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Preliminary Systematic Study of the Pupae of the Nitidulidae (Coleoptera)

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While studying the larvae of the Nitidulidae borrowed from the United States National Museum, I found a number of pupae associated with larvae or adults. As few beetle pupae have been studied systematically, I have prepared a key and brief comparative descriptions of these pupae. Fourteen species representing 10 genera and three of the six sub-families of Nitidulidae are treated.

These pupae are replete with taxonomic characters, which is perhaps not surprising as few congeneric species were available. As discovered with oedemerid pupae (Rozen, 1959), the most valuable characters are the differences in the number and arrangement of the setae and of the seta-bearing tubercles. Other features used or of potential use are the length of the elytra, the anatomy of the spiracles, and the general shape of the body.

Generally, the anatomical terminology employed here is so basic that it requires no explanation. As with the oedemerid pupae, the fourth abdominal segment was arbitrarily selected as a representative segment in the descriptions and the key. The terminology of the tubercles on this segment is the same as for the Oedemeridae (Rozen, 1959, fig. 1). However, because the margins of the fourth tergum are often obscure, tubercles found immediately mesad of the spiracles are lateral marginal

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tubercles, whereas those located laterad of the spiracles are pleural tubercles. The term "pleural tubercle," at least in the Nitidulidae, may be a misnomer, since on some specimens these tubercles arise on the lateral margins of the sternum. However, the term is used because the position of these tubercles cannot be definitely ascertained on the pupae of all the nitidulids examined, and because it has precedence.

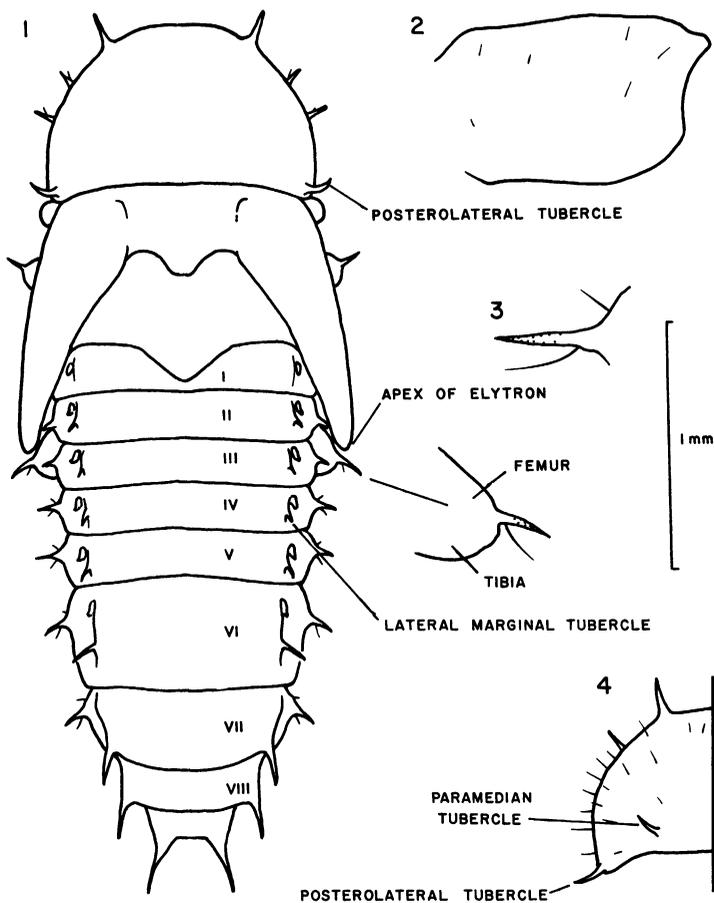
The elytra of the pupal nitidulids are normally wrapped closely around the body (figs. 7, 16). However, the elytra of some preserved specimens project from the body because of swelling.

Because beetle pupae are so poorly known, it is impossible to prepare a diagnostic description that will distinguish with certainty nitidulid pupae from those of other families. However, if refined family descriptions based upon pupae are ever to be forthcoming, they must be preceded by preliminary descriptions that can be added to and revised as additional studies are made. The following is offered on this basis.

DESCRIPTION OF THE NITIDULIDAE BASED ON THE PUPAE

Head without tubercles, with several pairs of short ones (fig. 9), or with one pair of long ones (fig. 6). Dorsal body surface with (fig. 10) or without (fig. 1) short, fine setae concolorous with integument in addition to conspicuous, normal-sized setae that are slightly pigmented; normal-sized setae sharp-pointed, not clubbed apically. Pronotum either with elongate tubercles (fig. 1) or without them (fig. 10), but, if the latter, then elytra truncate and short, not reaching posteriad of femorotibial joint of hind leg; pronotal tubercles, when present, with setae borne apically, subapically, or basally; tubercles found only on margin of notum (fig. 20). Mesonotum without normal-sized setae; elytra without normal-sized setae except in *Macrostola lutea* which bears single seta on base of each elytron (fig. 16). Metanotum without normal-sized setae except in *Macrostola lutea* which bears single pair sublaterally (fig. 16). Hind leg with single seta arising from apex of femur, as seen in dorsal view; this seta may (fig. 1) or may not be associated with tubercle. Abdomen without gin-traps and without transverse rows of asperities though some specimens having median longitudinal row of fine asperities extending nearly full length of body (fig. 10). Fourth abdominal tergum at most with one lateral marginal tubercle (fig. 1), without posterior marginal tubercles¹ and usually without discal tubercles (fig. 1); when present,

¹The discal setae of *Brachyepelus rubidus* and the posterior ones of *Macrostola lutea* may actually be posterior marginal ones.



FIGS. 1, 2. Pupa of *Carpophilus mutilatus* Erichson? 1. Entire body, dorsal view. 2. Left elytron, ventrolateral view.

FIGS. 3, 4. Pupa of *Carpophilus* species *a*. 3. Pleural tubercle. 4. Left half of pronotum, dorsal view.

The scale refers to figures 1, 2, and 4.

discal tubercles (fig. 16) at most three pairs in number and short, not being more than twice as high as basal diameter, excluding seta; tergal tubercles apically simple, not bifurcate; tergum without normal-sized setae except those associated with low tubercles. Fourth abdominal segment with one (fig. 1) or two (fig. 17) pairs of pleural tubercles.

Although the pupae of very few Nitidulidae are known, their comparative anatomy does not seem to support the subfamilial classification

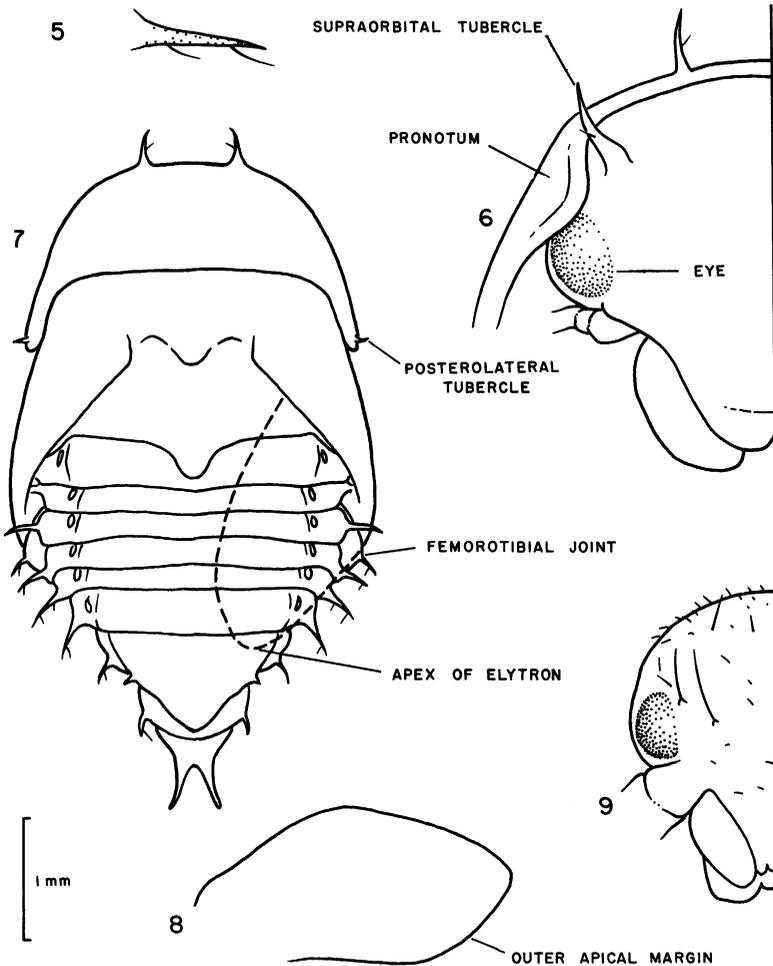
of the adults. Certainly the pupae of the Nitidulinae described here are homogeneous, but those of the Carpophilinae are very variable. For example, there is little similarity between the pupae of *Carpophilus* and those of *Brachypeplus rubidus* and *Macrostola lutea* beyond the shortened truncate elytra; even the anatomical agreement between the latter two may be superficial. On the other hand, *Carpophilus* and *Cryptarcha*, though assigned to separate subfamilies, share enough characteristics to suggest a close relationship.

KEY TO PUPAE OF NITIDULIDAE

1. Apex of femur (fig. 1) with sharp-pointed tubercle¹ many times longer than basal diameter; seta arising below apex of tubercle 2
 - Apex of femur without tubercle or with small one (fig. 15), at most as long as basal diameter; seta arising apically on tubercle when present 5
- 2(1). Head (fig. 6) with long supraorbital tubercle on each side 3
 - Head without supraorbital tubercles 4
- 3(2). Elytra with numerous fine long setae similar to but not so abundant as are shown in figure 12; elytra (as in fig. 2) truncate and short, not extending posteriad of femorotibial joints of hind legs; abdomen with setae inserted at base of each pleural tubercle (fig. 3); pronotum (fig. 4) with pair of paramedian tubercles on posterior margin in addition to posterolateral tubercles *Carpophilus* species a
 - Elytra (figs. 7, 8) without setae; each elytron with outer apical margin (fig. 8) curved; elytron long (fig. 7), reaching well posteriad of femorotibial joint of hind leg; abdomen with seta inserted subapically on each pleural tubercle (fig. 5); pronotum (fig. 7) with only posterolateral tubercles on posterior margin *Cryptarcha ampla* Erichson
- 4(2). Pronotum with elongate paramedian tubercles on posterior margin in addition to posterolateral tubercles (as in fig. 4); fourth abdominal tergum without lateral marginal tubercles *Carpophilus lugubris* Murray?
 - Pronotum (fig. 1) with only posterolateral tubercles on posterior margin; fourth abdominal tergum (fig. 1) with distinct lateral marginal tubercle on each side *Carpophilus hemipterus* (Linnaeus)?, *Carpophilus mutilatus* Erichson?
- 5(1). Fourth abdominal tergum (figs. 10, 15, 16) with one or more pairs of conspicuous discal setae²; elytra truncate (fig. 12) apically and short (figs. 10, 16), not extending posteriad of femorotibial joint; all pronotal tubercles short, at most twice as long as basal diameter (figs. 10, 14, 16) 6
 - Fourth abdominal tergum (fig. 17) without discal setae; each elytron with outer margin rounded apically (as in fig. 8); elytron long, extending well posteriad of femorotibial joint (as in fig. 7); some pronotal tubercles (figs. 20, 21) long, more than four times as long as basal diameter 9

¹ Not present on all femora of *Cryptarcha ampla*.

² The discal setae of *Brachypeplus rubidus* and the posterior ones of *Macrostola lutea* may actually be posterior marginal ones.



FIGS. 5-8. Pupa of *Cryptarcha ampla* Erichson. 5. Pleural tubercle. 6. Right half of head, cephalic view. 7. Entire body, dorsal view. 8. Left elytron, ventrolateral view.

FIG. 9. Pupa of *Conotelus stenoides* Murray, right half of head, cephalic view. The scale refers to figures 7 and 8.

- 6(5). Elytra (figs. 10, 12) with numerous fine light setae. *Conotelus* 7
- Elytra glabrous, except in *Macrostola lutea* (fig. 16) which bears single thick, darkly pigmented seta at base of each elytron. 8
- 7(6). Urogomphi (fig. 13) bifurcate, branches being equal. 8
- *Conotelus mexicanus* Murray
- Urogomphi simple (fig. 10) or bifurcate (fig. 11), with outer branches

- longer. *Conotelus stenoides* Murray
- 8(6). Base of each elytron (fig. 16) with dark stout seta; metanotum (fig. 16) with pair of sublateral, stout, dark setae; fourth abdominal tergum (fig. 16) with three pairs of dark, stout, discal setae. *Macrostola lutea* Murray
- Bases of elytra without setae; metanotum without setae; fourth abdominal tergum (fig. 15) with single pair of discal setae. *Brachypeplus rubidus* Murray
- 9(5). Fourth abdominal segment (fig. 17) with two elongate, equal-sized, pleural tubercles on each side. *Cyllodes biplagiatus* LeConte
- Fourth abdominal segment with single, elongate, pleural tubercle on each side. 10
- 10(9). Pronotum (fig. 20) with one or more pairs of long tubercles along posterior margin in addition to posterolateral tubercles. 11
- Pronotum (fig. 21) without long tubercles along posterior margin except for posterolateral tubercles. *Lobiopa insularis* (Castelnau)
- 11(10). Sixth abdominal tergum (fig. 18) with elongate lateral marginal tubercle on each side.
- *Phenolia grossa* (Fabricius), *Omosita colon* (Linnaeus) (Hinton, 1945)
- Sixth abdominal tergum (fig. 19) without lateral marginal tubercles.
- *Pallodes silaceus* Erichson

CARPOPHILINAE

Brachypeplus rubidus Murray

Figures 14, 15

Head without elongate tubercles but with several pairs of inconspicuous tubercles that are shorter than their basal diameters. Pronotum (fig. 14) without elongate tubercles but with numerous tubercles of intermediate length, longest being about twice as long as basal diameter; tubercles with setae borne apically; posterior margin with approximately three pairs of low, seta-bearing tubercles in addition to posterolateral ones. Each elytron truncate and short, not extending posteriad of femorotibial joint of hind leg; elytra without setae. Metanotum without setae. Apex of hind femur (fig. 15), as seen from above, having very low tubercle, with seta arising apically. Fourth abdominal segment (fig. 15) with tergum possessing pair of short, seta-bearing, lateral, marginal tubercles and pair of short, seta-bearing, discal tubercles¹; segment with single pair of short pleural tubercles, each bearing conspicuous seta apically. Sixth abdominal tergum with pair of short, lateral, marginal tubercles. Urogomphi rather short, simple.

MATERIAL: Eleven pupae, West Africa, February 3, 1938, in tigerwood (*Lovea klaineana*) under bark. One pupa, Africa (quarantine interception), November 15, 1938, *Lovea klaineana* [determined by W. H. Anderson].

¹ The discal setae may actually be posterior marginal ones.

Carpophilus

Figures 1-4

Head with or without pair of elongate supraorbital tubercles; tubercles, if present, bearing setae basally. Pronotum (figs. 1, 4) with number of elongate tubercles, bearing setae basally; posterior margin with (fig. 4) or without (fig. 1) pair of tubercles in addition to posterolateral ones. Each elytron truncate (fig. 2) and short (fig. 1), not extending posteriad of femerotibial joint; elytra (fig. 2) with scattered fine setae. Metanotum (fig. 1) without setae. Apex of hind femur, as seen from above (fig. 1), with elongate tubercle, bearing seta basally. Fourth abdominal segment having tergum either with (fig. 1) or without lateral marginal tubercles; segment with single pair of pleural tubercles (fig. 1), each bearing setae basally (fig. 3). Sixth tergum (fig. 1) with lateral marginal tubercles. Urogomphi (fig. 1) normally long, simple.

For identification of species, see the key.

MATERIAL: *Carpophilus* species *a*, Tampico, Mexico, on pineapples, intercepted at Philadelphia, Pennsylvania [with larvae of *Carpophilus humeralis* (Fabricius), *hemipterus*?, and unknown *Carpophilus*], [determined by J. G. Rozen].

Carpophilus hemipterus (Linnaeus)?, one pupa, China, in water chestnut, intercepted October 15, 1924, at Boston, Massachusetts (W. T. Owey) [larvae determined by J. G. Rozen].

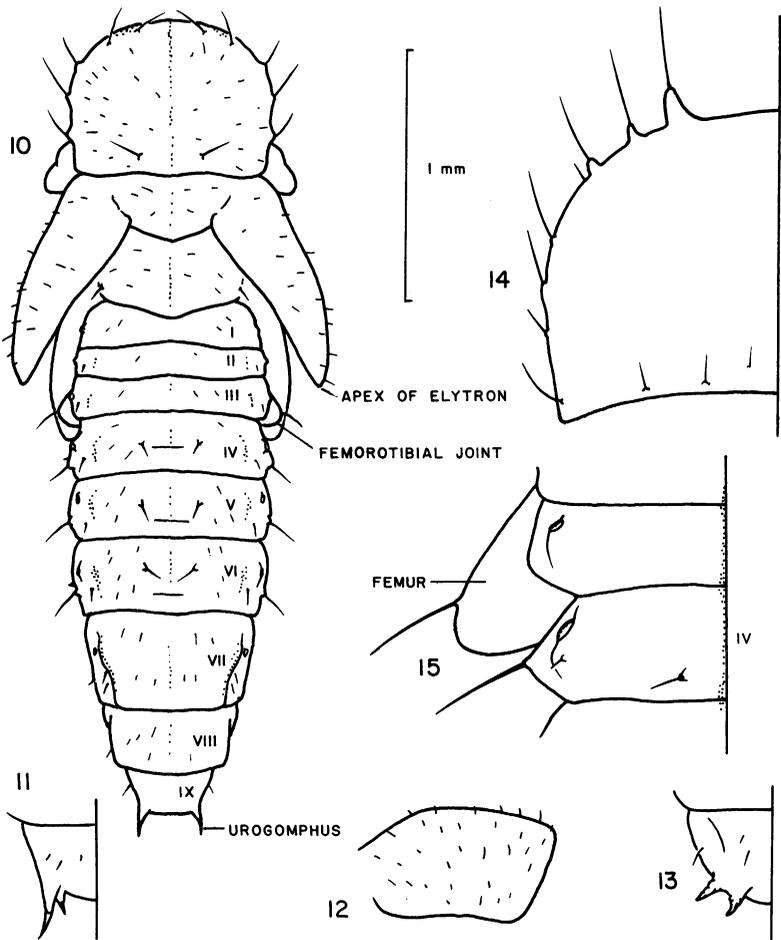
Carpophilus lugubris Murray?, two pupae, Falls Church, Virginia, August 3, 1943, injuring corn (Floyd Andre) [associated with one adult and four larvae of *C. lugubris* and with two larvae of *C. antiquus*, determined by W. A. Connell].

Carpophilus mutilatus Erichson?, 12 pupae, "C. City," Florida, October 17, 1881, bred from eggs [associated with four adults and 10 larvae of *C. mutilatus*, and with two larvae of *Carpophilus* species, determined by W. A. Connell].

Conotelus

Figures 9-13

Head (fig. 9) without elongate tubercles, but with several pairs of inconspicuous tubercles all shorter than basal diameters. Pronotum (fig. 10) without elongate tubercles, all tubercles being shorter than basal diameters; tubercles with setae borne apically; posterior margin with one pair of low tubercles in addition to posterolateral ones. Each elytron truncate (fig. 12) and short (fig. 10), not extending posteriad of femerotibial joint of hind leg; elytra (fig. 12) with numerous scattered fine setae. Metano-



FIGS. 10-12. Pupa of *Conotelus stenoides* Murray. 10. Entire body, dorsal view. 11. Left half of ninth abdominal segment, dorsal view. 12. Left elytron, ventrolateral view.

FIG. 13. Pupa of *Conotelus mexicanus* Murray, left half of ninth abdominal segment, dorsal view.

FIGS. 14, 15. Pupa of *Brachypeplus rubidus* Murray. 14. Left half of pronotum, dorsal view. 15. Femorotibial joint and left half of third and fourth abdominal segments, dorsal view.

The scale refers to figures 10, 12, 14, and 15.

tum (fig. 10) with scattered setae. Apex of hind femur (fig. 10), as seen from above, without tubercle, though with seta. Fourth abdominal seg-

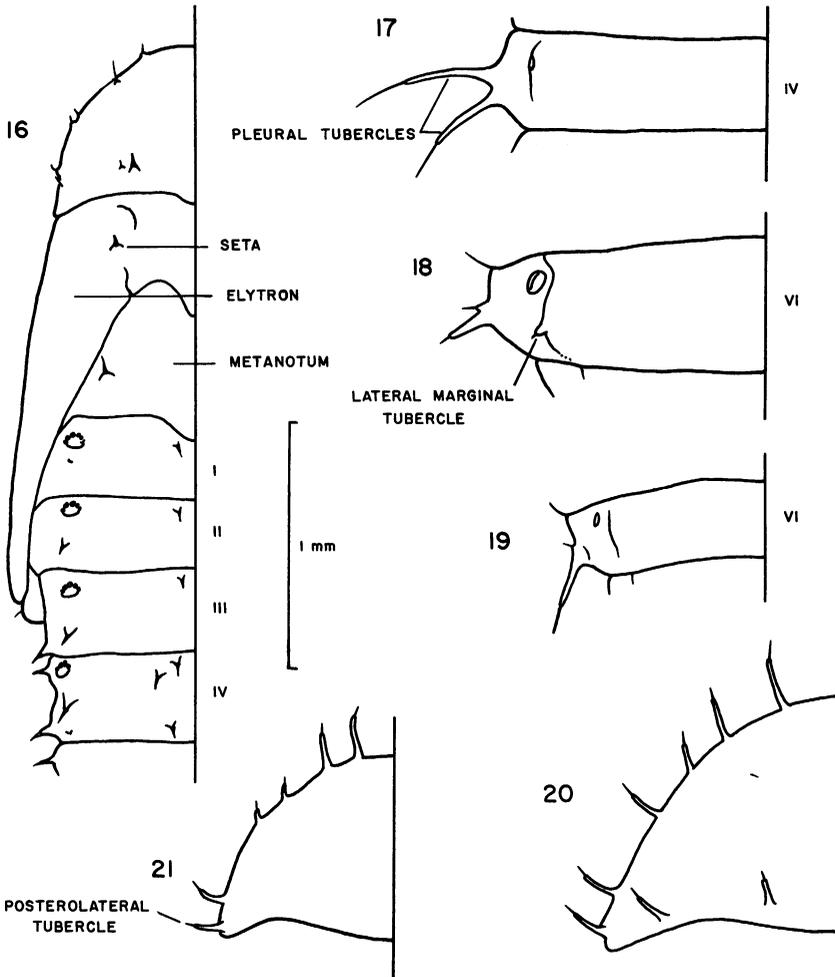


FIG. 16. Pupa of *Macrostola lutea* Murray, left half of thorax and of basal abdominal segments, dorsal view.

FIG. 17. Pupa of *Cyllodes biplagiatus* LeConte, left half of fourth abdominal segment, dorsal view.

FIG. 18. Pupa of *Phenolia grossa* (Fabricius), left half of sixth abdominal segment, dorsal view.

FIGS. 19, 20. Pupa of *Pallodes silaceus* Erichson. 19. Left half of sixth abdominal segment, dorsal view. 20. Left half of pronotum, dorsal view.

FIG. 21. Pupa of *Lobiopa insularis* (Castelnau), left half of pronotum, dorsal view.

The scale refers to figures 16-20; that for figure 21 equals one-half of other scale.

ment (fig. 10) having tergum without lateral marginal tubercles but with pair of distinct lateral marginal setae; tergum with pair of short, discal, seta-bearing tubercles; segment with pair of short pleural tubercles, each bearing conspicuous seta apically. Sixth abdominal tergum as described for fourth. Urogomphi short and either simple (fig. 10) or bifurcate (figs. 11, 13).

In view of the few specimens available for study and of the few differences found between species (see key), species descriptions are not provided.

MATERIAL: *Conotelus mexicanus* Murray, one pupa, intercepted at Nogales, Arizona, reared August 16–30, 1941, G. [or C.] F. Haller [adult determined by J. G. Rozen].

Conotelus stenoides Murray, one pupa, Pulaski, Giles County, Tennessee, July 5, 1946, ear of corn (with *Carpophilus*) (through G. M. Bentley) [adults determined by J. G. Rozen]. Four pupae, Mexico, in Irish potatoes, intercepted at New Orleans, Louisiana, March 24, 1923 (C. H. Russell) [adults determined by J. G. Rozen].

Macrostola lutea Murray

Figure 16

Head without elongate tubercles. Pronotum (fig. 16) without elongate tubercles, longest tubercle being no higher than its basal diameter; tubercles with setae borne apically; posterior margin with two pairs of low sublateral tubercles and without posterolateral ones. Each elytron truncate apically and short (fig. 16), not extending posteriad of femorotibial joint; elytron (fig. 16) bearing dark, stout seta at base. Metanotum (fig. 16) with pair of dark, stout, lateral setae. Apex of hind femur, as seen from above (fig. 16), without seta-bearing tubercle. Fourth abdominal segment (fig. 16) poorly defined but with one and in some cases two lateral marginal tubercles posteriad of each spiracle; tergum also with three pairs of discal seta-bearing tubercles¹; segment with two pairs of pleural tubercles, each tubercle bearing dark, stout seta apically. Sixth abdominal tergum with lateral marginal tubercle on each side in addition to discal tubercles. Urogomphi short, each bearing apically three or four setae on short tubercles.

MATERIAL: Seven pupae, Island of Monserrat, Lesser Antilles, West Indies, in closed flower case of *Philodendron* species (H. G. Hubbard) [determined by E. A. Schwarz].

¹The posterior discal setae may actually be posterior marginal ones.

Omosita colon (Linnaeus)

The following description is based upon the one given by Hinton (1945).

Head without elongate tubercles. Pronotum with numerous elongate tubercles, bearing setae apically; posterior margin with two pairs of tubercles in addition to posterolateral ones. Each elytron extending posteriad of femorotibial joint and probably with outer margin curved apically; unknown whether elytra possessing fine setae. Unknown whether metanotum possessing fine setae. Apex of hind femur, as seen from above, without elongate tubercle though with seta. Fourth abdominal segment with tergum possessing pair of lateral marginal tubercles, which bear setae apically; segment with single pair of pleural tubercles bearing setae apically. Sixth abdominal tergum with pair of lateral marginal tubercles. Urogomphi normally long, simple.

NITIDULINAE

Cylloides biplagiatus LeConte

Figure 17

Head without elongate tubercles. Pronotum with numerous elongate tubercles, bearing setae apically; posterior margin with three pairs of tubercles but none on posterolateral angles. Each elytron extending posteriad of femorotibial joint of hind leg and with outer margin curved apically; elytra without setae. Metanotum without setae. Apex of hind femur, as seen from above, with seta arising apically from low, rounded tubercle, which is as short as its basal diameter. Fourth abdominal segment (fig. 17) with tergum lacking tubercles; segment with two pairs of long, equal-sized, pleural tubercles, each tubercle bearing seta apically. Sixth abdominal tergum with elongate, lateral, marginal tubercle on each side. Urogomphi normally long, simple.

MATERIAL: Seven pupae, Springfield, Massachusetts, June 19, 1901 (Dimmock) [adult determined by J. G. Rozen].

Lobiopa insularis (Castelnau)

Figure 21

Head without elongate tubercles but with several pairs of inconspicuous tubercles that are shorter than basal diameters. Pronotum (fig. 21) with numerous elongate tubercles, bearing setae apically; posterior margin without elongate tubercles except for posterolateral ones. Each elytron extending posteriad of femorotibial joint of hind leg and with outer

margin curved apically; elytra without setae. Metanotum without setae. Apex of hind femur, as seen from above, with seta arising apically from short tubercle which is about as high as its basal diameter. Fourth abdominal segment with tergum lacking tubercles; segment with single pair of pleural tubercles, each bearing seta apically. Sixth tergum with or without lateral marginal tubercles. Urogomphi normally long and slender.

MATERIAL: Four pupae, Canal Zone, October 28, 1935, with *Spondeas cytherea* seeds [larvae determined by A. G. Böving].

Pallodes silaceus Erichson

Figures 19, 20

Head without elongate tubercles but with several pairs of low, seta-bearing tubercles, none of which is more than twice as long as basal diameter. Pronotum (fig. 20) with numerous elongate tubercles, bearing setae apically; posterior margin with two pairs of tubercles in addition to posterolateral ones. Each elytron extending posteriad of femorotibial joint of hind leg and with outer margin curved apically; elytra without setae. Metanotum without setae. Apex of hind femur as seen from above with seta arising apically from tubercle which is about as high as its basal diameter. Fourth abdominal segment with tergum lacking tubercles; segment with single pair of pleural tubercles, bearing setae apically. Sixth tergum (fig. 19) without tubercles. Urogomphi normally long, simple.

MATERIAL: Fourteen pupae, Plummers Island, Maryland, larvae and pupae in white, fleshy, gilled fungi on tulip poplar log, September 6, 1913, adult bred September 28, 1913 (Schwarz and Barber) [adults presumably determined by the collectors].

Phenolia grossa (Fabricius)

Figure 18

Head without elongate tubercles but with several pairs of inconspicuous tubercles between eyes; these tubercles with lengths less than basal diameters. Pronotum with numerous elongate tubercles, bearing setae apically; posterior margin with one or two pairs of elongate tubercles in addition to posterolateral ones. Each elytron extending posteriad of femorotibial joint of hind leg and with outer margin curved apically; elytra without setae. Metanotum without setae. Apex of hind femur, as seen from above, with seta arising apically from low rounded tubercle which is shorter than its basal diameter. Fourth abdominal segment either without tubercles or with pair of lateral marginal tubercles; segment with two pairs of pleural tubercles; anterior pair short, each about as

long as basal diameter; posterior ones elongate; both pairs bearing setae apically. Sixth tergum (fig. 18) usually with pair of variable-sized lateral marginal tubercles. Urogomphi normally long, simple.

MATERIAL: Three pupae, St. Louis, Missouri [larvae determined by J. G. Rozen]. Six pupae "in fungus brought to Springfield Bot. Club by Mrs. Owen, Oct. 12, 1900." One pupa, Dead Run, Virginia, near Potomac River, September 28, 1940, in *Hydnum* (?) (collected and reared by B. E. Rees) [adults determined by E. A. Chapin].

CRYPTARCHINAE

Cryptarcha ampla Erichson

Figures 5-8

Head (fig. 6) with pair of elongate supraorbital tubercles that are as long as or longer than pronotal tubercles; seta borne medially on each tubercle. Pronotum (fig. 7) with anterior paramedian tubercles elongate and bearing setae medially; other tubercles much smaller; posterior margin without tubercles except for posterolateral ones. Each elytron extending posteriad of femorotibial joint (fig. 7) and with outer margin curved apically (fig. 8); elytra without setae. Metanotum (fig. 7) without setae. Apex of hind femur, as seen from above (fig. 7), with seta arising medially from elongate tubercle. Fourth abdominal segment (fig. 7) with tergum lacking tubercles; segment with single pair of pleural tubercles, each with subapical seta and suprabaasal seta (fig. 5). Sixth abdominal tergum (fig. 7) without tubercles. Urogomphi (fig. 7) normally long, simple.

MATERIAL: Two pupae, Chicopee, Massachusetts, June 11, 1901, willow [adults determined by J. G. Rozen].

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