ (1 dissected), 1 ♀, slides no. 1967–102, St Helliers and Townsville, Queensland, 27.vii.1965, 18.i.1966;

1 ♂, 3 ♀, Endeavour Reef, Great Barrier Reef (*L.Harrison*); 1 ♂, 1 ♀, without data (all BMNH).

***Esthiopterum indicum* sp. n.**

(figs. 2, 5, 7, 11 and 15)

Type-host: *Grus antigone antigone* (L.)

This species is distinguished from *giganteum* in both sexes by its larger size, the shape of the preantennal region of the head, characters of the genital region, and in the male by the external genitalia.

Male and female. Preantennal region of head longer than in *giganteum* (fig. 2). Terminal sternum in male produced into a median, pointed process (fig. 15), which makes measurements of length of abdomen and of total length longer than those of female, unlike the other new species described here.

Chaetotaxy. Elongate pteronotal marginal setae: ♂ each side 13-18, \bar{x} 15.58 (26 sides), total 27-35 (13); ♀ 13-16, \bar{x} 14.45 (20 sides), total 27-31 (10). Pleural setae on segment III: ♂ 3 + 3 (12), 2 + 3 (2), 4 + 3 (1); ♀ 3 + 3 (11), ? + 3 (2). Setae in male genital region as in figure 15. Vulval marginal: each side 10-15, \bar{x} 12.94 (14 sides), total 21-28 (7), much finer and slightly shorter than in *giganteum*.

Measurements. Head: total length—♂ 1.29-1.54, \bar{x} 1.42 (4); ♀ 1.44-1.54, \bar{x} 1.46 (4); preantennal length—♂ 0.50-0.54, \bar{x} 0.52 (4); ♀ 0.50-0.57, \bar{x} 0.53 (4); breadth at temples—♂ 1.36-1.47, \bar{x} 1.40 (4); ♀ 1.36-1.44, \bar{x} 1.41 (4). Length of abdomen: ♂, up to the tip of the pointed process, 4.52-4.63, \bar{x} 4.59 (3); ♀ 4.38-4.59, \bar{x} 4.49 (3). Total length: ♂ 7.25-7.68, \bar{x} 7.43 (3); ♀ 7.39-7.61, \bar{x} 7.49 (3).

Holotype ♂, slide no. 8884a from *Grus a. antigone* (L.), INDIA: Rajputana (now Rajasthan), iii. 1937 (*R.Meinertzhagen*) (BMNH). *Paratypes.* From *G.a. antigone*, 10 ♂ (3 dissected), 12 ♀, with data as given for holotype (*R.Meinertzhagen*, 8884); 5 ♂ (1 pharate), 1 ♀, from *G. antigone* in Vincennes (U.S.A.: Indiana) Zoo (all BMNH). 1 ♂, from *G. antigone* in National Zoo Park, Washington, D.C. (EC).

Key to the species of Esthiopterum

- 1 Pteronotum with more than 13 very long marginal setae each side (total mean more than 26) (fig. 11) 2
- Pteronotum with less than 11 very long marginal setae each side (total mean less than 18) (figs. 10, 12) 3
- 2 (1) Head anterior to anterior dorsal setae relatively longer; in the male terminal sternum produced into a median process; in the female vulval marginal setae fine (figs. 2, 15) **indicum** sp. n.
- Head anterior to anterior dorsal setae relatively shorter (fig. 1); in the male terminal sternum as in figure 13; in the female vulval marginal setae stout (fig. 14) **giganteum** (Le Souëf & Bullen)
- 3 (1) Normally 2 + 2 pleural setae on segment III (fig. 10); male external genitalia diagnostic. (Male with 1-4 (mean 3) very long and stout setae in each lateral cluster in the genital region) **elbeli** sp. n.
- Normally 1 + 1 pleural setae on segment III (figs. 17, 18); male genitalia otherwise 4

- 4 (3) Males 5
- Females 8
- 5 (4) Terminal sternum produced into two lateral processes (fig. 27) **brevicephalum** (McGregor)
- Terminal sternum normal, somewhat curved (figs. 25, 26, 31) 6
- 6 (5) In each lateral cluster in the genital region, not seta x but 3-7 (mean 5.55) setae are the longest and stoutest setae; tergum XI characteristically pigmented (fig. 25) **paradisium** sp. n.
- In each lateral cluster in the genital region seta x is the longest and stoutest seta; tergum XI unpigmented or feebly pigmented (fig. 26) 7
- 7 (6) Basal apodeme well pigmented; pigmentation pattern of abdominal dorsum diagnostic, contours of lateral tergites II-X being distinct and pleurites III-VI widely pigmented (figs. 8, 18) **maximum** (Rudow)
- Basal apodeme almost or quite unpigmented; pigmentation pattern of abdominal dorsum diagnostic, contours of lateral tergites being extremely faint and pleurites III-VI narrowly pigmented; (figs. 9, 17) **gruis** (L.)
- 8 (4) Vulval marginal setae usually arranged in four groups, two median and two lateral, and all setae of identical proportions (fig. 28) **brevicephalum** (McGregor)
- Vulval marginal setae form a continuous row except for a narrow median gap, with the median setae shorter and finer than the lateral ones (fig. 16) 9
- 9 (8) Abdomen more extensively pigmented, with each lateral tergite IX + X having one curved pigmented area (fig. 36) **paradisium** sp. n.
- Abdomen less extensively pigmented, with each lateral tergite IX + X having two pigmented areas (figs. 33, 34, 35, 37) **gruis** (L.)
- maximum** (Rudow)
- elbeli** sp. n.
- africanum** sp. n.

Affinities of Esthiopterum

In the family Gruidae, comprising the cranes, Peters (1934) recognises 23 taxa contained in 14 species belonging to four genera. These birds harbour four phtirapterous genera—the amblyceran *Gruimenopon* and *Heleonomus* and the ischnoceran *Esthiopterum* and *Saemundssonina*, the last genus having perhaps become secondarily established (Clay, 1957). In a discussion on the host-parasite relationships of Gruiformes, Clay (1957: 148) states that the affinities of three genera (*Gruimenopon*, *Heleonomus* and *Esthiopterum*) are doubtful; *Saemundssonina* is characteristic of the Charadriiformes but is also found elsewhere. Eichler (1963) includes *Fulicoffula* and *Wilsoniella* together with *Esthiopterum* in Esthiopterinae, one of the five subfamilies of Esthiopteridae, indicating that he considers *Esthiopterum* to be closely related to these genera; unfortunately, he gives no suprageneric characters to justify this classification. A comparison of 10 characters constant for species of *Esthiopterum*, and from experience found to be taxonomically useful, was therefore made between *Esthiopterum*, *Fulicoffula* and *Wilsoniella*. The characters are: marginal carina; marginal temporal setae; antenna; pronotal chaetotaxy; mesonotal chaetotaxy; relative position of the thoracic trichobothrium, thoracic spiniform seta and the long pteronotal marginal setae; number and arrangement of the long

peronotal marginal setae; post-spiracular seta; female terminalia: nature of the lateral margin and of the ventral surface. Of these characters only two—the presence of dimorphic antennae and one very long marginal temporal seta (the fourth)—were common to the three genera. Not only are both these characters found in several other ischnoceran genera, but the antenna is notorious for its variability even in related congeneric species, *Rallicola* and *Degeeriella* being good examples. If Eichler's classification was based on either or both of these characters, the species of several diverse genera would have to be included with *Esthiopterum*, *Wilsoniella* and *Fulicoffula*; for the present, therefore, the affinities of *Esthiopterum* must remain obscure.

Relationships of Esthiopterum and Heleonomus parasitic on Balearica and Grus.

Esthiopterum has been examined from ten species of cranes. The specific status of the specimens from *Grus americana* proved indeterminable, and a single female from *G. monacha*, although a new taxon, has been left undescribed. Each of the remaining eight species of cranes has a taxonomically distinct *Esthiopterum*. The eight species of *Esthiopterum* have been placed in three species-groups, the inclusion of *E. africanum* in the *gruis*-group, to which the female from *G. monacha* also belongs, being provisional until its male is known.

From the known host distribution and interspecific relationships of *Heleonomus* (see Price, 1970) and of *Esthiopterum* the following information of interest can be gleaned.

(1) The two recognised species of *Heleonomus* from *Balearica* form a distinct species-group, but *Esthiopterum* from this host has been included in the *gruis*-group which has almost the same host distribution as the *macilentus*-group of *Heleonomus*. This difference is obviously due to the greater divergence of *Heleonomus*.

(2) *Esthiopterum* from *Grus canadensis* and *G. americana* are sufficiently distinctive to form a separate group. Authentic *Heleonomus* from *G. canadensis* is unknown, and that from *G. americana* is included in the *macilentus*-group. According to this evidence *Esthiopterum* from *G. americana* has diverged more from congeneric species from the Old World *Grus* that harbour the *macilentus*-group than have their *Heleonomus*—this being the reverse of the condition found in species of these genera parasitic on *Balearica*. If and when *Heleonomus* is available from *G. canadensis* it would be interesting to know how far its affinities support this conclusion.

(3) *Heleonomus laveryi*, belonging to the *abdominalis*-group, is found on *Grus antigone* and *G. rubicunda*; the other species in this group, *abdominalis* (Piaget) is found on *G. vipio*. *Esthiopterum* spp. from *G. antigone* and *G. rubicunda* also belong to a distinct species-group but are specifically separable. This distinct grouping of the lice of the two genera is indicative of a close relationship between their hosts, which, being in agreement with the accepted relationships (Peters, 1934) of *G. antigone* and *G. rubicunda*, shows once again the usefulness of the bird lice in understanding the affinities of their hosts. *Esthiopterum* has not been available from *G. vipio* which according to its *Heleonomus* is close to *G. antigone* and *G. rubicunda*.

(4) *Heleonomus macilentus* (Nitzsch) is found on *Grus antigone*, *G. vipio*, *G. grus* and *G. nigricollis*, and other species belonging to the *macilentus*-group occur on *G. monacha*, *G. americana* and *G. leucogeranus* and also on *Anthropoides*. All cranes of the genera *Anthropoides* and *Grus*, with the exception of *G. vipio* and *G. antigone*, therefore appear to be parasitised by only one species of *Heleonomus*. This distribution suggests either that

G. vipio and *G. antigone* have secondarily acquired *H. macilentus* or that the ancestral stock branched into two sympatric forms; while both the *abdominalis* and *macilentus* groups are extant on *G. vipio* and *G. antigone*, *macilentus* has become extinct on *G. rubicunda*.

I thank the Trustees of the British Museum (Natural History) for the privilege of working in the Department of Entomology, for financial help and for the microphotographs taken by Mr J.V. Brown of the Photographic Studio (BMNH); Dr K.C. Emerson for the loan of *Esthiopterum*; my brother, Dr Shivo K. Tandan, for financial help; and the University of Lucknow for leave. To Dr Theresa Clay I am grateful for help in numerous ways, not the least of which was to let me draw freely from her profound knowledge of the Phthiraptera and incorporate her ideas in the discussion.

REFERENCES

- References given in Kéler (1960) have been omitted
- CLAY T. 1970. The Amblycera (Phthiraptera: Insecta). *Bull. Br. Mus. nat. Hist. (Ent.)* 25: 73-98.
- CLAY T. & HOPKINS G.H.E. 1950. The early literature on Mallophaga Part 1, 1758-1762. *Bull. Br. Mus. nat. Hist. (Ent.)* 1: 223-272.
- EICHLER W. 1963. Arthropoda. Insecta. Phthiraptera 1. Mallophaga. In Bronn's Klassen und Ordnungen des Tierreichs, Leipzig 5 III.
- KÉLER S. von. 1960. Bibliographie der Mallophagen. *Mitt. zool. Mus. Berl.* 36: 146-403.
- KUMAR P. & TANDAN B.K. 1971. The species of *Ardeicola* (Phthiraptera: Ischnocera) parasitic on the Ciconiidae. *Bull. Br. Mus. nat. Hist. (Ent.)* 26: 117-158.
- PETERS J.L. 1934. *Check-list of birds of the World* 2. Cambridge, Mass.
- PRICE R.D. 1970. A review of the genus *Heleonomus* (Mallophaga: Menoponidae) from the cranes. *Ann. ent. Soc. Am.* 63: 1162-1174.