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# The species of *Ibidoecus* (Phthiraptera) on *Threskiornis* (Aves)

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## Abstract

The species of *Ibidoecus* parasitic on the Ibis genus *Threskiornis* are reviewed—*clausus* (Giebel), *dianae* Tandan, *insularis* sp.n., *tandani* sp.n., *threskiornis* Bedford—and a key for their identification presented. The host and geographical distribution of the phthirapteran parasites of this genus are discussed.

## Introduction

At the present time three species of *Ibidoecus* are known from *Threskiornis* (see Table 1), with two further species as described below. These are all rather similar to each other, the main characters being shown in the excellent figures and descriptions of Tandan (1958a, b).

### *Ibidoecus tandani* sp.n.

(Figs. 2–7, 10, 13, 14, 18)

Type host: *Threskiornis aethiopica abbotti* (Ridgway)

*Male.* Dorsal anterior plates as in Fig. 2, the posterior projection shows some intraspecific variation: in *tandani* this may be almost absent or longer, but always less well developed than in *threskiornis* and *insularis*. Chaetotaxy of head as in *dennelli* (Tandan, 1958b, Fig. 1), with a number of short to minute setae on the dorsal surface; antennae as in other species from *Threskiornis* with a long seta on the scape and pedicel. Chaetotaxy of the thorax as in *clausus* (Tandan, 1958b, Fig. 11), except that the inner marginal pronotal seta is about twice as long; lateral spiniform setae of pterothorax anterior to the lateral seta; metanotal marginal setae: range 26–35 (the two lateral setae each end omitted), $\bar{x}$ 31·43 (7). Meso- and metasternum each with two long setae, the mesoternal pair (approximately 0·19 mm*) being shorter than the metasternal pair (approximately 0·24 mm*). Terga as figured for *dianae* (Tandan, 1958a, Fig. 1) except tergite IX not fully separated from X (Fig. 5) and in *dianae* tergites on IX have an inner posterior pointed prolongation not present in *tandani*; IX with two central posterior colourless sensilla as in all the species considered here. Sternites II–VI as discrete lateral plates, VII continuous across the segment, subgenital plate as in Fig. 6. In both sexes the subgenital plate and sternite VII in the male are of various thicknesses so that there is no definite outline, but several rather indefinite ones as shown in Figs. 3 and 6. Genitalia similar to those of *clausus* and *dianae* (Tandan, 1958a, b), details as in Figs. 7, 13 and 14.

*Chaetotaxy of the abdomen.* Terga with a single row of setae with the exception of II and sometimes III. In both sexes there are one or two setae on varying terga in the position of post-spiracular setae which are included in the counts of the tergal setae. Tergum II, 10–13 and 2 central anterior; III, 11–16, one or two of these may be anterior to the row; IV, 9–12; V, 8–14; VI, 6–10; VII, 8–11; VIII, 8–9. Pleurum II, 2–3 each side; III, 4–5; IV, 3–5; V, 3–5; VI, 3–4; VII, 4–5; VIII, 4–5, one of which each side is the usual seta in the pocket of the integument. Sternum II, 2 small to minute, usually spiniform setae; III, 14–17; IV, 14–19; V, 14–15; VI, 11–15; VII, 4–7. Setae of posterior segments as in Figs. 5 and 6.

*Female.* Head and thorax similar to that of male. Pterothora marginal setae: range 28–33, $\bar{x}$ (7) 31·7. Tergites II–VIII widely separated in the mid-line; remaining tergites fused as one plate with the two anterior central setae usually placed on the tergite (Fig. 3), although if this breaks down centrally, the setae may not actually be on the plate; this is also true of *clausus* in which the setae may be on or off the plate: *threskiornis* may have four setae in this

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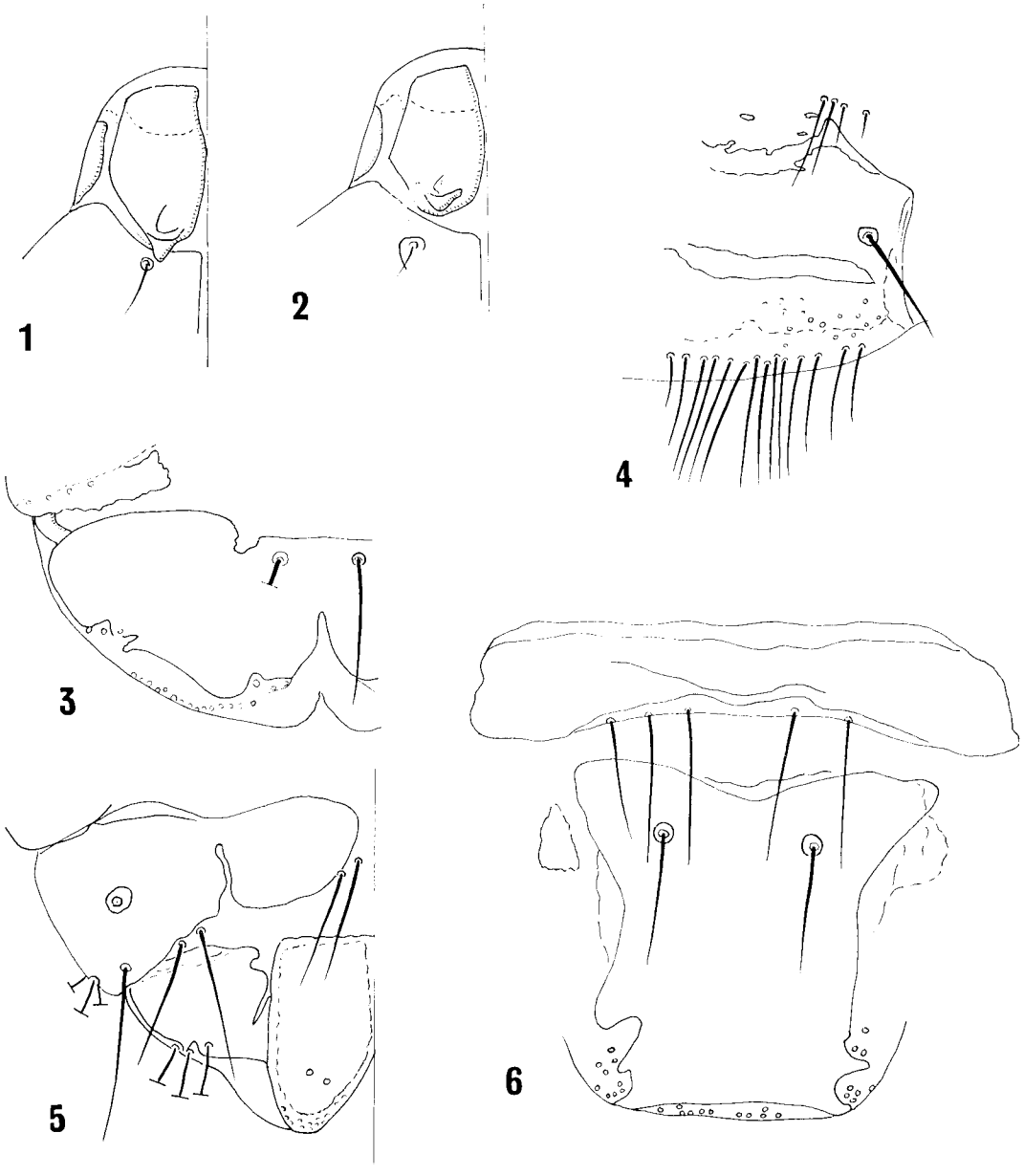
* See Clay (1966, 340; 1968, 208) for difficulty in measuring setae.




**Figs. 1–6.** *Ibidoecus* spp. (1–2) Anterior dorsal plate: (1) *I.threskiornis*; (2) *I.tandani*. (3–6) *I.tandani*: (3) ♀ terminal segments dorsal; (4) ♀ genital region; (5) ♂ terminal segments, dorsal; (6) ♂ terminal segments, ventral.

position. Sternites II–VII as discrete lateral plates, posterior sclerites as in Fig. 4. Spermathecal sclerite half-moon-shaped, not butterfly-shaped as in *Threskiornis* (Figs. 17 and 18).

*Chaetotaxy of the abdomen.* Terga with a single row of setae posterior to the tergites and an irregular double row centrally. Tergum II with 2 anterior setae and 12–18 posteriorly; III, 20–25; IV, 19–24; V, 20–23; VI, 19–23; VII, 18–22; VIII, 9–17; IX, anterior setae 2; see Figs. 3 and 4 for posterior segments. Pleurum II, 2–3 each side; III, 3–4; V, 4–5; VI, 4; VII, 4–5; VIII, 4–6. Sternum II, 2 small to minute setae; III, 15–18; IV, 15–20; V, 17–22; VI, 14–20; VII, short row of 4–6 each side of sternum; VIII, 1+1; the setae of latero-ventral clump each side of the anterior part of the last segment varies

from 2 to 4. Marginal setae of last segment appear partly dorsal and partly ventral in mounted specimens (in Fig. 3 they are shown dorsally), the number varies from 19 to 26 each side. Vulval setae: range: 11–15, $\bar{x}$ 12·5 (8); for *threskiornis*: range, 22–28, $\bar{x}$ 24·9 (10). The small circles on the genital plate in Fig. 4 represent minute colourless cone-shaped sensilla.

Dimensions (in mm). Temple width: ♂ holotype 1·03, range 1·02–1·07, $\bar{x}$ 1·05 (7). ♀ range 1·08–1·21, $\bar{x}$ 1·17 (6). Head length (hyaline margin not included): ♂ holotype 0·94, range 0·91–0·95, $\bar{x}$ 0·93 (7); ♀, range 0·95–1·09, $\bar{x}$ 1·04 (6). Head index: ♂, range 1·10–1·16, $\bar{x}$ 1·13 (7); ♀ range 1·08–1·17, $\bar{x}$ 1·13 (6). Prothorax width: ♂ 0·74; ♀ 0·74. Pteronotum width: ♂ 1·08; ♀ 1·08. Tergum V width: ♂ 1·48; ♀ 1·47. Total length: ♂ 3·22; ♀ 3·25.

*Material examined.* 6 ♂, 7 ♀ from *Threskiornis aethiopica abbotti* (Ridgway), ALDABRA, INDIAN OCEAN, South Island, 3–16.i.1968 (*B. Cogan and A. Hutson*); 6.vi.1968 and 13.vi.1968 (*R. S. Lowery*). Collected on the Royal Society Expeditions to Aldabra.

*Holotype.* ♂ in BMNH, slide No. 766, from the type host and type locality 3–16.i.1968 (*Cogan and Hutson*).

*Paratypes.* 5 ♂, 7 ♀ with data as given under 'Material examined'.

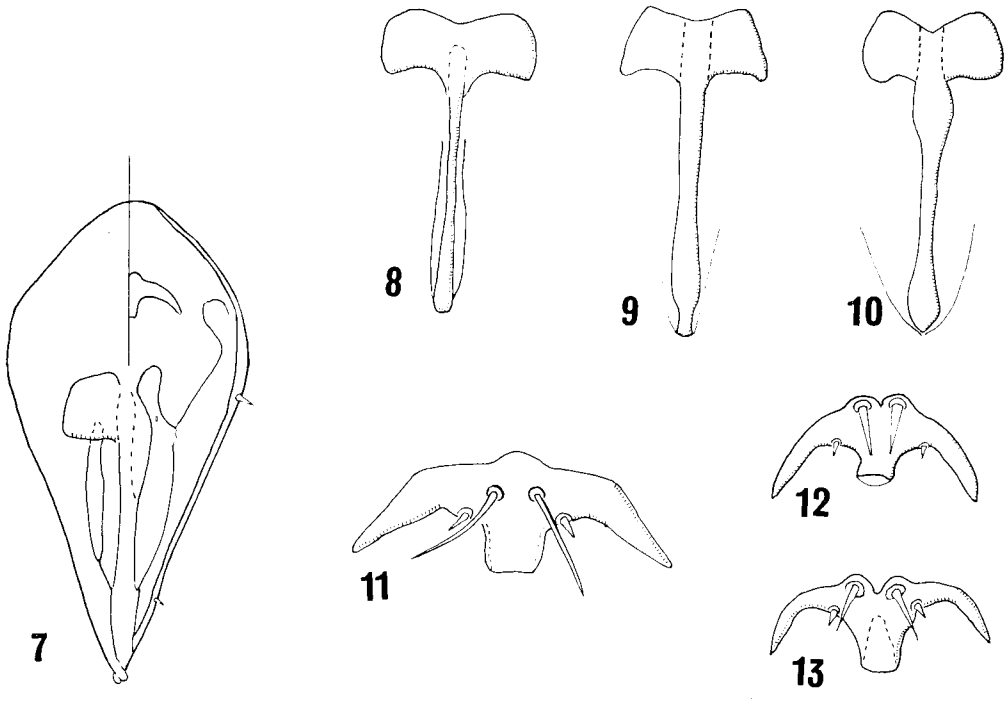
*Discussion.* This species is most similar to *insularis*, known only from the male, from which it is distinguished by the characters of the dorsal anterior plate and the genitalia. It is distinguished from *threskiornis* by a number of characters amongst which are size and shape of the anterior dorsal plates (Figs. 1 and 2) in both sexes. In the male by the smaller number of setae each side of the posterior end of the subgenital plate and the size and shape of the sclerites of the male genitalia (Figs. 8, 11 and 16). In the female by the smaller number of setae on the posterior margin of the abdomen and on the vulval margin and by the size and shape of the spermathecal sclerite (Fig. 17).

### ***Ibidoecus insularis* sp.n.**

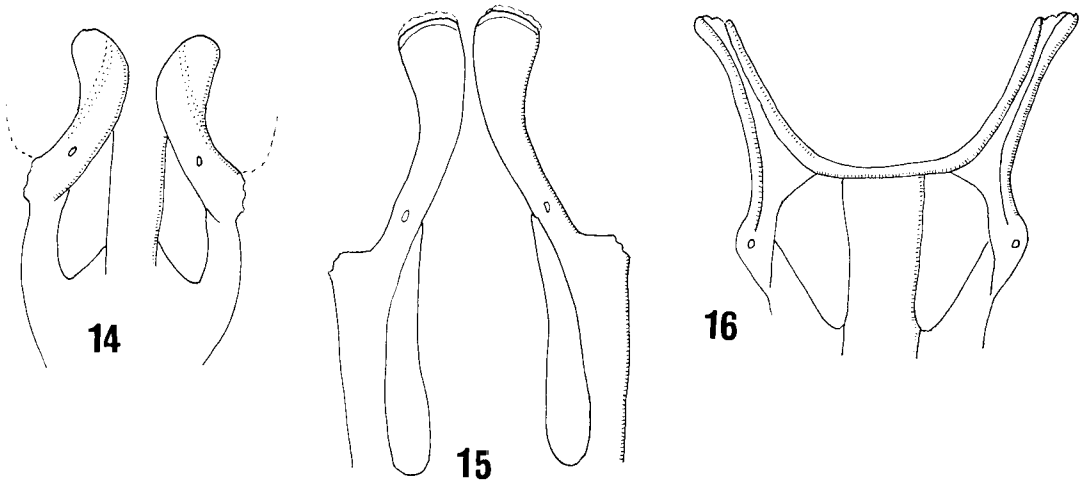
(Figs. 9, 12 and 15)

Type host: *Threskiornis aethiopica bernieri* (Bonaparte)

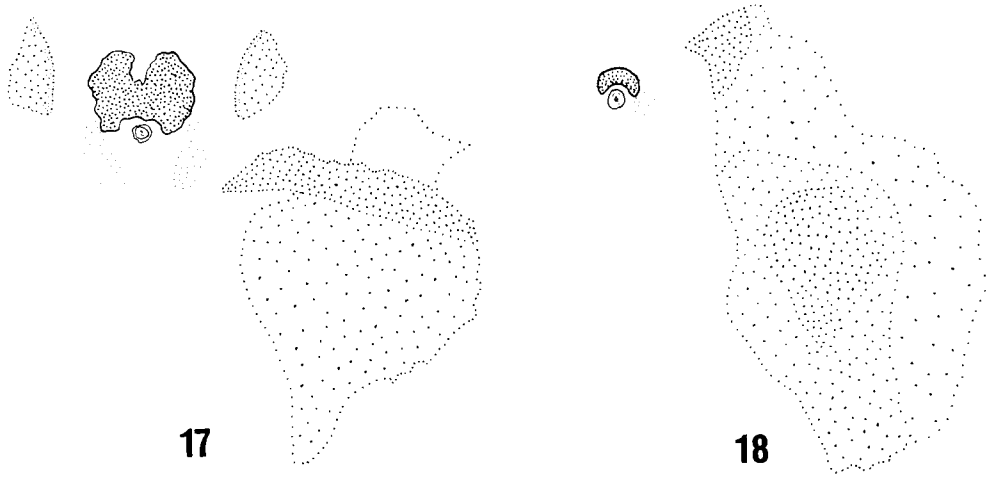
*Male.* Head and thorax as in *tandani*, except for the dorsal anterior plate which is similar to that of *threskiornis* (Fig. 1). The metasternal setae are longer (approximately 0·30 mm); marginal setae of




**Figs. 7–13.** *Ibidoecus* spp., male genitalia. (7) *I.tandani*. (8–10) Penis: (8) *I.threskiornis*; (9) *I.insularis*; (10) *I.tandani*. (11–13) Hypomere: (11) *L.threskiornis*; (12) *I.insularis*; (13) *I.tandani*.




**Figs. 14–16.** *Ibidoecus* spp., endomeres. (14) *I.tandani*; (15) *I.insularis*; (16) *I.threskiornis*.




**Figs. 17–18.** *Ibidoecus* spp. ♀ genital and associated sclerites. (17) *I.threskiornis*; (18) *I.tandani*.

metanotum 21–32, $\bar{x}$ 31·66. Abdomen as in *tandani* but tergites VII and VIII show a more definite division into two plates. Genitalia similar to those of *tandani*, but differ in details as shown in Figs. 9, 12 and 15. The setae of the abdomen fall within the range of those of *tandani*.

Dimensions (in mm). ♂. Temple width: 1·07, 1·07. Head length (hyaline margin not included): 0·89, 0·91. Prothorax width: 0·75, 0·75. Pteronotum width: 1·102, 1·102. Total length: 3·38, 3·32. Head index: 1·20, 1·17.

*Material examined.* 3 ♂ (one headless) from skin of *Threskiornis aethiopica bernieri* (Bonaparte), MADAGASCAR, Ampotaka, 2.v.1930 (*Archbold–Verney Exp.*).

*Holotype.* ♂ in BMNH, slide No. 767, from the type host and locality as given above.

*Paratypes.* 2 ♂ with data as given under holotype.

*Discussion.* This species is most similar to *tandani*, the differences being given under that species. It is unfortunate that there is no female available as the characters of the spermathecal sclerite would have been of considerable interest in considering its relationships.

All the species of *Ibidoecus* from *Threskiornis* are similar to each other and it is difficult to know

which characters show relationship. *I.tandani* and *insularis* resemble each other and differ from *threskiornis* in some of the characters of the male genitalia, while the anterior plate of *threskiornis* is more similar to that of *insularis* than of *tandani*. In the male genitalia the central penis and the paired telomeres are similar in all the species; the endomeres in *tandani* and *insularis* are similar, while those of *threskiornis* are rather distinct from all other species in the group (Fig. 16). The hypomere is similar in general characters throughout the group, that of *clausus* and *dianae* being proportionally narrower than those of the remaining species which are similar to each other in proportions: ratio of breadth to length in *tandani*, 0·46; in *insularis*, 0·44; *threskiornis*, 0·38; *clausus*, 0·94; *dianae*, 0·77. However, the anterior margin of the hypomere and the alveolus of the anterior spiniform setae are similar in *tandani* and *insularis*, differing from that of *threskiornis* (Figs. 11–13). The female genital region is similar throughout the group, differences being present in the position of the spermathecal sclerite; in *tandani* and *threskiornis* it lies anterior to the opening and posterior to it in *dianae*; no females of *insularis* are available and in *clausus* this thickening is absent, the two rather well marked sclerotized patches below the opening in *clausus* being found in the other species in addition to the spermathecal sclerite. Thus, there is little doubt that the Aldabra and Madagascar species are the most similar to each other and some indication that the African, Aldabra and Madagascar species are nearer to each other than to either the Indian or Australasian ones and that those of the latter regions are perhaps more nearly related to each other than to the more western species.

A puzzling similarity to members of this group is that of *I.dennelli* Tandan, 1951 from *Pseudibis papillosa*. As Tandan (1958a) has shown, the male genitalia are similar and the female is separable on minor characters only, the main difference between the species being the form of the male sternites of VII which in *dennelli* appear as lateral plates not a continuous plate across the segment. The proportions of the hypomere are similar to those of the African group (0·48).

### Key to the species of *Ibidoecus* on *Threskiornis*

In addition to the species parasitic on *Threskiornis*, two other species are included, namely: *I.dennelli* Tandan which parasitizes a related host (*Pseudibis papillosa*) and is similar to this group of species (Tandan, 1958b) and *I.australis* Kumar & Tandan parasitic on *Carphibis spinicollis*. This host was formerly included in *Threskiornis* and is found in the same locality as *Threskiornis molucca strictipennis*. Holyoak considered that it should be merged again with *Threskiornis* (see below).

*Males*

1 Sternite VII not continuous across segment.....2
– Sternite VII continuous across segment (Fig. 6).....3
2 Hypomere greatly elongated antero-posteriorly (Kumar & Tandan, 1966, Fig. 14).....*australis*
– Hypomere not elongated.....*dennelli*
3 Lateral arms of hypomere short (Tandan, 1958a, Fig. 16) 4
– Lateral arms of hypomere long and curved (Figs. 11 and 12) 5
4 Posterior margin of last sternum with central bilobed projection .....*dianae*
– Posterior margin of last sternum without such projection *clausus*
5 Anterior arms of endomeres, widely separated and shape as in Fig. 16 .....*threskiornis*
– Anterior arms of endomeres, not widely separated and shape as in Figs. 14 and 15.....6
6 Genital sclerites as in Figs. 10, 13 and 14.....*tandani*
– Genital sclerites as in Figs. 9, 12 and 15.....*insularis*

*Females*

*I.insularis* omitted

1 Centre of genital region with two heavily pigmented sclerites (Kumar & Tandan, 1966, Fig. 17).....*australis*
– Without such sclerites .....2
2 Without strongly pigmented spermathecal sclerite...*clausus*
– With strongly pigmented spermathecal sclerite.....3
3 Spermathecal sclerite posterior to opening of duct.....4
– Spermathecal sclerite anterior to or largely surrounds opening .....5
4 Genital plate narrow medianly (Tandan, 1958b, Fig. 12); vulval setae 15–21, mostly 17–20.....*dennelli*
– Genital plate broad medianly (Tandan, 1958a, Fig. 5); vulval setae usually more numerous, 20–31.....*dianae*
5 Spermathecal sclerite, well developed, butterfly-shaped (Fig. 17) ..... *threskiornis*
– Spermathecal sclerite, small, crescent-shaped (Fig. 18)..... *tandani*

### Parasite–host relationships and geographical distribution of the phthirapteran parasites of *Threskiornis*

Table 1 shows the usually accepted taxa of *Threskiornis*, although Holyoak (1970) considers that the

**Table 1**

| *Threskiornis* | *Colpocephalum* | *Ardeicola* | *Ibidoecus* |
|---|---|---|---|
| *aethiopica aethiopica* | *pygidiale* Mjoberg* | *clayae* Brelih* | *threskiornis* Bedford* |
| *aethiopica abbotti* | *abotti* Price* | *freemani* Tandan* | *tandani* sp.n.* |
| *aethiopica bernieri* | *abbotti* Price; *pygidiale* Mjoberg | *intermedia* Tandan* | *insularis* sp.n.* |
| *melanocephala* | *melanocephalae** | *indicus* Brelih* | *clausus* (Giebel)* |
| *molucca molucca*† | *aethiopicae* | *ibis* (Souef & Bullen) | |
| *molucca pygmaeus* | *aethiopicae* Price & Beer* | *ibis* | *dianae* Tandan* |
| *molucca strictipennis* | | *ibis** | *dianae* |

* Denotes type host of species.

† The specimens of *Colpocephalum* in BMNH labelled *T.m.molucca* from India (see Price & Beer, 1965) must have been incorrectly labelled as this host does not occur in India. Specimens of *Colpocephalum* from skins of *T.aethiopica bernieri* comprised a number of *C.abbotti* (from two host individuals) and *C.pygidiale* (from one host individual); this may signify the occurrence of *C.pygidiale* on all the subspecies of *aethiopica*. The populations of *Plegadiphilus* parasitic on the different taxa of *Threskiornis* do not show the clear-cut differences found in those of other genera and for the present can all be placed in *Plegadiphilus threskiornis* Bedford (see Ledger, 1971, 92).

relationship of these is best expressed by making them all of equal importance, regarding them as subspecies of *aethiopica*. The distribution of the Phthiraptera does, however, confirm the arrangement in Table 1 with three geographical groupings: Africa, Madagascar (Republic of Malagasy) and Aldabra Island; India; Far East and Australasia. Tandan (1976) demonstrates that the three species of *Ardeicola* from the first group are closer to each other than to those from India (*A.indicus*) and the Far East and Australasia (*A.ibis*), the latter two showing some similarity. As indicated above, the *Ibidoecus* species from Madagascar and Aldabra are similar to each other and in some characters, at least, nearer to that of Africa than to India or Australasia, but the evidence is difficult to interpret.

Price (1976) has shown that his new species *Colpocephalum abbotti*, from the Aldabra and probably the Madagascar* ibises, is a most distinctive form; it does, however, seem to have affinities with the *pygidiale* group of species (sensu Price & Beer, 1965). The three species of this group, together with *abbotti*, are found on hosts belonging to *Threskiornis* and all have a similar type of structure on the inner ventral wall of the female genital chamber. This comprises two vertically elongated bladder-like structures stretching anteriorly to a rounded or pointed part of the ventral wall from which a divergent suture passes posteriorly partly shown in Price & Beer (1965, Figs. 40 and 43). The two central structures are beset with colourless microtrichia and pigmented microtrichia are also found on the ventral wall, the latter being more numerous in *melanocephalae* and *aethiopicae* than in *pygidiale* and *abbotti* and with the arrangement also differing. The male genitalia of *abbotti* are similar to those of *pygidiale* and both differ from *melanocephalae* and *aethiopicae*.

Thus, the Madagascar and Aldabra ibises are parasitized either by the same species (*Colpocephalum*) or by similar species (*Ardeicola* and *Ibidoecus*); the African birds in at least two cases (*Colpocephalum* and *Ardeicola*) have parasites more similar to those of the Madagascar and Aldabra birds than to those of the other hosts and there is some indication of similarity between the Indian and Far Eastern and Australasian parasites. This distribution suggests that *T.aethiopica* and its subspecies have been separated longer from the original stock and that *melanocephala* and *molucca* have been derived from a common stock more recently.

Holyoak (1970) in a discussion on the relationships and evolution of the taxa of *Threskiornis* states that *aethiopica* and *molucca* resemble each other more closely in adult plumage than either of them resembles *melanocephala* but in juvenile plumage it is *molucca* and *melanocephala* that are more similar to each other than either is to *aethiopica*. Thus, the lice of *Threskiornis* may provide more definite evidence of relationship between their hosts than the hosts themselves. It is possible to suggest various areas in which the *Threskiornis* stock originated, one is Africa, spreading to India and other parts of Asia, the populations of the latter regions being separated early from Africa and the Middle East and from which the populations of *molucca* were developed spreading to Australia by means of island chains at a more recent date. Another possibility is that the ancestral *Threskiornis* stock originated at a time when the land masses of the future Africa, Madagas-

* No adult females available from this locality.

car and India were still sufficiently close to allow dispersal over this area and with the subsequent movement of India to a position from which migration to Australia could take place on the lines suggested above. However, this may presume a too early origin for the ancestral stock. Either of these theories would explain the greater similarity between the Indian parasites and those of the Far East and Australasia and the fact that the subspecies of *T.molucca* are parasitized by a single species of *Ardeicola*, *Ibidoecus* and *Colpocephalum* (as shown in Table 1), whereas the three subspecies of *T.aethiopica* have three species of *Ardeicola* and *Ibidoecus* and two species of *Colpocephalum*. This partly parallels the distribution of *Strigiphilus* on *Tyto alba*, in which of the two species parasitic on this owl (see Tandan, 1976), one is found in Africa and the other in India and Australia.

Holyoak also considers that *Carphibis spinicollis* (Jameson) should be included in *Threskiornis*; however, none of the three species (*Colpocephalum spinicollis* Price & Beer, 1965, *Ardeicola australis* Hajela & Tandan, 1967, and *Ibidoecus australis* Kumar & Tandan, 1966) parasitic on this ibis fits into the groups of species found on *Threskiornis* sens.str. The *Colpocephalum* female does not have the structure and microtrichia (see above) found in the genital chamber of the *pygidiale* group and the male genitalia are not like those of any of that group. The *Ardeicola*, although having characters in common with other species from the Threskiornidae, does not agree with the *ibis* subgroup especially in the absence of the modified area in the female genital chamber as described for that subgroup by Tandan (1976); also in other characters of the genital chamber and in those of the male genitalia. The precise affinities of this species are obscure but are certainly not with those of the *Threskiornis*-infesting ones. The *Ibidoecus* is again similar to some of the species parasitic on members of the Threskiornidae but is at once distinguished from those on *Threskiornis* by the male sternites of VII, the male genitalia and the sclerites of the female genital region. Thus, the parasites of *Carphibis* at once stand out as being different and suggest that the host is somewhat removed from those species now included in *Threskiornis*.

## Acknowledgments

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