THE RELATIONSHIP BETWEEN MALLOPHAGA AND HIPPOBOSCID FLIES

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(With 2 Figures in the Text)

It has been known for a long time that certain species of Mallophaga attach themselves to hippoboscid flies, the act taking place on the bird host. This has been referred to as Phoresy, 'a type of interrelationship between insects in which one is carried on the body of another larger insect, but the former does not feed on the latter', or, in other words, free passage without food.

The recorded cases are as follows:

1857. Aube. Two Mallophaga, said to be those from a magpie, *Pica pica*, recorded from *Ornithomyia aviculare* L. (quoted by Thompson, 1934).

1890. Sharp. Records a single *Ornithomyia aviculare* from Dartford, Kent, 'to which several specimens of Mallophaga were firmly adhering, apparently by the mandibles'.

1910. Mjöberg. Records two *Ornithomyia aviculare* from a starling (*Sturnus v. vulgaris*) in Sweden, the one with seven and the other with three *Philopterus leontodon* adhering to the long hairs of the abdomen. (*P. leontodon* = *P. sturni*.)

1910. Wanach. Records a *Philopterus* sp. probably from *Turdus m. merula*, the blackbird, on the abdomen of an *Ornithomyia aviculare* near Berlin.

1911. Jacobson. Records a single *Ornitoeca pusilla* taken off a pitta (*Eucichla cyanura*) near Batavia in Java with a Mallophaga clasped between the legs of the (dead) fly.

1912. Forsius. Records a single *Ornithomyia aviculare* with two *Degeeriella quadrulata* adhering to the base of the wing of a blackcock, *Lyrurus tetrix* in Finland. (*Degeeriella quadrulata* = *Lagopoecus lyrurus* Clay.)

Also a single *Ornithomyia aviculare* with two *Degeeriella uncinosa*, adhering, one to the hind tibia and another to the abdominal hairs. (*D. uncinosa* = *Bruelia uncinosa*.) Host *Corvus corone cornix*, the hooded crow.

1920. Banks. Records an *Ornithomyia* to which two Mallophaga were attached, one on each side near the tip of the abdomen.

1922. McAtee. Records an *Ornithomyia aviculare* from Saskatchewan on 11 August 1920, to which was attached a *Degeeriella rotundata*. Host unknown. A second *Ornithomyia aviculare* from Oregon on 30 September 1920 had a second *Degeeriella rotundata*, host *Corvus brachyrhynchus hesperis*, an American crow. (*Degeeriella rotundata* = *Bruelia rotundata*.) In both cases the Mallophaga were attached by their mandibles to the upper surface of the abdomen near the hind margin.

1922. Johnson. Records the same specimen as Banks. Two specimens of undetermined Mallophaga were attached to a single *Ornithomyia auchisecuria* taken from a jay, *Perisoreus canadensis barbouri*, on Anticosti Island on 3 September 1919. The Mallophaga were one on each side of the abdomen at posterior edge of 1st segment.

1927. Ewing. Records a specimen of *Ornithomyia aviculare* from a song sparrow, *Melospiza m. melodia*, to which were attached two *Degeeriella interposita* (=*Bruelia interposita*). They were adhering to the body wall of abdomen by the mandibles. In a second case, a specimen of *Ornithomyia aviculare* from a catbird, *Dumetella carolinensis*, to which was attached a single *Bruelia interposita*. In both cases the specimens were taken in Ohio.

1928. Warburton. Records a specimen of *Ornithomyia aviculare* captured on a window in Cambridge (England). Attached to the hairs of the abdomen was a specimen of *Degeeriella marginalis* (=*Bruelia marginalis*) a common parasite on members of the genus *Turdus*.

1928. Spencer. Records a single *Ornithomyia aviculare* taken on a Steller's jay, *Cyanocitta s. stelleri*, on Vancouver Island, and to it were attached sixteen *Degeeriella deficiens* (=*Bruelia deficiens*) holding on to the abdominal tergites with their mandibles.

1933. Thompson. Records an *Ornithomyia aviculare* taken in Hertfordshire from a young song thrush, *Turdus philomelos clarkei*, to which were attached three *Bruelia marginalis*. They were adhering to the posterior margin of the abdomen.

A second specimen of *Ornithomyia aviculare* found in the British Museum collection had eleven *Bruelia marginalis* fixed to the posterior portion of the abdomen. It was caught on a window at Woking in Surrey.

1934. Thompson. Records (ex Waterston) two specimens of *Ornithomyia aviculare* from the Shetlands each with a *Philopterus sturni* attached. Also (ex Britten) a specimen of *Ornithomyia aviculare* found on a window in Cumberland with a *Bruelia marginalis* attached.

1935. Thompson. Records a specimen of *Lynchia* sp. taken from an African weaver, *Euplectes orix sundevalli*, with a Mallophaga attached to abdomen and a specimen of *Ornithomyia chloropus* taken from a fieldfare, *Turdus pilaris*, in Sweden with a single *Bruelia marginalis* attached.

It is relevant to record here the case of *Trichodectes tibialis* being found attached to Culicidae (Thompson (1933) (ex Peus, *Z. Parasit.* 5, 740–41).)

It is also relevant to mention the case of mammal Mallophaga (*Gyropus* and *Trichodectes*) found attached to a dragonfly (*Ischnogomphus jessei* Williamson) in Columbia. (Mann (1930).)

In addition to the above, the following cases have come to our notice:

1. *Garrulus glandarius rufitergum*. Jay, Berkshire, July 1941. Specimen wrapped up and immersed in chloroform fumes at once. Host was infested with six *Ornithomyia avicularis* on two of which adhered Mallophaga. On one were 2♀ *Bruelia glandarii* attached to the lower abdomen; on the other was a single ♀ *Bruelia glandarii* on the left lower flank. Total population on host, 9 ♂, 26 ♀, 8 im. *Bruelia glandarii*. (Slide 14458, Meinertzhagen coll.)

2. *Aphelocoma c. californica*, California jay, California, no date. Specimen received from Boquaert. 1 ♀ *Bruelia* (probably from a species of Corvidae, but not from *Aphelocoma*) on *Ornithoica confluenta*, attached to the vein of the wing. One mandible

of *Bruelia* is underneath the junction of the costa and first longitudinal vein, pressing it upwards against the other mandible which has pierced the wing and lies on top (see Fig. 1). (Slide, Meinertzhagen coll.)

3. *Pastor roseus*, rose-coloured Pastor, Deccan, India, February 1937. Collected by Meinertzhagen. 1 ♀ *Philopterus* on *Ornithoica metallica*, attached to the last segment of the abdomen, probably by gripping the base of the hairs. Total population on host: 2 ♂, 3 ♀, 1 im. *Philopterus*; 1 ♂, 2 ♀, 1 im. *Bruelia*. (Slide 8828, Meinertzhagen coll.)

4. *Sturnus v. vulgaris*, starling, Estonia, August 1934. Collected by Meinertzhagen. 1 ♀ *Bruelia* on *Ornithomyia lagopodis*, attached to the last segment of the abdomen. Total population on host: 1 ♂ *Bruelia* and 5 *Myrsidea*. (Slide 1434, Meinertzhagen coll.)

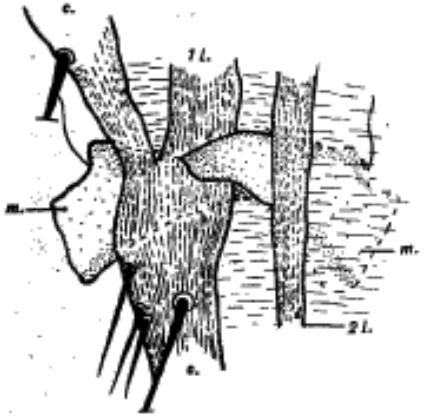

Fig. 1. Portion of the wing of *Ornithoica confluenta*, showing mandibles (*m*) of *Bruelia*. *c*, costa; *1l* and *2l*, 1st and 2nd longitudinal veins.

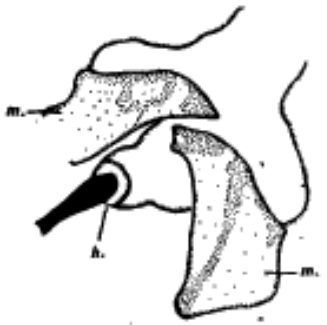

Fig. 2. Posterior end of the abdomen of *Ornithomyia avicularis* with mandibles (*m*) of *Bruelia meruloensis* attached to a hair (*h*).

5. *Sturnus vulgaris zetlandicus*, Shetland starling, Orkneys, August 1938. Collected by Meinertzhagen. A single *Ornithomyia lagopodis* was caught on bird when shot and found to be free of Mallophaga. Insect returned to host for an hour and then host was chloroformed. The dead fly was then found to have 3 ♀ *Philopterus sturni* attached to abdomen. Total host population: 9 ♂, 13 ♀, 3 im. *Philopterus sturni* and 5 ♂, 25 ♀ *Bruelia*. (Slide 11479, Meinertzhagen coll.)

6. *Sturnus vulgaris zetlandicus*, Shetland starling, Orkneys, August 1938. Collected by Meinertzhagen. A single *Ornithomyia lagopodis* was caught on bird when shot and found to be free of Mallophaga. Insect returned to host for an hour and then host was chloroformed. The dead fly was found to have 7 ♂ and 21 ♀ *Philopterus sturni* attached to abdomen. Total host population: 24 ♂, 32 ♀, 21 im. *Philopterus sturni* and 3 ♂, 24 ♀, 9 im. *Bruelia*. (Slide 11525, Meinertzhagen coll.)

7. ***Sturnus vulgaris zetlandicus***, Shetland starling, Orkneys, August 1938. Bird chloroformed within an hour of death. On shaking out for parasites, a single ***Ornithomyia lagopodis*** was found to have 2 ♂, and 4 ♀ ***Philopterus sturni*** attached, two on one flank of the abdomen and four on the posterior end of the abdomen. Total host population: 15 ♂, 24 ♀, 5 im. *Philopterus sturni*, 6 ♂, 2 ♀, 4 im. *Bruelia* and 2 ♀ *Menacanthus*. (Slide 11413, Meinertzhagen coll.)

8. ***Sturnus vulgaris zetlandicus***, Shetland starling, Orkneys, August 1938. This is perhaps the most remarkable of all cases which have come to our notice and deserves recording in detail. Immediately after being shot the bird was examined and seven ***Philopterus*** were seen to be adhering to the inside of the webs of some of the left wing feathers. On the right wing were eight *Philopterus* adhering to feathers. That makes fifteen *Philopterus* in all. The specimen was wrapped up in muslin at once and after about two hours was immersed in the fumes of chloroform. When shaken out for parasites, a hippoboscid fly (*Ornithomyia lagopodis*) fell out. 1 ♂ and 6 ♀ *Philopterus sturni* were found to be adhering to the abdomen, 3 ♀ *Philopterus sturni* were still adhering to the wing and 3 ♂ and 2 ♀ were shaken from the body. The whole philopterid population were therefore accounted for, some of which had taken the precaution of boarding the fly as the host cooled off, in other words, the Mallophaga appeared to use the fly as a lifeboat. Total host population: 4 ♂, 11 ♀ *Philopterus sturni* and 7 ♂, 25 ♀ *Bruelia*. (Slide 11308, Meinertzhagen coll.)

9. ***Sturnus vulgaris zetlandicus***, Shetland starling, Shetland, August 1939. Collected by Meinertzhagen. 1 ♀ *Philopterus sturni* on *Ornithomyia lagopodis* attached to the last segment of the abdomen. This fly was caught on the window and placed on the dead bird soon after it was shot. After chloroforming, the dead fly had the *Philopterus* attached. Total host population: 1 ♂, 4 ♀ *Philopterus sturni*, 3 ♂, 8 ♀ *Bruelia*, and 1 ♀ *Myrsidea*. (Slide 13609, Meinertzhagen coll.)

10. ***Pipilo maculatus megalonyx***, Towhee (U.S.A.). Received from Bequaert. 1 ♀ *Bruelia* on *Ornithomyia confluenta*, attached to the vein of the wing. The species of *Bruelia* is probably from some member of the Corvidae. (Slide, Meinertzhagen coll.)

11. ***Tschagra s. senegallus***, bush shrike, Morocco, October 1938. Collected by Meinertzhagen. 2 ♀ *Bruelia* on an unidentified hippoboscid fly, one attached to each flank of the abdomen. The species of *Bruelia* is the same as occurred on the host. Total host population: 1 ♀ *Philopterus*, 6 ♂, 7 ♀, 2 im. *Bruelia*. (Slide 11946, Meinertzhagen coll.)

12. ***Turdus m. migratorius***, the American robin, Mass., U.S.A. Received from Bequaert. 2 ♀ *Philopterus* on *Ornithomyia fringillaria*, one attached to each side of the abdomen. (Slide, Meinertzhagen coll.)

13. ***Cuculus c. canorus***, cuckoo, Suffolk, August 1935. 1 ♀ *Bruelia merulensis* on *Ornithomyia avicularis* attached to the hairs on the posterior end of the abdomen. *Bruelia merulensis* is only known from *Turdus merula*, the blackbird. There were no other Mallophaga on the cuckoo which was a juvenile specimen. See Fig. 2. (Slide 3919, Meinertzhagen coll.)

Of these thirteen cases, ten were collected by ourselves, and it is remarkable that between 200 and 300 hippoboscid flies have been taken from freshly killed birds in four continents with such meagre results.

The following additional experiments were carried out with hippoboscid flies in the Orkneys and Shetlands in August 1938 and August 1939. Eight living hippoboscids (*Ornithomyia lagopodis*) were placed on eight freshly killed and warm starlings known to be infested with *Bruelia* and *Philopterus* and remained in contact with the birds for two hours without a single fly having a Mallophaga attached. Also, four hippoboscids of the same species, fresh but dead, were placed on freshly killed starlings known to be infested with *Philopterus* and *Bruelia* without any result after three hours.

In addition, six living *Philopterus* and eight living *Bruelia* from a starling were placed in a small glass phial with two living hippoboscids (*Ornithomyia lagopodis*) for two days without any resultant attachments, though both classes of insects were in continual contact.

To revert for a moment to cuckoos. A recently fledged cuckoo, a beautiful albino now in the British Museum, was picked up dead in the New Forest on 18 July 1939. We saw it in the British Museum on the following day. It was then infested with 1 ♀ *Bruelia merulensis* and 2 *Philopterus* sp., probably from *Delichon urbica*, the house martin.

Young cuckoos are reared by foster parents and have no contact with their own parents; in fact, adult cuckoos leave Britain before their offspring are fully fledged. Therefore any Mallophaga found on a young cuckoo must have come either from the foster parent or from an infested hippoboscid fly. It is interesting to note that neither the blackbird nor the house martin are foster parents to the cuckoo, except in cases of negligible value.

In addition to the above case we have examined five young cuckoos in Britain and Estonia in July. None had Mallophaga. One had nine, two had five, one had two and one had no hippoboscid flies. In only one case were Mallophaga attached to the fly (see case 12 above). But it is clear that hippoboscid flies are partial to young cuckoos.

Of seven adult cuckoos shot in Britain, Poland and Afghanistan in summer, none had hippoboscid flies on them, but every specimen was fairly heavily infested with Mallophaga.

Of nine cuckoos obtained in Ushant on spring migration in 1935, there were two females. One of these had bred in the previous year and she was infested with three species of Mallophaga. The other female was a bird of the previous year and had never bred. She had a single *Cuculoecus* which must have been carried by some agency other than contact. The fact that she had but a single parasite indicates carriage by hippoboscid fly during the winter in tropical Africa.

It is difficult and unproductive to generalize on all the above evidence, which is insufficient and fragmentary. All we can say is that the only genera of Mallophaga known to be carried by hippoboscid flies are *Philopterus* and *Bruelia*, and that these probably attach themselves to the roots of the hairs or veins of wings and do not embed their mandibles into the abdomen of the fly. It is also significant that Mallophaga attach themselves to flies after the death of the host.

Any further evidence on this subject will be welcomed by the authors. Isolated cases, if published as they occur in various journals, are apt to be overlooked. If collected by one agency they could be collated and published periodically in co-ordinated form.

REFERENCES

BANKS (1920). *Psyche*, **27**, 20.
EWING (1927). *Ann. Ent. Soc. Amer.* **20**, 245–60.
FORSIUS (1912). *Medd. Soc. Fauna Fl. fenn.* **38**, 58–60.
JACOBSON (1911). *Tijdschr. Ent.* **54**, 169–79.
JOHNSON (1922). *Psyche*, **29**, 81–2.
McATEE (1922). *Ent. News*, **33**, 90.
MANN (1920). *Ent. News*, **31**, 252.
MJÖBERG (1910). *Ark. Zool.* **6**, 10.
SHARP (1890). *Proc. Ent. Soc. Lond.* **30**.
SPENCER (1928). *Canad. Ent.* **60**, 257–60.
THOMPSON (1933). *Nature, Lond.*, **132**, 605.
THOMPSON (1934). *Ent. Mon. Mag.* **70**, 134.
WANACH (1910). *Ent. Rdsch.* **27**, 121.
WARBURTON (1928). *Parasitology*, **20**, 175.

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Since going to press the following additional record has come to notice:

Emberiza c. citrinella, yellow hammer, Devon, October 1942. 2 ♀ *Bruelia* sp. on *Ornithomyia fringillina*, collected by Meinertzhagen, the Mallophaga being attached to the upper surface of the abdomen. There were no other Mallophaga on the host. (Slide 14802, Meinertzhagen coll.)