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BUCEROCOPHORUS, A NEW GENUS OF ISCHNOCERAN MALLOPHAGA FROM AFRICAN HORNBILLS (BUCEROTIDAE)

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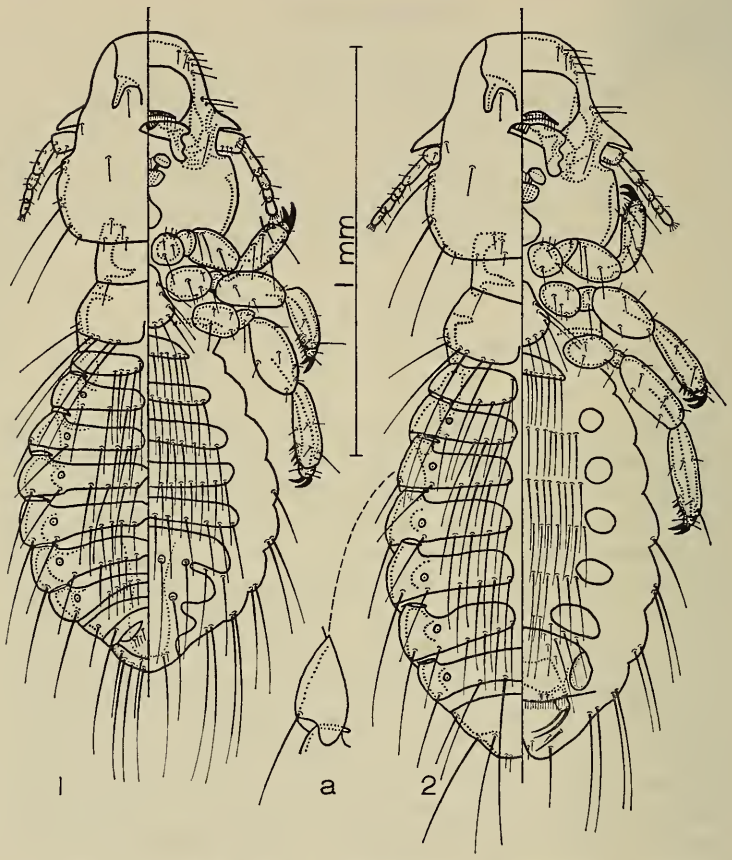
In revising the Hornbill ischnoceran Mallophaga, 3 species could not be included in either *Buceronirmus* or *Paroncophorus*. The new genus *Bucerocophorus* is described here for the species *Oncophorus latifrons* Piaget, 1885, *Docophorus pachycnemis* Giebel, 1876, and a new species, *B. watsoni*. For the loan of specimens appreciation is expressed to: Dr. Theresa Clay, British Museum (Natural History) (BMNH), Dr. K. C. Emerson, Smithsonian Institution (USNM), Dr. J. A. Ledger, South African Institute of Medical Research (SAIMR), and Dr. Savo Brelih, Yugoslavian Prirodoslovni Musej Slovenije (PMS). I obtained dried material from museum skins at the USNM, American Museum of Natural History (AMNH), and the Field Museum of Natural History (FMNH). Special thanks are extended to: Dr. L. T. Nielsen, Department of Biology, University of Utah, for providing space and facilities for this study, Drs. Clay and Emerson for their helpful suggestions, and Drs. Mary LeCroy, AMNH, and G. E. Watson, USNM, for supplying host and locality information. Mallophagan terminology follows Clay (1958) and nomenclature of the hosts is that of Sanft (1960).

Bucerocophorus, new genus
Figures 1 and 2

Dorsal anterior plate of forehead with 3 posterior extensions, 2 lateral and 1 medial. Antennae filiform, similar in both sexes. Pronotum with a short seta on each lateral margin. Pterothorax with posterior marginal row of 10–12, normally 10, long setae and a short seta



FIGS. 1–2. *Bucerocophorus pachycnemis* (Giebel), dorsal-ventral views, drawn to same scale: 1, Male. 2, Female; a, pleurite of abdominal segment IV.

on each lateral margin. Metasternal plate triangular, expanded posteriorly, with 10–14, normally 12, setae. Abdominal segments with tergites, sternites, and pleurites, the latter prolonged posteriorly on II–IV (Fig. 2a) and with setae on margins on IV–X or V–X. Tergites II–IV, II–V, or II–VI in male and II–VII in female divided medially, remainder complete; on II–VIII both sexes with a posterior marginal row of setae, the most laterad on III–VII being the post-spiracular seta. Sternites II–VI in male and II in female complete, III–VII in female circular or oval in shape, and on II–VII of both sexes a posterior marginal row of setae. Terminal segments as illustrated for

each species; male with 6–8, normally 6, dorsal setae on posterior margin and sternites VII–XI fused into single genital plate; female vulval margin with posterior marginal row of short setae and 4–6 spines; postvulval sclerite similar in shape for each species; fused IX–XI with 5 sternal setae each side, the anterior 2 stout and curved, arising from sclerite at lateral edge of vulval margin.

Bucerocophorus with 3 extensions of the dorsal anterior plate resembles most closely *Buceronirmus* with 1 dorsomedial extension of the marginal carina. Both genera lack the hyaline margin of *Paroncophorus* which is unique in having a median groove and 2 small chitinous plates on the marginal carina. These differences were described and illustrated by Piaget (1885) for *Oncophorus latifrons* Piaget and "*O. cephalotes* Nitzsch" *sensu* Piaget, the type species of *Paroncophorus* (Hopkins and Clay, 1952). *Bucerocophorus* resembles *Paroncophorus* in the posterior prolongation of pleurites II–IV which are not prolonged in *Buceronirmus*. On each lateral margin of fused IX–XI in the female, *Bucerocophorus* has the anterior 2 sternal setae stout and curved and arising from a sclerite at the lateral edge of the vulval margin but both *Buceronirmus* and *Paroncophorus* have a vertical line of sternal setae none of which arise from a sclerite at the vulval margin.

The male genitalia and number of pleural setae on segments IV–X are the best characters for separating species.

Type species: *Docophorus pachycnemis* Giebel, 1876.

Bucerocophorus latifrons (Piaget)

Figures 3–5

Oncophorus latifrons Piaget, 1885:36, pl. 4, fig. 6.

Type host: *Buceros semifasciatus* = *Tockus fasciatus semifasciatus* (Hartlaub).

Paroncophorus latifrons (Piaget). Hopkins and Clay, 1952: 265.

A lectotype female (BM 1928-325) is designated hereby from the Piaget collection in the BMNH. The slide has been so labeled.

Both sexes are about the same size as corresponding sexes of *B. pachycnemis*.

Male: Abdominal tergites II–V often VI divided medially; remainder complete. Tergocentral setae: II–V range 8–12; VI–VIII range 10–16; normally 10 on II–IV, 12 on V–VIII. Pleural setae each side: IV dorsally and ventrally 0–1, normally 0; V–VII dorsally 1–2, normally 1 on V, 2 on VI–VII; V–VII ventrally 1–3, normally 2; VIII–X ventrally 2–4. Sternal setae: II–VI range 10–16, normally 12, except 14 on III; VII range 8–14; VIII range 2–4. Normal chaetotaxy of terminal segments as in Figure 4. Genitalia as in Figure 3; penis with circular opening on posterior tip and endomeres with large lateral anterior lobes almost reaching anterior end of each lateral arm.

Female: Differs from male as follows. Tergocentral setae: II–VII range 8–12; VIII range 6–8; normally 10, except 8 on II and VIII. Sternal setae: II–VII range 10–16, normally 10 on II and VII, 12 on V–VI, 14 on III–IV. Normal chaetotaxy of terminal segments as in Figure 5; vulval margin with 30–38 short setae and 4–6 spines.

Measurements in mm: Head width, ♂0.42–0.47 ♀0.47–0.51; head length, ♂0.48–0.54 ♀0.53–0.56; pterothorax width, ♂0.31–0.36 ♀0.35–0.40; abdomen width, ♂0.56–0.64 ♀0.60–0.70; total length, ♂1.36–1.57 ♀1.66–1.83. Measurements given by Piaget (1885) for the female fall within the above ranges except for pterothorax width, 0.34. Males were unknown to him.

Material examined: Lectotype ♀, *Tockus fasciatus semifasciatus*, BM 1928-325, Piaget, in BMNH; 1♀, USNM skins, Mt. Coffee, Liberia, Africa, Feb.–Mar. 1897, R. P. Currie; 2♂♂ 2♀♀, *T. f. fasciatus* (Shaw), Luachimo River, Dundo, Angola, Africa, 4 Apr. 1971, SAIMR; 1♀, FMNH skin, Kyetume, Uganda, Africa, 1909, V. G. L. van Someren; 1♀, FMNH skin, Mt. Tandon, Mouila, Gabon, Africa, 6 Jun. 1951, H. A. Beatty; 2♂♂ 2♀♀, USNM skins, Omboue, Gabon, Africa, 1917, C. R. Aschemeier; 2♂♂ 2♀♀, *T. p. pallidirostris* (Finsch and Hartlaub), Cuango River, Cafunfo, Angola, Africa, 12 May 1971, S. A. Peles, SAIMR; 1♂ 1♀, *T. a. alboterminatus* (Buttikofer), AMNH skins, Kasai River, Luluabourg, Zaire, Africa, 1923–1924, R. Callewaert; 1♀, AMNH skins, Golungo Alto, Angola, Africa, Jan. 1904, W. J. Ansorge; 1♀, *T. a. geloensis* (Neumann), AMNH skin, Entebbe, Uganda, Africa, R. Grauer; 4♂♂ 5♀♀ AMNH skins, Uganda, Africa, 1918–1919, V. G. L. van Someren; 1♂, *T. a. suahelicus* (Neumann), AMNH skin, Monkey Bay, Malawi, Africa, 19 Sep. 1895, P. Rendall; 1♂, FMNH skins, Sokoke Forest, Kenya, Africa, Jun. 1932, V. G. L. van Someren; 1♀, USNM skins, Taveta, Kenya, Africa, Jun.–Aug. 1888; 7♀♀, *T. alboterminatus australis* (Roberts), Coguno, Mozambique, Africa, 25 Apr. 1964, A. L. Moore, USNM.

Bucerocophorus pachycnemis (Giebel)

Figures 1, 2, 6–8

Docophorus pachycnemis Giebel, 1876: 248.

Type host: *Buceros leucopygus* = *Bycanistes fistulator sharpii* (Elliott).

Paroncophorus pachycnemis (Giebel). Hopkins and Clay, 1952: 266.

Hopkins and Clay stated that the generic position of *pachycnemis* was doubtful. Specimens examined are not congeneric with *Paroncophorus*. Since Giebel's type series does not now exist, a USNM male from the type host is designated hereby as neotype of *B. pachycnemis* and the slide has been so labeled.

Male: About the same size as *B. latifrons*; slightly smaller than *B. watsoni*, n. sp., in head width. Normal chaetotaxy as in Figure 1.

Abdominal tergites II–IV often V divided medially; remainder complete. Tergocentral setae: II–VIII range 8–10, except 6–10 on V. Pleural setae each side: IV–VII dorsally 1; V ventrally 1–2; VI–X ventrally 2–3. Sternal setae: II and VI range 10–14; III–V range 12–20; VII range 8–10; VIII 2. Terminal segments as in Figure 6. Genitalia as in Figure 8; penis with circular opening on posterior tip and endomeres with small lateral anterior lobes reaching about half way to anterior end of each lateral arm.

Female: About the same size as *B. latifrons*; slightly smaller than *B. watsoni* in both head measurements. Normal chaetotaxy as in Figure 2. Differs from male as follows. Tergocentral setae: II–VII range 6–8; VIII range 4–6. Sternal setae: VII range 10–12. Terminal segments as in Figure 7; vulval margin with 30–36 short setae and 4 spines.

Measurements in mm: Head width, ♂0.42–0.47 ♀0.48–0.54; head length, ♂0.49–0.55 ♀0.54–0.59; pterothorax width, ♂0.34–0.40 ♀0.37–0.45; abdomen width, ♂0.53–0.72 ♀0.58–0.79; total length, ♂1.32–1.65 ♀1.53–1.93.

Type-material: Neotype ♂, *Bycanistes fistulator sharpii*, USNM skins, Omboue, Gabon, Africa, 1917–1918, C. R. Aschemeier, in USNM; neoparatypes: 5♂♂ 6♀♀, same data as neotype; 1♂, Ambam, Cameroon, Africa, 1955, J. Mouchet, BMNH; 5♂♂, FMNH skins, Gabon, Africa, Jan.–Jun. 1951, H. A. Beatty.

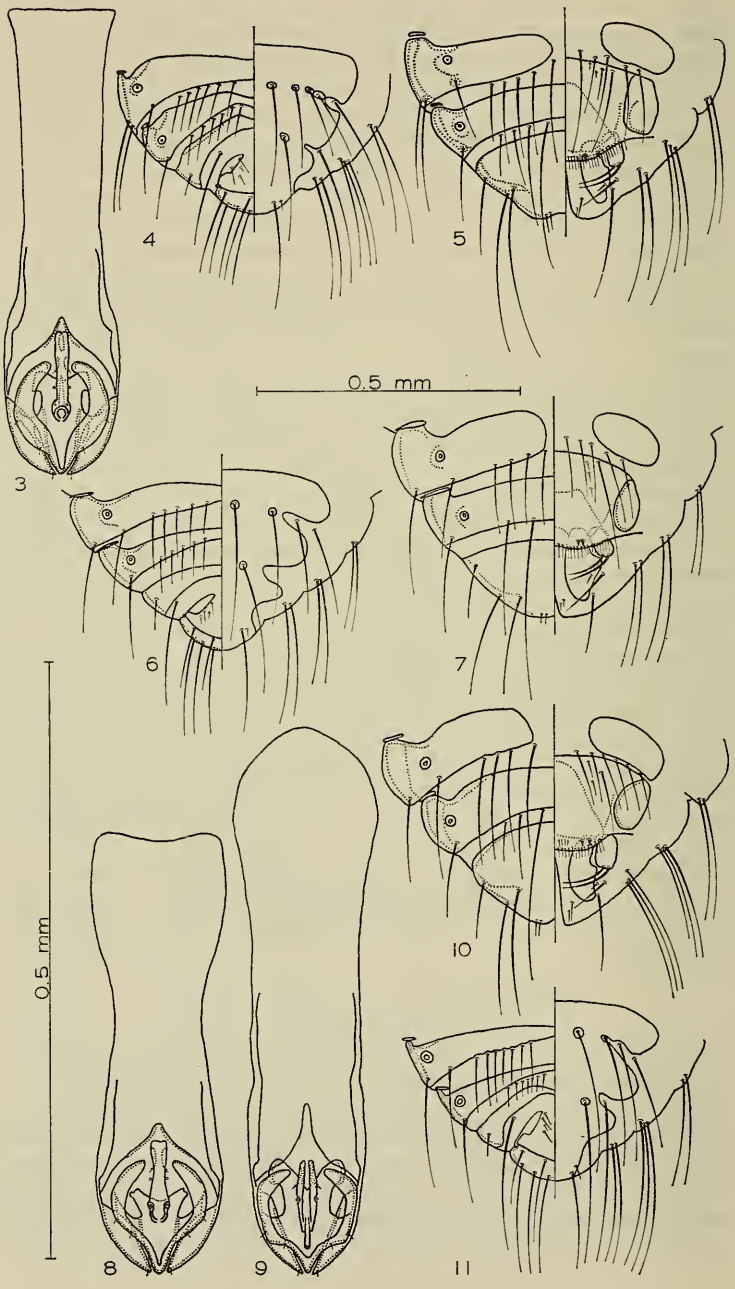
Other specimens: 1♂, *B. f. duboisi* (W. Sclater), FMNH skin, Ntotoro, Bwamba, Uganda, Africa, 3 Aug. 1944, V. G. L. van Someren; 1♂ 1♀, *B. bucinator* (Temminck), Zululand, Natal, South Africa, Nov. 1934, Meinertzhagen 2726, BMNH; 1♂ 1♀, Amani, Tanzania, Africa, R. E. Moreau, BMNH; 1♂, AMNH skin, Natal, South Africa, F. B. Cowles; 2♂♂ 1♀, AMNH skin, Lake Nyasa, Malawi, Africa, 23 Aug. 1895, P. Rendall; 1♀, AMNH skin, Hectorspruit, Transvaal, South Africa, 20 Dec. 1901, W. C. Giffard; 1♀, AMNH skins, Nsuguru, Tanzania, Africa, 11 May 1929, R. and L. Boulton; 1♂, FMNH skin, Zululand, Natal, South Africa, 6 Jan. 1904, C. H. B. Grant; 1♂, FMNH skin, Ukamba, Kenya, Africa, 14 Aug. 1918, V. G. L. van Someren; 1♂ 3♀♀, FMNH skin, Ndola, Zambia, Africa, 8 Apr. 1948, E. L. Button.

Bucerocophorus watsoni, new species

Figures 9–11

Type host: *Bycanistes cylindricus albotibialis* (Cabanis and Reichenow).

Male: Slightly larger than *B. pachycnemis* in head width. Abdominal tergites II–IV rarely V divided medially; remainder complete. Tergocentral setae: II range 8–12, normally 10; III–VIII range 10–16, normally 12 on III–VI. Pleural setae each side: IV–VII dorsally 1; VI ventrally 1–2, normally 1; VII–X ventrally 2–4. Sternal setae: II and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VI range 12–16, normally 14; III–IV range 18–24, normally 20; V range 16–20, normally 18; VII range 8–12; VIII 4. Normal chaetotaxy of terminal segments as in Figure 11. Genitalia as in Figure 9; penis with rod on posterior tip and endomeres with large lateral anterior lobes reaching ahead of each lateral arm.

Female: Slightly larger than *B. pachycnemis* in both head measurements. Differs from male as follows. Tergocentral setae: II–VI range 8–10, normally 8, except 10 on III; VII range 6–8; VIII range 4–8. Sternal setae: VII range 12–14. Normal chaetotaxy of terminal segments as in Figure 10; vulval margin with 36–48 short setae and 4–6 spines.

Measurements in mm: Head width, ♂0.46–0.53 ♀0.53–0.59; head length, ♂0.52–0.59 ♀0.59–0.64; pterothorax width, ♂0.35–0.43 ♀0.41–0.49; abdomen width, ♂0.60–0.75 ♀0.62–0.81; total length, ♂1.51–1.80 ♀1.75–2.11.

Type-material: Holotype ♂, allotype ♀, *Bycanistes cylindricus albotibialis*, Mbalmayo, Cameroon, Africa, J. Mouchet, in BMNH; paratypes: 1♂ 2♀♀, FMNH skins, Uganda, Africa, 1945–1946, V. G. L. van Someren; 2♂♂ 1♀, FMNH skins, Cameroon, Africa, 1948–1952, A. I. Good; 1♂ 1♀, FMNH skin, Fougamou, Gabon, Africa, 11 Aug. 1957, H. A. Beatty; 2♂♂, USNM skin, Cameroon, Africa, 20 Aug. 1910, G. L. Bates; 1♂, USNM skins, Ogooue River, Nkama, Gabon, Africa, 1918, C. R. Aschemeier.

Other specimens: 2♂♂ 1♀, *B. c. cylindricus* (Temminck), AMNH skin, Yonnibanna, Sierra Leone, Africa, 22 Sep. 1912, Kelsall; 1♂ 3♀♀, FMNH skins, Ganta Forest, Liberia, Africa, Feb.–Jun. 1948, H. A. Beatty; 2♀♀, *B. subcylindrus subquadratus* Cabanis, FMNH skins, Cameroon, Africa, 1940–1948, A. I. Good; 8♂♂ 9♀♀, Kampala, Uganda, 5 Oct. 1932, G. H. E. Hopkins, BMNH; 3♂♂ 3♀♀, Uganda, Africa, Apr. 1936, Meinertzhagen, BMNH; 2♂♂ 2♀♀, Cuango River, Cafunfo, Angola, Africa, 3 Jun. 1971, S. A. Peles, SAIMR; 4♀♀, FMNH skins, Kampala, Uganda, Africa, 1918–1933, V. G. L. van Someren; 5♀♀, *B. brevis* Friedmann, Mt. Kilimanjaro, Tanzania, Africa, Meinertzhagen 10862, BMNH; 2♀♀, Awassa, Ethiopia, Africa, 7 Nov. 1960, S. Brelih, PMS; 1♀, USNM skin, Mt. Kilimanjaro, Tanzania, Africa, 17 Sep. 1889; 1♂ 3♀♀, USNM skins, Nairobi, Kenya, Africa, Jun.–Aug. 1909,

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Figs. 3–11. Male genitalia, ventral views, drawn to same scale: 3, *Bucerocophorus latifrons* (Piaget); 8, *B. pachycnemis* (Giebel); 9, *B. watsoni*, new species. Terminalia, dorsal-ventral views, drawn to same scale: *B. latifrons* (Piaget)—4, male; 5, female. *B. pachycnemis* (Giebel)—6, male; 7, female. *B. watsoni*, new species—10, female; 11, male.

TABLE 1. Distribution of *Bucerocophorus* and *lophocerus* species-group, genus *Chapinia* (Elbel, 1967, 1969a), on African Hornbills (Bucerotidae) arranged according to Sanft (1960).

Host[1]	*Bucerocophorus*	*Chapinia*
Tockus n. nasutus		*C. lophocerus*
T. n. forskalii		
T. n. epirhinus		*C. lophocerus*
T. n. dorsalis		
T. e. erythrorhynchus		*C. lophocerus*
T. e. rufirostris		*C. lophocerus*[2]
T. e. damarensis		
T. deckeni		*C. lophocerus*
T. f. flavirostris		*C. lophocerus*
T. f. somaliensis		
T. f. elegans		
T. f. leucomelas		*C. lophocerus*
T. p. pallidirostris	*B. latifrons*	
T. p. neumanni		
T. c. camurus		*C. camuri*
T. c. pulchrirostris		
T. h. hartlaubi		
T. h. granti		*C. fasciati*[2]
T. f. fasciatus	*B. latifrons*	*C. fasciati*
T. f. semifasciatus	*B. latifrons*	
T. a. alboterminatus	*B. latifrons*	
T. a. geloensis	*B. latifrons*	*C. fasciati*
T. a. suahelicus	*B. latifrons*	*C. fasciati*
T. alboterminatus australis	*B. latifrons*	*C. fasciati*
Ceratogymna elata		*C. robusta*
C. atrata	*B. watsoni*	*C. robusta*
Bycanistes f. fistulator		
B. f. sharpii	*B. pachycnemis*	*C. bucerotis*
B. f. duboisi	*B. pachycnemis*	*C. bucerotis*
B. bucinator	*B. pachycnemis*	*C. bucerotis*
B. c. cylindricus	*B. watsoni*	*C. bucerotis*
B. c. albotibialis	*B. watsoni*	*C. bucerotis*
B. s. subcylindricus		
B. subcylindricus subquadratus	*B. watsoni*	*C. bucerotis*
B. brevis	*B. watsoni*	*C. bucerotis*

[1] Species not included are 5 of *Tockus* and 1 of *Tropicranus* from which no *Bucerocophorus* or *lophocerus* species-group, genus *Chapinia*, were found.

[2] American Museum of Natural History and South African Institute of Medical Research specimens not reported previously.

Loring and Mearns; 2♂♂ 4♀♀, *Ceratogymna atrata* (Temminck), Cameroon, Africa, J. Mouchet, BMNH; 2♂♂ 2♀♀, Luachimo River, Dundo, Angola, Africa, 25 Apr. 1971, S. A. Peles, SAIMR; 2♀♀, FMNH skin, Cameroon, Africa, 11 Jul. 1907; 2♂♂ 1♀, FMNH skins, Gabon, Africa, May–Aug. 1951, H. A. Beatty; 2♂♂ 1♀, USNM skins, Omboue, Gabon, Africa, Jul.–Nov. 1917, C. R. Aschemeier.

Etymology: This species is named for Dr. G. E. Watson, Curator of Birds, USNM, in appreciation for permission to examine skins in that museum and for suggestions on presentation of the aviparasitological relations.

Discussion

Bucerocophorus watsoni is slightly larger than either *B. latifrons* or *B. pachycnemis* in head width of corresponding sexes and in head length of females. Male abdominal tergite VI is often divided medially only in *B. latifrons*. There are normally more tergocentral setae on VIII of *B. latifrons* and *B. watsoni* than corresponding sexes of *B. pachycnemis* (Figs. 4–7, 10–11). Both *B. pachycnemis* (Figs. 1 and 2) and *B. watsoni* have a pleural seta on IV which is often absent in *B. latifrons*. The following pleural setae for segments VII–X are illustrated in Figures 4–7 and 10–11. *B. latifrons* normally has 2 dorsal pleural setae on VI–VII compared to 1 each for *B. pachycnemis* and *B. watsoni*. Ventrally on each side of V–VII *B. latifrons* normally has 2 pleural setae, *B. pachycnemis* has 1 on V, 2 on VI–VII, and *B. watsoni* has 1 on VI, 2 on VII. Both *B. latifrons* and *B. watsoni* have 3 ventral pleural setae each side of VIII but *B. pachycnemis* has 2. *B. watsoni* female normally has 3 ventral pleural setae each side of X but *B. latifrons*, *B. pachycnemis*, and *B. watsoni* male normally have 2. Sternal setae on III–V are more numerous in *B. watsoni* than in corresponding sexes of *B. latifrons*. *B. pachycnemis* male (Fig. 6) has 2 sternal setae on VIII but males of *B. latifrons* and *B. watsoni* normally have 4 (Figs. 4 and 11). The fused male genital plate has a shallower indentation between VII–VIII and VIII–X in *B. latifrons* (Fig. 4) than in *B. pachycnemis* or *B. watsoni* (Figs. 6 and 11). The male genitalia has the penis ending posteriorly in a rod for *B. watsoni* (Fig. 9) but a circular opening for both *B. latifrons* (Fig. 3) and *B. pachycnemis* (Fig. 8); endomeres have large lateral anterior lobes in *B. latifrons* that almost reach the anterior end of each lateral arm but in *B. pachycnemis* these lobes are small and reach about halfway to the anterior end of each lateral arm; lateral arms in *B. watsoni* do not reach the anterior end of each large lateral lobe. The female vulval margin normally has more setae in *B. watsoni* (Fig. 10) than in *B. latifrons* or *B. pachycnemis* (Figs. 5 and 7).

Aviparasitological Relations

Species of the ischnoceran genus *Bucerocophorus* infest Hornbill hosts only in the genera *Tockus*, *Bycanistes*, and *Ceratogymna* of the Ethiopian region. As shown in Table 1, this distribution corresponds with that of the *lophocerus* species-group in the amblyceran genus *Chapinia* (Elbel, 1967). *Bucerocophorus latifrons* and *Chapinia fasciati* are found on the same species of *Tockus* but no *Bucerocophorus* infests species of *Tockus* inhabited by *C. lophocerus* and *C. camuri*. Infestation of *Bycanistes* is by *Chapinia bucerotis* on all species, *Bucerocophorus pachycnemis* on 2 species, and *B. watsoni* on 3 additional species as well as on a species of *Ceratogymna* inhabited by *Chapinia robusta*. The dissimilarity in infestation in the 2 mallophagan genera is expected since Clay (1957) stated that speciation rates in the Amblycera and Ischnocera have been so different that comparisons on the same host group have little value. Elbel (1969b) showed different speciation rates in the ischnoceran genera *Buceronirmus* and *Paroncophorus* than in the amblyceran genus *Chapinia* on 2 species of *Rhyticeros*. The genus *Tockus* is widely separated from *Bycanistes* and *Ceratogymna* in Peters' (1945) phylogenetic arrangement of the Hornbills. Sanft (1960) placed the latter 2 genera near *Tockus* and *Tropicranus albo-cristatus* so his arrangement more nearly agrees with that based on morphological similarities of the Mallophaga. He placed *Ceratogymna* between *Tockus* and *Bycanistes* but mallophagan taxonomy indicates that *Ceratogymna* should follow *Bycanistes* (Peters, 1945). *Bucerocophorus latifrons*, found on *Tockus*, resembles most closely *B. pachycnemis*, found on the first 2 species of *Bycanistes*; *Bucerocophorus watsoni* infests the last 3 species of *Bycanistes* and *Ceratogymna atrata* (Table 1). One would expect similarities among Mallophaga to parallel those of their hosts since Mallophaga spend their entire lives on the host bird and new hosts are infested by migration of lice from one bird to another during copulation, nesting, or roosting (Kellogg, 1896). Mallophaga become isolated when their hosts become isolated and with time speciation might occur in both host and Mallophaga (Elbel, 1969b). The environment of the Mallophaga, the physical and chemical composition of the feathers and blood, presumably changes slower than do other factors leading toward speciation of the bird; until the feathers and blood change, Mallophaga remain unchanged (Clay, 1949). According to Kellogg (1896) the ancestral bird species spread and gave rise to geographical races which eventually became distinct species, often distinguished only by superficial differences in color, etc. but the Mallophaga remained nearly the same because their environment was essentially the same. In the *lophocerus* species-group, *Chapinia lophocerus* infests 7 hosts in 4 species of *Tockus*, *C. fasciati* infests 5 hosts in 3 species of *Tockus*, *C. bucerotis* infests 7 hosts in 5 species of *Bycanistes*, and *C. robusta* infests both species of *Ceratogymna* (Table 1). Similarly,

Bucerocophorus latifrons infests 7 hosts in 3 species of *Tockus*, *B. pachycnemis* infests 3 hosts in 2 species of *Bycanistes*, and *Bucerocophorus watsoni* infests 5 hosts in 4 species and 2 genera, *Bycanistes* and *Ceratogymna*.

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