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J. Med. Ent. Vol. 9, no. 3: 227–232 **20 June 1972**

HOPLOPLEURA DIAPHORA JOHNSON AND *HOPLOPLEURA KITTI* KIM: SIBLING SPECIES OF SUCKING LICE (ANOPLURA)?[1]

By **Phyllis T. Johnson**[2]

Abstract: *Hoplopleura diaphora* Johnson and *H. kitti* Kim are closely related Southeast Asian species of sucking lice. Both species occur normally on *Rattus bowersii*, and *H. kitti* also parasitizes *R. berdmorei* and *R. edwardsi*. Comparisons and illustrations of the nymphs of both species and illustrations of adults of *H. kitti* are included.

Host associations of species of Anoplura are usually more rigid than those found with other, more mobile, ectoparasites of mammals. A particular mammal species is seldom regularly parasitized by more than 1 species of a genus of Anoplura. If 2 species of a single genus occur regularly on the same host, usually they belong to different groups within the genus and are specially adapted morphologically for different ecological situations on the host. For example, there are long and short-headed species of *Linognathus* on African antelopes, and of *Polyplax* on African and near-eastern species of spiny mice of the genus *Acomys* (Hopkins 1949, Johnson 1960). Species that occur normally on the same host and resemble each other morphologically so closely that they could be called sibling species have not been recognized previously in the Anoplura.

In Southeast Asia (Malayan peninsula, Thailand, Laos and Vietnam) there is a pair of morphologically similar *Hoplopleura* species that are not closely related to other species in the genus, and that appear to be sibling species. These lice, *Hoplopleura diaphora* Johnson and *H. kitti* Kim, are found on related species of *Rattus* and in 1 case they occur normally on the same host species, *R. bowersii*. Indeed, through a regrettable *lapsus*, Johnson (1964) included in the paratypic series of *H. diaphora* certain specimens that actually are *H. kitti*. All specimens of *diaphora* that I have seen, from Malaya and Vietnam, were taken from the type host, *R. bowersii*. *H. kitti*, on the other hand, occurs on *R. bowersii* in Malaya and Laos, *R. berdmorei* (type host) in Thailand, and on *R. edwardsi* in Laos. Whether the host range of *H. kitti* is truly broader than that of *H. diaphora* cannot be decided on the basis of the few collections available.

H. diaphora and *H. kitti*, unlike typical species of *Hoplopleura*, have the abdominal plates strongly reduced (mainly missing in female *diaphora*) and lack the enlarged, paired setae of the 1st plate of the 3rd abdominal sternum (FIG. 1, 2). Further, all nymphal stages have the tarsal claw of the 1st leg deeply bifurcate (FIG. 9), which suggests, in an exaggerated fashion, the condition often found in both nymphs and adults within the genus *Neohaematopinus*. A relationship to the *Hoplopleura pacifica* group (discussed by Johnson 1972) is suggested by the condition of the nymphal abdomen which has vague paired plaques on some of the dorsal segments. The nymph of *H. kitti* further resembles species of the *pacifica* group by having 1 terminal abdominal seta on each side in the 1st instar, and by lacking such setae in both the 2nd and 3rd instars.

Since a tendency toward complete loss of 1 or more abdominal or paratergal plates and setae is not an uncommon expression of abnormality in specimens of sucking lice, it may be that only a few elements of genetic material are necessary for

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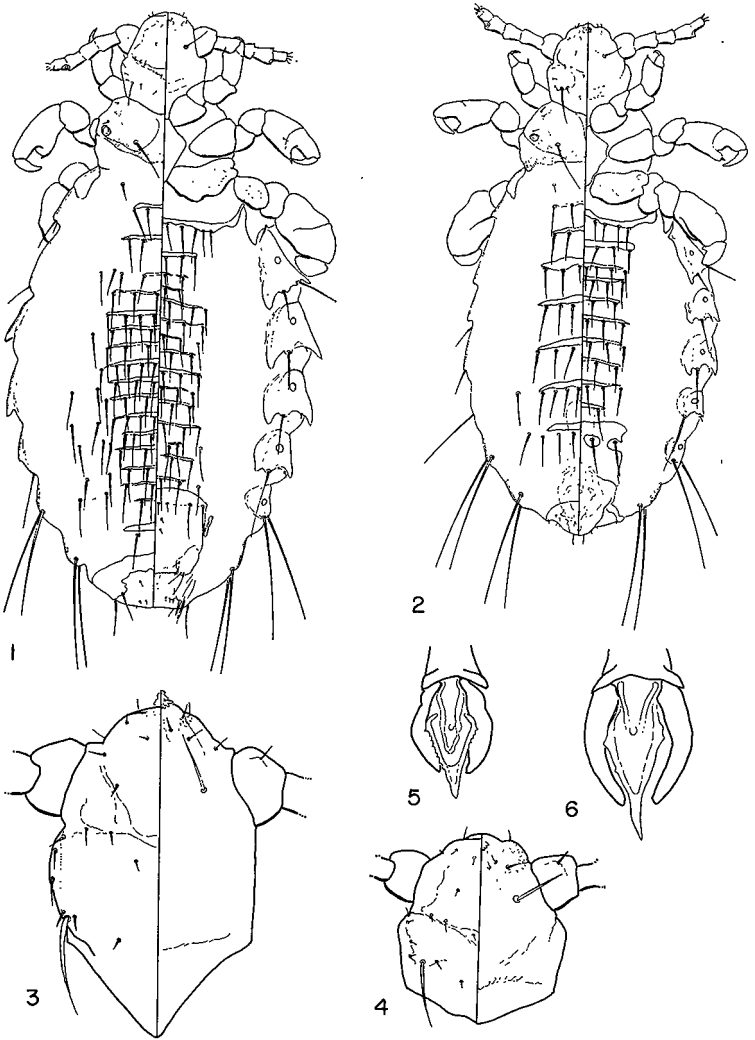

FIG. 1–6. *Hoplopleura diaphora* paratypes, and *H. kitti*, from *Rattus berdmorei*, Thailand. (1) *H. kitti*, ♀ (2) Same, ♂. (3) *H. diaphora*, head, ♂, Pahang, no. RT B-46012. (4) *H. kitti*, head, ♂. (5) Same, aedeagus. (6) *H. diaphora*, aedeagus, Selangor, no. R-44621.

production of those plates and setae. Thus, the lack of abdominal plates (except anteriorly) in female *H. diaphora* as opposed to the case in *H. kitti* females, which have the normal number, could be dependent on a somewhat simple gene pattern. The absence of terminal abdominal setae in 2nd and 3rd-instar nymphs of *H. kitti* might also be an expression of a simple "saltatorial" mutation. The closeness of the 2 species in other ways lends credence to the above suggestion.

Nymphs of *H. diaphora* and the 1st-instar nymph of *H. kitti* have not been described, nor have adults of *H. kitti* been illustrated. This paper compares adults and nymphs of the 2 species, provides illustrations of *H. kitti* adults, and describes and illustrates the nymphal stages of both species. Illustrations of like parts on a single plate are drawn to the same scale.

Most of the material reported upon here was collected by personnel of the Bishop Museum, Honolulu, and it is deposited there.

COMPARISON OF ADULTS

Kim (1968) listed absence of the accessory dorsal head seta in *H. diaphora* as an identifying character for that species. The accessory dorsal head seta is present (FIG. 3), but not obvious in the drawings in Johnson (1964). Differences between the adults, not discussed by Kim, include the following: *H. diaphora* is larger: males 1.20–1.40 mm, females 1.55–1.90 mm; *H. kitti* males 0.85–1.00 mm, females 1.20–1.40 mm. The head of *diaphora* is relatively

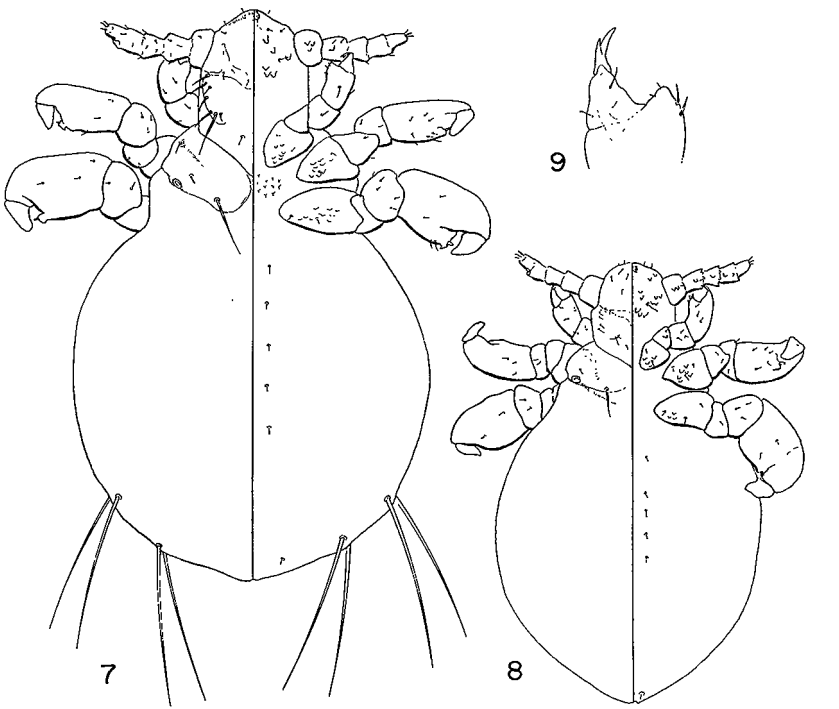

FIG. 7–9. *Hoplopleura diaphora* and *H. kitti*, 3rd-stage nymphs. (7) *H. diaphora*. Malaya, Pahang, no. RT B-46010. (8) *H. kitti*, from *Rattus edwardsi*, Laos. (9) Same, apex of 1st tarsus showing tarsal claw and developing adult tarsal claw within.

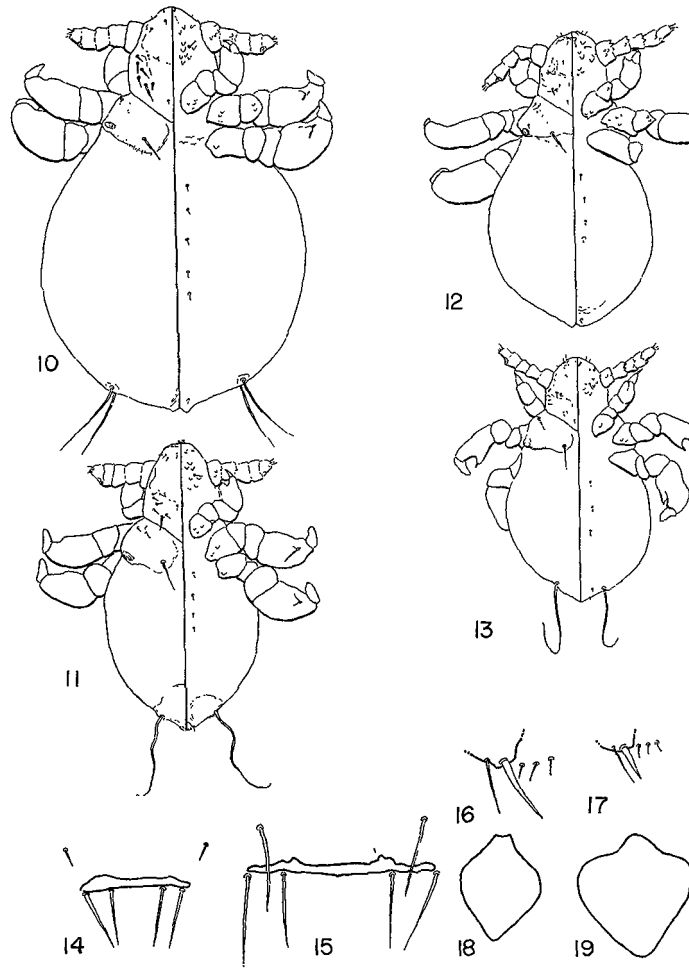

FIG. 10–19. *Hoplopleura diaphora* and *H. kitti*. (10) *H. diaphora*, 2nd-stage nymph, Laos. (11) Same, 1st-stage nymph. (12) *H. kitti*, 2nd-stage nymph from *Rattus bowersii*, Malaya, Perak, Maxwell's Hill, no. RT B-47624. (13) Same, 1st-stage nymph. (14) *H. kitti*, ♀, pair of dorsal setae on 1st abdominal segment and 1st tergal plate and setae of 2nd segment, from *R. berdmorei*, Thailand. (15) *H. diaphora*, Same, paratype, Selangor, no. RT B-44621. (16) *H. diaphora*, genital lobe and seta of 9th segment, ♀, as FIG. 15. (17) *H. kitti*, same, Thailand, from *R. berdmorei*. (18) *H. kitti*, thoracic sternal plate, ♀, as FIG. 17. (19) *H. diaphora*, same, ♀ as FIG. 16.

longer and both the preantennal area and posterior apex are extended, and the lateral occipital setae are larger than in *kitti* (compare FIG. 3, 4). Position of the lateral occipital setae, principal and accessory dorsal head setae, and the width of the head depend to some extent upon the amount of flattening that has occurred during mounting. However, the principal dorsal head seta of *H. diaphora* is apparently always nearer the lateral margin than is that of *H. kitti*. The pair of setae on the 1st abdominal tergun is short in *H. kitti* (FIG. 14) but as long as the setae of the tergal plate of abdominal segment 2 in *H. diaphora* (FIG. 15). In *H. kitti* paratergal plates IV–VI each have a minute dorsal apical seta in addition to the long ventral one (FIG. 1, 2). The genital seta of female *H. diaphora* (FIG. 16) is longer than that of *H. kitti* (FIG. 17). The male aedeagus differs as shown in FIG. 5 and 6.

Hoplopleura diaphora Johnson FIG. 3, 6, 7, 10, 11, 15, 16, 19

Hoplopleura diaphora Johnson, 1964: 75 (*partim*, not male and female paratypes from Maxwell's Hill, Perak).—Kim, 1968: 701.

Type data: ♀ holotype, ♂ allotype, 9 ♂, 7 ♀ paratypes from *Rattus bowersii*, Malaya, Selangor, Ulu Langat Forest Reserve 10.II.1956, no. R–44621. Remaining paratypes, all from *R. bowersii*, as follows: 18 ♂♂, 23 ♀♀ in 10 collections, various localities in Pahang. There were 3 third-stage nymphs, associated with adult paratypes, in 2 of the collections. From Perak, Mt Brinchang were 1 ♂, 3 ♀♀ in 2 collections. The remaining paratypes, 1 ♂ and 1 ♀, in 2 collections, from Perak, Maxwell's Hill, are *H. kitti*.

New records. All from *R. bowersii*, Malaya, Selangor, Ulu Langat Forest Reserve, 2 ♀♀, 2 third-stage nymphs, collected in 1970. From Vietnam, Djiring, 1 ♀, 7 second-stage, and 6 first-stage nymphs, collected in 1960.

Nymphal description. 2nd and 3rd instars immediately separated from those of *H. kitti* by having 2 pairs of terminal abdominal setae on each side in 3rd instar (FIG. 7), and 1 pair on each side in 2nd instar (FIG. 10). All instars differ from *H. kitti* by having dorsal setae of head much larger, and with principal dorsal seta obviously longer than others. *3rd instar* (FIG. 7) lacking tubercles on preantennal venter of head; lateral occipital setae well developed; principal dorsal head seta strong, almost as long as dorsal thoracic seta; accessory dorsal head seta present, short. 1st tarsal claw bifid apically (FIG. 9. *H. kitti*). Abdomen ventrally and dorsally scaly, ventral surface of thorax and anterior part of abdomen with scales drawn out posteriorly into short spicules. Dorsally abdomen often with small vague plaques on several segments; these occurring in pairs on either side. Apparently the plaques are formed from coalesced scales (not drawn on figures). Five pairs small setae ventrally on abdomen; anal lobe ventrally with 1–2 minute setae each side; this lobe not extended; 2 pairs long terminal abdominal setae on each side. *2nd instar* (FIG. 10) smaller, head similar to that of 3rd instar, but with shorter setae. Venter of abdomen with 4–6 pairs small setae; 2 minute setae ventrally on anal segment, which is not extended. Dorsal plaques indicated on abdomen. One pair terminal abdominal setae on each side, associated with small ill-defined plate. *1st instar* (FIG. 11) much as 2nd instar but smaller. Venter of abdomen with 3–5 pairs small setae; 2 minute setae ventrally on anal lobe, which is not extended; 1 terminal abdominal seta on each side. Ill-defined "plates" associated with anal segment (these are areas lacking typical scales of remainder of abdomen). *Length*. 3rd instar 0.90–1.20 mm (6 measured); 2nd instar 0.85–1.00 mm (7 measured); 1st instar 0.70–0.75 mm (6 measured).

Hoplopleura kitti Kim FIG. 1, 2, 4, 5, 8, 9, 12–14, 17, 18

Hoplopleura diaphora Johnson, 1964: 75 (*partim, err. det.*, paratypes from Maxwell's Hill, Perak).

Hoplopleura kitti Kim, 1968: 701.

Type data: ♀ holotype, ♂ allotype, 3 ♂♂, 19 ♀♀, 3 second-stage nymphs, 1 third-stage nymph, all paratypes, from *Rattus herdmorei*, Thailand, Pranchin Buri.

New records. From *R. bowersii*, Malaya, Perak, Maxwell's Hill, 1 ♂ no. RT B-47598; 1 ♀, 1 second-stage nymph and 2 first-stage nymphs no. RT B-47624 (adults were paratypes of *H. diaphora* Johnson). From *R. bowersii*, Maxwell's Hill, collected in 1970, 2 ♀♀, 4 third-stage nymphs, and 1 second-stage nymph. From *R. bowersii*, Laos, 18 km NW Xieng Khouang, 2 ♂♂, 2 ♀♀, 1 third-stage nymph, 4 second-stage nymphs, and a 2nd collection of 1 ♂, 2 second-stage nymphs; both collections made in 1960. From *R. edwardsi*, Laos, same locality and date, 2 collections: 1 ♀, 1 third-stage nymph, and 4 ♂♂, 8 ♀♀, 5 third-stage and 2 second-stage nymphs. From *R. herdmorei*, Thailand, Nakhon Ratchasima, Pak Thong Chai, collected in 1969, 2 ♂♂, 2 ♀♀.

Nymphal description. All stages with 1st tarsal claw apically bifid (FIG. 9). *2nd and 3rd stage* (FIG. 8, 12) described by Kim (1968). Nymphs studied fit his drawings and description except that setae of head much shorter and finer; 3rd stage has 4–7 pairs small setae on venter of abdomen (usual number, 5); and 2nd instar has 4–6 such pairs. Both instars have 2 minute setae ventrally on anal segment. Abdomen and venter of thorax rather evenly scaly, ventral scales of thorax and anterior part of abdomen with posterior spicules barely indicated. Dorsally abdomen with small vague plaques as in *H. diaphora* (which see); not indicated on the drawings. Terminal abdominal setae lacking in both 2nd and 3rd instars; anal lobe not extended. *1st instar* (FIG. 13) with head as in older instars; thorax and abdomen scaly, no spicules. Dorsal abdominal plaques indicated; 3 ventral pairs small setae on abdomen; 4 minute ventral setae on anal segment; 1 terminal abdominal seta on each side. *Length*. 3rd instar 0.75–0.95 mm (10 measured); 2nd instar 0.65–0.75 mm (8 measured); 1st instar 0.55 mm (2 measured).

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J. Med. Ent. Vol. 9, no. 3: 232 **20 June 1972**

BOOK REVIEW

A CRITICAL REVIEW OF THE TECHNIQUES FOR TESTING INSECTICIDES

By James R. Busvine. Issued by the Commonwealth Institute of Entomology, 56 Queens Gate, London S.W. 7, England. 2nd Ed., 1971. XIII + 345 p. $13.00 (£5.00).

It was a pleasure to read this well-written book. The printing and style are esthetically pleasing; the illustrations are cleanly defined line drawings; and the price is reasonable by today's standards.

There have been relatively few volumes published reviewing the subject of insecticide testing. Professor Busvine took upon himself a Herculean task when he prepared the 1st edition published in 1957. This 2nd edition incorporates the major items included previously with information published through 1969. No claim is made that this reference book is encyclopedic in scope; rather, it is as the title indicates- "a critical review". In this, the author is successful. His choice of techniques is varied and well-documented. Professor Busvine has done a thorough job of scholarship and selection.

In his preface to the 2nd edition, the author lists his major modifications and notes that "the 550 references quoted in the 1st edition have risen to 1250 and the text has increased about 80%; furthermore, while there are slightly fewer figures, over 20 are new or modified". It appears to this reviewer that this is a modest statement. The increase in new reference titles is far greater than the author suggests, since many of the references in the 1957 edition were deleted. The references were further improved by a complete listing of authors' names. In the 1st edition, if there were more than 2 authors, only the senior author et al. were given.

There were relatively few typographical errors discovered: on p. 12, *Tropical* for *Topical;* on p. 120, *topcock* for *stopcock;* and reference 1023, (*1939*) for (*1959*). There are probably a few others, but these do not detract in any way from general overall excellence in quality of the work.

The material is well arranged and each of the 12 chapters is well presented. The initial chapter on General Principles of Insecticide Testing gives a broad view of the problems involved. The information presented is a must for all entomologists regardless of their specialization. The need for international standardization of testing methods is stressed here and throughout the book.

The handling of insects and the subject of inactivation methods are covered in depth. The need for rearing and using standardized insects and the intrinsic and extrinsic factors involved are stressed by the author. He separates the discussion of repellent-testing from that of insecticides and lays great stress on mosquito research. This should make this volume of particular interest to the reader of the *Journal of Medical Entomology.*

This reviewer agrees with the author that the term *bioassay* should be restricted "to the use of insects as a tool for estimating potentially harmful pesticide residues in foodstuffs", and also with the statement "Most critics agree that the value of the Peet-Grady test is for evaluating aerosols containing pyrethrins. Tests with aerosols based on other insecticides can only be considered of doubtful validity".

An interesting point is raised on p. 177. In a discussion of mosquito larvicide testing, it was found that the "LC 50 values of DDT against *Culex p. fatigans* were significantly higher in distilled water than in tap water. The reason was not discovered, however, and she did not give the composition of the tap water". This could very well be due to pH. In our laboratory in Hawaii, the tap water can have a pH of 8.0 which could cause a breakdown of DDT.

The chapter on Injection or Application of Contact Insecticides to Individual Insects raises a number of questions. The descriptions of the various types of apparatus are detailed and comprehensive. There are detailed descriptions of many useful techniques throughout this review; however, it would have been helpful if methods of calculating the volume of a droplet from the various types of micropipettes or microsyringes were described.

The chapter on Toxicological Statistics contains an excellent summary of the statistics of the quantal response. Sufficient detail is given to satisfy the biologists who are mathematically oriented as well as those in need of a cookbook procedure.

I agree with Professor Busvine's conclusion that "insecticide testing will remain an important activity and that tests for the detection and measurement of resistance will substantially increase". It is, therefore, essential that those involved in insecticide testing be familiar with the techniques developed, and this volume is an important contribution towards this end.

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