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NOTICE: Volume L, Number 4, of The Journal of the New York Entomological Society was published on January 5, 1943.

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FLEAS OF NEW ENGLAND

By H. S. Fuller

The present paper is a preliminary report on the writer’s studies of New England fleas carried on for the past four years. No species are described as new, but several are recorded from New England for the first time. When more material is available, it is planned to publish a more complete paper, including all known records, and new keys.

The species are arranged according to the classification adopted by Irving Fox (1940), whose work, although not critical, is of great importance and value. I record only specimens examined personally by me. No material in the United States National Museum is included, for this was published by Fox (1940). In some cases, there is apparent duplication, owing to the fact that duplicates of certain collections had already been sent to the National Museum before my studies were begun. This also applies to apparent duplication in the case of a few records published by Jordan, where specimens had already been sent to him. All the specimens recorded from Milton, Sagamore Beach, Westboro, Massachusetts; and Center Ossipee, New Hampshire, were collected by me. With few exceptions, all the material from Vermont was collected by F. L. Osgood.

The writer takes this opportunity to express his appreciation to the following persons who have contributed to this study. Collections were loaned by George H. Plumb, Connecticut Agri-
tural Station; J. G. Conklin, University of New Hampshire; M. E. Smith, Massachusetts State College; Charles O. Dirks, University of Maine. Richard Dow made available the collection of the New England Museum of Natural History, Boston; and Nathan Banks and J. Bequaert, that of the Museum of Comparative Zoology, Cambridge. F. L. Osgood of Rutland, Vermont, loaned me some very worthwhile material, providing many new records from Vermont. Carroll N. Smith and H. K. Gouck, of the U. S. Bureau of Entomology, have very kindly sent numerous fleas collected on the island of Martha’s Vineyard. In one lot the writer has found a male and female of *Rectofrontia fraterna* (Baker), a species which has been recorded only once previously from the eastern United States.

Family Hectopsyllidae

*Echidnophaga gallinacea* (Westwood).—No records of the occurrence of this species north of the state of New York are known to the writer, although Trembly and Bishopp (1940) cite a record in the literature from Providence, Rhode Island. This species has been reported from New York City on rats, and there is a possibility that it might be found on rats in coastal regions of New England, especially in ports.

Family Pulicidae

1. *Hoplopsychus lynx* (Baker).—New Hampshire: Waterville, March 15, 1935, 3 males and 8 females, off *Lynx canadensis* (J. D. Smith). Hancock, 1 male and 1 female, off same host. Coos County, 3 males and 7 females, off wildcat.

2. *Xenopsylla cheopis* (Rothschild).—Massachusetts: Boston, a large series, collected off rats near wharves during a rat-flea survey conducted in 1934 by Dr. Marshall Hertig and Dr. E. Elizabeth Jones. Fox (1940) records it from Providence, Rhode Island.

3. *Pulex irritans* Linnaeus.—This species is recorded from Fall River, Massachusetts by Ewing (1931). Trembly and Bishopp (1940) list New Bedford, Massachusetts, in addition. No specimens from New England have come to the writer’s attention during the past four years, although he (1942) has recorded it from Newfoundland, and it probably should be expected sporadically in New England.


6. *Ctenocephalides canis* (Curtis).—**Massachusetts**: Wenham, 2 males and 2 females, off woodchuck. **Vermont**: Rutland, 1 male and 1 female, off domestic cat.

**Family Dolichopsyllidae**

7. *Trichopsylla lotoris* Stewart.—This species has been recorded by Fox (1940) from Maine, occurring on *Procyon lotor lotor*. No further records or specimens have been seen by the present writer.

Massachusetts: Natick, 4 males and 2 females, in mouse nest. Newton Center, 1 male, off *Blarina brevicauda talpoides*. Petersham, 1 female, off *Condylura cristata*. Sagamore Beach, 1 female, off *Blarina brevicauda talpoides*; a large series off *Tamias striatus*. Westboro, 1 female, off *Marmota monax* ssp. Concord, 2 males and 1 female, off *Blarina* sp. Barnstable, December 17, 1933, 1 male and 1 female, off *Microtus p. pennsylvanicus* (D. Griffin). Milton, 1 male, off *Blarina brevicauda talpoides*. Chilmark, March 26, 1942, off *Microtus pennsylvanicus*, 2 males and 4 females (H. K. Gouck, Bishopp no. 31124). Edgartown, March 25, 1942, off same host, 4 males and 2 females (H. K. Gouck, Bishopp no. 31123). Gay Head, off same host, several records as follows: February 17, 1942, 2 males and 3 females (H. K. Gouck, Bishopp no. 31116); March 19, 1942, 9 males and 11 females (H. K. Gouck, Bishopp no. 31120); April 17, 1942, 1 male and 8 females (H. K. Gouck, Bishopp no. 31129); March 19, 1942, in nest of same host, 8 males and 18 females (H. K. Gouck, Bishopp no. 31125); March 19, 1942, off *Peromyscus leucopus* ssp., 1 male and 2 females (H. K. Gouck, Bishopp no. 31121). Vineyard Haven, April 16, 1942, off *Microtus pennsylvanicus*, 9 males and 8 females; and April 18, off same host, 4 males and 4 females (H. K. Gouck, Bishopp nos. 31128 and 31130). West Tisbury, April 8, 1942, off same host, 9 males and 8 females (H. K. Gouck, Bishopp no. 31126). New Hampshire: Hancock, 1 male and 3 females, off *Parascalops breweri*. Franklin, 4 males and 1 female, off mole. Center Ossipee, 1 male and 2 females, and 1 male, all off *Blarina brevicauda talpoides*. Vermont: Breadloaf, 1 male, off *Blarina brevicauda*. Middlebury, 2 males, off same host. Rutland, 1 female, off same host. Sherburne, 1 female, off *Napaeozapus i. insignis*.

9. *Rectofrontia fraterna* (Baker).—Massachusetts: Edgartown, March 25, 1942, off *Microtus pennsylvanicus*, 1 male and 1 female (H. K. Gouck, Bishopp no. 31123). This record represents the first for New England, and the second for the eastern United States. Fox (1940) records a single male specimen, taken at Kensington, Maryland, off the same host. The species is ordinarily found on various small mammals in the western states, and as yet we know of only two eastern records. Further search should be made for this species.
Conorhinopsylla stanfordi Stewart.—No records of the occurrence of this species in New England are known to the writer. It was described from a red squirrel in New York State, and as it has been collected from other species of squirrels, it should be searched for in New England.


11. Odontopsyllus multispinosus (Baker).—Massachusetts: Canton, 1 female, off cottontail rabbit. Cohasset, 1 male, off same host. Harvard, 2 males and 1 female, off same host.

Ceratophyllus celsius Jordan.—No records of the occurrence of this species in New England are known to the writer. Fox (1940) records it from the nests of cliff swallows in New York State.


13. Ceratophyllus idius Jordan and Rothschild.—Massachusetts: Groton, June 26, 1941, 1 male, in nest of Iridoprocne bicolor (W. P. Wharton). North Eastham, 2 males and 2 females, off same host. Wakefield, large series, off same host (E. E. Tyzzer). Rock, 1 male and 3 females, off same host; 4 males and 2 females, in nest of Sialia sialis.

14. Ceratophyllus galline (Schrank).—Connecticut: Thomp-
sonville, male and female, in nest of *Sialia sialis*. Madison, 2 females, in poultry house. **Maine:** Eliot, male and female in chicken house. **Massachusetts:** Babson Park, June 7, 1928, 7 males and 8 females, in nest of *Sialia sialis*. Groton, male and female, off same host; male and female, in nest of starling. Wakefield, 2 males, in nest of *Iridoprocne bicolor* (E. E. Tyzzer). **New Hampshire:** Woodstock, male and female, in hen house.

15. *Ceratophyllus riparius* Jordan and Rothschild.—**Maine:** Kent Island, 2 males and 2 females, in nest of *Riparia r. riparia* (Audubon Society). **New Hampshire:** Durham, male and female, no host data.

16. *Opisodasys pseudarctomys* (Baker).—**Maine:** East Blue Hill, 1 female, off *Sciurus hudsonicus loquax* (V. G. Dethier). Windy Pitch, Mt. Katahdin, 4 males and 5 females, off *Glaucomys sabrinus*. **New Hampshire:** Peterboro, 2 females, off *Glaucomys sabrinus macrotis*. **Vermont:** Mendon, male and female, off *Glaucomys v. volans*. Saxtons River, 4 males and 6 females, off same host.

17. *Orchopeas wickhami* (Baker).—**Connecticut:** Mount Carmel, 1 female, off mouse. Hamden, 2 males and 2 females, off *Sciurus hudsonicus loquax*. **Massachusetts:** Amherst, 1 male and 5 females, off squirrel. Boxboro, 2 males and 2 females, off *Sciurus carolinensis leucotis*. Brookline, 6 males and 1 female, off same host. Cambridge, 1 male, off same host. Cohasset, 1 male and 1 female, off *Sylvilagus* sp. Dedham, 2 males, off *Sciurus hudsonicus loquax*. Harvard, 3 males and 1 female, off same host. Norwell, 1 female, off *Rattus norvegicus*; 1 male and 1 female, off *Sciurus hudsonicus loquax*; 3 females, off *Sciurus carolinensis leucotis*; numerous specimens, off same host, January 2, 1937 (C. V. MacCoy). Penikese Island, 1 female, off field mouse. Sagamore Beach, 2 males and 4 females, off *Sciurus hudsonicus loquax*; 1 male and 3 females, off *Sciurus carolinensis leucotis*; 1 female, off *Tamias striatus lysteri*. Wellesley, 1 female, off *Sciurus carolinensis leucotis*. **New Hampshire:** Center Ossipee, numerous specimens, off *Sciurus hudsonicus loquax*. Durham, 2 males and 2 females, off *Peromyscus* sp. Peterboro, 1 male and 1 female, off *Glaucomys sabrinus macrotis*. **Vermont:** Saxtons River, 1 male and 3 females, off *Glaucomys v. volans*.

19. *Orchopeas leucopus* (Baker).—Maine: Deer Island, 2 males and 2 females, off *Peromyscus maniculatus abietorum*. Katahdin Saddle, 1 male, off *Peromyscus maniculatus* ssp. Basin Pond, Mt. Katahdin, 1 male and 5 females, off same host. Massachusetts: Barnstable, 2 females, off *Mus m. musculus*. Concord, February 17, 1941, 1 male, off *Peromyscus leucopus* noveboracensis. Milton, October 19, 1941, 1 female; October 26, 1941, 1 male; 1 male; 1 female; November 9, 1941, 1 male, 2 females, 3 females; all off *Peromyscus leucopus* noveboracensis. Muskeget Island, 4 males and 3 females, off *Peromyscus leucopus* ssp. Wakefield, 1 female, off same host. Westboro, 2 males and 2 females (H. K. Gouck, Bishopp no. 31121); April 10, 1942, February 17, 1942, off *Peromyscus* sp., 1 female (H. K. Gouck, Bishopp no. 31117); March 19, 1942, off same host, 4 males and 2 females (H. K. Gouck), Bishopp no. 31121); April 10, 1942, off same host, 2 males and 2 females (H. K. Gouck, Bishopp no. 31127); March 19, 1942, off *Microtus pennsylvanicus*, 1 female (H. K. Gouck, Bishopp no. 31120). Vineyard Haven, April 16, 1942, off same host, 1 female (H. K. Gouck, Bishopp no. 31128).

New Hampshire: Ossipee, 1 male and 2 females, off *Peromyscus maniculatus graciosis*. Center Ossipee, numerous specimens, off *Peromyscus maniculatus graciosis*. Hampton, 1 male, off *Peromyscus* sp. Rhode Island: Kingston, 3 males and 2 females, off *Peromyscus leucopus* noveboracensis. Vermont: Sherburne, 3 males and 3 females, off *Clethrionomys gapperi ochraceus*. Pittsford Mills, 1 female, off *Peromyscus maniculatus gracilis*. Mendon, 3 females, off *Peromyscus leucopus* noveboracensis. Rutland, 4 males and 4 females, off same host.

20. *Megabothris asio* (Baker).—Massachusetts: Gay Head, April 10, 1942, off *Peromyscus leucopus* ssp., 1 female; January 21, 1942, off *Microtus pennsylvanicus*, 1 male; March 19, 1942,
in nest of same host, 1 male and 1 female; April 17, 1942, off same host, 3 males and 2 females. Chilmark, March 26, 1942, off same host, 1 male. Vineyard Haven, April 16, 1942, off same host, 1 female. West Tisbury, April 8, 1942, off same host, 1 male. (All collected by H. K. Gouck, Bishopp nos. 31127, 31115, 31129, 31124, 31128, and 31126 respectively.) Gay Head, December 15, 1941, 4 males, off same host (H. K. Gouck). Milton, October 26, 1941, 1 male, off *Microtus p. pennsylvanicus*. New Hampshire: Center Ossipee, 1 male, off same host; 2 males and 1 female, off same host; 1 female, off *Peromyscus maniculatus gracilis*. Durham, 1 female, off *Blarina brevicaudata talpoides*. Franklin, August, 1939, 1 female, off *Scalopus aquaticus* (V. G. Dethier). Vermont: Rutland, 1 male and 1 female, off *Microtus p. pennsylvanicus*.  


22. *Megabothris quirini* (Rothschild).—New Hampshire: Center Ossipee, 1 male, off *Microtus p. pennsylvanicus*; August 31, 1941, 1 male, off *Peromyscus maniculatus gracilis*.  

23. *Megabothris vison* (Baker).—Maine: Bayville, 2 females, off *Sciurus hudsonicus loquax*. East Blue Hill, August, 1941, 11 males and 17 females, off same host (V. G. Dethier). Blue Hill, August 30, 1941, 1 female, off same host; August 28, 1941, 1 female, off *Tamias striatus lysteri* (V. G. Dethier).  


Family Hystrichopsyllidae  

25. *Hystrichopsylla gigas tahavuana* Jordan.—New Hampshire: Franklin, 1 female, off *Scalopus aquaticus*.  


Athyloceras bishopi Jordan. No records of the occurrence of this species in New England are known to the writer. It has been collected off Blarina and Microtus in New York State and off Clethrionomys in West Virginia.

26. Stenoponia americana (Baker).—Massachusetts: Martha’s Vineyard, 1 female, off Microtus p. pennsylvanicus. Wellfleet, 1 male, off Scalopus aquaticus. Wareham, 1 male, off same host. Chilmark, March 26, 1942, off Microtus pennsylvanicus, 2 females (Bishop no. 31124). Edgartown, March 25, 1942, off same host, 1 female (Bishop no. 31123); and December 9, 1942, off same host, 4 males and 4 females. West Tisbury, April 8, 1942, off same host, 1 male (Bishop no. 31126). Gay Head, January 21, 1942, off same host, 1 male (Bishop no. 31115); March 19, 1942, off same host, 4 males and 2 females (Bishop no. 31120); April 17, 1942, off same host, 1 male (Bishop no. 31129); April 10, 1942, off Peromyscus leucopus ssp., 1 male and 2 females (Bishop no 31127). (All collected by H. K. Gouck.)

27. Peromyscopsylla hesperomys (Baker).—Massachusetts: Milton, October 19, 1941, 1 male and 1 female, off Peromyscus leucopus noveboracensis; October 26, 1941, 1 male and 2 females, off same host; November 9, 1941, 2 males, off same host. New Hampshire: Center Ossipee, numerous specimens, off Peromyscus maniculatus gracilis. Vermont: Chittenden, 1 female, off Pipistrellus subflavus obscurus.

28. Peromyscopsylla scotti I. Fox.—Massachusetts: Edgartown, November 13, 1937, 1 male, off Peromyscus leucopus fusus; October 29, 1937, 1 female (C. N. Smith). These specimens, of which the male is an allotype, are deposited in the United States National Museum. The writer has seen no additional material.

29. Peromyscopsylla catalina (Jordan).—Maine: Chimney Pond, Mt. Katahdin, 1 male, off Evolomys gapperi ssp. Massachusetts: Ashburnham, 1 male, off same host. Milton, October 19, 1941, 1 female, off Peromyscus leucopus noveboracensis. New Hampshire: Center Ossipee, 1 female, off Blarina breviceuda talpoides; October 13, 1941, 1 female, off Sciurus hudsonicus loquax (W. F. Gimpel); September 29, 1940, 2 females, off Microtus p. pennsylvanicus; September 1, 1941, 1 male, off Peromyscus maniculatus gracilis.
30. *Ctenopsyllus segnis* (Schönherr).—Massachusetts: Cambridge, 1 male, off mouse.

31. *Nearctopsylla genalis* (Baker).—Vermont: Sherburne, 1 female, off *Clethrionomys gapperi ochraceus*. Mendon, 2 females, off *Mustela c. cicognani*; 1 female, off *Glaucomys v. volans*. Saxtons River, 1 male, off same host.

32. *Doratopsylla blarina* C. Fox.—Connecticut: Rainbow, 1 female, off large short-tailed shrew. Massachusetts: Concord, 1 male and 1 female, off *Blarina brevicauda talpoides*. Milton, October 19, 1941, 2 males and 1 female, off same host; November 9, 1941, 1 male and 2 females, off same host; October 19, 1941, 1 female, off *Peromyscus leucopus noveboracensis*. Sagamore Beach, 2 males and 1 female, off *Blarina brevicauda talpoides*; July 13, 1941, 1 male, off same host. Westboro, 1 female, off same host.

Saxtons River, 1 male and 1 female, off same host. Doratopsylla curvata Rothschild. No records of the occurrence of this species in New England are known to the writer. It has been collected off *Blarina* in New York State.

33. *Epitedia wenmanni* (Rothschild).—Connecticut: Mount Carmel, 2 females, off mouse. Massachusetts: Barnstable, 1 male, off *Rattus n. norvegicus*; 1 female, off *Peromyscus leucopus noveboracensis*. Milton, October 26, 1941, 1 male and 1 female, off same host; November 9, 1941, 2 males, off same host; 1 female, off *Peromyscus maniculatus gracilis*; and 1 male, off *Microtus p. pennsylvanicus*. Penikese Island, 1 female, off same host. Wakefield, 1 female, off *Blarina brevicauda talpoides*. Westboro, 1 female, off *Peromyscus leucopus noveboracensis*. Oak Bluffs, January 16, 1942, off cottontail rabbit, 1 female (H. K. Gouck and C. N. Smith, Bishopp no. 31113). Gay Head, March 19, 1942, off *Microtus pennsylvanicus*, 1 female (Bishopp no. 31120); March 19, 1942, off *Peromyscus leucopus* ssp., 2 females (Bishopp no. 31121); and April 10, 1942, off same host, 2 females (Bishopp no. 31127). (All collected by H. K. Gouck.) New Hampshire: Center Ossipee, 4 males, off *Peromyscus maniculatus gracilis*;
1 female, off *Peromyscus leucopus* *noveboracensis*; October 12, 1941, 1 female, off same host; October 12, 1941, 1 female, off *Sciurus hudsonicus* *loquax*. VERMONT: Mendon, 1 female, off *Mustela c. cicognani*.

34. *Epitedia faceta* (Rothschild).—MASSACHUSETTS: The only New England record known to the writer is from Wilbraham, Massachusetts, male and female, off *Sciurus hudsonicus*. These two specimens are in the N. C. Rothschild Collection, in the British Museum.

*Epitedia testor* (Rothschild). No records of the occurrence of this species in New England are known to the writer. It was described from a female holotype collected at Lansingburgh, near Troy, New York, taken from a nest, presumably a mouse’s. The male is not known as yet.

35. *Tamiophila grandis* (Rothschild).—MASSACHUSETTS: Milton, October 19, 1941, 1 male, off *Peromyscus leucopus* *noveboracensis*. Petersham, 1 female, off *Mustela n. noveboracensis*. Sagamore Beach, 1 female, off *Tamias striatus* *lysteri*. NEW HAMPSHIRE: Center Ossipee, 4 females, off same host. VERMONT: Mendon, 2 females, off same host. Saxtons River, 2 males and 4 females, off domestic dog. The dog represents an accidental host.

36. *Catallagia borealis* Ewing.—MAINE: The only New England record of this species known to the writer is the type specimen, a female, taken at Basin Pond, Mt. Katahdin, Maine, off *Microtus p. pennsylvanicus*. It is in the United States National Museum.

As is shown in a paper by the writer (1942b), *C. onaga* Jordan (New York State) is identical with this species, and is therefore a synonym of *C. borealis*.

Family Ischnopsyllidae

37. *Myodopsylla insignis* (Rothschild).—CONNECTICUT: Kent, 8 males and 9 females, off bats. Canton Center, 5 females, off *Myotis l. lucifugus*. MASSACHUSETTS: Barnstable, December 17, 1933, 1 male, off same host (D. Griffin). Centerville, 1 male, off same host. Hatchville, numerous specimens, off same host. Mashpee, July 22, 1935, 2 males and 9 females, off same host (D.
Griffin). Pittsfield, 7 males and 6 females, off same host. Wrentham, 1 male and 1 female, off same host. NEW HAMPSHIRE: Franklin, 2 males and 6 females, off same host. VERMONT: Mt. Arolus, 1 female, off same host. Chittenden, 1 male, off Pipistrellus subflavus obscurus (F. L. Osgood); January 11, 1914, 1 female, off Myotis l. lucifugus (F. M. Allen).

SUMMARY

Of the thirty-seven species of fleas here listed from New England, five are reported for the first time in this paper: Recto- 
frontia fraterna, Ceratophyllus riparius, Orchopeas caedens, Hystrichopsylla gigas tahavuana, and Tamiophila grandis.

The following species, not yet reported from New England, possibly occur there: Conorhinopsylla stanfordi, Ceratophyllus celsus, Atyphloceras bishopi, Doratopsylla curvata, Epitedia testor.

Thus far there is only one record of Echidnophaga gallinacea from this region. The human flea, Pulex irritans, has been reported only rarely from New England.

Ctenocephalides felis is the flea commonly found on cats and dogs and infesting human dwellings. Ctenocephalides canis has been taken only rarely in New England.

Xenopsylla cheopis, an important species in the transmission of typhus and bubonic plague, where these diseases occur, has been found on rats in Boston and other Atlantic seaports. Nosopsyllus fasciatus, however, is by far the commonest rat-flea in the New England region.

REFERENCES


SUPPLEMENTARY NOTES ON WESTERN HEMISPHERE MONOCHAMINI

By Lawrence S. Dillon and Elizabeth S. Dillon

Since the publication\(^1\) of the work on this tribe, the receipt of additional material has brought to light species not previously seen as well as new locality records and synonymy for forms already reported upon. Furthermore, various friends of the authors have pointed out some errors and oversights which need correction. It is to bring these matters to notice that this supplement is offered.

Thanks are due to Lionel Lacey for the loan of his material, to Henry Dietrich and Mont Cazier for the privilege of studying the collections respectively at Cornell University and at the American Museum of Natural History, and to Warren S. Fisher and Dr. E. Gorton Linsley for notations regarding genotype designations.

*Taeniotes* Serville

The type of this genus had been previously designated by Thomson, *Systema Ceramb.*, 1864, p. 77, as *Cerambyx ocellatus* Oliv.

*Taeniotes naevius* Bates. A fine series of twenty-seven specimens in Lacey’s collection included fourteen from various localities in Ecuador, as follows: Ecuador: 1; Rio Anzu, Oriente. 1; Puyo. 1; Tungurahua. 4; Zatzayacu, Oriente. 1; El Partidero. 2; Abitaqua, Oriente. 2; Balzapamba. 1; La Palmera. 1; Playse de Montelvo.

*Taeniotes inquinatus* Thomson. Ecuador: 5; El Partidero, March 4, 1936 (W. MacIntyre) [L. Lacey].

*Taeniotes similis* Dillon and Dillon. Inadvertently, the listing of the toptotypic paratype in the authors’ collection was omitted in type-setting and the omission was not corrected in proofreading. New localities are listed here: Ecuador: ♂; Abitaqua, Rio Pastaza, Oriente, Nov. 26, 1936 (W. MacIntyre) [L. Lacey]. Colombia: ♂; no locality data (Felipe Ovalle) [A.M.N.H.].

Taeniotes dentatus Dillon and Dillon. Ecuador: ♂; El Partidero, Nov. 27, 1935 (W. MacIntyre) [L. Lacey].

Taeniotes praeclarus Bates. The correct spelling of the specific name as found in the original description is as given above. Ecuador: ♀; Abitagua, Oriente, Dec. 13, 1939 [L. Lacey].

Taeniotes buckleyi Bates. This species, correctly, should be placed before luciani, but this relationship could not possibly have been garnered from Bates’ description.

Elongate-ovate, robust, subcylindrical; elytra subconvex; dark brown or fuscous, covered with fine, short, grayish-brown pubescence and with yellow pubescence as follows: head with a narrow vitta from occiput to between antennal tubercles, slightly wider basally and apically, another behind each eye, widest at base, and a third rather narrow, outlining anterior margin of lower lobe of eye to behind base of mandibles; pronotum with a rather narrow vitta medially, which is slightly wider on middle two-thirds and interrupted at middle; and below each lateral tubercle a slightly wider one gradually narrowing apically; scutellum broadly vittate; elytra each with two larger, oval maculae, one at middle and one at apical third, these on center of disk, apical fourth at center with a row of fine dots which are sometimes slightly coalescent, lateral margin with a row of very fine dots to apical fourth, remainder of disk with few scattered, very small or minute maculae, center of base of each elytron with a very short, narrow, yellow vitta. Beneath dark brown or fuscous, thinly clothed with fine, brownish-gray pubescence, laterally with a broken, yellow vitta on sterna, and on sternites rather large maculae laterally, which are gradually smaller apically; prosternum with a rather wide vitta just before each procoxa. Antennæ and legs dark brown, antennæ somewhat lighter apically; legs thinly clothed with brownish-gray pubescence and antennæ with brownish pubescence. Head finely, densely punctate and with few coarse punctures which are frequently feebly rugose, a median impressed line from occiput to between antennal tubercles on front, thence carinate to epistoma; front rugosely-punctate; antennæ nearly twice body length in male, only about one-third longer in female; pronotum transverse, sides nearly straight; apex narrower than base; two basal and one apical
transverse sulci, apical one deep and nearly angulated at middle; disk rugose, and with a small tubercle either side of median vitta just before internal basal sulcus; lateral tubercles moderate, ending in a long, acute spine. Scutellum feebly elongate, sides straight, apex broadly rounded. Elytra with sides nearly straight, tapering to apex; apices rounded, near suture angulated; at base tuberculate for only a very short space, then very deeply punctate, punctures finer and evanescent apically. Meso sternum with a distinct rectangulare tubercle; fifth sternite at apex with a long, acute spine either side, male feebly emarginate, female feebly emarginate and with a narrow, shallow, triangular impression to base.

Length: 22–26 mm.; width: 6.75–8.5 mm.

Distribution: Ecuador and Peru.

Peru: 1 ♂; La Merced, Chanchamayo [L. Lacey]. ♀; Chan chamayo, April, 1928 [A.M.N.H.]. 1 ♂; Abneudrillo, Dept. San Martin, Nov. 14, 1936 [L. Lacey]. 1 ♂; Sani Beni, Yunin, Sept. 26, 1935 (F. Woytkowski) [L. Lacey].

Ecuador: 1 ♀; Tungurahua, May 23, 1939 (W. MacIntyre) [L. Lacey].

**Parastaeniotes** Dillon and Dillon, gen. nov.

In future listings, this should follow *Taeniotes*, which it resembles in the spined fifth abdominal sternite and in the form of the eye. It differs from it in the small, unarmored lateral tubercles of pronotum, which is more slender in form; pronotal disk transversely rugose at middle; and elytra without tubercles, its apices broadly dentate.

Medium to large, elongate-ovate, rather slender, subcylindrical; black, somewhat shining, with sparse, longish, fine pubescence, with vittae and maculae of white tomentum. Head sparsely, coarsely, rugosely punctate, punctures wide and shallow, almost foveate, with a fine carina from occiput to epistoma, stronger on front, front scabrose; antennal tubercles roughly scabrose. Eye with lower lobe transverse, large, two times genal height; upper lobe subequal in width to isthmus which is wide. Antennae two to two and one-half times body length in male, one and one-half to one and two-thirds its length in female, not fringed or only very feebly so beneath. Pronotum slightly elongate, sides feebly arcuate, narrower apically; a feebly but distinct tubercle laterally just behind middle; three basal and two apical transverse sulci; disk strongly, transversely rugose at middle. Scutellum slightly transverse. Elytra with sides feebly arcuate to apices, which are acute and bluntly dentate at tip. Prosternum angulate; procoxal cavities narrowly open. Meso sternum with a medium tubercle. Fifth sternite spined laterally in female and male. Legs in male very elongate; protarsi in female and male only slightly fringed on all segments.
Parataeniotes minus Dillon and Dillon, spec. nov.

Superficially, this species resembles Taeniotes farinosis very closely in form and coloration. It is somewhat more slender, however, and the elytra lack larger maculae, and the pronotal median vitta is very fine.

Elongate-ovate, slender, subcylindrical; black, with longish, sparse, fine white hairs, and with white tomentose markings as follows: head with seven very narrow vittae, one medially from occiput to between antennal tubercles, one either side of middle from base of head to and running a short distance along posterior margin of upper lobe of eye, these arcuate and nearly meeting medial vitta, a short one each side laterally from isthmus to base of head, and one either side of front outlining anterior margin of lower lobe of eye, from base of antennal tubercles to base of head almost to gula; pronotum with seven narrow vittae, one medially from base to apex, one either side of middle, above lateral tubercle, slightly arcuate and extending from outer apical to outer basal sulcus, one each side just below lateral tubercle, and one above procoxae short, only about one-third length of other vittae; scutellum with a median vitta, widest at base; elytra with about five irregular rows of very small, round maculae, in sutural and fourth rows forming a sort of indistinct vitta on apical quarter; beneath black, all over slightly more densely covered with same pubescence as above, prosternum with a narrow, white vitta between procoxae, this not attaining apex and much broader basally; on the mesepisterna an oblique vitta along base and ending in a small, rounded macula on metepisterna; epistoma with a short, oblique vitta not quite at base and a small macula at apex; metasternum with a narrow, oblique vitta almost from mesocoxae and followed by a small, round dot; sternites laterally with a small, round macula each side, on last sternite much elongate. Antennae with basal two segments piceous and very sparsely pubescent, third segment piceous basally and gradually becoming light reddish-brown at apex, remaining segments light reddish-brown.

Head above coarsely, rugosely-punctate, punctures wide and shallow, entire surface more finely, sparsely punctate; a very narrow median carina from occiput to epistoma; front scabrose; antennae with scape and basal half of third segment scabrose, only very slightly fringed underneath scape in both female and male. Pronotum slightly transverse, slightly rounded from base to apex; apex narrower than base; three basal and two apical transverse sulci, outer apical shallow, inner deep and very sharply curved at middle, almost angulate; two outer basal sulci shallow, inner deep and curved at middle; lateral tubercles small but distinct; disk at center rugosely-punctate, punctures very coarse, remainder of disk with small, scattered punctures. Scutellum slightly transverse, sides arcuate, apex subacute. Elytra with sides rounded to apices, which are acute and broadly dentate at tip; humeri prominent; base, particularly around scutellum and on humeri, coarsely, rugosely punctate, remainder of elytra with coarse, sparse punctures each bearing a short, white hair and these punctures somewhat finer apically. Prosternum rounded, abruptly declivious behind procoxae; mesosternum with broad, rather blunt tubercle in female and male; entire undersurface finely, moderately
punctate; fifth sternite in male and female truncate at tip, fringed and with
a robust spine each side, a row of long, coarse, black hairs from each spine
to base of fifth. Legs elongate in male, tarsi feebly fringed in both sexes,
slightly more so in male.

Holotype: Male; La Merced, Chanchamayo, Peru (Paul Martin) [L. Lacey].
Allotype: Female; Hansa Humboldt, Santa Catarina, Brazil; Sept., 1940 (A. Maller) [L. Lacey].
Paratype: Male; topotypie [L. Lacey].

**Neoptychodes** Dillon and Dillon

*Neoptychodes candidus* Bates. New localities: Canal Zone: 2; Barro Colorado, Feb. 8, 1936 (F. E. Lutz) [A.M.N.H.]. Costa Rico: 1; Reventazon [L. Lacey].

**Monochamus** Guerin


*Monochamus obtusus* Casey. British Columbia: ♀; Saanich, July 29, 1934, on *Abies grandis* (C. A. Hardy) [Victoria Prov. Mus.]. ♀; no locality data [L. Lacey].

**Plagiohammus** Dillon and Dillon

*Plagiohammus elatus* Bates. Previously this species was
known only from Nicaragua and Panama. Ecuador: ♀; Mapoto, Rio Pastaza, 1300 m., Oct. 22, 1938 (W. C. MacIntyre) [L. Lacey].

*Plagiohammus granulosus* Bates. While this species was not
seen before by the authors, the single example listed below was in too poor condition to redescribe here.

British Honduras: ♀(?); Punta Gorda, April, 1936 (J. J. White) [L. Lacey].

*Plagiohammus sticticus* Bates. The remarks under the above
species apply here also. Ecuador: 1; Zatzayuea, Oriente [L. Lacey].

*Plagiohammus imperator* Thomson. A comparison by Dr.
Linsley of a specimen of this species with his type of *Deliathis albida*, verifies that the two are identical, his name falling then
into synonymy.
Deliathis Thomson

Genotype designation, as *Taeniotes buquetii* Taslé, was made by Thomson, in Syst. Ceramb, 1864, p. 77.

*Deliathis quadritaeniator* White. Costa Rica; 1; Guapiles, Santa Clara [L. Lacey].

*Goes* Leconte

The genotype designation should be credited to Thomson (1864), rather than to Casey.

*Goes fisheri* Dillon and Dillon. Texas: ♀; no locality data [L. Lacey]. ♀; Anhalt, Coma Co., June 28, 1917 [Corn. U.].
NEW GENERA AND SPECIES OF CHINESE CICADAS
WITH SYNONYMICAL AND NOMENCLATORIAL NOTES*

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The Chinese species of the family Cicadidae have been described and named for the most part by European workers whose writings are scattered through a great number of publications. The Chinese species of this family were named and described earlier than other groups of Chinese insects. The first Chinese species was described by Linné and named Cicada repanda based on specimens from India. In 1773 Drury described a species from China which he called Cicada maculata, but did not give a definite locality, and in the same year De Geer described and named a third species, Cicada sanguinea. Many additional Chinese species were described subsequently by Fabricius (1775–1803), Olivier (1790), Westwood (1824), White (1844), Signoret (1849), Walker (1850 and 1858), Stål (1863–1870), Motschulsky (1866), Uhler (1861–1862) and Karsch (1894).

Most of the cicada material described by the earlier writers was made available through the incidental collecting of travelers and missionaries who failed to record definite locality data. Thus, many type locality names need confirmation because the collectors either transliterated Chinese names to English, German, French, etc., or in modern times the Chinese names have been changed, or only the name of the country "China" was given. This has caused considerable confusion and lack of knowledge regarding the geographical distribution of the cicadas recorded from China.

The most valuable cicada material available in museums is largely the result of organized collecting expeditions. The most important collectors who participated in these various expeditions are as follows:

* Selected portions of a thesis entitled "A Contribution to the Knowledge of Chinese Cicadas," submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science.
Potanin. C. N. Potanin started from Peiping the latter part of 1892 and proceeded to Tian-fu and from there crossed over the Tsinling mountains. He then visited Chengtu, Ya-an and Tatsien-lu, the present provincial capital of Sikang Province. From here he went northward to Changu, Fu-pien, Hung-kiao and Li-fan, all of which are in the northwest part of Szechwan Province. Here two of his fellow travelers were taken ill which necessitated his return to Peiping. On the return trip he collected at Shitsuan, Chang-ming and Pao-ning, all in the northern part of the Province of Szechwan. The material he collected on this trip was deposited in the Zoological Museum of Leningrad. Cf. Melichar (1902).

Berezovski. M. Berezovski traveled from Peiping to Hui (= Wei) in southeastern Kansu Province. He remained there from March to December, 1892. From Wei he proceeded to Lung-an, Szechwan, to Chengtu, the provincial capital of Szechwan and back to Lung-an. He remained near there at the village of Mu-kua-chi, District of Hotsingou, from April, 1893, to January, 1894, and then returned to Peiping. His cicadas were deposited in the Zoological Museum of Leningrad. Cf. Melichar (1902).

Kershaw. Wm. Kershaw collected in South China principally at Hanlik and Macao. His material was reported upon by Kirkaldy (1909).

Muir. F. Muir collected at Lu-fou-shan and Macao in Kwangtung Province. Kirkaldy (1909) reported on his cicada material.

The Chinese cicadas reported upon in numerous papers by W. L. Distant came from many sources. Some of the collectors of the specimens he recorded are Horsfield, Bowring, Whitehead, Cros-Jean, David, Excoffier, Maw and the Chinese collector and taxidermist Tan Wang-wang. Haupt (1923) reported on the material collected by Walter Stötzner near Peiping and Western Szechwan. Schmidt’s (1920) material was collected by R. E. Mell. Schmidt (1933) also reported on the material collected by Dr. C. F. Wu of Yenching University. The Heude Museum, Shanghai, has had collectors for many years in the Provinces of Kiangsu, Chekiang and Anhwei. China (1925) reported on the material collected by Gregory in Yun-nan Province. Schumacher (1915) described the material collected by H. Sauter in Formosa.
The writer, as an employee of the University of Nanking, undertook a collecting trip designed primarily for the collection of insects for the entomology museum at the University of Nanking. The author departed from Nanking and collected along the Tientsin-Pukow railway line to Peiping returning by way of the Peiping-Hankow railway line to Chengchow. A whole summer was spent at Tienmushan, Chekiang Province, and at Hwangshan, Anhwei Province. In 1937, another trip was made to Southern Chekiang Province and Kuling, Kiangsi Province. In 1938, an opportunity arose to collect specimens in Szechwan Province. Along the northeastern border of this province there are high mountainous ranges, undulating inward from Tibet. On these high ranges the fauna is Palæarctic, while at their foot and on the plains the species are typically Oriental. The writer climbed to the Tibet border (6,000 feet in the valley) and lived in a Lama Temple for five weeks. During this trip, numerous specimens were added to the collection. In the same year, specimens were also extensively collected by colleagues at well-known Mt. Omei, 10,400 feet above sea level.

My study of the cicadas leads me to believe that the natural boundary separating the Palæarctic and Oriental Regions in China is the Yang-tsze River. Faunal studies of other groups of animals have led to different opinions. Along each side of the Yang-tsze River, there is a sort of "debatable land" where Palæarctic and Oriental forms strive for supremacy. The Palæarctic part of China consists of two subregions, Manchurian and Siberian. The dominant forms of cicadas in the Manchurian Subregion are the species of * Tibicen* and a few species of *Melampsalta* and *Tibicina*. It is interesting to note that all these genera also occur in the Nearctic Region. One species of *Melampsalta* recorded from the Balkans, and another species of the same genus recorded from Turkestan, are both present in Northern Szechwan. The cicada fauna of the Manchurian Subregion has a strong affinity with that of the Siberian and European Subregions on the one hand and with that of the Nearctic Region on the other. The Oriental fauna of China consists of a greater number of genera and species, which are gradually reduced in numbers as one proceeds toward the north and east towards the Palæarctic Region.
and only a few species actually extend into the Manchurian Sub-region. This would seem to indicate that the Oriental cicada fauna in China is the result of the invasion from the Indo-Malayan Region. The Yang-tsze River is a more or less natural boundary between these two great Zoological Regions. This boundary extends westward along the Yang-tsze River through the Yang-tsze Gorge; it then leaves the River and turns northward along the southern slope of the Chungnaanshan and Tsinling ranges to the border of the Tibet Plateau and then continues with the Himalayan mountains. I do not agree with those who suggest that the boundary extends along a certain degree of latitude.

The present paper includes descriptions of new genera, new species, synonymical notes and nomenclatorial changes. The complete thesis treating all the species available for study and containing extensive data on geographical distribution is on file in the library of the University of Minnesota.

This study was carried out under the supervision of Dr. C. E. Mickel and the writer wishes to express sincere thanks for his valuable suggestions and criticism. Thanks are also due to Dr. H. S. Chen of the National Institute of Zoology and Botany, Academia Sinica, Nanking, for presenting me with the specimens from Kwangsi and Kweichow Provinces. Dr. We-i Yang and Mr. A. S. Chao of the Fan Memorial Biological Institute, Peiping, sent me a collection from Hainan, Kwangtung Province, and Chungnanshan, Shensi Province. In 1938, Prof. Y. Chou of the North Western Agriculture College collected for three months in Sikang Province (eastern Tibet). He was kind enough to turn over to me all the cicada specimens collected during his trip. I would like to mention those who assisted in the building of the University of Nanking cicada collection: Messrs. C. S. Tsi and S. O. Hsia of the Division of Entomology, University of Nanking; Dr. Y. D. Feng, Nankai University, Tientsin, Manchurian collection; Mr. C. Y. Liu, Kwangsi University, Liuchow, Kwangsi specimens; Chekiang Bureau of Entomology, Hangchow; Kiangsu Bureau of Entomology, Nanking; Mr. K. F. Chu, Kwangtung Provincial Bureau of Agriculture and Forestry, Kwangtung specimens; Mr. K. R. Wang, Sun Yat-son University, Canton, Canton specimens; Mr. C. C. Tao, Shantung University, Tsingtao.
specimens; Mr. I. F. Yang, Bureau of Reconstruction, Foochow, Fukien specimens; Father P. O. Piel, the Director of the Heude Museum, Shanghai, Kuling specimens.

**Dundubia vaginata** Fabr.


This species was first recorded as *Cicada mannifera* in 1754 by Linné. Stål (1866) found out that it was the same species as Fabricius' *Tettigonia vaginata*. Moulton (1923) pointed out that *mannifera* was a prelinnean name and was not subsequently recorded by Linné in his other writings, so *D. mannifera* L. should be changed to *D. vaginata* Fabr. Although, in 1764, Linné mentioned *Cicada mannifera* as a synonym of *Cicada tibicen* from Surinam and Carolina, this does not validate the name.

**Genus Platylomia** Stål


Stål proposed the genus *Platylomia* and included the single species *Dundubia flavida* Guérin. According to the rules of Zoological Nomenclature, a genus proposed to include a single species
must take that species as genotype. Distant used Stål’s name and redescribed the genus, stating that the characters given by Stål cannot be accepted because they refer to Guérin’s figure and cannot be found in the species. Distant designated another species *Tettigonia spinosa* Fabr. as the genotype of *Platylomia*, but his designation cannot be accepted because of the above rule. Distant stated that *flavida* Guérin and *spinosa* Fabr. are congeneric, therefore the recognition of *flavida* Guérin as the correct genotype does not affect Distant’s concept of the genus *Platylomia*.

According to Distant, this genus includes those species having the head (including the eyes) about as wide or little wider than the base of the mesonotum and almost as long as the breadth between eyes. He put this genus in a group possessing the length of head equal to the breadth between the eyes. Moulton pointed out that the head of *P. flavida* is distinctly shorter than the breadth between the eyes. This is also true of all the Chinese species in the genus.

**Tibicen slocumi** sp. nov. (Fig. 1)

**Male.** Head deflected anteriorly, much shorter than space between the eyes, including the eyes wider than the base of mesonotum. Front prominently produced; front and anterior lateral angles of vertex not continuous; front ochraceous, a subquadrangular spot at each side black. Vertex ochraceous, a trapezoidal spot with the sides diverging posteriorly, a lateral broad band between it and the eyes, and the area posterior to eyes, black. Eyes yellowish brown, projecting beyond the anterior margin of pronotum. Ocelli about twice the distance apart from eyes as from each other. Pronotum a little longer than the head, and shorter than the mesonotum (excluding cruciform elevation), its lateral margins amplified; pronotum ochraceous, two narrow, median, linear, longitudinal fasciae much widened laterally at the anterior ends, and terminating posteriorly in a circular spot, all black. Lines between the disk and the lateral and posterior marginal areas, black.

Mesonotum black, with a central w-shaped spot and with lateral, longitudinal, marginal fasciae, greenish ochraceous; a black spot at the center of the cruciform elevation.

Abdomen above black, with a series of oblique, whitish spots on each side of the abdominal segments. Lateral fourths of tympanal coverings greenish ochraceous. Eighth tergite longer medially than the two preceding ones. Ninth tergite prolonged behind to form a pair of angular projections. Anal tergite shining black with an ochraceous spot at the posterior margin.

Tegmina and wings hyaline. Tegmina with the costal membrane and
Chen: female, male, expansion 25 female, anal

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basal cell greenish ochraceous; basal cell about twice as long as wide, infuscated; veins inside the almost obsolete nodal line greenish ochraceous, the outer part of the veins piceous, the vein in front of the basal cell also piceous; the cross veins at the bases of the second, third, fourth, fifth and seventh apical areas infuscated. Wings with veins of the basal half ochraceous, the apical half piceous. The extreme base of tegmina and wings ochraceously sanguineous; margins of claval area of wings semi-opaque.

Body beneath ochraceous, covered with thickly greyish pile. Antennæ, transverse striations to face, the broad fascia between eyes and face, areas adjacent to eyes, disks of lora, lateral depressed areas of elypeus, mesopleura, metepisternum, lower surface of coxae and apex of rostrum, all black. Two strong spines on front femora and small spines on hind tibiae, castaneous, the hind spine of the front femora not erect, but closely appressed against the surface of femora, the apical spine projecting outwardly. Opercula reaching the hind margin of the second sternite; lateral margins straight, strongly turned upward; posterior margins convexly rounded and slightly overlapping at their inner margins; color ochraceous.

Abdomen beneath brownish black, the second sternite, the posterior margin of third to sixth sternites ochraceous. Subgenital plate ochraceous with a transverse black fascia on the anterior portion, its length equal to the three preceding segments, posterior half somewhat transversely wrinkled, posterior margin more or less truncate. Hypandrium as long as subgenital plate, ochraceous in color, longitudinally convex, the posterior margin broadly rounded. Spiracles adorned with white powder.

Length of body, 35 mm.; expansion of tegmina, 96 mm.

Holotype: male, Lifan, Szechwan Province, China, August 20, 1939 (Chen), in collection of the University of Nanking.

Allotype: female, larger; anal tergite longer medially than the two preceding segments, posteriorly produced into a strong spine. Genital plate about twice as broad as long, posterior margin deeply cleft medially.

Length of body, 38 mm.; expansion of tegmina, 102 mm.

Allotype: female, Lifan, Szechwan Province, China, August 20, 1939 (Chen), in collection of the University of Nanking.

Paratypes: four males and one female collected at the same place and on the same date with the holotype by Chen; length of male paratypes varies from 33.5 to 37.5 mm.; expansion of tegmina, 89 to 98 mm. Length of the female paratype is 35 mm.; expansion of tegmina 100 mm. One male paratype is deposited in the National Institute of Zoology and Botany, Academia Sinica, Nanking, China. One male paratype is deposited in the Department of Entomology and Economic Zoology, University
of Minnesota, U. S. A. The rest are in the collection of the University of Nanking.

This species is closely allied to *sinensis* Distant, but it differs by the larger size, infuscation of the fifth and seventh apical areas, absence of the black band across the posterior margin of the pronotum, and the color of the venation of the tegmina.

![Image of insect wings]

**Fig. 1.** Tegmen and hind wing of *Tibicen slocumi* sp. nov.

*Tibicen tsaoapoenensis* sp. nov. (Pl. I, Fig. 1)

This species in general appearance is very closely related to *T. sinensis* Distant. The markings of the body are similar to the latter. The characters which separate it from *T. sinensis* are as follows:

1. The hypandrium of the new species equal in length to the subgenital plate, that of *sinensis* longer than the latter.
2. The greatest width of the subgenital plate in *tsaoapoenensis* longer than the length of the four preceding abdominal sternites, while in *sinensis* it is equal only to the length of the four preceding sternites.
3. The eighth tergite in this species longer than the sixth and seventh tergites together; in *sinensis* the length of the eighth tergite is equal to the length of the sixth and seventh tergites.
4. A wide zigzag infuscated band coincides with the bases of apical areas across the tegmen, only broken at the base of the sixth apical area. In *sinensis* only the bases of the second and third apical areas infuscated.
5. On the tegmen, a small areole is separated from the apex of the radial area, while this is absent in *sinensis*.
6. In *tsaoapoenensis*, the apical portion of the basal cell is blackish and the claval area of wings strongly infuscated, while in *sinensis* the basal cell is uniform in color throughout and the claval area of wings only very slightly infuscated.
7. In this species both the fore and hind wings are slightly, obscurely infuscated and the veins are darker in color. In *sinensis* they are hyaline and the color of veins is lighter.
8. The abdomen is dull black, and one pair of whitish oblique pubescent dots on the lateral sides of only the first abdominal tergite. The posterior margin of eighth tergite is yellowish. In *sinensis*, there is a pair of whitish pubescent dots on each of the tergites. The posterior margin of the eighth tergite concolorous.
9. The species is larger in size than *sinensis*. 
Holotype: male, Tsaopao, Western Szechwan Province, China, August 9, 1938 (Chen), in the collection of the University of Nanking.

*Chremistica nana* sp. nov. (Pl. II, Fig. 9)

**Male.** Body above ochraceous. Head including eyes wider than the base of the mesonotum. Length of the head scarcely more than half the breadth between the eyes. Front and the anterior and lateral angles of vertex continuous. Front and vertex medially and longitudinally sulcate. A continuous, broad, black fascia across the anterior portion of front, and the anterior and lateral margins of vertex. Eyes obliquely porrect; color fuscous. Ocelli about twice the distance from eyes as from each other, color pinkish red.

Pronotum longer than head, much shorter than the mesonotum (excluding cruciform elevation), its width more than two times its length, deflected anteriorly. Pronotum with incisures; mesonotum with faint obconical spots on its disk, and the lateral triangular markings faintly castaneous.

Abdomen equal to the length of the head and thorax together, attenuated posteriorly with the posterior segmental margins brownish ochraceous. Anal tergite produced posteriorly into a strong spine, its posterior margin deeply concave laterally. The first three abdominal segments much shorter than the following segments. Eighth tergite medially equal to the sixth and seventh tergites together. Width of fifth tergite equal to the length of the first four tergites together.

Tegmina and wings hyaline. The width of the tegmina about one-third its length. Venation ochraceous on the basal half, fuscous on the apical half. Tegmina with nine apical areas; wings with six apical areas.

Body beneath and legs, pale ochraceous, yellowish pilose, covered with whitish powder. Apex of the rostrum, and claws, piecous. Three spines beneath the front femora, two near the distal part, and one near the base. The most distal one is very small. Opercula about half the length of the abdomen, with the disk slightly convex, yellowish pubescent and covered with white powder; outer margins of opercula almost straight and obliquely slanting inward, leaving the tympanal orifices laterally exposed, the inner margins sinuate near the basal fourth and nearly overlapping throughout, the posterior margin convexly rounded. Rostrum exceeding intermediate coxae. Coxal thorn thin, concave on the ventral surface, curved inwardly and reaching the basal third of the operculum. The subgenital plate depressed immediately near the base, its length equal to the two preceding sternites. Hypandrium longer than subgenital plate, globose, projecting beyond the anal tergite. The posterior margin of the subgenital plate slightly emarginate.

Length of body, 18 mm.; expansion of tegmina, 58 mm.

Female smaller than the male. The tegmina with eight apical areas, the extreme base lightly ferruginous. Two linear fuscous fasciae on the disk of mesonotum. The posterior margin of genital plate deeply concave.

Holotype, male; allotype, female, Hainan, South China, April
5, 1934. Holotype in Fan Memorial Biological Institute, Peiping; allotype in the University of Nanking.

This species is closely allied to Walker’s *ochracea*. The size is much smaller than *ochracea*. A strong spine is not formed in *ochracea*. The hypandrium is longer than the subgenital plate, but it is shorter than the subgenital plate in *ochracea*. The abdomen in this species is attenuated, the width of the fifth abdominal segment being equal to the length of the first four abdominal segments. In *ochracea*, the abdomen is more or less parallel before the sixth segment, so that the width of the fifth tergite equals the combined length of the first five abdominal segments. The opercula of *nana* just about reaches the middle of the abdomen. They are distinctly more than half the length of the abdomen, and the tympanal orifices are entirely covered by the opercula in *ochracea*. The abdominal sternites are flat in Walker’s species, while they are convex in *nana*.

All the other species in the Oriental Region are large; *C. nana* is the smallest species known.

**Cryptotympana atrata** Fabricius


1790. *Cicada nigra* Olivier, Enc. Méth. 5: 749 (Chine).

1850. *Fidicina bubo* Walker, List Homop. 1: 82 (Hong-Kong).


This species was first named by Fabricius in 1775, in his first publication, Systema Entomologiae. On page 681 Fabricius described: *Tettigonia atrata* (14). “T. atra, alis albis, basi nigris; venis testaceis. Habitat in China, Gannerus. Magnitudo praeecedentium: tota, abdominis margine, inprimis ultimi segmenti, testaceo. Alae omnes albiae, basi nigrae, venis testaceis.”

In 1787, Fabricius on p. 267 of Mantissa Insectorum exactly repeated, “*atrata* 22. T. atra, alis albis, basi nigris; venis testaceis,” and described another species, *Tettigonia pustulata*, habitat in America meridionali. Later both Olivier and Germar treated them as two species. These two names were proved to be one species by Distant (1891), but he incorrectly gave *pustulata* priority and considered *atrata* as being a synonym of *pustulata*. After that *atrata* disappeared from the publications of Distant, Matsumura, Jacobi, Schmidt, Moulton, China, Kato and Liu. Apparently *atrata* is a valid name and *pustulata* is a synonym of *atrata*.

**Cryptotympana atrata** var. *castanea* Liu


**Cryptotympana atrata** var. *fukienensis* Liu


**Platyleura kaempferi** Fabricius


Recently Liu described a new species from Mt. Omei. I can not find any structural difference such as Dr. Liu pointed out. His most important character, that the anal tergite is retracted, is also true for *P. kaempferi*. In the long series in our collection, *P. kaempferi* shows a great variation in color, size, spots on the fore wings, powdery adornments and pilosity.

**Platyleura cœlebs** Stål

Distant recorded this species from Chusan, in 1889, on the basis of a specimen found in the Indian Museum, Calcutta. The Heude Museum made several collections on that Island, but not one specimen was collected, and there is no record from any other part of China. The occurrence in Chusan needs confirmation. It may possibly be found on some of the Pacific Islands.

**Platypleura semusta** Distant


This is a tiny species described by Distant based on a single specimen from Chusan deposited in the Indian Museum. No specimens other than the type are known and the type locality is doubtful as in the case of *P. caelebs*.

**Suisha coreana** Matsumura


The specimens in the Heude Museum, Shanghai, were incorrectly named by Liu as *Pyena repanda* L. *Suisha coreana* is common in Hangchow, Kashing, Nanking and westward to Chengtu, while *Pyena repanda* L. is an Indian species. Whether the latter extends to Hangchow or not I do not know. However, I did not collect *P. repanda* in Hangchow and up to the present time there are no specimens in the collection of the Bureau of Entomology, Hangchow. Liu (1939) indicated the possibility that his determination *Pyena repanda*, Hangchow, might prove to be *Suisha coreana*.

The adults appear very late and sing in the fall. The writer noticed the adults in Nanking and Chengtu; they are wiped out by the first frost. In Nanking, adults could be collected from September 10 to November 3. In Chengtu, it is warmer; there *S. coreana* can persist as late as December 31.

**Pyena repanda** Linné

Pycna repanda is a common species in N. India. It is not present in Eastern China and Japan. Haupt first recorded the species in Szechwan Province. This species almost always inhabits high mountains about 6,000 feet. At Mt. Omei and Wenchwan, the males continue to sing in the rainy and foggy weather. Mr. C. S. Tsi collected three specimens in the lantern trap at Kewla-tung about 8,000 feet up on Mt. Omei. Specimens in our collection are from Mt. Omei, Tsapao (Szechwan Province), Tanpa, Tsalou (Sikang Province), from July 25 to October 18.

Polyneura ducalis Westwood

This large, greenish insect lives on the leaves at the top of trees. A loud sound produced by the male when sitting on the tree and on the wing attracts our attention. They are found at an elevation of 7,000 feet to 8,000 feet on the high mountains in Szechwan and Sikang Provinces. The writer collected specimens from Tsapao, Western Szechwan. Haupt’s record from Omisien (=Mt. Omei) needs confirmation, for we were in Mt. Omei for three months but did not hear its song. One male from Tachow, Sikang Province, was presented by Dr. Y. Chou.

Gæana maculata var. consors Distant

? Gæana consors White, manuscript name.
1892. Gæana maculata var. consors Distant (nee White), Mon. Or. Cicad.: 105, t. 3, f. 20 (India, Burma).

White’s Gæana consors is a manuscript name. Although Walker (1850) listed consors and cited Proc. Zool. Soc. 1850, the name was never published by White. The first published description of consors is by Distant (1892) and the name must be credited to him.

Sinopsaltria gen. nov.

Head including the eyes as wide as the base of the mesonotum; length of head shorter than the space between the eyes; ocelli less than twice the distance from the eyes as from each other; front prominent, deflected anteriorly. Pronotum a little longer than the head and shorter than the mesonotum (excluding basal cruciform elevation), with the lateral margins more or less
laminately expanded, but not toothed, its posterior lateral angles lobately produced. Abdomen in male longer than the space between the apex of the head and the base of the cruciform elevation; tympanal coverings rudimentary, both shorter and narrower than the tympana, leaving the greater part of the tympana exposed. Face globose, with obsolete striations. Front femora spiny beneath. Metasternum elevated at the middle with a posterior process directed backward. Opercula short, widely separated. Tegmina and wings opaque, the former elliptical ovate in shape, the length about three times their breadth; ambient vein close to the margin; apical areas eight in number, long and narrow; length of basal cell more than two times its breadth; wings with six apical areas, the claval area greatly expanded. Rostrum exceeding the intermediate coxae.

The systematic position of the genus *Sinopsaltria* is between *Balinta* and *Formotosena*. This genus, in general, resembles *Tosena* Amyot et Serville; however, it can easily be separated from the latter by the rudimentary tympanal coverings. It is also close to *Formotosena* Kato, but the lateral margins of the pronotum are not toothed, the tegmina are elongate, and more or less elliptical ovate in outline, and the ambient vein is very close to the margin.

Genotype: *Sinopsaltria bifasciata* sp. nov.
Distribution: Kweichow Province, Western China.

**Sinopsaltria bifasciata** sp. nov. (Pl. I, Fig. 2)

**Male.** Body black. Eyes brownish ochraceous; ocelli pinkish. Pronotum with the anterior margin turned up to form a narrow elevated band which is testaceous laterally; the lateral margins and posterior lateral lobes, neutral orange (Seguy). Mesonotum with the lateral oblique depressed areas brownish black; abdomen above grape black in color, with the posterior segmental margins shining black; tympanal coverings concolorous, rudimentary, convexly rounded anteriorly; tympana largely exposed. Eighth tergite a little longer than the seventh, with the posterior margin broadly rounded. The anal tergite laterally appendiculate.

Tegmina and wings opaque, fusaceous, except the tegmina with the extreme base, including basal cell, costal area, costal vein, anterior margin of radial area, claval area, a broad fascia across the tegmen from the apical portion of the radial area to the hind margin, and the basal half of the wing, neutral orange; veins piceous, margined with greyish black, the latter diffusing gradually; second apical area of tegmen very short, about half the length of the first ulnar area; apical areas three to eight very long.

Front very convex, shining black, only very slightly striated; rostrum exceeding intermediate coxae; two well-developed spines on the front femora, the basal one at the middle of the femur, large, not erect, lying in apposition with the femora; opercula widely separated, short, not reaching the posterior
margin of the second segment, not covering the tympana laterally, the outer
margin of the opercula convex, the posterior margin broadly rounded, the
inner margin obtusely angulated.

Abdomen beneath raisin black in color, darker toward the apex, medially
and longitudinally keeled; subgenital plate wider than long, the posterior
third projecting convexly, the posterior margin emarginate medially. Hypan-
drium longer than the subgenital plate.

Length of body: 32 mm.; expansion of tegmina: 90 mm.

Female. Abdomen short, about as long as the head and thorax together,
very convex above, more or less compressed. Anal tergite as long as eighth
tergite. The genital plate lengthened at the central portion but emarginate
at its tip.

Length of body: 34 mm.; expansion of tegmina: 88 mm.

Holotype. Male, Kweiting, Kweichow Province, China, June
30, 1930, in the National Institute of Zoology and Botany, Academ-
ia Sinica.

Allotype. Female, Kweiting, Kweichow Province, China, June
29, 1930, in the University of Nanking, presented by Dr. S. H.
Chen, Academia Sinica.

**Leptosemia huasipana** sp. nov. (Pl. II, Fig. 6)

Male. Head shorter than the space between the eyes, including the eyes
as broad as the mesonotum. Color olivaceous. Vertex with a large spot in
the ocellar area which is forked posteriorly, a broad lateral fascia curved
posteriorly, and a crescent fascia next to eyes, black. The anterior margins
of the vertex widened laterally and an oblong spot on the apex of the front,
ochraceous. A longitudinal sulcation behind the median ocellus. Eyes ochra-
ceous. Ocelli pinkish red.

Pronotum longer than the head, obliquely depressed anteriorly, lateral
margins slightly ampliate. Color olivaceous, with two central longitudinal
fasciae, much widened near the anterior end and united at the posterior end,
lateral margins of the inner area, incisures, and two transverse spots on the
posterior lateral lobe, black.

Mesonotum about as long as the head and pronotum together. Color
olivaceous. A central linear, longitudinal fascia extending posteriorly to the
disk of the cruciform elevation. Three paired black markings lying in appo-
sition on each side of the central linear markings, the innermost pair short
and curved inwardly; lateral to the latter is a pair of very short triangular
spots, and the outermost pair somewhat L-shaped; all these black fasciae aris-
ing from the anterior margin and margined on both sides by ochraceous. Two
black round spots in front of the anterior angles of the cruciform elevation,
the latter olivaceous green.

Abdomen much longer than the head and thorax together, greenish olivace-
cous, somewhat pilose. Tympanal flaps narrower than the orifices, ochraceous.
Posterior segmental margins testaceous; a longitudinal black stripe on the middle of the second tergite and anterior part of the third tergite; a series of fuscous spots darkened and enlarged one after another on the lateral margins of the abdominal tergites. The eighth tergite abruptly narrowed, black, a little longer than the seventh. Anal tergite compressed, posteriorly angularly produced on each side.

Tegmina and wings hyaline, the former with the length about three times its breadth. Tegmina with the venation olivaceous; longitudinal veins of apical part fuscous. Bases of second, third, fifth and seventh apical areas, one spot near the apex of each longitudinal vein, and the outer marginal area infuscated. A slight longitudinal infuscation in the middle of the third, fourth and fifth apical areas. Second apical area shorter than half the length of the first. Wings with the venation fuscous, except the anterior marginal vein of the fourth ulnar area greenish, the anterior margin of the claval area and the outer marginal area of the wing infuscated. The clavus of tegmina and wings greyish.

Body beneath olivaceous green, greyish pilose. The transverse spot between the eyes and face, striations, and an oblong spot on the center of face, cheeks, lateral areas of clypeus, apex of rostrum, all black. A small spot at the base of the front coxae, the apices of the front, middle and hind femora, bases and apices of tibiae, the tarsi and claws fuscous. Rostrum exceeding the hind coxae.

Opercula widely separate, small, not covering the orifices posteriorly, convex outwardly, and rounded posteriorly, obtusely angulated inwardly. Color greenish olivaceous, the lateral margins narrowly fuscous.

Abdomen beneath semi-transparent, ochraceous, except testaceous towards the apex. Spiracles covered with white powder. Subgenital plate broad, more than two times its length; posterior fifth inflected downward; the posterior margin broadly rounded. Hypandrium longer than the subgenital plate. Length of subgenital plate and hypandrium much longer than the two preceding sternites.

Length of body: 28 mm.; expansion of tegmina: 70 mm.

**FEMALE.** Smaller, the abdomen much shorter than that of the male; the greenish tinge is obscure; the genital plate is longer at the middle.

Length of body: 22 mm.; expansion of tegmina: 72 mm.

**Holotype:** male, Chengtu, Szechwan Province, China, June 25, 1938 (Chen).

**Allotype:** female, same locality, June 28, 1938 (Chen). Types in the collection of the University of Nanking.

**Paratypes:** four males, one female, same locality, June 1 to 25, 1938 (Chen). Paratypes deposited in the University of Nanking; the National Institute of Zoology and Botany, Academia Sinica; and the University of Minnesota, U. S. A.

This species is the largest known in this genus. It is allied
with L. takanonis Matsum. from the same province (without definite locality), lives in the same habitat, and adults appear almost at the same time. L. huasipana has a cylindrical abdomen, quite distinct from the tapering abdomen of L. takanonis. The posterior margin of the subgenital plate in takanonis is slightly indented; it is entire and not indented in huasipana. The former has the combined length of the subgenital plate and hypandrium slightly longer than the two preceding sternites; the latter has it much longer than the two preceding sternites.

The females of these two species are easily distinguishable by their genital plates. In huasipana, it is wider and has the same depth near the central and near the lateral positions (Pl. II, Fig. 7). In takanonis, it is narrower and has its greatest depth near the central portion (Pl. II, Fig. 8).

**Mogannia cyanea** Walker


There is no definite locality for the type specimen, which was collected by Fortune from Northern China. The specimens in the Heude Museum were determined by Kato and were collected at Tienmushan. Ouchi described this as a new species from the same locality. In the collection at the University of Nanking there are three male and two female specimens collected by the writer, also from Tienmushan.

**Huechys sanguinea** De Geer

1773. *Cicada sanguinea* De Geer, Mem. 3: 221, (18), pl. 33, f. 17 (Chine).


Haupt (1924) wrote that the Chinese medical insect *H. sanguinea* De Geer was mononymically named “the Sanguinea” by De Geer. He cited the translation of De Geer’s work by Goeze
(1778) in Ent. Beitrage, Bd. ii, p. 150, 9, as being the first to use the combination Cicada sanguinea. Fabricius described the same species (1775) and named it Tettigonia sanguinolenta, from China. I quote here De Geer’s original description (1773) Mem. pour serv. a l’hist. des ins., Tom. iii 5°, 221 (18), “Cicada (sanguinea) alis superioribus fuscis, fronte abdomine thoracisque maculis binis sanguineis,” with a detailed description in a long paragraph. I therefore maintain that this species should be credited to De Geer.

Huechys philæmata Fabricius

1788. (La cigale chinoise a Taches rouge de sang) Stoll, Cicaden: 3, f. 26 (Chine).
1803. Tettigonia philæmata Fabricius, Syst. Rhyng. 42 (47) (China).

Stoll in 1778 described and figured a Chinese insect without a valid name. He called it “La cigale Chinoise a Taches Rouge de Sang.”

Fabricius 1788 described and figured a new species, Tettigonia philæmata. “T. nigra fronte, scutello utrinque abdomineque sanguineis, alis fusco diaphanis. Habitat in China.” “alis fusco diaphanis” distinctly differs from H. sanguinolentæ, which Fabricius wrote “alis nigris.” This character is very constant. Distant, Kato and Liu treated Fabricius’ philæmata as a variety of sanguinea, but it seems fairly reasonable to raise it to specific rank.

Hea fasciata Distant


Distant described this species on the basis of a specimen from China without definite locality. He obtained it at the sale of the collection of Mr. R. Cholmondeley. The description was published in 1906, but it was too late to be listed in his catalogue. No one mentioned this species afterwards. In 1936 the writer made a collecting trip to Tienmushan, Chekiang Province and met
Father P. O. Piel, the Director of the Heude Museum, Shanghai. He told me about a remarkable cicada collected at Kuling, Kiangsi Province; a robber fly had captured a cicada and Father Piel collected both. It stimulated me to try to collect this species at Hwangshan and Kuling, but in vain. In July, 1940, an English Entomologist, Mrs. Richardson, collected one male specimen at Kuanhsien, Western Szechwan Province. She was kind enough to present this specimen to our collection. When I visited the Heude Museum, Shanghai, in 1940 I examined the cicada specimens. It was found that this remarkable species had also been described by Ouchi as *Kinoshitaia sinensis*. Both Distant and Ouchi gave a very good illustration with their descriptions.

Genus *Melampsalta* Amyot  
Genotype: *Cicada musiva* Germar


*Cicadetta* (Cigalette) 1847. Amyot, Ann. Soc. Ent. Fr. (2) 5: 156.


There has been considerable disagreement as to the correct name for this genus. Stål, Karsch and Distant recognized *Melampsalta* as correct, while Fieber, Melichar and Horváth favored *Cicadetta*. The name *Melampsalta* has priority if it is regarded as established by Amyot when published in 1847. This generic name was proposed and accompanied by a description, length measurements and definite type locality, but no species name was mentioned. The International Commission of Zoological Nomenclature has ruled in Opinion 46 that "In genera published without mention, by name, of any species, no species is available as genotype unless it can be recognized from the original generic publication." Amyot's description was based entirely on color together with a length measurement and a type locality. Kolenati (1857) was able to recognize the species from Amyot's original description and assigned a single species, *Melampsalta musiva* Germar var. *caspica* Kolenati, to *Melampsalta*. Several subsequent workers in Homoptera have approved Kolenati's recognition of *musiva* Germar as the species Amyot originally described, and have therefore accepted *Melampsalta* as a valid monobasic genus with *M. musiva* Germar as genotype. One would have to prove that Kolenati was entirely wrong in order to invalidate the name *Melampsalta* and bring into consideration *Cicadetta* as the next available name. I think that it would be almost impossible to prove that Kolenati was wrong in his interpretation of the species that Amyot intended to describe, and therefore accept *Melampsalta* as the correct name rather than *Cicadetta*. Under these conditions the name *Melampsalta* must be credited to Amyot and date from 1847.

This is a very large genus including about one hundred and twenty species with almost a cosmopolitan distribution (except
Neotropical Region); it is an especially dominant group in Australia and New Zealand.

Recent workers in this group have attempted at various times to subdivide Melampsalta into additional genera (see synonyms above), but none of these have been generally accepted as having either generic or subgeneric value.

**Melampsalta fusoclavalis** sp. nov. (Pl. II, Fig. 10)

**Male.** Ground color of body black. Head and thorax greyish pilose. Length of head shorter than the distance between the eyes, and head including the eyes narrower than the base of the mesonotum. Front testaceous red with two large black spots one on each side. Vertex medially longitudinally sulcate, its anterior lateral margins convex. Vertex testaceous red with two small faint black round spots in front of the median ocellus, the area lateral and posterior to the lateral ocelli black. Eyes piecous brown, ocelli red.

Pronotum longer than the head, narrowed anteriorly, deflected laterally, its lateral margins sinuate, the anterior lateral angle entire. The inner area of pronotum entirely black, the anterior extreme edge, lateral and posterior margins, a central longitudinal fascia, slightly widened anteriorly and much widened near the posterior end where there is a median black spot, all testaceous red.

Mesonotum black with two obconical spots on the disk margined with testaceous red, the oblique depressed lateral marginal area, the cruciform elevation and its anterior and posterior arms, testaceous red.

Abdomen about as long as the head and thorax together, gradually attenuated posteriorly; in cross section, triangular in shape. The first tergite, a spot on each lateral area of the second tergite, posterior margins of the third to seventh tergites, the posterior portion of the eighth tergite, all testaceous. The eighth tergite with long greyish pile. The posterior margin of the eighth tergite a little indented medially. Anal tergite medially longitudinally keeled, and produced posteriorly into a spine.

Tegmina and wings hyaline. Breadth of tegmina more than one-third their length. Nodal line indistinct. Basal cell about three times as long as its breadth. Costal membrane and costal vein testaceous red. Venation of the basal two-thirds of tegmen fuscous brown, of the apical third piceous, the extreme base and clavus sanguineous. Veins M and Cu contiguous only at the basal points. Wings with veins fuscous, some parts piceous, the margins of claval area and basal part of clavus infuscated.

Body beneath reddish ochraceous, thickly, greyish pilose. Face longitudinally sulcate, only slightly striated. Striations of face, disks of cheek, antennae, posterior two-thirds of rostrum, mesonotum, wedge-shaped spots on front coxae, spot on each intermediate and hind coxae, streaks on intermediate and hind femora and tibiae, all black. Rostrum exceeding the middle coxae. Front femora strongly spined beneath, the basal spine largest, the apical one smallest and bifid to form two tiny spines.
Abdomen beneath black, the posterior segmental margins of the second to sixth sternites, greater part of subgenital plate, and hypandrium, all testaceous red. Subgenital plate narrowed, deflected, and flattened at the posterior third, a little longer than the two preceding segments together, very convex, longer than wide. Opercula separated at their inner margins, not quite reaching the posterior margin of the second segment, their lateral margins expanded at the base, then narrowed, their posterior margins convexly rounded, their inner margins obtusely angulated; disk of each operculum depressed.

Length of body: 20 mm.; expansion of tegmina: 52 mm.

Holotype: male Chungnanshan, Shensi Province, China, May 1, 1936, in Fan Memorial Biological Institute, Peiping.

This species resembles *M. radiator* Uhler from Mukden and Japan in general appearance. The hypandrium in *M. radiator* is about as long as wide, the subgenital plate about as long as the three preceding sternites. *M. fuscoclavalis* is allied with *M. walsini* Liu because of the breadth of the head and the length of the subgenital plate, but it differs from the latter by having veins M and Cu contiguous instead of fusing. The color markings of the two species are distinctly different.

*Melampsalta fuscoclavalis* var. *chungnanshana* var. nov.

**Male.** Head black, a spot on the apex of the front, anterior lateral margins of vertex and a longitudinal median fascia near the base of vertex, testaceous red. Pronotum without a median longitudinal fascia. Mesonotum with two angular spots on the disk. Face black, with the lateral areas and the apical portion testaceous. Opercula blackish, fuscous at the posterior third. Subgenital plate not flattened at the posterior portion.

Length of body: 20 mm.; expansion of tegmina: 50 mm.

Holotype: male, Chungnanshan, Shensi Province, China, May 1, 1936, in the collection of the University of Nanking.

Paratype: one male specimen collected at the same locality and on the same date with the holotype. The paratype is deposited in the collection of the University of Nanking.

**Genus Subpsaltria** gen. nov.

Head including the eyes narrower than the base of the mesonotum, its length less than the distance between the eyes. Front prominent, deflected anteriorly. Ocelli about the same distance from the eyes as from each other. Pronotum much longer than the head, convex, laterally depressed, obliquely narrowed anteriorly, the posterior angles strongly lobately produced. Mesonotum strongly convex, narrowed posteriorly, its length about as long as the
head and pronotum together. A pair of striated areas present on the anterior lateral sides of the mesonotum. Abdomen of female about as long as the head and thorax together, the lateral margins strongly recurved and very prominent. Face very convex, two median longitudinal ridges separated by a longitudinal sulcus. Anterior femora robust and very strongly spine beneath. Tegmina and wings shining, finely transversely wrinkled; tegmina broad, their length about two and a half times their breadth, the basal cell about three times as long as wide. Tegmina with eight, wings with six apical areas. Rostrum reaching the intermediate coxae.

Genotype: *Subpsaltria yangi* sp. n.

Distribution: Northwestern China.

The systematic position of this genus is in the subfamily Tettigadinae which was erected by Jacobi (1907).

The genus *Subpsaltria* appears to be similar to *Paharia* in the subfamily Tibicinae described by Distant (Ann. Mag. Nat. Hist. (7) 16: 25), except for the presence of a pair of striated areas situated on each of the sides of the mesonotum, and a projecting scraper formed by the base of the claval area of each tegmen.

*Subpsaltria yangi* sp. nov. (Pl. II, Fig. 5)

**Female.** Head including the eyes much narrower than the base of the mesonotum, its length less than the space between the eyes. Front prominent, triangularly produced, about as long as the vertex. Color black, thickly brownish pilose, with the posterior area of front, anterior and lateral margins of vertex, the median sulcation behind the median ocellus, all testaceous red.

Pronotum much longer than the head, convex, laterally depressed, obliquely narrowed anteriorly, the posterior angles strongly lobately produced. Extreme edge of pronotum, the median longitudinal fascia, incisures, two oblique spots on the disk, two large lateral spots on the posterior margin and extreme narrow area of lateral margin, all testaceous red.

Mesonotum about as long as the head and pronotum together, strongly deflected on each side. Color black, thickly brownish pilose, two longitudinal fasciae on the disk curved inwardly and enlarged at the posterior tip, two somewhat triangular spots in front of the anterior angle of the cruciform elevation, anterior lateral obliquely striated areas, all brownish ochraceous.

Tegmina and wings ochraceous, finely transversely wrinkled, with the venation testaceous. Apical areas very short. The extreme base of tegmina and wings, their clavus and claval areas ochraceously sanguineous. The claval area of wings greatly developed.

Abdomen about as long as the head and thorax together, brownish ochraceous; first tergite entirely, and the anterior median half of second tergite, black; the anterior marginal black fasciae of the third to seventh tergites narrowed gradually; a series of continuous black spots at the middle of the
abdominal tergites, a brownish black marginal spot on the last tergite. Anal tergite triangular in shape, about as long as the two preceding tergites.

Body beneath brownish black, thickly brownish pilose. Face medially longitudinally sulcate. Striations of face, streaks of front coxae, hind femora and spots on intermediate and hind coxae, castaneous. Anterior femora robust, strongly spined beneath, the apical spine larger than the basal one, and a very small one scarcely detectable in front of the apical one. Apical half of the rostrum and the spines of the front femora, piceous. Rostrum reaching intermediate coxae. Abdomen beneath deeply depressed, with the lateral edges strongly developed and very prominent. Surface sparsely pilose, the posterior segmental margins castaneous. Genital plate deflected laterally and deeply cleft centrally.

Length of body: 29 mm.; expansion of tegmina: 82 mm.

Holotype: Chungnanshan, Shensi Province, China, May 3, 1936, in the collection of the University of Nanking.

The name of the species is dedicated to Dr. We-i Yang, the Entomologist of the Fan Memorial Biological Institute.

Subpsaltria sienyangensis sp. nov.

Female. Head and pronotum, thickly brownish pilose; the anterior sulcation, and the posterior area of front, the anterior and lateral margins and the median longitudinal sulcation behind median ocellus, median longitudinal fascia, incisures, two oblique spots on the inner area of pronotum, all testaceous red; pronotum with the extreme lateral edges and the posterior area of the hind margins, brownish ochraceous. Mesonotum black, only sparsely brownish pilose; two median linear fasciae, the anterior lateral obliquely striated areas and the disk of the cruciform elevation, testaceous red.

Fig. 2. Tegmen and hind wing of Subpsaltria sienyangensis sp. n.

Abdomen castaneous; the entire first tergite black, the transverse black fascia widened medially on each of the abdominal tergites from two to seven and a median longitudinal spot on the eighth tergite to form a continuous series of black fasciae; a series of black spots on the lateral areas of the abdominal segments and the ninth tergite brownish-black.

Tegmina and wings ochraceous, finely transversely wrinkled; venation ochraceous; veins of the tegmina margined on both sides by fuscous black;
basal cell fuscous black. Wings slightly infuscated. The ulnar areas of wings margined with fuscous. The extreme base and claval areas of tegmina and of wings, testaceous sanguineous (Fig. 2).

Body beneath, rostrum and legs, black; face, disk of lora and sternum thickly brownish pilose; face deeply longitudinally sulcate, the sulcus widened at its middle; a spot on the apex of the front, a wedge-shaped fascia on the intermediate and hind coxae, streaks on the fore, intermediate and hind femora, all testaceous red; rostrum reaching intermediate coxae, two strong spines and a very minute one beneath front femora. Hind tibiae spined on outer and inner sides.

Abdomen beneath black, with the posterior segmental margins ochraceous. The female genital plate deeply cleft at the median posterior margin. The length of the genital plate at the middle equal to the length of the preceding segment and at the lateral area equal to two preceding segments measured on the median line.

Length of body: 33 mm.; expansion of tegmina: 86 mm.

Holotype: female, Sienyang, Shensi Province, China, in September, 1939. A somewhat damaged specimen collected by Mr. Y. S. Wu, in the collection of the University of Nanking.

This species is closely allied to S. yangi from Chungnanshan. It can be separated easily from yangi by the larger size, veins of tegmen margined by fuscous black and the relatively shorter length of the genital plate. In yangi, the genital plate of the female is longer than the preceding segment medially, and the greatest length at the lateral area is greater than the two preceding segments measured by the same method.

In both of these Chinese species, the specimens I examined possess a striated area on each of the anterior lateral sides of the mesonotum. I cannot be sure that these striated areas are used for secondary sound production, and the collectors of the specimens did not inform me.

At the lateral sides of the base of the mesonotum there is a somewhat oblong area obliquely situated. It is ochraceous in color, 2 mm. long and 1.5 mm. wide, and is free from hairs. Upon examination of this area, it is seen that the finely, obliquely, parallel, sharp-edged ridges run diagonal to the body axis and are inclined toward the middle. The surface is convex. The number of striations is eighteen. On the tegmina, the base of the claval area supported by the bases of the veins pl. and 1v., which are enlarged and much sclerotized, projects out and is sup-
ported underneath by Va. This projection (Fig. 3, Sc.) functions as a scraper against the striated area (Fig. 3, St.).

When the insect is in repose, the elevated scraper is in a perpendicular position to the ridges of the striated area. If a dull insect pin is scraped across the ridges of the area, a weak sound can be heard. Since only the female specimens are present in our collection, I can only conclude that such secondary stridulating organs are not limited to the male sex as is the case with the primary sound-producing organs.

![Diagram](image)

Fig. 3. The secondary stridulating organs of the female *Subpsaltria yangi* sp. n. St.—striated area. Sc.—scraper.

Jacobi (1907) claimed that similar secondary sound-producing organs in the same position were present in the genera *Tettigades*, *Chonosia* and *Babras*, and the subfamily *Tettigadinæ* was erected by him to include these three genera. Our specimens, after careful examination, appear to be similar to the genus *Paharia* Dist. in which only four species are known, but are apparently very different because of the presence of these stridulating areas on the mesonotum. Jacobi (1927) mentioned two species and one variety of *Paharia* from Afghanistan, but did not mention the presence of such stridulating organs in those species.
Genus *Sinosena* gen. nov. (Pl. I, Figs. 3 and 4)

Head narrowed, depressed, including the eyes considerably narrower than the base of the mesonotum; pronotum obliquely depressed anteriorly, longer than the head, its lateral margins distinctly toothed; mesonotum large, very convex, a little longer than the head and pronotum together, the cruciform elevation raised and narrowed posteriorly; abdomen short and robust, the tymbals and tympanal coverings absent, the second abdominal segment not elongated laterally and ventrally and entirely the same form as the following segments; opercula in male developed, but widely separated; tegmina and wings hyaline, and maculated; nodal line weakly indicated; breadth of tegmina more than one-third of the length; veins M and Cu of tegmen coalesced for a considerable distance. Tegmina with eight, wings with six apical areas. Rostrum exceeding the hind coxae, front femora weakly spined beneath. Females larger than the males.

Genotype: *Karenia ccelatata* Distant.

*Sinosena cælatta* Distant

1890. *Karenia ccelatata* Distant, Ent. 23: 91 (China: Chia Kou Ho).

This mute species was described from a single female specimen by Distant (1890) from China. The female resembles the female of the species *Karenia ravida*, that has the tympana developed in the male. The author collected twenty-five males and seventeen females at Tsaopao, Western Szechwan Province, in a big forest belonging to a Lama Temple, but was not able to obtain a single specimen outside the forest, in the nearby regions.

In the more primitive genera *Platypedia* and *Neoplatyypedia* of the Nearctic Region, the tympanum is absent, the metepimeron is not prolonged posteriorly to form the operculum, the abdomen is attenuated and the genital plate of the male is lengthened. All these characters demonstrate an archaic relation with the ancestor of the species of *Tibicina* and its allies. On the other hand, the primitive species *Sinosena cælatta* Dist. has the opercula developed in both sexes, has a robust body, the tegmina maculated, a weak nodal line and very large size; all of which would seem to indicate a relation with the ancestor of the tribe *Dundubiiini*, which is the most dominant group in the Oriental Region.
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Plate I

Figure 1. *Tibicen tsaopaonensis* sp. nov., type.
Figure 2. *Sinopsaltria bifasciata* sp. nov., type.
Figure 3. *Sinosena ccelatata* Distant, Western Szechwan, China, Aug. 9, 1938.
Figure 4. *Sinosena ccelatata* Distant, Western Szechwan, China, Aug. 5, 1938.
1  TIBICEN TSAOPAONENSIS

2  SINOPSALTRIA BIFASCIATA

3  SINOSENA CAELATATA

4  SINOSENA CAELATATA

Chinese Cicadas
Plate II

Figure 5. *Subpsaltria yangi* sp. nov., type.
Figure 6. *Leptosemia huasipana* sp. nov., type.
Figure 7. Female genital plate of *L. huasipana*.
Figure 8. Female genital plate of *L. takanonis*.
Figure 9. *Chremistica nana* sp. nov., type.
Figure 10. *Melampsalta fuscoclavalis* sp. nov., type.
LEPTOSEMIA HUASIPANA

LEPTOSEMIA HUASIPANA

LEPTOSEMIA TAKANONIS

CREMISTICA NANA

MELAMPSALTA FUSCOCLAVALIS

Chinese Cicadas
BOOK NOTICE


Illinois Biological Monographs are always noteworthy and the present one, which is No. 3 of Volume XIX is no exception. It should be welcomed by taxonomists and also by economic entomologists because of the economic importance of several species of Conotrachelus. On the basis of morphological characters, which included the body regions and their appendages, color and vestiture, secondary sex characters and male genitalia, and after a study of the relative importance of each, the author divides the genus into four groups as opposed to six groups by previous authors. These four groups indicate the phylogenetic relations of the species more clearly. Keys to the groups and to the species within each group are provided and each species is described or redescribed on the basis of external morphological structures and male genitalia. In addition there is a discussion of the distribution, biology, phylogeny and nomenclature of each species. A bibliography and nine plates of aedeagi and other taxonomic structures complete this excellent monograph which includes 29 species, six of which are described as new. I know that there must have been good reasons for limiting this study to the species of the North Central United States, but I can’t help mentioning the well-known fact that the users of these monographs are continually in need of such worthwhile treatments for, at least, the country as a whole. But until taxonomists are more richly rewarded, I fear that we shall have to take what we can get and be thankful for it.—H. B. Weiss.
LIPID NERVE SHEATHS IN INSECTS AND THEIR PROBABLE RELATION TO INSECTICIDE ACTION

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INTRODUCTION

This study is an outgrowth of previous work in which it was shown that toxic petroleum oils cause a degeneration that seems largely a separation of the individual nerve cells and their processes (Richards, 1941a). While studying the action of toxic oils it was noted that oil solvents marked with Sudan dyes penetrated electively into the nervous system from tracheae. Correlating these two sets of data resulted in the hypothesis that, despite current beliefs to the contrary, insect nerve cells and their processes are surrounded and insulated by some lipid material. The present paper confirms this idea. It shows that insect nerves are surrounded by bound lipid sheaths, and further that the penetration of oil solvents, and so presumably of oils, is correlated with the distribution of this lipid, and that the destruction of the lipid nerve sheath is at least one of the effects of certain neurotoxic insecticides.

OBSERVATIONS ON THE NERVE SHEATHS

When mosquito larvae (Culex pipiens; Richards, 1941b) come into contact with a layer of xylol the fluid readily enters the spiracles and more or less fills the tracheal system. Such larve become paralyzed within a minute or two, and the heart stops beating in about 15 minutes. If the xylol is marked with Sudan dyes, it is found that in those segments in which the tracheae are filled with xylol the nerve cord soon becomes intensely colored and stands out in contrast to the other tissues which remain uncolored. Obviously the marked xylol can penetrate from tracheae into the nervous system more readily and in vastly larger quantity than it can into other tissues.

Dissection of such specimens shows that the color is more con-
centrated in fiber tract regions (Fig. 2). Only a relatively small amount can be discerned in the cell-body regions. Dissection of specimens in which the marked xylol is just beginning to penetrate into the nervous system shows that it diffuses rapidly from the small tracheae into and then along the fiber tract regions (Fig. 3). This suggests the intermediation of some material in which considerable quantities of xylol are readily soluble, i.e., a lipid.

Brains and nerve cords of larvæ dissected in 10 per cent formalin (4 per cent formaldehyde) and left in the formal for 24 hours can be readily stained with Black Sudan B\(^1\) (Figs. 4–5). Such larvæ show only a diffuse stain in the fiber tract regions such as has been recently reported by Wigglesworth (1942) for mosquito larvæ fixed in Bouin’s fluid. Short fixation in 10 per cent formalin is inadequate in the sense that subsequent staining in the alcoholic dye results in a partial release of lipid.\(^2\)

The larval nervous system may be similarly stained by brief immersion of living ganglia in the alcoholic stain, but alcohol soon releases the lipid which then stains as dark particles. This experiment is most easily performed by carefully removing the top of the larva’s head (in saline) and placing the part containing the intact nervous system in the alcoholic stain for about five minutes. After removal and rinsing, the dissection is completed in saline. The stain will not have penetrated completely to the suboesophageal ganglion, and a full series of effects will be obtained in a single brain (Figs. 6–7). In the exposed upper part the lipid will have been released by the alcohol and stained as particles, in the suboesophageal ganglion the lipid will be undetectable (and presumably unaffected), and in the intermediate

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\(^{1}\) For source and techniques see Hartman (1940). Staining of entire nerve cords takes only 5–15 minutes in the stain in 70% alcohol but several hours in a saturated solution of the stain in 50% alcohol. As mounting medium I have used Apathy’s Gum Syrup. This is made by dissolving 50 grams of gum arabic and 50 grams of sucrose in 50 cc. of warm distilled water, filtering, cooling and then adding 1 cc. of formalin. For the fats of the adipose tissue this makes a good permanent mounting medium that does not require sealing (I have slides over three years old) but the nerve sheath lipids are soon altered in this as in other media tried.

\(^{2}\) This might conceivably be due either to inadequate fixation or to the slow removal of one lipid fraction in 10% formalin. See Weil (1933).
parts a region will be found with diffuse staining which grades into particulate staining above and unstained tissue below.

Material fixed in 50 per cent alcohol and then stained with Black Sudan B shows all or almost all of the color located in particles (Fig. 8). These particles are concentrated in the fiber tract regions and are clearly outside the nerve fibers since by crushing the fresh whole mount they can be made to float around freely independently of the uncrushed cells. Smaller and less numerous particles also occur between the cells, giving indication of a lipid layer extending around the cells as well as around the processes.

The lipid particles released by alcohol are usually small, have irregular shapes (Fig. 10), stain intensely with Sudan dyes, and have a high melting point (> 100° C.). Oblong particles exhibit negative birefringence with respect to their long axes. The material composing these particles is rapidly removed by high concentrations of ethyl alcohol (70 per cent and higher) and slowly by low concentrations of alcohol and even by water. The nerve sheaths also appear to be heat labile, for while osmium tetroxide heavily blackens the interfibrillar material in larvae killed by heat (45° C. for 3 minutes), it does not do so in control animals (Figs. 11–13).

The lipid composing the nerve sheaths is clearly different from the lipids of the adipose tissue. The latter are not visibly affected by aqueous fixing fluids or by a temperature of 45° C., and, while they are soluble in 95 per cent alcohol, they are insoluble in 70 per cent alcohol.

To determine whether or not the lipid nerve sheaths occur generally throughout the group a miscellaneous set of insects were collected, opened and fixed in 10 per cent formalin, and then the dissected nervous systems stained with Black Sudan B and examined as partially crushed whole mounts. Species examined were: Gryllus assimilis (Orthoptera), Phymata erosa (Hemiptera), Harpalus sp. (Coleoptera), Bombus sp. (Hymenoptera) and Eristalis tenax (Diptera). With all of these species the same results were obtained as have been recorded above for formalin-fixed mosquito larva. It would seem from these observations that lipid nerve sheaths are of general occurrence among insects.
The preceding data also suggest that the lipids of the nerve sheath are, at least in part, bound phospholipids (phosphatids). To check this, extracts were made from brains (supracæsophageal ganglia) and subæsophageal ganglia of honey bees (workers). This work is purely qualitative and based solely on solubilities; as such it is to be considered as preliminary although indicative. Brains (usually including the subæsophageal ganglia) were removed from normal bees and carefully cleaned of surrounding tissues. The adhering tracheal sheath was peeled off to insure removal of all pieces of the head glands, the Æsophagus removed as a unit, and the optic and ocellar nerves severed to prevent inclusion of any eye pigments. Dissections were performed in lots of five or six, and the nervous tissue then dried in a vacuum where it was gradually accumulated (in darkness). From 225 such dissections, 53 milligrams (dry weight) of pure nervous system were obtained. This was extracted with dry ethyl ether (in darkness), filtered, an excess of dry acetone added to the filtrate, and the tube placed in a refrigerator overnight. A fine white precipitate resulted. This was filtered and the residue after drying redissolved in ether and concentrated on a warm water-bath. Portions of the redissolved material were dried on clean slides and tested for alcohol solubility: a majority of the material dissolved in 95 per cent ethyl alcohol but a small amount was insoluble. The ether-acetone filtrate was likewise concentrated and portions dried on clean slides; a considerable residue was present after drying. This latter residue is readily soluble in 95 per cent ethyl alcohol and slowly soluble in 70 per cent alcohol. The original ether extract then shows acetone-soluble and acetone-insoluble fractions, both of which can be stained with Black Sudan B in 50 per cent alcohol. The acetone-soluble fraction is also soluble in ethyl alcohol. The acetone-insoluble fraction is divisible into an alcohol-soluble and a smaller alcohol-insoluble fraction. Using the data given by Page (1937), the above suggests the presence of considerable amounts of cholesterol (acetone- and alcohol-soluble) and lecithin (acetone-insoluble, alcohol-soluble) and small amounts of cephalin (acetone- and alcohol-insoluble). While some of these substances were doubtless extracted from the nerve cells themselves, comparison with
the histochemical data indicates clearly that the nerve sheaths contain the same lipids as the extracts.³

RELATION OF THE NERVE SHEATHS TO INSECTICIDE PENETRATION

The elective penetration of stained xylol into the nervous system (Fig. 1) not only indicates the presence of lipids but also shows that these lipids are of prime importance in the penetration of oil solvents. Specimens dissected during the penetration process show the course of diffusion of the stain from the tracheae into and then along the fiber tracts (Fig. 3). Presumably this relationship will also be true for toxic oils and oil-borne toxins.

RELATION BETWEEN THE PENETRATION OF XYLOL AND PARALYSIS

Specimens in which by chance the penetration into successive ganglia is progressive and not too rapid show paralysis of those segments in which the ganglia are stained while the more anterior segments (farther from the spiracles) are still reacting. There is then a direct correlation between the penetration of xylol into a ganglion and the prompt paralysis of that segment. Such a correlation is commonly pointed out in insecticide studies but in this case penetration of the toxin can be observed directly instead of assumed.

Unfortunately, the destructive action of alcohol makes it difficult to study the action of insecticides on the nerve sheaths. Techniques are now being studied in a search for better procedures.

Xylol is obviously a nerve poison. Its rapid penetration into the nervous system is correlated with and so presumably conditioned by the lipid nerve sheaths. But it does not seem to destroy these sheaths, at least not to the extent that toxic petroleum oils and postmortem degeneration do (Richards, 1941a). Xylol must also penetrate (more slowly and in smaller quantity) into other tissues as is shown by the cessation of heartbeat in approximately 15 minutes. Quite likely the toxic effect of xylol is a general one

³ Comparison with the data given for crustacean nerve sheaths by Schmitt, Bear and Clark (1935) would suggest that cholesterol is also involved in the insect nerve sheath complex but the histochemical data given in the present paper are not sufficient to make any statement at this point.
and xylol seems to be a nerve poison largely because of the speed of its penetration into the nervous system. The nature of the action of xylol on living cells is not known.

DISCUSSION

The definite demonstration of bound lipid nerve sheaths is new for insects (Richards, 1942). It has generally been considered that insect nerves lack myelin sheaths or any counterpart thereof (e.g., Lindsay and Craig, 1942). Hanström (1928) does not even discuss the possibility of interneuronal material other than connective tissue. The same is true for the brief reviews by Clayton (1932) and Hilton (1942), and the papers on non-nervous elements by Scharrer (1939, 1941). When the present study was nearing completion Wigglesworth (1942) published a paper on insect nutrition in which he noted a diffuse staining with Black Sudan B in the central fibrous region of the nerve ganglia of mosquito larvae but he did not carry the analysis further.

In invertebrates other than insects there is a growing literature on myelin-like or bound lipid nerve sheaths. The data are largely derived from optical studies on large peripheral nerves, and concern nerve fibers of Annelida (Young, 1937), Crustacea (Retzius, 1890; Schmitt, Bear and Clark, 1935; Bear and Schmitt, 1937; Chinn and Schmitt, 1937) and the Squid (Bear, Schmitt and Young, 1937). Data presented herein on insects are largely (not exclusively) derived from the central nervous system, and are based on histochemical methods including extractions. However, the histochemical and optical data are probably comparable. At least in the mosquito larva bound lipid nerve sheaths of submicroscopic thickness are clearly indicated for both the central nervous system and for the individual fibers of the peripheral nerves. Preliminary observations on representatives of other orders of insects suggest, as would be expected, that bound lipid nerve sheaths will be found throughout the class Insecta.

The chemical identity of the lipid or lipids in the nerve sheath is still uncertain. The histochemical data and melting point sug-

4 It might also be mentioned that even the so-called non-myelinated nerve fibers of vertebrates have similar lipoprotein sheaths (Schmitt and Bear, 1937). For a review of the literature on nerve sheaths see Schmitt and Bear (1939), and for more recent papers see Taylor (1940) and Holmes (1942).
gest a phospholipid. Ether extracts of bee brains can be separated into fractions, the solubilities of which suggest cholesterol, lecithin and perhaps small amounts of cephalin. Comparison of these data with the data of Schmitt, et al., clearly suggests that the submicroscopic insect nerve sheaths are composed of one or more phospholipids (lecithin?), and perhaps cholesterol, bound with protein.

The presence of bound lipid nerve sheaths is of histological value but their probable relation to the penetration of neurotoxic insecticides is of major interest in any study of the mode of action of these toxins. Insects differ fundamentally from vertebrates in that toxins cannot only reach the nervous system from the blood but also directly from the tracheæ. The entrance of oil solvents such as xylol into the nerve cord from the tracheæ is correlated with the distribution of this lipid and so presumably conditioned by it. It seems reasonable to assume that the same will be true for any oil or oil solvent that can penetrate tracheal walls. In fact, any toxin, entering either from the tracheæ or blood, must traverse this bound lipid sheath to enter the nerve cells or processes. Partition coefficients would favor lipid-soluble materials.

The histopathological effects produced by toxic petroleum oils (Richards, 1941a) are consistent with the view that the destruction of the lipid nerve sheaths is intimately involved in the neurotoxic action of the oils. It seems likely that the same is true for the action of pyrethrins (see especially Klinger, 1936). Sheath degeneration also occurs as a relatively early postmortem change in asphyxiated mosquito larvæ (Richards, 1941a). But whether or not the sheath destruction is directly concerned in the production of paralysis and death is unknown. (See below.)

Another interesting analytical trend comes from the compari-

5 In studying the effect of 'Flit' on bees, Nelson (1927) reports the penetration of the stained mixture from tracheæ into the nerve ganglia, muscles, and some of the malpighian tubes. The data are not strictly comparable to those presented in the present paper. However, the coloring of the ganglia is suggestive. And, in view of the long time factor (15 hours), the coloring of some other tissues is not surprising. Xylol must affect other tissues too since it causes a cessation of the heartbeat within 15 minutes, but only in the nervous system does it accumulate in sufficient quantity to visibly color the tissue by the time of death.
son of a series of papers which unfortunately deal with different species of insects and so must be correlated with caution. (1) Feldberg (1940) demonstrated phosphatase activity for bee venom by using it to prepare lysolecithin from purified lecithin. Bee venom appears to have the same action as cobra venom in producing lysolecithin in vertebrate tissues and in releasing histamine (see also Feldberg and Kellaway, 1937). Whether the toxic effect is produced by lysolecithin directly or through the intermediation of histamine is another question but need not be considered here. (2) It is well known that many parasitic or parasitoid wasps cause a true paralysis by stinging the ganglia of their arthropod prey. Hartzell (1935) has reported that the venom of the wasp, Sphecius speciosus, causes nerve lesions in the ganglia of the cicada, Tibicen pruinosa. (3) The present paper reports the presence of bound lipid nerve sheaths in insects, and gives data suggesting that the lipids are phospholipids including considerable amounts of some lecithin. (4) And, finally, the present paper points out that at least some of the types of insect nerve lesions reported by various authors seem interpretable as due to the breakdown of these phospholipid sheaths.

If these apparent correlations could all be demonstrated in one study, it would follow that paralyzing venoms probably act on arthropods by disrupting the lipid nerve sheaths and producing lysolecithin which in turn acts on the nerve cells (perhaps also indirectly). If this is true, another interesting point may be that the important destructive effects are not really the histologically visible lesions, because Feldberg (1940) has noted that the destructive effects of lysolecithin are not histologically demonstrable in the vertebrate adrenal gland.

The relationship of the data in the preceding two paragraphs to the action of neurotoxic insecticides is unknown. There is as yet no evidence that phosphatase activity is involved in insecticide action. Also neurotoxic insecticides kill whereas the venoms injected by wasps only paralyze. Data from surgical operations show that mere elimination of parts of the central nervous system does not necessarily cause death (Kopeć, 1923; Metalnikov and Korvine-Kroukovsky, 1927). Data from the effects of toxic pe-

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6 Dosage rather than intrinsically different effect may be involved.
troileum oils suggest that destruction of the lipid nerve sheaths is an important act of these insecticides (Richards, 1941a). At least some of the data from the effects of pyrethrins likewise suggest destruction of the nerve sheaths (especially Klinger, 1936), but Wigglesworth (1941) reports that pyrethrins dissolved in liquid paraffin cause a far more general cellular destruction within ten days after paralysis,⁷ and Hartzell and Scudder (1942) point out that the effects of pyrethrum are not necessarily confined to the nervous system. It seems to me certain that the lipid nerve sheaths are important factors in the penetration of neurotoxins and that these sheaths are commonly broken down by insecticides, but this does not mean that degeneration of the sheaths per se causes death or that other tissues cannot be penetrated and affected by neurotoxic insecticides.

**SUMMARY**

1. Insect nerve cells and their processes are surrounded and insulated by bound lipid sheaths of submicroscopic thickness. Solubility data suggest that the lipids are phospholipids, perhaps with the addition of cholesterol.

2. The lipid nerve sheaths are correlated with and so presumably condition the penetration of oil solvents into the nervous system from tracheae. Presumably this finding will apply also to the penetration of toxic oils and oil-borne toxins.

3. One of the effects of certain neurotoxic insecticides seems to be the destruction of these bound lipid sheaths.

4. Some aspects of the relationships of these data to the study of insecticide physiology are discussed.

**LITERATURE CITED**


⁷ How much of this tissue dissolution precedes or accompanies the death of the cells is unknown. The mere fact that the heart is still beating does not necessarily mean that the nervous system is alive. The cells of the central nervous system may have been dead and undergoing a kind of postmortem degeneration for days. If this is true, the degree of degeneration of the nervous tissue is not necessarily any index of the type or extent of the insecticide action. The same criticism may be made of all other studies in which histopathology is used without a check on the physiological condition of the cells (see Richards, 1941a, pp. 182–183).


PLATE III

Figure 1. Photomicrograph of two abdominal segments of mosquito larva treated with xylol stained with Black Sudan B. The body was cut longitudinally along one side, spread open, the gut removed, and mounted as a whole mount. Shows the intensely colored ganglia and their connectives. Also shows many small tracheae containing stained xylol; these tracheae branch around and through uncolored muscle, adipose and epithelial tissues. Magnification 75x.

Figure 2. Whole mount of brain (supraoesophageal ganglion) of mosquito larva treated with xylol stained with Black Sudan B. Note color is concentrated in the fiber-tract regions. Magnification 95x.

Figure 3. Whole mount of intact thoracic ganglia of a mosquito larva treated with xylol stained with Black Sudan B. Note metathoracic ganglion into which xylol is penetrating from the xylol-filled tracheae on the left side. In the original mount the distinction between stain in the tracheae and in the nerve tissue is much clearer. Magnification 270x.

Figure 4. Whole mount of removed thoracic and first abdominal ganglia of a mosquito larva fixed in 10% formalin for 37 hours and then stained with Black Sudan B in 70% alcohol. Magnification 120x.

Figure 5. Crushed whole mount of brain and suboesophageal ganglion of a mosquito larva fixed in 10% formalin for 37 hours and then stained with Black Sudan B in 70% alcohol. Air-filled tracheae appear black, fluid-filled tracheae are transparent. Black areas are fiber tract regions. Suboesophageal ganglion broken in half and twisted in mounting with result that one half lies above the brain, the other half below. Magnification 120x.
PLATE IV

Figure 6. Portion of crushed whole mount of brain of mosquito larva showing diffuse stain along fiber tract leading to circumesophageal commissures. Prepared by rapid staining of living brain in alcoholic stain. See text. Magnification 190 ×.

Figure 7. Another example of same of Fig. 6. Magnification 190 ×.

Figure 8. Portion of whole mount of brain fixed and stained in a saturated solution of Black Sudan B in 50% ethyl alcohol (6 hours). Stain mostly in free particles of various sizes. Note some particles in cell-body regions although bulk of stain is in fiber tract regions. Magnification 190 ×.

Figure 9. Whole mount of thoracic ganglia of larva fixed and stained in a saturated solution of Black Sudan B in 70% ethyl alcohol (5 minutes). Stain approximately half in free particles, half diffuse. Magnification 180 ×.

Figure 10. Higher magnification of released stained particles in a crushed whole mount of a brain fixed in 50% alcohol (15 hours) and then stained. Note that particles lying free in the mounting medium retain their irregular shapes. Magnification 250 ×.

Figure 11. Section of abdominal ganglion of normal larva fixed in 1% osmic acid for 24 hours. All parts of the nerve cord are colored a uniform light brown (same intensity as in the muscles). Magnification 340 ×.

Figure 12. Section of abdominal ganglion of a larva killed by 3 minutes at 45° C. and then fixed in 1% osmic acid for 24 hours. Nerve cell bodies are colored a light brown (as in controls) but the fiber tracts are intensely blackened between the fibers. Magnification 340 ×.

Figure 13. Another section from a different specimen of same lot of larvae as Fig 12. Note that the blackening of the fiber tracts is incomplete on one side in this particular section. Magnification 340 ×.
ADDITIONS TO SMITH’S 1909 DIPTERA LIST

By William F. Rapp, Jr.

During the summer of 1942 I did considerable collecting of Diptera in the Glassboro region. All the species listed were taken in the vicinity of Glassboro, Gloucester County, New Jersey. I wish to thank Dr. S. W. Bromley, Dr. A. Stone, Dr. M. T. James and Mr. C. T. Greene for identifications in their respective groups.

Family TENDAIPEPIDIDÆ
Chironomus dimorphus Mall. V-23-42.

Family SIMULIDÆ
Simulium decorum Walk. VI-21-42.

Family ASILIDÆ
Diagmites misellus Loew. VII-21-42.

Family DORILAIIDÆ
Dorilas confraternus Banks. VI-20-42.
Dorilas dubius Cresson. V-23-42.

Family LARVEVORIDÆ
Aplomya theclarum Scud. VIII-1-42.
Bonnetia comta Fall. VII-11-42.
Diener grisescens Mg. VII-21-42.
Hyalomyia aldrichi Tns. VIII-3-42.
Leucostoma atra Tns. VII-11-42.
Metachaeta carbonaria Panz. V-23-42.
Nemorilla floralis Fall. VI-20-42.
Neophorocera claripennis Mg. V-23-42.

Family SARCOPHAGIDÆ
Amobia signata Meig. VIII-1-42.

Family ANTHOMYIIDÆ
Hylemyia betarum Lint. VIII-1-42.

Family TETANOCERIDÆ
Limnia saratogensis ottawensis Mel. VI-20-42.

Family OTITIDÆ
Chatopsis fulvifrons Macq. V-23-42.

Family AGROMYZIDÆ
Agromyza virens Loew. VIII-1-42.

Family CHLOROPIDÆ
Chloropisca glabra Macq. V-23-42.
The
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Entered as second class matter July 7, 1925, at the post office at Lancaster, Pa., under the Act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized March 27, 1924.
RACIAL DIFFERENTIATION IN NEARCTIC SPECIES OF DIANTHIDIIUM (HYMENOPTERA, APOIDEA)

By P. H. Timberlake

University of California Citrus Experiment Station
Riverside, California

This study of our North American species of Dianthidium is not intended to be monographic; yet all the types located on the Pacific Coast have been examined, and the interpretations of Herbert F. Schwarz, who has studied other types in New York, Philadelphia, and Washington, have been followed in the main. There is little or no doubt, therefore, about the strict application of the names here involved.

The species herein recognized are distinguishable by such morphological characters as structure of the mandibles in the females, modification of the apical tergite, ventrite, and the genitalia in the males, and by size and sculpture in both sexes. The subspecies, on the other hand, are differentiated by variation in the extent and color of the maculations, by the character of the pubescence, and by relatively minor differences in the sculpture. On the Pacific Coast, in several widely distributed species, there is a progressive increase in maculation, both in extent and in depth of color, from British Columbia and Washington southward to southern California. Farther south, in Lower California, the tendency is reversed, specimens from this region

1 Paper No. 469, University of California Citrus Experiment Station, Riverside, California.
exhibiting a contraction of the maculations, although the color may remain equally bright. In certain species, however, in the more arid or desert portion of the habitat, there is a distinct bleaching of the color. Another interesting variation is the conspicuous increase in the length of pubescence shown by specimens of two species of the Sierra Nevada region.

The material basis of this study has been the collections of the California Academy of Sciences and the University of California Citrus Experiment Station, the Cazier collection now belonging to the American Museum of Natural History, and a small but important set of specimens from the collections of the Bohart brothers and of Messrs. Linsley and Michener.

In the following key, the females of nearly all our species are distinguished by characters that are almost exclusively morphological. The key, on this account, may prove to be difficult for the beginner who has no authentically identified specimens for comparison; in such a case it should be supplemented by use of keys that have been published by Schwarz.

**Key to the Females of Nearctic Species of Dianthidium**

1. Large species, about 12 mm. long; sides of tergites 2 and 3, or 2 to 5, more or less inflated, with the posterior angles widely diverging from base of following segment ................................................................. 2.

Smaller species, about 10 mm. long, or less; sides of middle tergites not inflated ................................................................................................................................................................................................. 3.

2. Sides of tergites 2 to 5 strongly inflated; tergite 6 broadly truncate at apex, with posterior corners rounded; spur of hind coxae long and conical ........................................................................................... *singulare* (Cresson).

Sides of tergites 2 and 3 weakly inflated but strongly diverging from base of following segment; tergite 6 broadly rounded at apex; spur of hind coxae short and stout ........................................... *cressonii* (Dalla Torre).

3. Coxae of fore legs armed with a short hairy spine at apex ............... 4.

Anterior coxae unarmed at apex, rarely with a rounded crest on ventral surface ........................................................................................................................................... 6.

4. Large species, 8–10 mm. long, abdomen nearly 4 mm. wide; markings of head and thorax more or less reddened; lateral face-marks ending broadly above antennae ........................................................................................................... 5.

Smaller, about 8 mm. long; maculations yellow throughout; lateral face-marks narrowed above ................................................................. *simile* (Cresson).

5. Punctures of frons and vertex coarse and close, becoming a little more separated on vertex, especially behind ocelli ...................... *curvatum* (Smith).

Punctures of frons and vertex as in *curvatum*, but slightly closer and nearly uniformly spaced throughout ........................................... *sayi* Cockerell.
6. Punctures of frons more or less close but separate enough to leave shining interstices .................................................................................................................. 7.

Punctures of frons very dense, so that the surface is more or less dull; mesoscutum also dull and densely punctured .................................................. 15.

7. Mandibles with a small preapical notch, but preapical tooth very blunt or hardly developed .................................................................................. 8.

Mandibles with a distinct preapical tooth, set off on one side by a preapical notch and on the other side by a more or less concave cutting edge ........................................................................................................ 9.

Mandibles with the cutting edge straight, relieved only by small acute notch preapically; the apical tooth small, not, or hardly, projecting beyond contour of cutting edge ........................................................................................................ 10.

Mandibles with a large well-developed apical tooth, followed by a broadangled notch, which thus sets off a low blunt preapical tooth, with the cutting edge beyond straight; ventral scopae more or less fuscous.

*desertorum* n. sp.

9. Punctures of face, vertex, and mesoscutum nearly uniformly coarse and close, and only a little finer than those of mesopleura; large, robust species, resembling *curvatum* and *sayi*, with legs mainly red.

*subrufulum* n. sp.

Punctures of mesoscutum fine and close, becoming a little finer and denser on anterior middle; those of frons and vertex somewhat coarser; those of mesopleura much coarser ............. *pubicum* (Cresson).

10. Mesoscutum with the interstices between the punctures more or less shining ............................................................................................................. 11.

Mesoscutum dull, the interstices between the very close punctures tessellate ............................................................................................................. *fraternum* n. sp.

11. Punctures of frons more or less coarse and at least equal to those of clypeus ............................................................................................................. 12.

Punctures of frons and vertex fine, uniformly and closely spaced, fading out on posterior border of vertex and subequal to those of mesoscutum, a little finer than those of clypeus and much finer than those of mesopleura ............................................................................. *platyurum* Cockerell.


Punctures of mesoscutum becoming distinctly finer and denser on anterior middle; punctures of frons, vertex, and clypeus rather coarse, uniformly close, and subequal to the coarser punctures of mesoscutum; legs red ............................................................................................................. *concinnum* (Cresson).

13. Punctures of frons, at least in the middle, somewhat separated, some of the interstices equal to one-half to one puncture-width ............................................................................................................. 14.

Punctures of frons almost touching, honeycomblike, and about as close as those of mesoscutum ............................................................................................................. *subparvum* Swenk.

14. Punctures of clypeus, frons, and mesoscutum moderately fine and subequal, becoming a little separated on frons, with those of vertex a little finer and sometimes a little sparser behind ocelli.

*parvum* (Cresson).
Punctures of clypeus and frons rather coarse and rather well separated on middle of frons; those of vertex finer, becoming more widely spaced behind ocelli; punctures of mesoscutum very close throughout and slightly finer than those of frons \textit{profugum} Cockerell.

15. Mandibles with distinct apical and preapical teeth, the cutting edge within concavely areuate

Mandibles with or without a small acute preapical notch, the cutting edge within straight, so that a preapical tooth is little or not at all indicated

16. Apical and preapical teeth of mandibles large, broad at base, the inner one blunt, both together occupying half the apical cutting edge; punctures of mesoscutum moderately coarse, not becoming denser on anterior middle \textit{ulkei} (Cresson).

Teeth of mandibles smaller, acute; areuate portion of cutting edge fortified by a carina on inner surface close to margin; punctures of mesoscutum rather fine and dense, becoming finer and denser on anterior middle \textit{consimile} (Ashmead).

17. Mandibles with a preapical notch, but apical tooth short and blunt, hardly projecting beyond contour of cutting edge; mesoscutum finely and densely punctured, the sculpture finer and denser on anterior middle \textit{plenum} n. sp.

Mandibles with a distinct apical tooth strongly projecting beyond contour of remainder of cutting edge, but without a preapical notch and tooth; punctures of mesoscutum nearly as fine as in \textit{plenum}, but the sculpture not appreciably finer and denser on anterior middle. \textit{macswaini} n. sp.

\textbf{GROUP OF DIANTHIDIIUM SINGULARE (CRESSON)}

Here belong two remarkably large and handsome species, \textit{D. singulare} and \textit{cressonii}, which have the sides of middle tergites peculiarly inflated.

\textbf{Dianthidium singulare} (Cresson)

The male of \textit{singulare} has the seventh tergite strongly trilobed, with the median lobe narrowly triangular, the emargination each side of it deep and flaring on outer side, and the lateral lobes very obliquely truncate from within outward, with outer margin strongly rounded. The lateral lobes thus appear to be divergent and subtriangular in shape, with rounded apex.

\textbf{Dianthidium singulare singulare} (Cresson).

The type from Nevada has the yellow band on tergites 1 and 2 broken into three spots, and that on tergite 3 broken into four spots, although the two inner spots are almost confluent.
In a male previously reported by Cockerell from Meadow Valley, Plumas Co., California (Van Dyke), the bands on the first two tergites are broken into three spots, but that on the third is entire and encloses two black spots, as do also the following bands. A female from Cisco, California, June 13, 1939 (G. E. Bohart), has similar markings, except that the two black spots in the band on tergite 3 break through on the anterior margin.

**Dianthidium singulare perluteum** Cockerell.

In this race from southern California, the abdominal bands are all entire. In the Academy collection are 7 specimens of both sexes, from Santa Rosa Peak, 8,000 feet, June 22; Idyllwild, San Jacinto Mts., June 19 to 23; Forest Home, San Bernardino Mts., June 17 and 18 (Van Dyke); and from Mill Creek, 6,000 feet, San Bernardino Mts., on Chrysothamnus, Oct. 11 (I. McCracken). I have also taken it at Bear Valley, San Bernardino Mts., on Eulophus, Aug. 10; at Forest Home on Cirsium, July 5; and at Mill Creek, 6,000 feet, on Erysimum, June 21. At 6,200 feet, Mill Creek, on Sept. 7, 1935, a female was discovered building its nest on the side of a partially buried rock in the creek bed, and 2 males that had followed it to the nesting site were captured. This nest was inspected several times during the following summer, but nothing issued. During the second winter, the creek bed was scoured out by a severe flood, and the rock and all must have been swept away.

**Dianthidium cressonii** (Dalla Torre)

This species has the sides of the middle tergites less inflated and the apex of the last tergite much less truncate than in *singulare*. I have not seen the male.

One female, Ward, Colorado, Aug. 10 (Cockerell); another, Nederland, Colorado, at flowers of wild rose, July 1, 1939 (Timberlake).

**GROUP OF DIANTHIDIUM CURVATUM** (SMITH)

The *curvatum* and *ulkei* groups are closely allied and similar in the structure of the seventh tergite of the male. This sclerite in both groups is broadly truncate at apex, with a shortly projecting median lobe or tooth. In the *curvatum* group, the median lobe is set off by a small but distinct notch on each side of its
base; the sixth ventrite is rather short and has its apical margin broadly rounded; the front coxae are armed at the apex with a short spine projecting horizontally, as in certain species of Colletes and Nomada; and the sagittal lobes of the genitalia are devoid of hair. In the ulkei group, the median lobe of the seventh tergite is but little more than a short projection from the otherwise truncate margin, the notch on each side of it being more or less evanescent (more distinct in ulkei than in the other species of its group); the sixth ventrite is produced medially, with the sides of the margin converging to a comparatively narrow, rounded, subtruncate or even notched apex; the front coxae are unarmed; and the sagittal lobes of the genitalia are fringed with hair on outer margins or provided with a short erect pile on the dorsal surface.

The males of the *curvaratum* group may be distinguished as follows:

1. Large species, generally over 9 mm. in length, with the maculations more or less reddened, especially on thorax, legs, and abdomen; lateral face-marks ending more or less broadly at level of anterior ocellus .......................... 2. Black, with yellow maculations; lateral face-marks narrowed above and ending at level of middle of frons; fringe of hair on fifth ventrite thin, and that on fourth considerably less developed .................. *simile* (Cress.).

2. Fringe of hair on fourth and fifth ventrites rather thin, but not less developed on the fourth segment ........................................ *curvatum* (Smith).

Venter very hairy, with a dense fringe on fourth and fifth segments, and on sides of the sixth ................................................................. *sayi* Ckl.

**Dianthidium simile** (Cresson)

Of this species I have examined a female from Browns Mills, New Jersey, and a male from Ogunquit, Maine, kindly loaned by Mr. Schwarz.

**Dianthidium curvatum** (Smith)

The Academy collection includes the following material: a pair from Mobile, Alabama, Sept. 19, 1939; 1 female, Fort Morgan, Alabama, Sept. 20; one pair, Eureka Springs, Ouachita Mts., Arkansas, Sept. 4; 1 male, Hot Springs, Arkansas, Oct. 1; and 4 males, Branson, Missouri, Sept. 7 and 11, 1939 (all Van Dyke).
The Fort Morgan female has the markings of clypeus, vertex, mesoscutum, scutellum, and first two tergites considerably reddened, the band on vertex narrow and continuous, the legs little blackened at base, the two spots on tergite 5 small and round, and the marks on mesoscutum extended backward on lateral margins. It thus resembles sayi in many ways, but the punctures of frons and vertex are sparser. The Missouri and Arkansas specimens tend to have the marks on anterior margin of mesoscutum reduced and sometimes not extending outward beyond the inner end of the scale-like expansion of tubercle.

*D. curvaturn* and *sayi* are very close structurally and may ultimately prove to be races of one species, but the punctures of the frons and vertex are sparser in *curvaturn* in both sexes, and the venter of the male of *sayi* is much more densely hairy. The genitalia and accessory parts are nearly identical in the two species.

*D. floridiense* Schwarz agrees with *curvaturn* except in color and in my estimation is merely a race of that species.

**Dianthidium sayi** Cockerell

This species was described by Say (1824) under the preoccupied name of *interruptum*, from Missouri. Although Missouri gained statehood in 1821, it is possible that Say cited the locality loosely, and it seems probable that his types were captured farther west. At any rate, by modern records the species is known to occur only as far eastward as the western parts of Kansas and Nebraska.

A series including both sexes, from Lewiston, Idaho, July 14-22, 1925 (C. L. Fox), is in the Academy collection. One specimen is marked "Gaillardia," and perhaps all were taken on that flower. Among specimens submitted by Messrs. Linsley and Michener were 2 males of *sayi* from Utah, one taken at Trenton, Aug. 23 (Knowlton and Hardy), the other at Hooper, Sept. 19 (D. E. Hardy). I also have specimens from Salt Lake City, Utah, and from Boulder, Denver, and La Junta, Colorado.

From Mesilla, New Mexico, Cockerell has described the race *xerophilum*, which has the red or ferruginous color spread over nearly all the head and thorax and a part of the abdomen.
GROUP OF DIANTHIDIUM ULKEI (CRESSON)

The males of this group may be distinguished as follows:

1. Species 9 mm., or less, in length; apex of sixth ventrite not notched; maculations yellow .................................................. 2.

Larger, similar to curvatum and sayi in size and maculations and with more or less red suffusions, especially on legs and venter; apex of sixth ventrite distinctly notched ........................................... subrufulum n. sp.

2. Frons and mesoscutum shining, the punctures close but not dense; median lobe of seventh tergite set off by a very shallow emargination on each side ................................................................. ulkei (Cress.).

Frons and mesoscutum dull and densely punctured; notch on each side of median lobe of seventh tergite small but usually distinct; venter very hairy, with a long fringe on segments 2 to 5 and on each side of 6 at base ................................................................. 3.

3. Frons and mesoscutum finely and closely punctured, the punctures finer than those of clypeus and much finer than those of mesopleura; venter hairy and sagittal lobes of genitalia fringed laterally ........... platyurum Ckll.

Frons and mesoscutum more coarsely punctured, the punctures subequal to those of clypeus and only a little finer than those of mesopleura; punctures of frons a little separated; fringes of ventral segments very thin, the sides of the sixth with short erect hair; sagittal lobes shallowly furrowed lengthwise above and invested with a fine erect pile.

Dianthidium subrufulum new species

Along with the few specimens of curvatum from Missouri and Arkansas, Van Dyke collected a large series of a similar species, which is liable to be confused with either curvatum or sayi. The male differs from either of those species in having the apical lobe of the sixth ventrite with nearly straight convergent sides and the rather narrow apex distinctly notched. The sagittal lobes are also rather densely fringed with hair. (In curvatum and sayi the sixth ventrite is broadly and evenly rounded at apex, and the sagittal lobes are glabrous.) The female has the punctures of frons and vertex a little finer and considerably closer, especially on each side of vertex, than in either sayi or curvatum. In the mainly ferruginous legs, it resembles sayi, although yellow stripes are generally present at base of tibiae. In the black thorax and abdomen with yellow maculations, it resembles curvatum; yet sometimes the sternum, propodeum, and base of abdomen are more or less red or suffused with red. Actually, subrufulum is
closer to *ulkei*, but its considerably larger size and the notch at apex of sixth ventricle of the male will distinguish it. Schwarz described *D. ulkei* var. *cooleyi*, from Montana, as having ferruginous legs, but he made no claim that it was distinguishable from *ulkei* in any way except color.

**Male.**—Size and form as in *curvatum*. Black; the tegulae, ground color of legs, venter, reflexed sides of first tergite, and sometimes sides of propodeum above hind coxae, ferruginous red. Scape beneath and at base more or less reddened, but flagellum black. Front and middle coxae black, except apex, but hind pair nearly all red except the yellow spurs. Spot at apex of femora above, stripe on front and middle femora behind (sometimes evanescent), broad stripe on outer side of front and middle tibiae, basal mark and preapical transverse band on outer side of hind tibiae, and stripe on basitarsi, yellow. Maculations of head, thorax, and abdomen bright yellow, although generally a little paler on face. Markings include mandibles, except apical margin; clypeus; small supraelypeal spot; lateral face-marks nearly reaching summit of eyes and generally a little more pointed above than in *curvatum*; stripe behind upper part of eye, sometimes extended to form interrupted band across vertex (the portion on vertex sometimes divided into four spots); dot or spot on frons; large mark on tubercles; curved mark on tegulae; mark on each side of anterior margin of mesoscutum, generally rather small, but sometimes extended to lateral margin; spot on axillae; continuous band at apex of scutellum; band on tergites 1 to 5; and most of tergite 7. Band on tergite 1 interrupted on each side. Bands on tergites 2 to 5 biarceduated by a broad anterior emargination in middle anteriorly and by a shallower emargination on each side posteriorly, those on 4 and 5 narrowly interrupted medially, that on 3 sometimes interrupted, and that on 2 most frequently continuous. Spur on hind coxa large and acute. Tergite 7 as in *ulkei*. (Nearly the same as in *curvatum* and *sayi*, but the median tooth less set off by a small emargination on each side of its base.) Puncturation throughout similar to *curvatum*, but a little finer and considerably sparser on frons and vertex. Mesoscutum a little dullish from a minute tessellation between the close punctures. Pubescence about as in *curvatum*, the vestiture of venter much less dense than in *sayi*. Wings rather dark fuliginous, the nervures black. Length, 9–11 mm.; anterior wing, 9 mm.; width of abdomen, about 3.9 mm.

**Female.**—Similar to male. Mandibles black, and scape less reddened than in males. Yellow of clypeus divided into two spots by a broad median black area. Supraclypeal mark absent, or rarely represented by a yellow dot. Legs ferruginous red, with a small spot at apex of middle and hind femora and basal spot or stripe on outer side of tibiae, generally reaching middle on front and middle pair, yellow. Tarsi sometimes a little infuscated or even blackish, except on one or two apical joints. Yellow bands on tergites 2 to 5 rather broadly interrupted medially, with inner ends of marks more or less pointed on 2 and 3, the two marks on tergite 5 lacking the portion laterad of the usual posterior emargination. Tergite 6 and venter black, but reflexed
sides of tergite 1 more or less red. Band on tergite 1 usually interrupted on each side, but occasionally continuous. Ventral scopa yellowish. Length, 8–10 mm.; anterior wing, 8 mm.; width of abdomen, nearly 4 mm.

In both sexes the red coloration is sometimes extended over a large part of sternum, most of propodeum, and lower part of metapleura, with more or less red suffusion on dark parts of first two tergites and, more rarely in male, on lateral margins of following tergites and on apical margin of the sixth. The male occasionally has a yellow dot on middle of anterior margin of the mesopleuron.

Holotype, male, and allotype, Branson, Missouri, Sept. 15, 1939. Paratypes as follows: 14 males, 26 females, Branson, Missouri, Sept. 7–16, 1939; 3 males, 7 females, Eureka Springs, Ouachita Mts., Arkansas, Sept. 4 and 5; and 7 males, 7 females, Hot Springs, Arkansas, Oct. 1, 1939 (all E. C. Van Dyke).

Types in collection of the California Academy of Sciences.

**Dianthidium ulkei** (Cresson)

**Key to the Subspecies, or Varieties, of ulkei, Females**

1. Legs black, with yellow or cream-colored markings .......................... 2.
   Legs light reddish brown, with a yellow stripe of variable length on tibiae; veater also more or less reddish brown (Musselshell and Billings, Montana) .................................................. 2. cooleyi Schwarz.

2. Markings yellow ........................................................................... 3.
   Markings cream color; outer side of tibiae pale; an elongated spot on frons and large band behind upper part of eyes (Santa Fe, New Mexico) .................................................. 2. perterritum Ckl.

3. Maculations full on mesoscutum, axillae, scutellum, mesopleura, and sixth tergite ........................................................................ 4.
   Maculation on parts named above reduced, the mesoscutum and axillae sometimes entirely black; sixth tergite entirely black or with two yellow dots (Washington, Oregon) .................................. 4. reducatum n. subsp.

4. Mandibles yellow, except on outer margin and apex; stripe behind eyes extending whole length of eye; two yellow spots on a band between antennae above usual supraelytcal mark; frontal spot large, more or less oval; abdominal bands very broad, mostly entire, except on middle segments, the posterior emarginations generally absent except on first and last segments (southern California) ........................................... 4. davidsoni Ckl.
   Mandibles with a small yellow spot or entirely black; no yellow mark between antennae; stripe behind eyes shorter; frontal spot more parallel-sided; abdominal bands less broad, interrupted medially on tergites 2 or 3 to 6 and often more or less emarginate behind on each side (Colorado to northern California) ........................................... 4. ulkei (Cress.).
Dianthidium ulkei ulkei (Cresson).

*D. ulkei* was described from Utah and has been recorded by Cockerell from New Mexico and Colorado and by Swenk from Nebraska, where an undermaculated variety was observed. The female typically has a yellow spot at base of mandibles, which is almost always present in California material but absent in all Colorado females that I have seen.

Typical *ulkei* is represented in the Academy collection by a large series from Twain Harte, 4,000 feet, Tuolumne Co., California, on *Grindelia*, July, 1937 (Blaisdell); and by one or more specimens from each of the following localities: Meadow Valley, Plumas Co., June 30 and July 4, 1924 (Van Dyke); hills back of Oakland, July 29, 1929 (E. C. Zimmerman); Buck Creek, Modoc Co., July 21 and 25, 1922 (C. L. Fox); Mt. Lassen, 6,000–8,000 feet, Aug. 2, 1938 (Van Dyke); Myers, Humboldt Co., July 7, 1937 (Van Dyke); Carrville, Trinity Co., June 30, 1931 (Van Dyke); Huntington Lake, 7,000 feet, Fresno Co., July 30, 1919 (Van Duzee); Mt. St. Helena, May 12, 1926 (Van Duzee); Glacier Lodge, Big Pine Creek, 8,000–11,000 feet, Inyo Co., California, Aug. 1929 (I. McCracken); Bryce Canyon, Utah, June 21, 1933 (O. H. Swezey); Bluff, Utah, on *Aster*, Sept. 14, 1938 (I. McCracken); and Lake of the Woods, Klamath Co., Oregon, July 10, 1934 (Van Dyke).

The following material of *ulkei* has been recorded by Cockerell, the males as *parvum* and the females as *consimile*: males, Huntington Lake, 7,000 feet, Fresno Co., California; females, Cascada, 6,000 feet, Fresno Co.; males and females, Cayton, Shasta Co.; and males from Strawberry Valley, Eldorado Co., California, and from Ashland, Oregon.

In the Cazier collection (American Museum), *ulkei* is represented from Safford, Arizona, and from the following localities in California: Davis; Mammoth Lake and Hot Creek, Mono Co.; Carson Pass, 8,000 feet; and north of Bishop, Inyo Co. (all Bohart).

The female from Mt. St. Helena lacks the yellow spot on mandible, but is otherwise fully maculated. The female from Glacier Lodge also lacks yellow on mandibles and is otherwise somewhat undermaculated, having the yellow bands on tergites 2 to 5 well
interrupted medially and the yellow on tergite 6 reduced to two round, well-separated spots.

**Dianthidium ulkei davidsoni** Cockerell.

This was described from southern California, where it is found in the mountains. The female has the yellow mark on mandible very large, black mark on clypeus small or absent, a yellow mark or two dots usually present between antennae (above the usual supraclypeal mark), frontal spot large, and bands of abdomen very broad, continuous, and little if at all emarginate behind, except on tergites 1 and 6. The male differs from typical *ulkei* chiefly in having the posterior emarginations of abdominal bands much smaller.

In the Academy collection *davidsoni* is represented by a female from Antioch, Contra Costa Co., Sept. 9, 1936 (Van Dyke); a female from Piñon Flat, San Jacinto Mts., June 21, 1941 (Van Dyke); and a male from Pinnacles, San Benito Co., California, Aug. 17, 1933 (J. T. Howell and L. S. Ross). A male from Mill Creek, San Bernardino Mts., has been recorded by Cockerell as *parvum*.

I have collected it at Camp Baldy and Big Pines Camp, San Gabriel Mts.; at Pinecrest, Arrowhead Ranger Station, Bear Valley, Mountain Home Creek, Mill Creek, and Vivian Creek trail, San Bernardino Mts.; and at Idyllwild, San Jacinto Mts. These localities range from about 4,000 to 7,000 feet in altitude.

**Dianthidium ulkei reductum** new subspecies.

This is a considerably undermaculated form occurring in parts of the Northwest and represented at least by individual variants farther east, as noted by Swenk in Nebraska. The putative female of *D. heterulkei* described by Schwarz seems to belong here, but *heterulkei* was based on a male with apparently good morphological characters. The most distinctive characters of *reductum* are the usually very small markings of the thorax, which is sometimes almost entirely black except on tegulae and tubercles, and the entirely, or almost entirely, black sixth tergite of the female.

**Female.**—Like *ulkei* in punctuation, pubescence, and structure of mandibles. Mandibles entirely black. Anterior margin and broad median stripe on
clypeus, black. Lateral face-marks normal. Frontal spot small and linear. No marks on vertex, and the stripes behind eyes short. Spots on anterior margin of mesoscutum very small. Spots on apex of scutellum small. Spots on axillae and mesopleura and stripes on femora, evanescent. Stripes on tibiae rather narrow; stripe on hind pair broad at base, with a narrow extension on dorsal margin nearly to apex, where it curves forward. Basitarsi immaculate. Tergites 1 to 5 each with a yellow band, broader on apical segments, well interrupted medially on 2 to 5 and emarginate behind on each side. Emarginations rather large and deep on tergite 1 and becoming progressively smaller on following segments, those on 4 and 5 tending to become enclosed. Tergite 6 black, with a suffused yellow dot on each side.

Two paratypes (Madras, Oregon) have a supraelyypeal dot or small spot, stripe behind eyes longer, markings on mesoscutum, axillae, scutellum, and mesopleura rather well developed, but bands on tergites 2 to 5 well interrupted medially, and tergite 6 either entirely black or with two evanescent dots.

**Male.**—Markings of head and thorax as in female, except usual sexual difference. Supraelyypeal mark small. Spots on axillae and mesopleura absent. Yellow stripes of tibiae broad, but on hind pair restricted by a broad black extension from the under side before the apex. Basitarsi maculated on outer side. Band on tergite 1 divided into three spots, those on 2 to 5 slightly interrupted medially and broadly emarginate behind on each side. Tergite 6 black, with a small transverse sinuate mark on each side. Tergite 7 yellow, except basal margin.

In paratypes there may be a short stripe on front and middle femora, the hind tibiae may lack the broad dark subinterruption, and the yellow lines on tergite 6 may extend far mesad and become bisinuate. The allotype has the yellow marks on tegulae and tubercles unusually small.


A female of **ulkei** from Dripping Springs, New Mexico, Aug. 10 (Townsend), in American Museum, agrees well with **reductum** in most respects. It differs from the type of **reductum** in having the markings paler yellow or almost cream color and the dark portion of tegulae bright ferruginous. It thus shows intergradation with **perterrimum** Ckll.

Swenk has recorded **reductum**-like specimens from Nebraska (Sioux and Dawes Counties). Schwarz has also recorded undermaclated **ulkei** from Three Sisters, Oregon, which I presume
were similar to paratypes of *reductum* from Madras. He has also recorded specimens of *ulkei* from British Columbia (Fairview, Keremeos, Vernon, and Summerland), but made no comment on their markings.

It thus seems that *ulkei* tends to be more or less undermaculated in various parts of the periphery of its range. However, as it is probable that the reduction of the maculations has occurred independently in different regions, I would hesitate to refer the Dripping Springs specimen to *reductum*, which race should be considered as properly restricted to the Northwest.

*Dianthidium desertorum* new species

In the contour of seventh tergite of the male, this species is very similar to *ulkei*, but the parameres of stipites, instead of the sagittal lobes, are fringed with long hairs. The female differs from other species of the United States, except *concinnum*, in having the ventral scopa fuscous; but the legs are black, with yellow markings. It differs in markings and other ways from *platyurum* and *profugum* from Lower California.

**Male.**—Black, with clear lemon-yellow markings. Large mark on basal half of mandibles, clypeus, lateral face-marks narrowed above, small supra-clypeal mark, stripe behind upper part of eyes and dot on posterior orbits at anterior end of eyes, large mark on each side of anterior margin of mesoscutum, broad continuous band apically on axillæ and scutellum, small spot on mesopleura and large mark on teguleæ and tuberæs, yellow. Apex of femora broadly, broad stripe on front and middle femora behind, broad stripe on outer side of tibiae, and stripe on basitarsi, yellow. Hind tibiae with an enclosed black or brownish spot. Tergites 1 to 6 each with a broad yellow band, that on 1 interrupted, the others with broad posterior emarginations on each side, and those on 3 to 6 notched medially in front. Tergite 7 yellow except basal margin; its subhyaline apical margin unusually narrow. Head and thorax shining. Punctures of frons moderately coarse and a little separated; those of vertex much finer and closer. Punctures of mesoscutum similar to those of frons, but closer and becoming dense on anterior middle. Punctures of mesopleura coarse and close. Abdomen a little dullish, punctured about as usual, except that punctures of seventh tergite are fine and sparse. Pubescence whitish, rather long and loose, with numerous long erect hairs on mesoscutum, besides shorter subapressed hair. Hair of vertex and mesoscutum pale brownish ochreous. Hair of venter sparser than usual, but there is a dense transverse apical tuft on segment 3. Length, 9 mm.; anterior wing, 7 mm.
FEMALE.—Clypeus, except anterior margin and a thin uneven line on dorsal margin, broad lateral marks narrowed above, minute dot on supracylpeal area, stripe behind whole length of eye but interrupted below middle, large anterior marks on mesoscutum, reaching lateral margins, broad apical band on axillae and scutellum, large marks on tubercles and tegulae, and irregular, medium-sized mark on mesopleura, lemon yellow. Markings of legs as in male, except on basitarsi, which are marked with a basal spot only on the hind pair. Tergites 1 to 5 each with a broad yellow band, slightly interrupted medially on 2 to 5 and broadly interrupted on each side on 1. Posterior emarginations on each side are of medium size and represented by enclosed black spots on 4 and 5. Tergite 6 with two large roundish and well-separated yellow marks. Mandibles with an acute apical and a very short blunt preapical tooth, the latter, together with concave cutting edge within, forming a bisinuate margin. Pubescence and puncturation as in the male, the punctures of apical tergite, however, about as in other species. Ventral scopa fuscous, becoming whitish on apical segment. Length, 8 mm.; anterior wing, 7 mm.

A paratype from Borego differs in having a rather broad median black stripe on clypeus, enclosing a yellow dot above, the yellow stripe behind eyes nearly obliterated on anterior half, the yellow stripe on front tibiae abbreviated apically, yellow of hind tibiae confined to basal half, spot on mesopleura very small, and ventral scopa more a fulvous-brown tinge. Another paratype from Tahquitz Canyon differs in having a supracylpeal spot, the emarginations of the yellow band on first tergite not quite breaking through, and those on following segments represented by enclosed black spots.


Dianthidium platyurum Cockerell

D. platyurum was described from San Franciscquito Bay, Lower California, but I find the species well represented in southern California. Here in the cismontane area it is represented by the race baculifrons, described by Cockerell as a race of parvum and redescribed by Schwarz as D. ulkei var. raparii (new synonymy). In my opinion platyurum, together with its race baculifrons, is quite distinct from either parvum or ulkei, but obviously close to the latter. It differs from ulkei in having the
head and thorax shining, with fine, slightly separated punctures. The male genitalia of the two species are nearly the same, but the sagittee in ulkei are more constricted subbasally, and the para-
meres of the stipites of platyurum have a longer, somewhat broader apical expansion, with an incurved or upturned acute point on the inner or dorsal margin at the apex. In Schwarz’s figure of the genitalia of riparius (Journal of the New York Entomological Society, Vol. XXXVI, plate 13, 1928) the para-
meres are not quite accurately depicted, as the acute apical angle is represented as being on the outer or inferior margin.

The races of platyurum may be distinguished in the female sex as follows:

1. Tergite 6 entirely black; hind tibiae with a basal spot; basitarsi entirely dark ................................................................. 2.

- Tergite 6 with two oval convergent yellow marks; tergites 1 to 5 each with a broad band interrupted medially on 2 to 5 and emarginate behind on each side on 1 and 2, the emarginations on 3 to 5 being repre-
- sented by enclosed black spots; yellow marks on sides of clypeus united by a yellow band across the top; hind tibiae with a small apical spot confluent with the basal mark by extension of the yellow along dorsal margin; hind basitarsi with a yellow spot ................. mohavense n. subsp.

2. Yellow band on tergites 1 to 5 rather broad, interrupted medially on 2 to 5; posterior emarginations of bands on each side, deep but rather narrow, sometimes breaking through on 1, and sometimes enlarged on 5 to isolate a small lateral yellow spot; yellow mark on each side of clypeus moderately large, often so shaped as to make the median black area broad above and narrowed below; mark on mesopleura rather small .................................................................................. baculifrons Ckll.

Maculations paler yellow; spot on each side of clypeus in the form of a small vertical stripe, or entirely absent; mark on mesopleura very small or absent; yellow band on tergites 1 to 4 narrower, more broadly inter-
rupted medially on 2 to 4, that on 1 divided into three spots, that on 2 into four, and the posterior emarginations on 3 and 4 very deep and almost breaking through; band on 5 represented by two roundish or subtriangular marks .................................................................................. platyurum Ckll.

Dianthidium platyurum platyurum Cockerell.

I have one of the two original males from San Francisquito Bay, Lower California.

A female from Morongo Valley, San Bernardino Co., Califor-
nia, on Gutierrezia lucida, Sept. 12, 1940 (Cockerell), agrees with the original description except in having a short pale-yellow ver-
tical line on each side of clypeus. The yellow dot on the mesopleuron no doubt will be found to disappear when a series is available. There are no spots on the vertex, and the yellow line behind the eye is short.

**Dianthidium platyurum baculifrons** Cockerell.

Specimens of *riparius* Schwarz, of which I have the type, have been compared with the type of *baculifrons* and found to be identical. *D. baculifrons* is a common species at Riverside. In the Academy collection it is represented by a male from Voltaire, Los Angeles Co., Sept. 5, 1923 (J. D. Gunder), and a female from Bishop, Inyo Co., June 21, 1929 (Van Dyke). I have also seen a female from San Diego Co., Oct. 4, 1913 (Van Duzee).

**Dianthidium platyurum mohavense** new subspecies

Similar to typical *platyurum* and *baculifrons* in structure, but with considerably more extensive markings.

**FEMALE.**—Black, the maculations a little more orange yellow than in *baculifrons*. Yellow marks of clypeus large and united across the summit by a narrow yellow band. A small supraocular spot present. Lateral marks of face and frontal spot as in *baculifrons*. Two small spots on vertex behind ocelli. Stripe behind eyes nearly as long as the eye. Marks on notum, including tubercles and tegulae, as in *baculifrons*. Mark on mesopleuron larger, but only moderately large in comparison with some other species. A small yellow spot on metapleuron. Apex of femora broadly and stripe on front and middle femora behind, yellow. Stripe on outer side of front and middle tibiae and spot at base of hind basitarsi, yellow. Hind tibiae with the yellow on basal half confluent with a small apical spot by an extension along dorsal margin. Tergites 1 to 5 each with a broad yellow band, narrowly interrupted medially on 2 to 5. Bands on 1 and 2 narrowly emarginate behind on each side, but the emarginations on following segments represented by small enclosed black spots. Tergite 6 with two large convergent oval marks. Length, 7 mm.; anterior wing, 6 mm.

One female (holotype), Mohave River, near mouth of Deep Creek, San Bernardino Co., California, on *Eriogonum fasciculatum*, Aug. 14, 1936 (Timberlake), in collection of the Citrus Experiment Station.

This may prove to be merely an extreme variation of *baculifrons*.

**Dianthidium concinnum** (Cresson)

This species, of which I have not seen the male, probably belongs to the *ulkei* group. I have examined 2 females from Boulder, Colorado, one collected on *Psoralea*, Aug. 10, 1906 (W.
P. Cockerell), the other on *Chrysopsis*, June 27, 1939 (Timberlake); 1 female, Prescott, Arizona, on *Lotus wrightii*, July 5, 1932 (Timberlake); and 1 female, Sheridan County, Kansas, Aug. 27, 1941 (Dean).

The specimens examined are all very similar in color and markings, and the Kansas specimen, together with three others of the same data, was compared by Schwarz with the Cresson types and found to be virtually identical. However, in the specimens examined by the writer, the ventral scopa is yellowish white, whereas Cresson described it as fuscous. It is possible that a more northern and western race is indicated by the pale scopa; but, on the other hand, nothing is known of the variation in the type region, Texas, and besides, it is a well-known fact that several North American Anthidiines that have the scopa normally dark, vary greatly in this respect, and that the variation is mostly not of racial significance.

**GROUP OF DIANTHIDIUM PARVUM (CRESSON)**

The males of the three species of the *parvum* group are separated as follows:

1. Hind coxal spur conical; front coxae unarmed; sagittae of genitalia taken together nearly parallel-sided, little depressed at apex, with apical corners less prominent .................................................. 2. Hind coxal spur short, bulbous at base and rather blunt at apex; front coxae with a low rounded longitudinal crest on under surface at apex; sagittae broader, strongly depressed, and concavely impressed at apex, with apical corners prominent and rounded ............ *subparvum* Swenk.

2. Median lobe of seventh tergite triangular, acute at apex; sagittal lobes with a common large oval foveate impression, invested with a fine appressed pubescence .................................................. *fraternum* n. sp. Median lobe of seventh tergite more parallel-sided, blunt at apex, the notch between it and lateral lobes consequently more pronounced and rounded; spurs of hind coxae larger; sagittal lobes nude on the more depressed disk, with a fringe of very short hair on each side of the apex .................................................. *parvum* (Cress.).

The recently described *D. heterulkei* Schwarz may also belong to the *parvum* group, but I have not been able to examine it.

**Dianthidium subparvum** Swenk

The identity of the species described by Swenk has remained a little uncertain. Schwarz, in his account of a small series of the
parvum group from British Columbia (the Canadian Entomologist, Vol. 60, p. 217, 1928), reports that some of the males had a short bulbous spine on the hind coxa, which in other examples was well developed. It is thus evident that both parvum and the species with the short bulbous spine exist side by side in that region and that both exhibit considerable undermaculation. It is therefore a question whether subparvum is the short-spined species or actually an undermaculated form of parvum. Referring to Swenk's description of the type female from Pullman, Washington, we find that he says: "Vertex and mesoscutum very closely punctured, finely so on the vertex." In regard to the male from British Columbia, he says: "Hind coxae with large stout yellow spines; head and thorax densely but not coarsely punctured." In parvum the punctures of the frons and vertex are a little separated, distinctly more so than on the mesoscutum, and also the conical coxal spine of parvum would hardly be called "stout." I believe that it is evident, therefore, that the species Swenk described is the one with the short bulbous coxal spine in the male sex, which in its various forms has been described by Schwarz as semiparvum, gallatine, and swenki.

Holding to this belief, I present the following table of the races, or nominal forms of subparvum (females):

1. Abdominal bands moderately wide, all emarginate behind on each side or with enclosed black spots on posterior segments; tergite 6 entirely black or with two yellow spots; mesopleura immaculate 2.

Bands on tergites 1 to 6 very broad, not interrupted, except slightly on middle segments, and without posterior emargination, except slight ones on tergites 1 and 6; mesopleura with a large yellow spot; outer side of tibiae entirely yellow; clypeus yellow, with a narrow median black stripe (southern California) swenki Schwarz.

2. Tergite 6 immaculate; band on tergite 1 in form of three spots 3.

Tergite 6 with two yellow spots; band on tergite 1 entire, or with emarginations partially breaking through; bands on tergites 2 to 5 more or less interrupted medially, with the posterior emarginations on each side rather small and sometimes replaced by enclosed black spots on 3 to 5; axillæ and scutellum usually maculated; median black area of clypeus broad; yellow stripe on tibiae nearly complete (Utah to northern California) semiparvum Schwarz.

3. Posterior emarginations of abdominal bands broad, those on tergite 1 completely breaking through; axillæ and scutellum immaculate, or with traces of yellow spots; yellow marks of mesoscutum often absent;
clypeus with a small yellow spot on each side; yellow stripes on tibiae more or less confined to basal half, at least on front and hind leg (Washington and British Columbia) \textit{subparvum} Swenk. Similar, but band on tergite 2, and sometimes that on 3, broken into four spots; mesoscutum maculated (Montana) \textit{gallatinae} Schwarz.

\textbf{Dianthidium subparvum subparvum} Swenk.

It is probably that \textit{gallatinae} will prove to fall within the limits of variation of \textit{subparvum}, when large series are available for study from the northwest.

Of \textit{subparvum}, I have examined a male from Summerland, British Columbia, Aug. 9, 1916 (Sladen), and a female from Wenatchee, Washington, June 8, 1919 (Melander), both in the American Museum collection.

\textbf{Dianthidium subparvum semiparvum} Schwarz.

This was described by Schwarz from Utah, but I would include all moderately undermaculated forms from northern California and Oregon.

In the Academy collection I find 1 male, quite typical, from Moscow, Idaho, July 25, 1925 (C. L. Fox); 1 female, Mt. Hood, Oregon, 3,000–6,000 feet, Aug. 6, 1925 (Fox); a male and female from Modoc Co., California, the female from Buck Creek, July 21, 1922, the male from Lake City, July 28 (Fox); 1 female, Mt. Lassen, 6,000–8,000 feet, Aug. 2, 1938 (Van Dyke); 1 female, Lassen National Park, Sept. 9, 1941 (Van Dyke); and 1 female, Gold Lake, Sierra Co., Aug. 4, 1921 (Fox).

In the Cazier collection of the American Museum is a series of eight specimens, mostly collected by the Bohart brothers at Carrville, Trinity Co., California, Hot Creek and Leavitt Landing, Mono Co., and at Donner Lake. These were all collected in May and June.

\textbf{Dianthidium subparvum swenki} Schwarz.

This was described as a variety of \textit{parvum}, but included two species, the majority of the specimens being actually a form of \textit{parvum}, whereas the holotype and three male paratypes are a form of \textit{subparvum}. Schwarz has given a good figure of the genitalia (see \textit{Journal New York Entomological Society}, Vol. XXXVI, plate 13, 1928), which will answer just as well for typi-
The southern race differs in the much fuller maculations. As two distinct species were confused in Schwarz's description, it is desirable to redescribe the race as follows:

**Male.**—Mandibles, clypeus, supracylpeal and lateral marks and stripe behind eye, pale yellow. Frontal spot sometimes present. Anterior marks on mesoscutum and marks on axillae and scutellum usually moderately large, although those on axillae sometimes very small. Apex of femora, stripe on front and middle femora behind, tibiae except beneath, and basitarsi on outer side, yellow. Broad band on tergites 1 to 6, and tergite 7, except basal margin, yellow. Bands all continuous, but at least those on tergites 3 to 5 more or less deeply notched in front medially, and all with a rather small emargination behind on each side. Puncturation of frons and mesoscutum somewhat coarser than in *parvum*, the scutum less shining. Pubescence yellowish, much more abundant than in *parvum*, the scutum with numerous erect hairs. Spur of hind coxa short and bulbous at base. Median lobe of seventh tergite approximately as in *parvum* and not so broad as in typical *subparvum*. Length, about 7.5–8.5 mm.; anterior wing, about 6.8 mm.

**Female.**—Mandibles black. Clypeus yellow, with a rather narrow median black stripe. A very small supracylpeal spot and sometimes two yellow dots between antennae. Frontal spot rather large. Stripe behind eye often extending whole length of eye, but no spots on vertex. Maculations on tegulae, tubercles, mesoscutum, axillae, scutellum, and mesopleura very large. Large spot at apex of femora, broad stripe behind on front and middle femora, tibiae except beneath, large spot on hind basitarsi, and small spot on front and middle pair, yellow. Tergites 1 to 6 each with a broad yellow band. Bands on tergites 2 to 4 narrowly interrupted medially, those on 5 and 6 notched medially in front, and all with a small emargination behind on each side. Mandibles nearly as in *ulkei*. Punctures of clypeus, frons, mesonotum, and mesopleura rather coarse and very close, on a shining surface. Punctures on these parts and on tergites nearly uniform in size. Pubescence ochraceous, moderately dense, with numerous short erect hairs on mesoscutum. Scopa pale fulvous. Length, about 8 mm.; anterior wing, 6.7 mm.
I have the male holotype of *swenki* from Riverside, and 3 male paratypes from Big Pines Camp, San Gabriel Mts. The true female of *swenki* was included under *davidsoni* by Schwarz and is indeed very similar to that species in many ways, but *davidsoni* has the frons dull, with finer, denser punctures.

In the Academy collection is 1 male from Herkey Creek, June 24, 1934 (I. McCracken), and 1 male from Idyllwild, June 25, 1928 (Van Dyke), in the San Jacinto Mts. In the material recorded by Cockerell in 1925, is a pair from Bear Valley, San Bernardino Mts., Aug. 1913 (F. C. Clark), the male determined as *parvum* and the female as *consimile*. This race has been collected also by Linsley at Hemet Reservoir, Idyllwild, and at Van deventer Flat, in June, 1939. The male has been taken by the writer in the San Jacinto Mts., and the female at Riverside, Big Pines Camp, Idyllwild, and Bear Valley, at flowers of *Gutierrezia, Pentachæta, Chænactis, Erigeron, Corethrogynæ and Aster*.

**Dianthidium fraternum** new species

This is another segregate of the *parvum* group, which is actually closer to *parvum* than to *subparvum*. The male characters have been given in a preceding table. The female is distinguished from *parvum* by having the mesoscutum dull, with the punctures comparatively dense and becoming very crowded on the anterior middle.

The two known races of *fraternum* may be distinguished by the following table, which may be used for either sex, although the color characters apply especially to the females:

1. Punctures of mesoscutum fine; pubescence short and appressed; usual marks of thorax well formed, except mark on mesopleuron, which is small or absent; tergite 6 with two roundish yellow spots.

   *fraternum* n. subsp.

Punctures of mesoscutum coarser; pubescence comparatively long and erect; yellow markings reduced, the supraclypeal area, frons, vertex, mesopleura, and tergite 6 immaculate

   *hirtulum* n. subsp.

**Dianthidium fraternum fraternum** new subspecies.

**MALE.**—Black, the base of tegulae ferruginous. Mandibles (except apex), clypeus, lateral face-marks narrowed above, small frontal spot, short stripe behind eyes, usual marks on tubercles, tegulae and anterior margin of mesoscutum, and continuous or slightly interrupted band on axillae and scutellum, pale yellow. Spot at apex of femora, stripe behind on front and middle
femora, outer side of tibiae and basitarsi, and markings of abdomen, pale yellow. Hind tibia sometimes with a black mark invading yellow from anterior side just beyond middle. Bands on tergites 1 to 5 moderately wide, with the posterior emargination on each side rather deep and moderately wide, those on 1 often breaking through. Bands on tergites 2 to 5 (sometimes 3 and 4 only) narrowly interrupted medially. Band on tergite 6 narrow, but widened in middle and emarginate behind, or sometimes reduced to small lateral spots. Tergite 7 pale yellow, except basal margin. Punctures of frons close and rather coarse, with shining intervals, those of the vertex becoming more separated in middle and a little finer at sides. Punctures of clypeus and mesopleura close, subequal to those of frons. Mesoscutum dull, rather finely and subrugosely punctate, the sculpture on anterior middle becoming denser and more obscure. Pubescence whitish, that of mesoscutum more ochreous, very short, and mostly appressed. Tergite 7 similar to that of parvum, but the median lobe or tooth triangular, acute at apex, with the emargination between its base and lateral lobes small. Genitalia as in parvum, but sagitta have a common, large, oval, foveate impression, lined with fine appressed hairs. Length, 7-9 mm.; anterior wing, 6.5-7.8 mm.

FEMALE.—Similar to male. Markings pale lemon yellow, including triangular mark on each side of clypeus, lateral face-marks narrowed above, small frontal spot, stripe behind eyes, usual marks on tegulae, tuberolee and anterior margin of mesoscutum, nearly continuous band on apical rim of axillae and scutellum, small spot on mesopleura (sometimes wanting), spot at apex of femora, stripe on front and middle femora behind, incomplete stripe on outer face of tibiae (that on hind pair reaching middle on dorsal margin), a band on tergites 1 to 5, and two roundish spots on tergite 6. Band on tergite 1 interrupted on each side, and those on 2 to 5 well interrupted medially. Posterior emarginations of bands on 2 to 5 moderately large, becoming progressively smaller on apical segments, those on 5 sometimes represented by enclosed black spots. Mandibles with two small apical teeth and concave cutting edge as in parvum. Sculpture and pubescence as in male. Ventral scopa pale brownish fulvous. Length, 7-8 mm.; anterior wing, 6.4-7 mm.

Holotype, male, and allotype, taken in copula, on Gaillardia pinnatifida, at Prescott, Arizona, July 7, 1932. Paratypes as follows: 6 males, 14 females, at Prescott, on Gaillardia, Cirsium, Erigeron, Asclepias tuberosa, Lotus wrightii and Aplopappus gracilis, June 26 to July 7, and Aug. 30; 1 female, 5 miles northwest of Prescott, on Senecio, July 4; and 1 female, near Jerome, Arizona, about 7,000 feet, on Monarda stricta, July 3 (Timberlake). Foregoing types in collection of the Citrus Experiment Station. One female (paratype) from Tex Canyon, Chiricahua Mts., Cochise Co., Arizona, 5,000-6,000 feet, Oct. 8, 1927 (J. A.
Kusche), in collection of California Academy of Sciences. One female (paratype), Dripping Springs, New Mexico, Aug. 10 (Townsend), in American Museum collection.

The two female paratypes from Southern Arizona and New Mexico are nearly typical, but a male from Carr Canyon, Huachuca Mts., Arizona, Aug. 10, 1940 (Michener), differs in having the markings creamy white.

**Dianthidium fraternum hirtulum** new subspecies.

This form looks like a separate species in regard to sculpture and pubescence, but as the other morphological characters, including structure of the male genitalia, are exactly as in *fraternum*, it is evidently only a race of that species.

**MALE.**—Black, with rather bright yellow markings. Mandibles (except apex), elytra, lateral marks narrowed above, small spot behind upper part of eyes, smallish spot on tegulae, tubercles and anterior margin of mesoscutum, and broadly interrupted slender line on apex of scutellum, yellow. Small spot at apex of middle and hind femora, stripe on outer side of tibiae, not quite reaching apex, that on hind pair curving forward near apex to set off a large black invasion from anterior side, and incomplete stripe on basitarsi, much longer on hind pair, yellow. Tergites 1 to 5 each with a rather narrow yellow band, that on 1 interrupted on each side, those on other segments slightly interrupted medially and broadly emarginate behind on each side. Tergite 6 with a yellow dot medially near apex. Tergite 7 yellow, with tip of median lobe and basal margin rather broadly black. Spur of hind coxa rather small and conical. Frons and vertex shining, with rather small, nearly contiguous punctures, becoming coarser on middle of frons. Mesoscutum a little shining, with coarse contiguous punctures about equal to those on middle of frons. Mesopleura coarsely and closely punctured. Pubescence unusually long and loose, the hair of mesoscutum entirely erect. Length, about 8 mm.; anterior wing, 7.2 mm.

One paratype (Truckee) has maculations a little fuller, those on thorax larger, with narrow stripe on scutellum continuous and a small spot on each axilla, band on tergite 2 continuous, and tergite 7 yellow except basal margin. Another paratype (Yosemite) has maculations behind eyes and on tegulae, tubercles and mesoscutum very small, axillae and scutellum immaculate, band on tergite 2 divided into four spots, tergite 6 immaculate, and tergite 7 black except on lateral lobes.

**FEMALE.**—Black, the base of tegulae piceous. Clypeus black, with a small yellow spot on each side. Lateral face-marks reduced to a slender line above antennæ. Stripe behind summit of eyes short. No marks on supraclypeal area, frons, and vertex. Marks on tegulae, tubercles, anterior margin of mesoscutum, and scutellum, small. Mark on axillae very small or absent; mesopleurum immaculate. Small spot at apex of middle and hind femora, basal stripe on front and middle tibiae reaching middle, and basal spot on
hind tibiae, yellow. Tergites 1 to 5 each with a yellow band, rather strongly interrupted medially on 2 to 5 and divided into three spots on 1. Posterior emargination of the bands on 2 to 5 broad, those on 5 abbreviating the band laterally. Tergite 6 immaculate. Frons less shining than in fraternum, the punctures closer, becoming slightly separated in middle; mesonotum less dull; the punctures coarser. Punctures of mesopleura coarse and close. Face, vertex, and mesonotum unusually hairy, the pubescence long, erect, pale fulvous brown. Ventral scopa nearly of the same color. Wings strongly infuscated. Length, 8 mm.; width of abdomen, 3 mm.; anterior wing 7 mm.

Holotype, male, Mineralking, Tulare Co., California, Aug. 4, 1923 (C. L. Fox), and two male paratypes, from Truckee, Nevada Co., June 21, 1927 (Van Duzee), and Yosemite Valley, July 12, 1921, (Van Dyke), in collection of California Academy of Sciences. Two male paratypes from Mineralking, Aug. 5, 1935 (Bohart), and Carson Pass, 8,000 feet, Sept. 1, 1934 (Bohart), in Cazier collection, American Museum. Two females (allotype and paratype) from Convict Lake, Mono Co., Aug. 6, 1938 (Bohart), in the Bohart collection.

**Dianthidium parvum** (Cresson)

The following table will distinguish the known forms of *parvum*. The variety *heteropoda* Schwarz is not included, but I believe it would run with typical *parvum*, from which it differs by the ferruginous legs.

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<tr>
<td>1. Females</td>
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<td>2. Markings pale yellow, or nearly creamy white; mesopleura and sixth tergite immaculate; stripes on front and middle femora little developed; hind tibiae yellow on basal half; bands on tergites 1 to 5 with rather large posterior emargination on each side</td>
<td>parvum (Cress.)</td>
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<tr>
<td>Markings bright yellow; mesopleura with a large spot; sixth tergite with two yellow marks; stripes on femora well developed and outer surface of tibiae nearly all yellow; posterior emarginations of abdominal bands small and sometimes absent except on basal segments.</td>
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<td>schwarsi n. subsp.</td>
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<td>3. Maculations full; femoral stripes well developed; tibiae almost entirely pale on outer surface; anterior marks of mesoscutum large</td>
<td>4.</td>
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<td>Femoral stripes less developed, often absent on middle femora; stripes on tibiae not covering full width of outer surface, the hind tibiae often with a black area beyond the middle on anterior side; anterior marks of mesoscutum small; abdominal bands with large posterior emarginations, those on tergite 1 dividing band into three spots.</td>
<td>parvum (Cress.).</td>
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Dianthidium parvum parvum (Cresson).

I have typical or nearly typical parvum from 6 miles north of Embudo, New Mexico, Aug. 15, 1931, on Cleome; and from Prescott, Arizona, on Asclepias, Lotus, Cirsium, Aplopappus, and Gaillardia, June 27 to Sept. 1 (Timberlake). In the Academy collection is one female from Logan, Utah, July 18, 1922 (Van Duzee). In the Bohart collection is another female from Convict Lake, Mono Co., California, Aug. 6, 1938. The type locality is Colorado.

Dianthidium parvum schwarzi new subspecies.


Female.—Black; the base of tegulae ferruginous, and dark parts of abdomen often a little stained with this color. Small marks on each side of clypeus, lateral face-marks attenuate above, large frontal spot and stripe behind eyes, usual marks on tegulae and tubercles, large mark on each side of anterior margin of mesoscutum, continuous band on apical rim of axillae and scutellum, and rather large mark on mesopleura, bright yellow. Apex of femora, broad band on front and middle pair behind, tibiae except beneath, and mark on basitarsi, large on hind pair, yellow. Tergites 1 to 6 each with a broad yellow band, those on 3 and 4 interrupted, those on 5 and 6 deeply notched in front medially, or all except that on tergite 1 slightly interrupted medially. Posterior emarginations of bands on each side small, generally limited to tergites 1 and 2, but sometimes present on 3, with small enclosed black spots on 4 and 5. Mark on tergite 6 generally bandlike, although abbreviated laterally and sometimes reduced to two well-separated roundish spots. Mandibles with distinct preapical notch and tooth, the cutting edge within concave. Frons shining, with slightly separated punctures. Mesoscutum less shining, with smaller and closer punctures than the frons. Pubescence of mesoscutum short and mostly appressed. Length, 6.5–8 mm.; anterior wing, 5.2–6.8 mm.

Male.—Like female, but clypeus and mandibles, except apex, yellow. A small supraclypeal mark present. Maculations of thorax often a little smaller, the mark on mesopleura small or absent. Legs as in female, but basitarsi entirely yellow on outer side, and the small joints of tarsi ferruginous.

4. Maculations creamy white, paler than in typical parvum; posterior emarginations of abdominal bands rather large, the band on tergite 1 sometimes divided into three spots; fourth antennal joint, dark part of legs and venter sometimes ferruginous red basingeri n. subsp. Maculations bright yellow; posterior emarginations of abdominal bands small, sometimes almost absent on middle segments or replaced by small enclosed black spots; band on tergite 1 entire schwarzi n. subsp.
Sometimes the hind tibiae have a small invasion of black from the anterior side beyond the middle. Bands on tergites 1 to 6 broad and continuous, although more or less narrowed or notched medially in front on middle segments. Posterior emargination on each side small, sometimes in form of enclosed spots on posterior segments. Tergite 7 entirely yellow, except extreme basal margin. Venter usually dark ferruginous, and the dark parts of tergites, especially apically, often stained with this color. Puncturation and pubescence as in female. Length, 6.5–8.5 mm.; anterior wing, 5.9–6.9 mm.

Type series in collection of the Citrus Experiment Station includes 88 specimens of both sexes from Riverside, California, May 29 to Oct. 26, taken mostly on Gutierrezia californica, but also on Stephanomeria, Heterotheca, Corethrogyne, and Lotus scoparius. The holotype is a female marked as the allotype of swenki, and the allotype is a paratype male of swenki, both taken May 29, 1925. (The type series also includes 13 other paratypes of swenki.) In addition, there is 1 female (paratype), Mohave River, near mouth of Deep Creek, taken on Eriogonum gracile, Aug. 14 (Timberlake); and 1 male (paratype), Jacumba, San Diego Co., on Eriogonum, Aug. 12, 1917, the latter specimen in collection of Dr. Bequaert.

Dianthidium parvum basingeri new subspecies.

A race of parvum from southern Arizona and the Colorado desert, similar to schwarzi, but with cream-colored maculations. (Specimens from northern Arizona are almost typical parvum, with the markings nearly as pale as in basingeri but considerably more reduced.) Sometimes the dark parts of the legs in this race are ferruginous; in this respect they are similar to heteropoda Schwarz, which apparently is no more than an individual variant of D. parvum parvum (Cresson). I suspect that the ferruginous color is much more frequent in basingeri than in heteropoda, however, as it is present in one of two specimens examined from the type locality.

Male.—Black; the central boss of tegulae ferruginous. Maculations creamy white and nearly as full as in D. parvum schwarzi. Mandibles except apical margin, clypeus, lateral face-marks narrowed above, supraclypeal and frontal spots, broad stripe behind upper end of eyes, large marks on tegulae, tubercles and anterior margin of mesoscutum, and broad band at apex of scutellum and axillae, white. Apex of femora broadly, stripe on front
and middle femora behind, tibiae except beneath, and outer side of basitarsi, white. Tergites 1 to 6 each with a rather broad white band, narrowed medially in front on 2 and 3 and notched medially on 4 and 5. Posterior emarginations on each side in the form of transverse oval black marks, becoming enclosed on tergites 5 and 6. Tergite 7, white. Puncturation and white pubescence normal for parvum. Length, 8.5 mm.; anterior wing, 7 mm.

A paratype has band on tergite 1 interrupted on each side and posterior emarginations of bands on apical segments not becoming enclosed. Dark part of legs and venter ferruginous, this color much apparent on the basal concavity of the first tergite and on the interruptions and emarginations of bands of first two segments. Joint 2 of flagellum also strongly reddened.

Two males (holotype and paratype) collected on the Silverbell road, 12 miles west of Rillito, Arizona, May 2–5, 1935 (A. J. Basinger), in collection of the Citrus Experiment Station. One male (paratype), Shaver’s Well, Riverside Co., California, Apr. 8, 1934 (Bohart), in the Cazier collection, American Museum.

GROUP OF DIANTHIDIUM PUDICUM (CRESSON)

The males of this group have the median lobe of the last tergite comparatively long and curved downward, so that the apex lies a little below the level of the lateral lobes. Between the median lobe and the broad lateral lobes is a distinct rounded emargination on each side. This tergite seems to be practically identical in the three known species, but the genitalia show small but constant differences. The three species may be separated as follows:

1. Frons more or less dull, the punctures dense; punctures on anterior middle of mesoscutum becoming appreciably finer and denser; in female the cutting edge of mandible with a distinct notch preapically; sixth ventrite of male not notched at apex .................................................. 2

Frons shining between the slightly separated punctures; punctures of mesoscutum hardly finer and denser on anterior middle; mandible of female with only a slight preapical notch, the cutting edge otherwise nearly straight; sixth ventrite of male with a slight notch at apex.

Pudicum (Cress.)

2. Cutting edge of mandible (female) distinctly concave between preapical notch and inner angle and fortified by a reciprocally curved carina on inner surface; sagittal lobes of male genitalia tapering gradually on outer margin to the sharp apex ................................................. consimile (Ashm.)

Cutting edge of mandible straight between preapical notch and inner angle, without a supporting carina on inner surface; sagittal lobes broader and bluntly rounded at apex .............................................. plenum n. sp.
Dianthidium pudicum (Cresson)

The four races of *pudicum* may be distinguished as follows:

1. Clypeus with at least a small yellowish or whitish spot on each side; lateral face-marks not evanescent above antennae; pubescence of both sexes short and more or less appressed ................................. 2
   Clypeus entirely black; extension of lateral face-marks above antennae very thin or lacking; abdominal bands divided into three spots on tergite 1 and more or less completely divided into four spots on tergites 2 to 4; head and mesoscutum unusually hairy, especially in male, the hair of mesoscutum being comparatively long and erect.

2. Frons and mesopleura maculated; bands on tergites 1 to 4 showing little tendency to become interrupted on each side; markings on legs less restricted .............................................................................. 3
   Frons and mesopleura immaculate; bands on tergites 1 to 4 more or less interrupted on each side, especially on 1 and 2; markings on legs restricted to a small spot at apex of femora and a spot at base of tibiae (more extensive in male); marks on mesoscutum, axillary, and scutellum small, the axillae frequently immaculate .................. *decorum* n. subsp.

3. Maculations creamy white; stripe on front and middle tibiae reaching beyond middle, that on hind pair confined to basal third .......... *inyoense* n. subsp.
   Maculations bright yellow; stripes on tibiae sometimes complete, at least on middle pair ........................................................................ *provancheri* Titus

Dianthidium pudicum pudicum (Cresson).

It is my conclusion that the female described by Cresson as *pudens* belongs with typical *pudicum* which was described from the male. Both were collected by Morrison in Nevada and were probably taken at one and the same place. The female is notable for its depleted maculations, and the male for its unusually hairy condition. A male from Onion Valley, Mono Co., California, and another from Giant Forest, Tulare Co., have the markings yellower than usual and in this respect verge toward the race *provancheri*.

In the Academy collection I have examined 3 males from Yosemite Valley, July 7, 1921 (Van Dyke); Giant Forest, July 14, 1923 (C. L. Fox); and Fallen Leaf Lake, California, July 17, 1917 (Van Duzee). I have also examined 3 females from Strawberry Valley, Eldorado Co., Aug. 14, 1912 (Van Dyke); Huntington Lake, 7,000 feet, Fresno Co., California, July 4, 1919 (Van Duzee); and from Longmire, Ranier National Park, Washington,
July 27, 1920 (Van Dyke). In the American Museum collection is one pair from Mammoth Lake, Mono Co., California, the female taken July 14, 1933, and the male, Aug. 6, 1936 (R. M. and G. E. Bohart). The Onion Valley specimen mentioned above was taken June 17, 1937, and was submitted to me by Linsley and Michener. In my own collection is a female from Lake Tahoe, California, July, 1925 (F. X. Williams).

**Dianthidium pudicum decorum** new subspecies.

This apparently is the form of *pudicum* recorded by Cockerell, Swenk, and Schwarz from Colorado, Montana, Wyoming, Utah, and the Northwest, and from the province of Alberta. It differs from typical *pudicum* in being considerably less hairy and in having somewhat fuller maculations.

**Female.**—Black, with creamy-white markings. Clypeus black, with a small white spot on each side, more or less separated from lateral face-marks by a black line. Lateral face-marks slender above level of antennae. A short white line behind summit of eyes. Marks on anterior margin of mesoscutum and on axillae and scutellum small, the axillae frequently immaculate. No marks on middle of frons or mesopleura, but tubereles and tegulae well maculated. Small spot at apex of middle and hind femora, and basal spot on tibiae, white. Tergites 1 to 5 banded, the bands on 2 to 5 strongly interrupted medially and deeply emarginate (or sometimes interrupted) on each side behind. Band on tergite 1 divided into three spots. Tergite 6 immaculate. Head and mesoscutum less hairy than in *pudicum*, the hair of mesoscutum mostly very short and subappressed. Ventral scopa yellowish white. Length, 6.75–8 mm.; anterior wing, 6–6.5 mm.

**Male.**—Mandibles, clypeus, lateral face-marks narrowed to a line above antennae, and small supraclavicle mark, creamy white. Mark behind summit of eyes and maculations of thorax as in female. Small spot at apex of femora, short narrow line on lower posterior margin of front femora (often feeble or absent), stripe on outer side of four anterior tibiae, basal and apical spot on hind tibiae, and outer side of basitarsi, white. Bands on tergites 1 to 5, and tergite 7 except basal margin, white. Band on tergite 1 interrupted on each side; bands on 2 to 5 usually interrupted medially and deeply and more or less broadly emarginate behind on each side, emarginations sometimes breaking through on 2 and more rarely on 3. Tergite 6 usually immaculate (in one specimen with four spots in a transverse row). Hair of mesoscutum mainly appressed, with a few short erect hairs interspersed. Length, 7–8 mm.; anterior wing, 6.1–7 mm.

Six females, 7 males (holotype, female, allotype, and paratypes), Lewiston, Idaho, July 14–21, 1925 (C. L. Fox); 2 males, 1 female (paratypes), Madras, Oregon, July 29, 1937 (Van
Dyke); and 1 male (paratype), Salt Lake City, Utah, June 27, 1922 (Van Duzee), in collection of California Academy of Sciences; 1 male (paratype), Boulder, Colorado, on Chrysopsis, June 26, 1939 (Timberlake).

Dianthidium pudicium inyoense new subspecies.

Much like provancheri, but the maculations creamy white as in typical pudicium.

**Female.**—Black, with creamy-white markings. Face-marks include usual lateral marks, a rather large spot on each side of clypeus, and a minute linear frontal spot, besides usual line behind each eye. Maculations of mesoscutum, axillae, and scutellum, large, but spot on mesopleura small. Apex of all femora, short stripe behind on front and middle femora, stripe on front and middle tibiae, reaching a little beyond middle, and basal third of hind tibiae, creamy white. Tergites 1 to 5 each with a rather broad band, continuous on 1, well interrupted medially on 2 to 5, and all with a rather small oval emargination behind on each side, but emarginations on 4 and 5 almost enclosed. Tergite 6 entirely black. Sculpture and pubescence as in provancheri. Length, 7.5 mm.; anterior wing, 6 mm.

**Male.**—Usual face-marks present, including a rather large supra-clypeal spot and a well-developed stripe behind summit of eyes. Markings of thorax as in female, except that spot on mesopleura is rather large. Apex of femora, short stripe on middle femora behind, stripe on front femora behind, nearly reaching base, tibiae on outer side, and basitarsi, yellowish white. Hind tibiae with a small enclosed brownish spot beyond the middle. Tergites 1 to 5 each with a broad creamy-white band, with posterior emarginations on each side rather small. Band on tergite 1 continuous, those on 2 to 4 narrowly interrupted medially, and that on 5 deeply notched in front. Tergite 6 with a narrow curved white band on each side and a dot subapically in middle. Tergite 7 pale as usual, except basal margin. Pubescence white, the hair of mesoscutum short and appressed, but with rather numerous short erect hairs interspersed. Length, about 7 mm.; anterior wing 6 mm.

Holotype, female, Independence, Inyo Co., California, June 14, 1937 (Van Dyke); and allotype, Lone Pine, Inyo Co., June 6, 1937 (Van Dyke), in collection of California Academy of Sciences.

One male (paratype), Owens Valley, Inyo Co., Aug. 2, 1936 (R. M. and G. E. Bohart), verges more toward decorum. It has the band on first tergite divided into three spots, the spot on mesopleura lacking, and dark spot on hind tibiae larger and placed near the middle, where it is confluent with dark area on inner surface.
Dianthidium pudicum provancheri Titus.

This is the common form of *pudicum* in southern California, with its range extending northward at least as far as Antioch. It differs from the other forms of *pudicum* in having the maculations bright yellow.

In the female the clypeus is broadly black in the middle. A small frontal spot and another on mesopleuron are usually present, and the markings on mesoscutum, axillae, and scutellum are large. The band on the first tergite is merely emarginate behind on each side, like those on following segments, and the yellow stripes on front and middle tibiae usually reach the apex. Sometimes the clypeus is almost all yellow, and the tibiae on outer side, even including the posterior pair, are occasionally almost entirely yellow.

In my collection, *provancheri* is represented from Riverside; from Mill Creek, 4,500 feet, San Bernardino Mts.; ridge north of Pleasant Valley, Mohave Desert, reared from nest (H. S. Fawcett); Camp Baldy, San Gabriel Mts.; from 1½ miles west of Perris, reared from nest; and from 12 miles north of Ensenada, Lower California. The collection includes both sexes reared from a nest and also a pair taken in copula. In the Academy collection is 1 male from Alpine, San Diego Co., Apr. 10, 1915 (M. C. Van Duzee). In the Cazier collection of the American Museum is a small series from Antioch, taken May 18 to Sept. 15. Linsley and Michener have submitted a set of both sexes from Antioch, reared from a nest (H. Lange); and in the Bohart collection are 2 males from Indian Flat and Briceburg, Mariposa Co., and 1 female from El Portal.

Specimens of *pudicum* taken at or near Prescott, Arizona, possibly should be referred to *provancheri*, although they have the maculations a little less full and considerably paler yellow.

**Dianthidium consimile** (Ashmead)

This species is distinguished from *pudicum* by the denser punctuation of frons and mesonotum, by the sparser punctuation of mesopleura, and also by the more notched cutting edge of mandible of female and by the genitalia of the male. From *plenum* it is distinguished mainly by the concave cutting edge of mandible
Dianthidium consimile (Ashmead).

The female of typical consimile has the clypeus entirely yellow, a long stripe behind eyes, the frontal spot and marks on mesoscutum, axillae, scutellum, and mesopleura large, and the abdominal bands broad, although moderately emarginate behind on each side, or with enclosed black spots.

In the Academy collection this race is represented from Idyllwild, San Jacinto Mts.; Mill Creek, San Bernardino Mts.; and from Soboba Hot Springs, Riverside Co., California. The localities represented in my collection are Mt. Lowe; Camp Baldy and Lone Pine Canyon, San Gabriel Mts.; Snow Creek, 5,000 feet, Mountain Home Creek, and Mill Creek, San Bernardino Mts.; and San Felipe Creek, San Diego Co. In the Cazier collection of the American Museum are specimens from Keen Camp, San Jacinto Mts.; Sunset Valley, Santa Barbara Co.; Palmdale, Mohave Desert; and Leavitt Meadows, Mono Co. In the Linsley-Michener collection I found specimens from Palmdale; from Westwood Hills, Los Angeles County; and from Vandeventer Flat and San Jacinto River, 2,500 feet, San Jacinto Mts.

Two females of consimile from Mt. Diablo, collected probably by E. Brannigan, are nearly like the typical subspecies, but the clypeus has a broad median black stripe, the pubescence is a little denser, with numerous short erect hairs on the mesoscutum, and the punctures of mesopleura are closer, quite equalling the condition in some forms of pudicum. Possibly these specimens represent another race, but more material is desirable.

Dianthidium consimile dubium Schwarz.

This race is easily distinguished from the preceding by the ferruginous boss of the tegulae and the brownish to testaceous
color of the apex of the tergites. The maculations are paler yellow than in typical *consimile* but are otherwise similar, except that the clypeus has a median black stripe and the posterior emarginations of the abdominal bands are larger and deeper, yet often enclosed by the yellow on fourth and fifth tergites. The band on first tergite is often broken into three spots; that on the second, into four.

In the Academy collection there is a large series from Twain Harte, 4,000 feet, Tuolumne Co., on *Grindelia*, July (Blaisdell); Murphy, 2,500 feet, Calaveras Co., on composite, Sept. 8–19 (Blaisdell); Potwisha, Sequoia National Park, June 20 (Van Dyke); and Three Rivers, Tulare Co., July 29 (C. L. Fox). Specimens from Cascada, Fresno Co., from Mokelumne Hill, Calaveras Co., California, and from Ashland, Oregon, that were recorded by Cockerell as *consimile*, also belong here, although a female from Cascada was determined by him as *provancheri*. At the Citrus Experiment Station are specimens from Hospital Rock, Sequoia National Park, Sept. 4 (Michener), and from Camp Nelson, Tulare Co., on *Lotus americanus*, June 25 (Timberlake), besides type material previously recorded by Schwarz. In the Bohart collection are specimens from Briceburg, El Portal, Yosemite Valley, and Mariposa, California. In the Cazier collection of the American Museum are specimens from Sequoia National Park, 3,500 feet, and Yosemite Valley, 4,000 feet.

*Dianthidium consimile mccrackenae* new subspecies.

The female of this race differs from other forms of *consimile* in having the sixth tergite immaculate. It looks much like *pudicum*, but the dense punctures of the frons and mesoscutum, sparse punctures of the mesopleura, and the structure of the mandibles indicate its place as a form of *consimile*.

**Female.**—Black, with pale-yellow maculations as follows: small spot on each side of clypeus, lateral marks expanded below antennae and slender above, short line on middle of frons, stripe behind upper part of eyes, usual mark on tubercles and tegulae, smallish mark each side on anterior margin of mesoscutum, mark on axillae and interrupted apical band on scutellum, small mark on mesopleuron, small spot at apex of middle and hind femora, long stripe on posterior side of front femora below, narrow stripe on front and middle tibiae expanded apically on middle pair, small spot at base of hind
tibiae, and band of medium width on tergites 1 to 5. Abdominal bands with deep, rather broad emargination on each side behind, those on tergites 1 and 2 more or less completely breaking through. Bands on 2 to 5 rather broadly interrupted medially; hence tergite 1 with three spots, and tergite 2 with four. Tergite 6 entirely black. Punctures of mesopleura unusually well separated. Pubescence white, very short, and appressed on mesonotum. Ventral scopa yellowish white. Length, 8 mm.; anterior wing, 6 mm.

**Male.**—Maculations of head and thorax similar to female, excepting the usual sexual difference. Mandibles, except apex and clypeus, entirely white. A minute supraclypeal spot present and a trace of a frontal spot. Marks on anterior margin of mesoscutum and on mesopleura smaller than in female. Mark at apex of femora larger and a short stripe present on under side of middle femora. Outer side of the tibiae almost entirely yellowish white but enclosing oval dark spot near middle of hind pair. Outer side of basitarsi also yellowish white. Bands on tergites 2 to 5 pale yellow, with a deep, broadish posterior emargination on each side, completely breaking through on tergites 1 and 2; hence, tergites 1 and 2, each with three spots, the median one on 2 almost twice as broad as that on 1. Bands on tergites 3 to 5 narrowly interrupted medially. Tergite 6 with a slender transverse mark far to each side. Tergite 7 yellowish white, except basal margin and extreme apex of median lobe. Pubescence white, rather long and dense, with numerous erect hairs on mesoscutum.

Holotype, female, and allotype, Glacier Lodge, Big Pine Creek, 800–1,100 feet, Inyo Co., California, Aug., 1929 (Isabel McCracken), in collection of California Academy of Sciences. There are also 2 male paratypes, one from Convict Lake, Mono Co., Aug. 6, 1938 (R. M. Bohart), and one from type locality, June 20, 1937 (W. C. Reeves), in Linsley and Michener collection.

**Dianthidium plenum** new species

This species is closely allied to *consimile* and is distinguished in the female by the straight cutting edge of the mandible, and in the male by the rounded contour at apex of sagittal lobes of genitalia.

In the following table of the races of *plenum* (females), the characters assigned to *williamsi* apparently are not typical. Probably the true *williamsi* female, when discovered, will have the markings nearly as in *convictorum*, but yellow instead of yellowish white.

1. Tergites 1 to 6 each with a broad yellow band, those on 3 to 5 or 6 narrowly interrupted medially; sides of propodeum and metapleura with a small yellow mark

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2
Tergites 1 to 5 each with a yellow or whitish band, more strongly interrupted medially; tergite 6 with two dots or small roundish spots; propodeum and metapleura often immaculate ........................................ 3

2. Abdominal bands very broad, with a shallow emargination behind on each side on tergites 1 and 2; small supraelypeal mark and outer side of tibiae and basitarsi yellow .................................................. *plenum* n. subsp.

Bands on tergites 1 to 6 with an emargination behind on each side, or with enclosed black spot on 4 and 5; no supraelypeal spot; markings on metapleura and propodeum evanescent .......................... *williamsi* n. subsp.

3. Markings yellowish white; posterior emarginations of abdominal bands deep, the band on tergite 1 broken into three spots and that on 2 into four spots; tergite 6 with two dots; median black area of elypeus very broad; punctures of mesopleura rather sparse ...... *convictorium* n. subsp.

Markings bright yellow; abdominal bands emarginate behind or with enclosed black spots on tergites 4 and 5; median black area of elypeus varying from absent to more or less broad; mesopleura with coarse close punctures .......................................................... *australe* n. subsp.

**Dianthidium plenum** *plenum* new subspecies.

**Male.**—Color and markings much as in *consimile*. Maculations yellow except that the face-marks are more or less creamy white. Supraelypeal and frontal spots generally small and sometimes absent. Axillae and scutellum maculated. Spots on anterior margin of mesoscutum and mark on mesopleura generally large. Apex of hind coxae and spurs, apex of femora and broad stripe beneath on front and middle pair, all tibiae except dark stripe beneath not reaching apex, and basitarsi, yellow. Small joints of tarsi mainly ferruginous. Tergites 1 to 6 each with broad yellow band, broadly emarginate behind on each side, the emarginations tending to become gradually smaller on the apical segments. Band on tergite 1 often divided into three spots; bands on 3 to 6 more or less deeply notched in front medially, or even narrowly interrupted. Tergite 6 sometimes almost all yellow except basal margin and median notch, but the posterior emarginations generally more or less developed. Tergite 7 yellow, except basal margin. Ventral fringes on segments 4 and 5 less elongate than in *puaticum*; ventrite 6 also less hairy and not notched at apex. Sagittal lobes of genitalia each rounded at apex. Length, 7.5–9 mm.; anterior wing, 6.8–7.8 mm.

**Female.**—Maculations nearly as in *consimile*. Clypeus yellow with a median black stripe, sometimes rather narrow and continuous, or widened above and abbreviated anteriorly, or reduced to a narrow line on dorsal half (in *consimile*, clypeus generally all yellow). Postorbital stripe shorter than in *consimile*, and the two transverse marks on vertex small or absent. Supraelypeal spot small or absent, but frontal spot generally well developed. Marks on mesopleura and mesoscutum averaging a little smaller than in *consimile*. Maculations of legs and abdomen as in *consimile*, except that the posterior emarginations or enclosed dark spots of abdominal bands are sometimes
very small or even absent on tergites 4 to 6. Structure, sculpture, and pubescence similar to con simile, except cutting edge of mandible, which is straight instead of concave between preapical notch and inner angle. Length, 8–9 mm.; anterior wing, 6.6–7 mm.

Holotype, male, and allotype, Yosemite Valley, above Vernal Falls, on Monardella lanceolata, June 27, 1926 (Timberlake), in collection of the Citrus Experiment Station. The following paratypes are in the collection of the California Academy of Sciences; 3 males, 1 female, Twin Rocks, Mendocino Co., July 10 (Van Dyke); 1 male, Giant Forest, Tulare Co., July 22 (C. L. Fox); 1 female, Mt. St. Helena, May 12 (M. C. Van Duzee); and 1 male, Middletown, Lake Co., California, July 22 (Van Duzee).

Dianthidium plenum williamsi new subspecies.

Male.—Like typical plenum, but supraelypeal and frontal spots lacking. Anterior spots of mesoscutum very small, and mark on mesopleura small or lacking. Maculations of axillae and scutellum reduced to an interrupted thin line, sometimes absent on scutellum. Abdominal bands narrower, with much broader posterior emarginations. Band on tergite 1 divided into three spots; bands on 3 to 5 (or even 2 to 6) interrupted medially. In one paratype (Buck Creek, Modoc Co.), band on tergite 2 in broadly interrupted on each side, and the slender median mark is also narrowly interrupted medially. Tergite 7 yellow, except basal margin. Length, 7.5–9.5 mm.; anterior wing, 7–7.9 mm.

Holotype, male, Truckee, California, July, 1925 (F. X. Williams), in collection of the Citrus Experiment Station. The following paratypes are in the collection of the California Academy of Sciences: 2 males, type locality, July 5 (Mr. and Mrs. E. P. Van Duzee); 1 male, Buck Creek, Modoc Co., July 25 (C. L. Fox); 1 male, South Fork, Kings River, California, July 8 (Van Dyke); and 1 male, Eagle Ridge, Klamath Lake, Oregon, June 24 (C. L. Fox).

The Kings River male has the maculations paler yellow than in the type, and it thus verges toward the race convictorum.

One female from Buck Creek, taken with male recorded above, and another from Meadow Valley, Plumas Co., California, 4,000–5,000 feet, June 30 (Van Dyke), are placed with williamsi but are not made types, as they seem to be too transitional toward typical plenum, differing only in somewhat smaller markings, as recorded in the preceding table.
**Dianthidium plenum convictorum** new subspecies.

This is a desert race with unusually pale markings.

**Female.**—Black, with yellowish-white markings. A rounded mark on each side of clypeus, lateral marks, small frontal spot, and short line behind eyes, white. Usual marks on mesoscutum, axilla, scutellum, tegulae, tubercules, and mesopleura, well developed. Apex of femora broadly and broad stripe behind on front and middle pair, stripe reaching apex on front and middle tibiae, outer surface of hind tibiae with enclosed black mark at middle, and spot on basitarsi, yellowish white. Tergites 1 to 5 each with a yellowish-white band, well interrupted medially except on 1. Posterior emarginations of bands rounded, moderately large, but breaking through on tergites 1 and 2 to form three and four spots, respectively. Tergite 6 black, with two whitish dots. Length, about 7.5 mm.; anterior wing, 6.3 mm.


**Dianthidium plenum australe** new subspecies.

This race is referred to *plenum* with a little doubt, as the male has not been seen. The female is considerably smaller than in other forms of *plenum*, and the frons and mesoscutum are less dull, although densely punctured.

**Female.**—Black, with bright-yellow markings. Clypeus entirely yellow except anterior margin, or with a median black stripe, usually narrowed below. Supraclypeal area black, or rarely with a small spot. Lateral face-marks gradually narrowed above antennae. Frontal spot linear to oval. Stripe behind eyes about one-half to three fourths as long as the eye. Vertex immaculate, or with two transverse spots. Maculations of mesoscutum, axilla, scutellum, tegulae, tubercules, and mesopleura, large. A small yellow spot sometimes present on upper end of metapleuron and a smaller one on basal corner of propodeum behind base of wings. Apex of femora rather broadly, broad stripe on front and middle femora behind, outer side of tibiae, and basitarsi, yellow. Tergites 1 to 5 each with moderately wide yellow band, more or less strongly interrupted medially on 2 to 5 and with small but distinct emarginations behind on each side. Posterior emarginations on tergites 4 and 5 sometimes replaced by enclosed black spots. Tergite 6 with two roundish yellow marks varying from medium-sized to rather large. Frons and mesoscutum with rather dense, moderately fine punctures, the surface less dull than in typical *plenum*. Punctures of mesopleura coarse and close. Pubescence of mesoscutum very short and subappressed. Ventral scopal yellowish white. Length, 6.5–7 mm.; anterior wing, 5.6–5.9 mm.

Holotype, female, Andreas Canyon, near Palm Springs, California, on *Eriodictyon crassifolium*, May 15, 1932 (Timberlake). Paratypes as follows: 1 female, type locality, on *Krameria canes-*
cens, Apr. 24; 1 female, Riverdale, on Trichostema lanceolatum, Aug. 11; 1 female, Puente Hills, near Whittier, on Phacelia distans, May 11; and 2 females, Camp Baldy, San Gabriel Mts., on Stephanomeria cichoriacea, Aug. 21 (all Timberlake), in collection of the Citrus Experiment Station. One female, Palm Springs, Apr. 16 (R. M. Bohart); 1 female, Palm Canyon, Riverside Co., on Lotus, Apr. 15 (Bohart); and 1 female, Mt. Diablo, in collections of Messrs. Bohart, Linsley and Michener. One female, Mt. Diablo, June 14, and another, Antioch, Sept. 15 (G. E. and R. M. Bohart), in collection of American Museum of Natural History.

**Dianthidium macswaini** new species

As far as can be determined in absence of the male, this species is a member of the *pubicum* group, nearest *plenum*. It is distinguished by having the cutting edge of mandible perfectly straight except for the projecting apical tooth. The mandible lacks the preapical notch seen in *consimile* and *plenum* and to a lesser degree in *pubicum*.

**Female.**—Black, with bright-yellow markings. Clypens with a large yellow mark on each side, leaving anterior margin and rather broad median stripe somewhat widened above, black. Lateral face-marks almost reaching summit of eyes and acute above. Postorbital stripe reaching middle of eyes. Two transverse spots on vertex sometimes present but absent in holotype. Frontal spot narrow. No yellow on supraclypeal area or on mandibles. Markings on mesoscutum, axillae, scutellum, tegulae, tubercles, and mesopleura, large. Apex of femora rather broadly, stripe on front and middle femora, on lower posterior margin, broad stripe on tibiae, and spot on base of basitarsi, yellow. Stripe on hind tibiae sometimes narrowed at the middle. Tergites 1 to 5 each with a broad yellow band, narrowly interrupted medially on 3 to 5 and emarginate behind on each side on 1 to 3. Posterior emarginations on 4 and 5 represented by more or less enclosed black spots. Tergite 6 black, with two large yellow marks. Frons moderately dull, densely punctured, the punctures finer than those of clypeus. Punctures of vertex somewhat sparser and fading out toward posterior rim. Mesoscutum dull, finely and very densely punctured, with the punctures finer than those of frons and not becoming finer and denser on anterior middle. Punctures of mesopleura coarse and rather close. Pubescence of head and thorax pale fulvous, rather long and erect on frons and vertex, but mostly short and subappressed on mesoscutum. Ventral scopa pale fulvous. Wings strongly infuscated. Length, about 7 mm.; anterior wing, 6.2 mm.

Two females (holotype and paratype) reared from a nest, Mt. Diablo, Contra Costa Co., California, May 9, 1939 (J. W. MacSwain), in collection of E. Gorton Linsley.
NEW RECORDS (LEPIDOPTERA)

The following recent records may be of interest:

55. *Zerene caesonia* (Stoll).
This species is seldom recorded from the New York area. One ♀ was captured by L. D'alonzo, near Calumet Iron Works at Wilson and Hyatt Avenues, Newark, N. J., 14 July, 1938.

327. *Asterocampa celtis* (Boisduval and LeConte).
This species, reported not infrequently in the last few years in the New York area, is a recent comer. Mr. F. E. Watson says that his first local record of its occurrence was New Brunswick, N. J., ♀, 19 August, 1930, collected by Mr. R. N. Barnett.

372. *Strymon m-album* (Boisduval and LeConte).
A specimen was captured by Mr. John L. Bull, Jr., at East Hampton, Long Island, N. Y., ♂, fresh, 24 September, 1939. Mr. J. B. Ziegler captured the species on Watchung Mountains, above Scotch Plains, N. J., 2 ♂, fresh, 4 May, 1941. W. P. Comstock.
NEW NEOTROPICAL TABANIDÆ (DIPTERA)

BY CORNELIUS B. PHILIP

HAMilton, MONTANA

The following new species of Neotropical Tabanidae are described through courtesy of Drs. C. H. Curran and J. C. Bequaert in whose respective institutions, American Museum of Natural History (AMNH) and Museum of Comparative Zoology (MCZ) of Harvard University, the types are deposited.

Proboscoides new genus

Resembles Esenbeckia Rondani in general characters including the closure of cell R_5 of the wing, and sicle-shaped palpi, but differs in the remarkable and complete chitinization of the proboscis including the labellae, which are produced and somewhat tapered in the same axis as the shank. While the proboscis appears unusually heavy as in the African Subpangonia Surcouf it lacks the peculiar pectinate labellae described in both sexes by Bequaert (1930) and others. Genotype, P. fairchildi n. sp. from Peru.

Proboscoides fairchildi new species

In appearance, superficially resembles Esenbeckia species of the ferruginea group but is at once distinguished by the stocky, chitinous proboscis.

Holotype ♂, length of body excluding appendages of head, 12.5 mm. Eyes bare. Front about 4½ times taller than basal width, slightly divergent above and below, yellowish pollinose with a narrow, darker, denuded ridge in the upper half, almost reaching the anterior ocellus. Face not produced, brownish pollinose and sparsely pilose. Antennae orange to tips, flagellum 8-segmented, of the usual pangoniine shape, the apical segment attenuated and almost three times the length of the preceding. Two basal antennal segments normal with sparse dark brown hairs. Palpi brown, slender, crescentric, subequal in length to antennae, but a little shorter than shaft of proboscis; invested on the basal segment with yellowish hairs, and on the second, except a long, bare, outer face, with brownish black hairs. Proboscis heavy basally, protruding forward in general axis of body, the labellae produced to approximately two-thirds the length of the shaft, dark-brown shining chitin over all; length a little longer than the thorax.

Thorax, abdomen, wings and legs uniformly light brown with concolorous hairs above and below, a little darker caudally. Wing translucent yellow; venation as in Esenbeckia, the basal spurs on R_4 short. Subepaulets bare. No black hairs on legs.

Middle Rio Ucayali, Peru, December 1, 1923, "F6178 (H. Bass- ler)." In AMNH.
Named for Dr. G. B. Fairchild, an industrious student of the Neotropical tabanid fauna, to whom the author is greatly indebted for many favors.

**Proboscidiose rostrum** new species

(L., "a beak")

Similar to the preceding but a little more robust, hind legs and abdomen caudally darker, with blackish hairs.

Holotype ♀, 13.5 mm. Eyes bare, contiguous. Ocellar tuberula but little exceeding upper eye level viewed from in front. Frontal triangle grayish laterally, including facial pile, but yellowish mesally and below. Face receding below. Antennae and palpi as in the preceding but more slender, the latter bare only on outer, apical half, and only a little more than half the length of the shaft of the proboscis. The last, shiny brown chitinized as in *fairchildi*, but less robust basally, and the labellae more blunt, and less tapered, only about two-thirds the length of the shaft.

Body chiefly yellowish covered with bright, golden yellow hair except as follows: Breast and first 2 pairs of coxae gray with pale hairs, third and following tergites and sternites with indefinite darker shadows, and black hairs basally on each. Wings and anterior 2 pairs of legs as in *fairchildi* but femora with dark brown hairs. Hind legs including vestiture deep brown to blackish.

Data as for *fairchildi* but "December 26, 1926, F6113." In AMNH.

This was at first considered to be the male of *fairchildi* and may prove to be at most a subspecies when adequate material is available, but until intergrades are found, the tinctorial differences appear to justify separate description at present. Since this peculiar, chitinized proboscis occurs in the male also, it seems unlikely it is a modification to facilitate biting.

**Scione grandis** new species

A robust, blackish species with brilliant yellow pile on pleura and face, and large, contrasting clear spots on the dark wings.

Holotype ♀, 12.5 mm. Eyes covered with dense, short, brown pile. Front gray, slightly divergent below, about four times taller than basal width, covered with yellowish pile, black decurved hairs above the ocelli. Subcellus and face gray pollinose, latter and cheeks covered with dense, bright yellow pile. Antennae, palpi and proboscs black. Scape slightly swollen, about three times the length of the pedicle, both covered with coarse black hairs, flagellum with eight annuli, the last not unusually elongated. Basal palpal segment with some yellow hairs, remainder black; second segment slender crescentic with a lateral furrow nearly its full length. Proboscis shorter than height of head, stout, completely chitinized including the labelae.
Thorax dark with two sublateral narrow grayish lines on the dorsum, a wide contrasting band of coarse yellow hairs running forward from above and below the base of the wings onto the prothorax and base of the fore coxae; black with blackish hairs below.

Legs and their vestiture entirely black, the apical spurs of the hind tibiae peculiarly appressed along the base of the metatarsal segments.

Wings with cells R₃, M₃, and the anal closed and petiolate at the margin; black except for sharply defined fenestrate areas in the two basal cells, the anal area, cell Cu₁, the mesal area of the discal and adjacent parts of adjoining cells above and below, and an apical triangle based in the margin of cell R₄ and produced apically into cell R₁. Subepaulets bare, R₁ setose. Halteres dark brown.

Abdomen very robust, black with black hairs, and violaceous, iridescent pollinosity.


Stibasoma currani new species

A medium-sized, blackish fly, with thoracic margins, face and antennae bright, contrasting orange, and blackish wings with the tips hyaline. The antennae and legs have the characteristic shapes of the genus, but the body is a little less compact or "bumblebee-like" than some other species.

Holotype ♂, 16 mm. Eyes bare. Front subparallel, narrow, about six times taller than wide, gray pollinose, with a median blackish keel gradually widened below to almost the width of the front; vertex shining brown, with a vestigial anterior ocellus. Subcallus, face and cheeks yellowish, with bright orange pile on the last (probably worn off the face). Antennae bright orange, the first two segments normal with a few black hairs, the flagellum with a long doro-basal tooth, not quite reaching the first annulus, of which there are four. Palpi missing. Proboscis, including labelle, black, shining, chitinized.

Thorax black, with blackish, iridescent hairs above; pleura bright contrasting orange pollinose and pilose, the chest and coxae dark brown.

Legs black including hair which is longest on the femora. Tibiae, particularly the fore pair, thickened. Abdomen bluish black, not particularly robust.

Auyantepui, Venezuela. February, 1938. 1100 m. Phelps Venezuela Exped. In AMNH.

Named for Dr. C. H. Curran whose studies in Diptera are well known.

Tabanus Fabricius

The following two species are described in Tabanus sens. lat. because their restricted relationship to available, Neotropical, tabanine genera is not clear. That they will eventually be reassigned is certain, however, because of the hairy eyes and bare
subepaulets. These characters and the totally different eye banding also prevent their inclusion in Nearctic *Whitneyomyia* Bequaert to which the peculiar head characters appear otherwise to relate; there is not the general subshiny head and body integument seen in *W. beatifica* Whitney. Their restricted generic status is therefore left to the future reviewer.

**Tabanus bequaerti** new species

A medium-sized brownish species with swollen, bare frontal and facial calli, banded abdomen, and brownish wings with elongated pale streaks in the middle.

Holotype ♀, 16 mm. Eyes apparently with short, sparse hairs (though obscured in this specimen); with two widely separated, narrow, purple lines on a green ground (relaxed), the lower one short and narrowly separated from the lower border. Front yellowish pollinose, about three times taller than wide, slightly convergent upward; no ocelligerous tubercle at vertex. Basal callosity swollen in profile and separated from the subcallus by a deep transverse sulus; convex, transverse, width about double its height, lower corners rounded, a short, mesal ridge starting upward, but no median callosity. Subcallus more swollen than the callosity in profile, both denuded, pale brown. Face immediately below antennae also swollen, denuded and pale brown. Except for two smaller denuded areas at either side on the cheeks, remainder of face yellowish pollinose. Antennae with first two segments pale brown, with coarse black hairs, the plate brick red, and the annuli black, chunky; the plate broad, scarcely excavated, the dorso-basal angle very blunt. Palpi slender, deep yellow, crescentric and acuminate apically. Shaggy yellow hair on lower cheeks and first palpal segments, appressed yellow and black hairs on the second segment. Proboscis fleshy, black, about one-third longer than palpi.

Thoracic integument dark, covered with yellowish pollinosity and pilosity; no evident lines.

Legs yellowish red, fore-coxae entirely, remainder mostly covered with yellowish hair, a few black ones on femora, and what remains of hind tibial fringe.

Wings opaque brown with pale translucent, longitudinal streaks in cells $R_1$ and $R_3$ below the stigma, in the discal and 2nd M cells, and narrowly along the hind margin. Halteres brown, yellow on the knob. Subepaulets bare. All cells open, except anal closed and petiolate; a short spur at base of $R_4$, on each wing.

Abdomen yellowish on entire venter, and dorsally except for dark spots in the middle of tergites 1 and 2, and rather narrow dark bands basally on each of the remainder. Vestiture (worn) apparently predominantly yellow, possibly dark over the dark areas.

Allotype ♂, 16 mm. Very similar in appearance to ♀, except for sexual characters. Eyes contiguous, hairs sparse and short, upper areas of enlarged facets moderately enlarged, occupying about two-thirds of the total area.
Vertical tubercle very reduced and small. Frontal triangle extremely pro-
tuberant about attachment of antennæ, bare, shining yellow above, yellow
pollinose beneath. Scape moderately swollen, about thrice the length of the
pedicel, hardly produced above, yellowish with sparse black hairs; pedicel
chunky with a short tooth dorsally; plate reddish, narrower than first two
segments, the annuli grading from brown to black on the apical ring, termin-
nating bluntly. Palpi about twice as long as thick, entirely covered with
yellow hair. The denuded areas on face smaller than in the ♀. Body and
wing patterns as in ♀, but thoracic hair longer and wings a little lighter, the
markings less contrasting. There is a short spur on only one wing.

Both from El Salto Diego, Mexico, May 29, 1937. 9300 feet
(J. Manuel). In MCZ.

The writer takes pleasure in naming this for Dr. J. C. Bequaert,
friend and scholar, to whom he is indebted in many ways, and
who had already decided the undescribed status of this species
as well as similarities to Whitneyomyia, from which it seems
excluded for reasons given above.

**Tabanus piliferus** new species
(Gr., ‘‘pile bearing’’)

Smaller than the preceding and closely related, but much more hirsute and
differing as described below.

Holotype ♀, 13 mm. Eyes contiguous, the upper area of facets not as dif-
ferentiated as in *bequaerti*, and much more densely pilose. The verticle
tubercle very small, a striking row of thick, erect, long black hairs across the
head behind the eyes. Frontal triangle very swollen at base of antennæ,
denuded, yellow mesally, dark brown laterally; another group of suberect,
dark hairs between the eyes at the apex. Facial tubercles somewhat swollen
on either side with a yellowish, bare area in the disc of each; two small, mesal
denuded areas inside the apodemes; face otherwise extensively whitish pol-
linose. Vestiture dense and creamy white with a few black hairs on either
side above. Antennæ in structure and color very like *bequaerti*, but with
more dense bushy black hair on the 2 basal segments, the annuli relatively a
little longer, and black. Palpi also yellowish with yellow hair, but more
blunt, the second segment also about twice longer than thick.

Thoracic integument also dark, but with more dense, paler yellow hair than
in *bequaerti*. Color and vestiture of legs the same, but pile, particularly of
fore-coxae, paler. Wings with pattern about the same but more indefinite
especially in posterior areas. No spurs. Subepaulets also bare.

Abdomen reddish yellow above and below with a series of large, posteriorly
rounded, mesal, dark spots which practically cross all tergites, and also occur
on the two basal sternites. These are thus broader on the tergites than in
*bequaerti*, and are not produced laterally to form bands. The vestiture con-
sists of long yellowish hairs with a few black ones laterally on each tergite
and across the face of the third and following ones.
El Salto Diego, Mexico, May 29, 1937. 9300 feet (J. Manuel). In MCZ.

Though the locality data are identical, it hardly seems possible this could be a variant of bequaerti considering the differences in vestiture, particularly of the head and eyes, and the tinctorial differences. Nevertheless, more material is obviously needed and particularly the female of this to confirm its specific distinctness. Though the hairs on the eyes of the bequaerti allotype are obviously somewhat damaged, it does not appear possible so great a difference could have been due purely to mechanical causes.

SUMMARY

The new Neotropical Tabanidæ described in this paper are: Proboscoides fairchildi, n. gen., n. sp. (genotype), ♀, P. rostrum n. sp., ♂, and Scione grandis n. sp., ♀, from Peru; Stibasoma curranii, n. sp., ♀, from Venezuela; and Tabanus (sens. lat.) bequaerti n. sp., ♂, ♀, and T. pilosus n. sp., ♀, from Mexico.

REFERENCE

INSECT BEHAVIOR TO VARIOUS WAVE LENGTHS OF LIGHT

By Harry B. Weiss, Frank A. Soraci, and E. E. McCoy, Jr.

This is the fourth paper, of a series, relating to the group behavior of certain insects to light of various wave-lengths. The first three appeared in this Journal. The present paper is a report of the results of additional tests made in 1942 in the sector type equipment which is fully described in the third paper of the series. As noted previously, in the third paper, the insects were placed in an introduction chamber, six feet away from the filter chambers after the lamps were on and all filter chambers were open. At the ends of the exposure periods the filter chambers, the central compartment, introduction chamber and dark chamber were closed and separated from each other by metal slides. Counts were then made.

In order to determine if the sector type equipment was influencing the behavior of the test insects, by reason of its design, nine white lights of equal intensities (40-watt lamps) were placed at equal distances from clear glass windows and five different tests were made with a total of 1,431 Japanese beetles, for an exposure of 25 minutes. Theoretically, 11.1 per cent of the beetles should have been found in each of the nine compartments. Actually the percentage distribution for the five tests combined was 9, 10, 10, 14, 13, 13, 11, 9, 11, and the average deviation was 1.44 per cent. In view of these results it was concluded that the equipment, from a construction standpoint, was satisfactory enough for our purpose.

RESULTS

In Table 1 there are presented the results of exposing six species of insects to ten wave-length bands of equal physical intensities, in the sector type equipment. By consulting the percentage distributions of those reacting positively to the various

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<th>Name and date tested</th>
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<th>Total no. insects involved</th>
<th>Exposure minutes</th>
<th>Per cent in black chamber!</th>
<th>Per cent in introduction chamber</th>
<th>Per cent reacting to wave-lengths</th>
<th>Distribution of those reacting positively to various wave-lengths*</th>
<th>Relative physical intensity at introduction point</th>
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<tbody>
<tr>
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<tr>
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<td>45</td>
<td>45 (34) 15 9 22 7 7 2 1 2 1 2 1</td>
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<tr>
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<td>25</td>
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<td>42 (30) 20 11 16 8 6 3 4 1 1 1</td>
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<td>6</td>
<td>50</td>
<td>41 (27) 14 13 16 8 9 6 6 2 2 4 1</td>
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<td>35</td>
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<td>66 (19) 9 10 24 18 14 2 2 1 1 3 3</td>
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</table>

* Angstrom units represent peak intensities of bands.
† These percentages include the relatively small numbers that entered the black chambers between the light chambers.
wave-length bands and by an examination of the group behavior curves in Figures 1, 2 and 3, it may be noted that the largest numbers of most of the species reacted positively to 3650–3663 Å (ultraviolet).

The nine different lots of Drosophila melanogaster behaved in a remarkably uniform pattern. This is shown graphically on Figure 1, where it may be noted that the peak response took place in the ultraviolet, with a minor secondary peak at 4920 Å (blue-blue-green) or 5150 Å (blue-green). The results of our tests do not differ qualitatively from those of Bertholf who worked with 30 wave-lengths from 2300 Å to 7000 Å, using an entirely different experimental method. Quoting from Bertholf's paper: "The results show that, starting with the longer wave-lengths the efficiency is very low until it starts to rise at about 5750 Å; from here it rises to a maximum in the so-called visible spectrum at 4870 Å . . .; from this wave-length it decreases again at 4250 Å; then it rises suddenly and attains a maximum value of 3650 Å . . .; from here it decreases rapidly to zero at 2540 Å."

The group behavior of the remaining five species is shown in detail in Table 1 and graphically by Figures 2 and 3. Except for the Japanese beetle, the peak response took place in the ultraviolet (3650 Å) and secondary peaks occurred at 4920 Å (blue-blue-green) or at 5150 Å (blue-green). The Colorado potato beetles used in these tests were all overwintering adults that had emerged in the spring and were feeding and copulating.

In Table 2 and Figures 4 and 5, are shown the responses of 8 species of Coleoptera to nine spectral bands of equal physical intensities exclusive of ultraviolet. In other words the most stimulating part of the spectrum, to many insects, i.e., ultraviolet, was omitted. With the exception of the Japanese beetle, the most stimulating part of this reduced spectrum for these species was either 4360 Å (violet-blue), or 4360 Å (violet-blue) and 4920 Å (blue-blue-green) both of which were approximately equal in stimulating efficiency. In addition 5150 Å (blue-green) and 5460 Å (yellow-green) attracted slightly larger numbers than usual.

<table>
<thead>
<tr>
<th>Name and date tested</th>
<th>No. tests</th>
<th>Total no. insects involved</th>
<th>Exposure minutes</th>
<th>Per cent in black chamber</th>
<th>Per cent in introduction chamber</th>
<th>Per cent reacting to wave-lengths</th>
<th>Distribution of those reacting positively to various wave-lengths*</th>
<th>Relative physical intensity at introduction point</th>
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<tbody>
<tr>
<td>Coleoptera</td>
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<td>Plagiodera versicolora, 5-28-42</td>
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<td>15</td>
<td>4</td>
<td>32</td>
<td>45</td>
<td>19</td>
<td>3</td>
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<td>Lina lapponica, 5-28-42</td>
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<td>5</td>
<td>32</td>
<td>32</td>
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<td>4</td>
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<td>28</td>
<td>60</td>
<td>18</td>
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<tr>
<td>Tetraopes tetrachalimus, 6-24-42</td>
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<td>4</td>
<td>12</td>
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<td>42</td>
<td>26</td>
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<td>23</td>
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<td>5</td>
<td>5</td>
<td>25</td>
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<td>17</td>
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<td>10</td>
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<td>24</td>
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<td>Popillia japonica, 7-8-42</td>
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<tr>
<td>Leptinotarsa decemlineata, 6-4-42</td>
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<td>25</td>
<td>7</td>
<td>11</td>
<td>38</td>
<td>44</td>
<td>18</td>
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</tbody>
</table>

* Angstrom units represent peak intensities of bands.
† These percentages include the relatively small numbers that entered the black chambers between the light chambers.
In fact if we combine the figures for 4920 Å, 5150 Å, and 5460 Å it will be found that in our entire spectrum the largest percentage was stimulated by wave-lengths from 4920 to 5460 Å. In the absence of ultraviolet this part of the spectrum was the most stimulating for the species tested. The peak response for the Japanese beetle in these and in former tests where ultraviolet was available took place for the most part in the region 4700–5280 Å (blue-blue-green).

The group behavior of the Colorado potato beetle to ultraviolet light of low intensity in comparison with various other colors at higher intensities is set forth in Table 3. In these tests the introductory intensity (i.e., that to which the insects were first exposed), of the ultraviolet was 3 and the intensity of each of the other wave-lengths was 100. From Table 3 it may be noted that weak ultraviolet was more stimulating than wave-lengths of stronger intensities from infra-red to yellow-yellow-green, and that ultraviolet at an intensity of 3 was approximately equal in stimulating efficiency to wave-lengths from yellow-green to violet-blue at intensities of 100. These tests were made in the two-way apparatus described and figured in the third paper.9

In order to determine if previous behavior to a particular wave-length band influenced succeeding behavior, groups of Japanese beetles and potato beetles were placed in the introduction chamber of the sector type equipment and exposed to certain wave-length bands. After an exposure period of 20 or 30 minutes the insects that had gone to a particular filter chamber were removed and immediately exposed to 10 wave-length bands of equal physical intensities including the one to which they had previously been "conditioned."

The results of these tests with the Japanese beetles are shown in Table 4 and Figure 6. In general the behavior to the 10 wave-length bands was more or less similar to the behavior of groups that had never been previously conditioned to any particular band. Apparently the previous conditioning of the five different groups of beetles utilized in Table 4 had no influence upon their subsequent behavior pattern. Perhaps the conditioning period was too short. Perhaps the sensitivity of the iris pigment in

### TABLE 3

**Behavior of the Colorado Potato Beetle to Ultraviolet Light of Low Intensity in Competition with Various Other Colors at Comparatively High Intensities**

<table>
<thead>
<tr>
<th>No. tests</th>
<th>No. insects involved</th>
<th>Per cent not reacting</th>
<th>Per cent reacting</th>
<th>Exposure minutes</th>
<th>Wavelength bands (intensity 3)</th>
<th>Per cent reacting positively</th>
<th>Wavelength bands* (intensity 100)</th>
<th>Per cent reacting positively</th>
<th>Colors of light transmitted by filters in Column 8</th>
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<tbody>
<tr>
<td>3</td>
<td>289</td>
<td>26</td>
<td>74</td>
<td>35</td>
<td>3650–3663</td>
<td>95</td>
<td>7200</td>
<td>5</td>
<td>infra-red</td>
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<tr>
<td>3</td>
<td>243</td>
<td>12</td>
<td>88</td>
<td>15</td>
<td>3650–3663</td>
<td>72</td>
<td>6420</td>
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<td>orange-red</td>
</tr>
<tr>
<td>3</td>
<td>500</td>
<td>11</td>
<td>89</td>
<td>15</td>
<td>3650–3663</td>
<td>70</td>
<td>6060</td>
<td>30</td>
<td>yellow-orange</td>
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<tr>
<td>3</td>
<td>383</td>
<td>12</td>
<td>88</td>
<td>15</td>
<td>3650–3663</td>
<td>64</td>
<td>5750</td>
<td>36</td>
<td>yellow-yellow-green</td>
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<td>5400</td>
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<td>12</td>
<td>88</td>
<td>15</td>
<td>3650–3663</td>
<td>51</td>
<td>5150</td>
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<td>blue-green</td>
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<td>87</td>
<td>15</td>
<td>3650–3663</td>
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<td>86</td>
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<td>4300</td>
<td>54</td>
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*Peak of intensity of bands.
these insects was such as to result in rapid adaptation. Whatever
the reason, previous conditioning as described did not result in
any appreciable change in their behavior pattern.

In Table 5 and Figure 7, the results are given for a similar set
of tests with the Colorado potato beetle. These results and con-
clusions are the same as those recorded in the preceding para-
graph for the Japanese beetle.

Table 6 records the results of testing the behavior of Drosophila
melanogaster to blue-blue-green at a fixed introductory intensity
in competition with ultraviolet at varying introductory intensi-
ties. These tests were conducted in the two-way apparatus which
consisted of two wooden light-tight runways emanating at right
angles to each other from an introduction chamber about 8.5 inches
square. (See Jour. N. Y. Ent. Soc., Vol. L, p. 16, 1942, for de-
scription.) With this apparatus it was possible to test the in-
sects from 1 to 11 feet away from the light chambers and conse-
quently at different introductory intensities. The 18 tests
recorded in Table 6 involved the use of over 16,000 insects. All
were killed after each test so that they could be counted. Speri-
mens found in the runways leading to light chambers were
counted as reacting positively although they had not actually
reached the light chambers at the ends of the exposure periods.

According to Table 6 when ultraviolet and blue-blue-green were
of equal physical intensities approximately 71 per cent of the
insects went to ultraviolet. When the insects were introduced
to ultraviolet at such reduced intensities as 11, 3, 1.2 and 0.8 while
the blue-blue-green introductory intensity was kept at 100, their
reactions were approximately unchanged. Ultraviolet at the
weak introductory intensities remained about the same in stimu-
ling efficiency. The apparent progressive increase in the per-
centages of insects reacting positively to ultraviolet as the intro-
ductory intensity was reduced, we do not consider significant.
Drosophila melanogaster is temperamental. As a rule, young
flies, 3 to 4 days old appeared to be less interested in light than
older ones, 6 to 8 days old. And those of all ages unless they were
in the right physiological or other state refused to perform and
stayed in the introduction chamber. The only conclusion to be
drawn from the results in Table 6 is that Drosophila in the right
state is extremely photopositive to small amounts of ultraviolet.
### TABLE 4

Distribution of those reacting positively to various wave-lengths:

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<tr>
<th>Wave-lengths</th>
<th>Per cent</th>
<th>Per cent</th>
<th>Per cent</th>
<th>Per cent</th>
<th>Per cent</th>
<th>Per cent</th>
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<td>4120 A</td>
<td>4700 A</td>
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<thead>
<tr>
<th>Wave-lengths</th>
<th>Per cent</th>
<th>Per cent</th>
<th>Per cent</th>
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<th>Per cent</th>
<th>Per cent</th>
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<tbody>
<tr>
<td></td>
<td>2.0</td>
<td>1.0</td>
<td>20.0</td>
<td>30.0</td>
<td>20.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

**Note:** Peak intensities of bands.

*Behavior of the Japanese Beetle to Ten Wave-length Bands of Colors Immediately Following Their Exposure to a Single Band of Color.*
**TABLE 5**

Behavior of the Colorado Potato Beetle to Ten Wave-length Bands or Colors Immediately Following Their Exposure to a Single Band or Color

<table>
<thead>
<tr>
<th>Previously exposed for 30’ to</th>
<th>No. tests</th>
<th>Total no. insects involved†</th>
<th>Exposure minutes</th>
<th>Per cent in black chamber</th>
<th>Per cent in introduction chamber</th>
<th>Per cent reacting</th>
<th>Distribution of those reacting positively to various wave-lengths*</th>
</tr>
</thead>
<tbody>
<tr>
<td>4120–4760 Å violet-blue</td>
<td>1</td>
<td>74</td>
<td>20</td>
<td>3</td>
<td>11</td>
<td>47</td>
<td>39</td>
</tr>
<tr>
<td>3650–3663 Å ultra-violet</td>
<td>1</td>
<td>42</td>
<td>20</td>
<td>4</td>
<td>2</td>
<td>44</td>
<td>50</td>
</tr>
<tr>
<td>4420–5000 Å blue</td>
<td>1</td>
<td>43</td>
<td>20</td>
<td>6</td>
<td>12</td>
<td>38</td>
<td>44</td>
</tr>
<tr>
<td>4700–5280 Å blue-blue-green</td>
<td>1</td>
<td>48</td>
<td>30</td>
<td>6</td>
<td>0</td>
<td>42</td>
<td>52</td>
</tr>
<tr>
<td>Not previously exposed to any wave-lengths</td>
<td>2</td>
<td>386</td>
<td>90</td>
<td>20</td>
<td>7</td>
<td>42</td>
<td>31</td>
</tr>
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</table>

* Peak intensities of bands.
† All tests were made during the last few days of September.
<table>
<thead>
<tr>
<th>No. tests</th>
<th>No. insects involved</th>
<th>Per cent not reacting</th>
<th>Per cent reacting positively</th>
<th>Exposure minutes</th>
<th>Per cent reacting positively to 3650-3663 Å (ultraviolet)</th>
<th>Relative physical intensity of ultraviolet</th>
<th>Per cent reacting positively to 4700-5280 Å (blue-blue-green)</th>
<th>Relative physical intensity of blue-blue-green</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2,386</td>
<td>59</td>
<td>41</td>
<td>10</td>
<td>71</td>
<td>100.0</td>
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<td>100</td>
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<tr>
<td>3</td>
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<td>20</td>
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<td>11.0</td>
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<td>100</td>
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<tr>
<td>3</td>
<td>2,961</td>
<td>33</td>
<td>67</td>
<td>20</td>
<td>84</td>
<td>3.0</td>
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<td>100</td>
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<tr>
<td>5</td>
<td>5,269</td>
<td>46</td>
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<td>20</td>
<td>78</td>
<td>1.2</td>
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<td>100</td>
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<tr>
<td>3</td>
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<td>30</td>
<td>70</td>
<td>15</td>
<td>86</td>
<td>0.8</td>
<td>14</td>
<td>100</td>
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**TABLE 6**

Behavior of *Drosophila melanogaster* to Blue-blue green at a fixed introductory intensity in competition with ultraviolet at varying introductory intensities.
NOTES

Photinus scintillans Say. A preliminary test of this species of "firefly" (Lampyridae) in the sector type equipment, in which it was exposed to the ten wave-length bands used in the other tests, indicated that ultraviolet (3650 Å) was highly effective in stimulating efficiency. Owing to the small number (41) available, and these were dark adapted for one hour, it is not possible to be definite about their reactions. Their behavior to ultraviolet is interesting, however, in view of the fact that they are nocturnal and because the spectra of fireflies, which extend from about 5000 Å to 5900 Å, contain no ultraviolet or blue.

Autoserica castanea Arrow. This nocturnal species when dark adapted for 24 hours was highly sensitive to ultraviolet.

Popillia japonica Newm. Seven tests, involving 1,900 beetles, were run in the sector type equipment. The ultraviolet band (3650–3663 Å) had a relative physical intensity of 3 and the 9 remaining spectral bands, each had an intensity of 1.5. After exposures from 20 to 30 minutes, the group behavior was found to be similar to that resulting from the exposure of the Japanese beetle to 10 wave-length bands each with an intensity of 3.

In general the results of our 1942 tests were approximately the same as those for 1941, when the same experimental methods were used with different groups of the same species. Within certain limits variations in group behavior are to be expected when one considers that an insect's reaction to light is influenced by many factors, previous exposure to light, angle of incidence, variations in sensitivity of different parts of the compound eye, position of the iris pigment and the rate of pigment migration in relation to light intensity, temperature, moisture, air currents, chemotropism, its variable physiological state, the stimulation of sense organs other than the eyes, the influence of the central nervous system and the wave-length and intensity of the radiation to which it is first exposed.
Figure 1. Behavior of *Drosophila melanogaster* to 10 wave-length bands from 3650 Å to 7200 Å. Physical intensities equalized.

1, 34 flies (1 test), age 7 days +, dark conditioned for 18 hours before test.
2, 39 flies (1 test), age 3 days +.
3, 135 flies (1 test), age 3 days +, dark conditioned 3 hours before test.
4, 90 flies (1 test), age 4 days.
5, 128 flies (1 test), age 8 days +.
6, 91 flies (1 test), age 7 days +.
7, 33 flies (1 test), age 7 days +.
8, 170 flies (1 test), age 7 days +.
9, 87 flies (1 test), age 7 days +.

Figure 2. Behavior of Coleoptera to 10 wave-length bands from 3650 Å to 7200 Å. Physical intensities equalized.

1, 163 Colorado potato beetles (3 tests).
2, 114 Colorado potato beetles (2 tests).
3, 215 *Chrysochus auratus* (2 tests).
4, 160 *Chrysochus auratus* (2 tests).
5, 245 Japanese beetles (2 tests).

Figure 3. Behavior of Coleoptera to 10 wave-length bands of equal physical intensities from 3650 Å to 7200 Å.

1, 136 Colorado potato beetles (2 tests).
2, 194 Colorado potato beetles (2 tests).
3, 26 Colorado potato beetles (1 test).
4, 69 Colorado potato beetles (1 test).
5, 90 *Macrobasid unicolor* (2 tests).

Figure 4. Behavior of Coleoptera to 9 wave-length bands from 4360 Å to 7200 Å. Physical intensities equalized.

1, 79 *Disonycha quinquedentata* (1 test).
2, 284 *Chrysochus auratus* (2 tests).
3, 197 Japanese beetles (2 tests).
4, 182 Japanese beetles (2 tests).
5, 216 Japanese beetles (3 tests).
PLATE VI

Figure 5. Behavior of Coleoptera to 9 wave-length bands from 4360 Å to 7200 Å. Physical intensities equalized.

Upper—1, 37 Plagiodera versicolora (1 test).
2, 69 Lina lapponica (1 test).
3, 205 Macrodactylus subspinosus (2 tests).
4, 106 Tetraopes tetraophthalmus (3 tests).

Lower—1, 76 Colorado potato beetles (1 test).
2, 114 Colorado potato beetles (3 tests).
3, 249 Colorado potato beetles (3 tests).

Figure 6. Behavior of the Japanese beetle to 10 wave-length bands of equal physical intensities from 3650 Å to 7200 Å, after having previously been exposed or "conditioned" to particular wave-lengths. Second exposure to 10 bands followed immediately the first exposure to one band.

1, Previously exposed to 3650–3663 Å, ultraviolet.
2, Previously exposed to 4120–4760 Å, violet-blue.
3, Previously exposed to 4700–5280 Å, blue-blue-green.
4, Previously exposed to 4940–5660 Å, blue-green.
5, Previously exposed to 5300–5760 Å, yellow-green.

Figure 7. Behavior of the Colorado Potato Beetle to 10 wave-length bands of equal physical intensities from 3650 Å to 7200 Å, after having previously been exposed to particular wave-lengths.

1, Previously exposed to 4120–4760 Å (violet-blue).
2, Previously exposed to 3650–3663 Å (ultraviolet).
3, Previously exposed to 4420–5000 Å (blue).
4, Previously exposed to 4700–5280 Å (blue-blue-green).
5, Behavior to 10 wave-length bands without previous exposure to any.
6, Behavior to 10 wave-length bands without previous exposure to any.
NEW RECORDS (LEPIDOPTERA)

On a collecting trip in the Laurentides National Park below lake St. John, P. Q., Mr. Sidney A. Hessel took:

148. *Erebia discoidalis* (Kirby) at Camp de la Traverse, ♀, 29 May, 1941; at Camp de la Belle Riviere, 8 ♂, 5 ♀, 1-4 June, 1941. These captures are believed to be the most eastern records for this species.

208. *Brentis freija* (Thunberg) at Camp des Bouleaux, 3 ♂, 7 June, 1941. These captures may extend the range of this species further southeast than previously recorded.

Reported from Nesconset, Long Island, N. Y. are the following southern noctuids which have been occasionally recorded from New York State:

3280. *Autographa oo* (Cramer) 6 October, 1941.

3590. *Anticarsia gemmatilis* Hübner, the Velvet Bean Caterpillar, 8 specimens, 6 October, 1941. W. P. Comstock.
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Organized June 29, 1892—Incorporated June 7, 1893
Reincorporated February 17, 1943

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SEPTEMBER, 1943

Journal
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Devoted to Entomology in General

Edited by HARRY B. WEISS

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NOTICE: Volume LI, Number 2, of The Journal of the New York Entomological Society was published on May 6, 1943.
A SPECIFIC REVISION OF THE GENUS METARRANTHIS (LEPIDOPTERA, GEOMETRIDÆ, ENNOMINÆ)

BY LAURENCE R. RUPERT
HORSEHEADS, N. Y.

The genus *Metarranthis* Warren is one of several genera of the Geometridæ which have never been well understood. The combination of structural similarity of the various species with the tendency to considerable intraspecific variation in size, color, and wing maculation, has been a great barrier to easy and accurate determination. The following descriptions and comments are a result of several years' work with the genus. They are not intended as the final word on the subject, but I believe they may be of considerable assistance in clearing up some of the difficulties which are most likely to be met.

Of the various species now placed in *Metarranthis*, the first to be described was *obfirmaria* by Hübner in 1806. He placed the species in *Epirranthis*, a genus which he had previously created for his species *pulverata*. That *obfirmaria* is not congeneric with *pulverata* was recognized by Guenée in 1857, when he correctly associated *obfirmaria* with *duaria*, placing both in *Numeria*. This association was apparently not generally accepted, and *obfirmaria* continued to be referred to *Epirranthis* until Warren (Nov. Zool. I, p. 436, 1894), also aware of the lack of close relationship between *pulverata* and *obfirmaria* proposed the generic name *Metarranthis* for the latter. Subsequently, Dr. Dyar in his Check List (1902) accepted Guenée's association of *obfirmaria*.
with \textit{duaria}, placing them along with \textit{hypochraria}, and related species, in \textit{Gonodontis} Hbn. In 1916, however, Barnes and McDunnough (Contrib. to the Nat. Hist. of the Lepid. of N. A., III, p. 255) pointed out that the male genitalia of the North American species of the \textit{duaria} group are quite unlike those of the old world species of \textit{Gonodontis}, and applied \textit{Metarranthis} to this entire group of North American species. This application marked the beginning of the use of \textit{Metarranthis} in the general sense in which it is now understood.

\textit{Metarranthis} belongs to a small group of genera occurring in North America and Eurasia, among the North American representatives of which are \textit{Plagodis} Hbn., \textit{Anagoga} Hbn., \textit{Hyperetis} Gn., \textit{Metanema} Gn., \textit{Priocycla} Gn., and \textit{Selenia} Hbn. \textit{Metarranthis} seems, in natural sequence, to lie between \textit{Hyperetis} and \textit{Metanema} as listed. The European genus \textit{Cepphis}, which superficially resembles \textit{Metarranthis}, seems actually to be more closely allied to \textit{Priocycla}.

In McDunnough's 1938 Check List, Part I, p. 169, eight species are referred to \textit{Metarranthis}. One of these, \textit{antidiscaria} Walker, is better referred to \textit{Stenaspilates} Packard, on the basis of both general appearance and structure of genitalia. I have examined the genitalia of a male from Lakehurst, N. J., and of both males and females from Florida, including one of the type series of \textit{lentaria} Hulst, and I find the Lakehurst specimen identical with those from Florida.

In addition to the remaining seven species of the McDunnough Check List, there appear to be at least four more valid species of \textit{Metarranthis}. Two of these, \textit{lateritiaria} Guenée, and \textit{homuraria} Grote, have formerly been considered races of \textit{hypochraria} Herrich Schäffer, but are evidently specifically distinct from that species and from each other. The other two species are described for the first time, I believe, in this article.

\textbf{Metarranthis obfirmaria} (Hübner)

\textit{Epirranthis obfirmaria} Hübner, Samml. exot. Schmett. II, 219, Tafel 432; Figs. 1, 2, ♂; Figs. 3, 4, ♀. 1806.
\textit{Epirranthis obfirmaria} (Hbn.), Packard, Mon. of Geom. Moths, 499; Plate XII, Fig. 7. 1876.
1894.
Gonodontis obfirmaria (Hbn.), Holland, Moth Book, 350; Plate XLV, Fig. 14, ♂. 1903.
Metarranthis obfirmaria (Hbn.), Barnes and McDunnough, Cont. to the Nat. Hist. of the Lepid. of N. A. Ill, 255-259; Plate XXXII, Fig. 5 (♂ genitalia). 1916.

Basal and terminal areas of fore wings and most of terminal area of lower wings bright dark reddish brown; median area of fore wings and inner half of lower wings bright orange yellow, sometimes somewhat obscured by a coarse powdering of dark brown scales; antemedial line of fore wings narrow, reddish, curved strongly inward at the costa; postmedial line of fore wings almost straight, dark brown, often preceded by a red or orange line; postmedial line of lower wings dark brown, slightly angulate; discal spots small or missing on fore wings, large and black on lower wings, joined to the base of the wings by a black dash which is sometimes incomplete; terminal area of lower wings showing some bright yellow near the apex; fringes dark brown, concolorous with the terminal area on the upper side. Under side bright orange yellow with reddish brown postmedial lines, and a considerable scattering of reddish brown scales, especially near the apex of the fore wings; discal spots present on all four wings, redder than on upper side. Expanse 1-1¾ inches.

Male Genitalia.—Uncus long and slender, bluntly pointed, and scarcely spatulate; left branch of furca stout, moderately long, considerably curved, with two unequal pointed processes at the tip, sometimes with a trace of one or two additional shorter processes at the tip only; right branch of furca similar but shorter; valves rounded with a very slight excavation, or at least a straightening of the edge, along the upper third of the outer margin. Other features are as shown in the drawing.

Female Genitalia.—Genital plate narrow, pointed at both ends. Above and behind this, one on each side of the ostium are two pocket-like formations, smaller and more distinctly quadrangular than in any other species having them. I believe the other features, which show very little difference throughout the genus, are adequately represented in the drawing.
Egg.—Pale yellow, slightly elliptical, flattened above, below, and at one end; scattered loose. There is no color change until just before hatching, when they become dark slate gray.

Larva.—I have bred this species only once, and then only in rather limited numbers. Hence my observations are too few for generalizations. I found the first stage larvae to be black with the appearance of six white bands encircling the body, the first between the third and fourth segments of the body, the last between the eighth and ninth. Under a hand lens these bands are seen to be composed of irregularly shaped white spots, closely crowded together. They persist in the second stage, but almost or quite disappear after the second molt.

The mature larvae were light grayish brown with a paler longitudinal line along the upper side, and four rectangular spots on each segment, the first two on each segment being smaller and almost square, the last two much longer than wide. There were two broken and somewhat obscure dark stripes along each side, but no stripes underneath. Since in several other species of the genus the pattern of the upper side of the larvae is not constant, it is reasonable to expect various patterns here also. The reported food is Vaccinium, but since that was not readily available when I was rearing the larvae, I gave them choke cherry, which they ate with evident relish.

I am placing obfirma a first in the series of species of the genus, since I believe it to be the most highly specialized species structurally. It is certainly the most brilliantly colored member of the genus, and is not easily confused with any of the others. It is common in acid soil localities in the states of the Atlantic seaboard from Canada to Georgia, and is to be found less regularly farther west. The series in the U. S. National Museum collection contains a single specimen from Kansas.

Metarranthis warneri (Harvey)


Upper surface gray with a more or less brownish cast, occasionally somewhat reddish; antemedial line conspicuous, dark brown or blackish, followed by a darker shade; postmedial line
of fore wings dark brown or almost black, straighter than in any other species except _obfirmaria_, but with a slight outward curve or very blunt angulation just below vein M₂, preceded by a darker shade, and followed by a paler line; subterminal shade usually present, sometimes quite conspicuous in the females; fringes concolorous with the terminal area; outer margins of wings rounded; apex distinctly pointed in the females. Under side pale gray with some reddish scales, especially along the veins; transverse lines obscure, sometimes hardly discernible; subterminal shade occasionally present underneath. Expanse 1\frac{1}{4}–1\frac{3}{4} inches.

**Male Genitalia.**—Uncus slender and not quite so long as in _obfirmaria_; left branch of furca very stout, ending in two pointed processes, longer and more slender than those at the tip in _obfirmaria_; right branch similar, more slender, and with one additional pointed process considerably below the two at the tip. I have not figured the _aedoeagus_ of this species, nor of any of the following species, since there seem to be no essential differences in this structure throughout the genus.

**Female Genitalia.**—Distinguished by the heavy genital plate, constricted in the middle and tapering to a point at each end. The pocket-like formations are moderately large, kidney-shaped, and quite ragged along the inner edges.

**Early Stages.**—In June, 1943, Dr. Brewer sent me four lots of eggs from Augusta, Me. These were pink, resembling the eggs of _duaria_, but paler. The newly hatched larvae had the white bands wider than in any other species seen, and in addition, the thoracic segments and the terminal abdominal segments were almost entirely white. As this is written, the larvae are in the second and third stages, and the general color is slate gray to gray brown, with a conspicuously mettled darker pattern, intermediate between the usual patterns of _obfirmaria_ and _duaria_. They are rather general feeders, but seem to have a preference for various species of cherry and dogwood.

Typical _warneri_ is to be found in the New England States and in eastern New York. Some form of the species is to be expected in adjacent parts of Canada and north of the Great Lakes. It has never been reported, so far as I know, from western New York.
Metarranthis warneri race capsaria new race

Metarranthis warneri (Harv.) B. and McD., Contrib. to the Nat. Hist. of the Lepid. of N. A. III, 255; Plate XXIX, Fig. 1, $\delta$; Plate XXXIII, Fig. 1 (♀ genitalia). (Figured as typical warneri.)

Similar in maculation to typical warneri, but much darker, with a distinctly sooty appearance over the entire upper surface, and apparently lacking any tendency to redness on the upper side. The dark shade preceding the postmedial line is usually broader than in typical warneri, especially on the lower wings. Under side darker than in typical warneri, more heavily flecked with reddish scales, and with a wide darker band indicating the position of the postmedial line.

Holotype.—♀, Beulah, Manitoba, May 28. (United States National Museum Collection.)

Paratypes.—5 $\delta\delta'$, Cartwright, Manitoba, May and June; 1 $\delta'$, Beulah, Manitoba, May 16, 1902; 2 $\delta'$, merely labeled Manitoba (all in the United States National Museum Collection); 1 $\delta'$, Saskatoon, Saskatchewan, June 9, 1934; 1 $\delta'$, McCreary, Manitoba, July 6 (both in Brower collection); 1 $\delta'$, Madison, Wis., June 4, 1932 (in Franclemont collection); 1 $\delta'$, 1 $\delta$, Hessville, Ind.; 1 $\delta'$, Miller, Ind.; (all in Wyatt collection), 18 $\delta\delta'$, Harlan, Sask. May and June (in Bruggemann, Franclemont, and Rupert collections); 1 $\delta'$, Sunnydale, Alta. (in Rupert collection).

Cappsaria is named in honor of Mr. H. W. Capps, who has assisted me greatly by making the material in the National Museum available to me for study, and in preparing many genitalia slides of specimens in that collection.

Metarranthis duaria (Guenée)

Endropia duaria (Gn.), Packard, Mon. of Geom. Moths, 502; Plate XII, Fig. 10. 1876. (Packard's figure probably represents franclemonti, rather than duaria.)
Endropia duaria (Gn.), Dyar, Psyche, IX, 371. 1902. (Early stages.)

Gonodontis duaria (Gn.), Holland, Moth Book, 350; Plate XLV, Fig. 2, ♀. 1903.

Metarranthis duaria (Gn.), B and McD., Cont. to the Nat. Hist. of the Lepid. of N. A. III, 255; Plate XXIX, Fig. 4, ♀; Fig. 5, ♀; Plate XXXIII, Fig. 4 (♂ genitalia). 1916.

Metarranthis duaria form hamaria (Gn.), B. and McD., Cont. to the Nat. Hist. of the Lepid. of N. A. Ill, 255; Plate XXIX, Fig. 6, ♂. 1916.

Numeria duaria Gn., Oberthür, Etudes de Lep. Comp., Fasc. XVII, 22; Plate DVII, Fig. 4234 (♀ type). 1920.

Numeria hamaria Gn., Oberthür, Etudes de Lep. Comp., Fasc. XVII, 22; Plate DVII, Fig. 4235 (♀ type). 1920.

Upper surface variable in color, ranging from pale gray through various red-grays to quite dark brownish gray; antemedial line brownish gray to blackish, somewhat blurred, often interrupted at the veins, and rarely almost obsolete; postmedial line similar in color, curving outwardly on the upper half of the fore wings, inwardly below; evenly curved on the lower wings, variable in appearance, usually somewhat blurred, heavier on the lower half of each wing; often interrupted at the veins, sometimes reduced to a series of blurred spots, rarely almost missing; median area concolorous with basal and terminal area; discal spots distinct, blackish, on all four wings; subterminal shade usually present, occasionally distinct across all four wings, but more often reduced to one or two blurred spots on the fore wings, midway between costal and inner margins; fringes concolorous with terminal area, or a bit redder. Under side grayish, more or less flecked with reddish scales; postmedial line reddish, variable in sharpness, sometimes indicated only by a somewhat denser band in the red scaling; subterminal band sometimes present, but obscure. Expanse 1\textfrac{1}{4}–1\textfrac{5}{8} inches.

Male Genitalia.—Uncus narrow, almost as long as in obfirma; left branch of furca stout, somewhat blunt, ending in many pointed processes, the longest ones at the tip, and gradually becoming shorter along the edges below, not tufted; right branch similar to left branch, but shorter, narrower, and sharper.

Female Genitalia.—Similar to warneri, but with the genital
plate much narrower. Too much significance should not be attached anywhere in this genus to apparent differences in the genital plate, since, in the processes of dissection and mounting, it may assume various positions and manners of folding.

Egg.—Yellow, soon turning orange red; not attached to any surface.

Larva, first stage.—Black with only five bands of white spots, the usual sixth one being missing, or at most showing as a faint dot or two on each side; under side uniformly dark; face dark.

Mature Larva.—About 1½ inches long; moderately stout; medium to dark brown, with various types of mottling, but never, so far as I have seen, with patches of red. A more or less distinct pale line extends the entire length on the upper side, but no stripes show underneath. The eleventh segment has two rather prominent tubercles, each tipped with a single bristle. I have found choke cherry an excellent food for larvae of this species, as well as for all the other species of the genus that I have bred. They seem quite willing to take almost any of the Rosaceae, and probably have a rather wide range of food among other trees and shrubs. Dr. McDunnough has reared this species on both blueberry and linden.

Daaria is apparently the most variable in color and distinctness of maculation, the most common, and the most widespread species of Metarranthis, ranging in some form or another from the Atlantic to the Pacific in southern Canada and northern United States, as far south as North Carolina in the east, Indiana and Illinois farther west, and Colorado in the mountain region. I have seen Pacific coast specimens only from British Columbia, Vancouver Island, and Washington. Specimens from the western mountains and coast, and from Canada, are in general referable to the race septentrionaria Barnes and McDunnough. The red form hamaria Guenée seems so completely to intergrade with other forms that I cannot define its limits. Hence I consider it better placed in the synonymy.

Metarranthis duaria, race septentrionaria
Barnes and McDunnough

Metarranthis septentrionaria B. and McD., Contrib. to the Nat. Hist. of the Lepid. of N. A. III, 257; Plate XXIX, Fig. 2, ♂;
Fig. 3, ♂; Plate XXXIII, Fig. 2 (♀ genitalia). 1916.

Distinguished from typical *duaria* by the distinct reddish brown shade preceding the postmedial line on the upper side often more or less covering the median area; by the tendency of the postmedial line to be more sharply defined, not so likely to be incomplete or broken at the veins, and more likely to be followed by a paler line. It is the regular form of *duaria* from the western mountains eastward across Canada to Quebec and the New England states, where it mixes with typical *duaria*.

Barnes and McDunnough mentioned slight differences between the male genitalia of *septentrionaria* and those of *duaria*, but I find these differences difficult to discover, and insufficient to have much significance. They are no greater than the differences frequently found in specimens from the same locality.

**Metarranthis angularia** Barnes and McDunnough

*Metarranthis angularia* B. and McD., Contrib. to the Nat. Hist. of the Lepid. of N. A. III, 258; Plate XXIX, Fig. 7, ♂; Fig. 8, ♀; Plate XXXIII, Fig. 3 (♀ genitalia). 1916.

Basal and terminal areas of fore wings, and terminal area of lower wings, reddish brown, about the color of the reddest *duaria*; median area of all wings and basal area of lower wings, much paler yellowish red, coarsely flecked with red and brown scales; antemedial line much as in *duaria*, but redder; postmedial line variable in width, continuity, and completeness, as in *duaria*, more likely to be completely missing than in *duaria*, redder, more angulate, and less in contrast with the terminal area; subterminal shade rarely conspicuous, but often indicated by a spot or two midway between costal and inner margins; discal spots as in *duaria*; fringes fully as red as terminal area. Under side heavily and coarsely flecked with red on a paler background, with no distinct transverse lines, but normally with the median area paler, as on the upper side. Occasional specimens, especially from the southern portions of its range, are much darker than the normal form. I have seen two males, one from Pennsylvania and one from Georgia, which are extreme in this respect, the upper surface being almost uniform dark brown, with the pattern very obscure. Such specimens, however, are not much darker underneath than the normal form. Expanse 1½–1¾ inches.
Male Genitalia.—Similar to *duaria* except in the structure of the furca; left branch of furca long, bluntly rounded, with the longest pointed processes below the tip, which is equipped with a tuft of fine hairs; right branch shorter, sharper, with long pointed processes at the tip, and an irregular series of shorter ones, and a few hairs, below.

Female Genitalia.—Quite similar to those of *duaria*, but usually with the bursa considerably longer.

Egg.—Similar to that of *duaria*.

Larva, first stage.—Dark slaty gray, not so intensely black as in the preceding species, with six bands of white spots, wider than the bands of *duaria*. There is a trace of still another such band between the second and third thoracic segments, and the eleventh segment has a few white spots.

Mature Larva.—About 1½—1⅛ inches long; brown, less mottled than that of *duaria*, generally grayer, with the characteristic pale longitudinal stripe along the back, and a tendency toward dark, but obscure, longitudinal stripes underneath. The tubercles on the eleventh segment are slightly smaller than those of *duaria*. Food, wild cherry and other *Rosaceae*, and probably other trees and shrubs.

In spite of its wide range, from Quebec to Georgia, and westward at least as far as Illinois, *angularia* is much less common in collections than *duaria*. It has been confused with *duaria*, but is readily separable by the paler median area, by the coarser "pebbled" appearance of the darker flecking, by the more angulate postmedial line, and usually by the ruddier coloring.

*Metarranthis franclemonti* new species

Upper surface reddish gray to gray-brown, females sometimes almost neutral gray; antemedial line distinct, reddish, somewhat curved at each end; postmedial line bright reddish to reddish brown, distinct, uniform in width, complete, not interrupted at the veins, outcurved with a slight angulation at vein M₂ of the fore wings, more distinctly angulate on the lower wings; below this angulation, more strongly curved inward and upward than in *duaria*; never preceded nor followed by paler lines or darker shades, although in some specimens the entire median area is paler than the rest of the wings. (In the females the postmedial line is less constant than in the males, occasionally being incomplete, broken at the veins, and heavier along the lower half of each wing. Such females are very similar in appearance to the normal females of *duaria*, but can usually be distinguished by the
angulation of the postmedial line, especially on the lower wings.) Subterminal shade sometimes absent, but usually distinct, occasionally becoming so pronounced in the females as to form a contrasting dark brown band across all four wings; discal spots small, distinct, reddish brown, usually present on all four wings; fringes concolorous with the terminal area. Under side similar to *duaria*, but usually more heavily flecked with red, and with a more distinct postmedial line. Expanse 1 1/4–1 1/2 inches.

**Male Genitalia.**—Uncus a little shorter and more spatulate than in *duaria*; furca, symmetrical; both branches ending in a sharp, slightly hairy point.

**Female Genitalia.**—Distinguished from *duaria* and *angularia* by the much smaller pocket-like formations beside the ostium; from *obfriraria* by the kidney-shaped form of these processes. The genital plate is wider, constricted at the middle as in *warneri*, but smaller and much less conspicuous than in that species. The bursa is longer than in *duaria*, averaging almost as long as in *angularia*.

**Egg.**—Similar to that of *duaria*, yellow, soon turning red, less intense than the red of *hypochraria* eggs, but not so orange as in *duaria*; scattered loose.

**Larva, First Stage.**—Black, with six bands of white spots, of approximately equal width. The head and prolegs are dark.

**Mature Larva.**—About 1–1 1/4 inches long, similar in color and variable mottling to the larva of *duaria*, but usually darker, and often, but not always, showing patches of bright reddish brown on the upper side; longitudinal pale stripe along the back as in *duaria* and *angularia*; dark longitudinal stripes on the under side of the first two abdominal segments only; tubercles on the eleventh segment smaller than in *duaria* and *angularia*. I have successfully reared three lots of larvae on choke cherry, but since the species seems to be restricted in distribution to isolated acid soil localities, I suspect the preferred food is something else, possibly *Aronia* or *Vaccinium*.

*Franclemonti* seems to be rather common in the proper acid soil localities where it flies along with *obfriraria*. It occurs on the bogs at Passadumkeag, Me., and McLean, N. Y., on the dry hills around Horseheads, N. Y., in the pine barrens around Lakehurst, N. J., and I have seen a few specimens from other localities, the most westerly one from Hessville, Ind.

This species is quite variable, and can easily be confused with both *duaria* and *angularia*. From *duaria* it is most easily separated by the ruddiness and the greater angulation of the postmedial line, and usually by the uniformity and continuity of this line. From *angularia* it can be distinguished by the uniform postmedial line, by the powdery, rather than "pebbled," appearance of the red scaling, and usually by the median area, which is not noticeably paler than the rest of the wings except in ocea-
sional specimens, usually from the New England States. I suspect that Packard’s figure of *duaria* is based on this species, but, like most drawings, it is too inaccurate for certain determination.

**Holotype.**—♂, Lakehurst, N. J., June 4 (Frederick Lemmer). In U. S. N. M. collection.

**Allotype.**—♀, Lakehurst, N. J., June 11 (Frederick Lemmer). In U. S. N. M. collection.

**Paratypes.**—7 ♂♂, 10 ♀♀, Lakehurst, N. J. (Frederick Lemmer); 44 ♂♂, 23 ♀♀, Horseheads, N. Y. (L. R. Rupert); 6 ♂♂, 2 ♀♀, Passadumkeag, Me. (A. E. Brower); 1 ♂, Bar Harbor, Me. (A. E. Brower); 1 ♂, Hampton, N. H. (S. Albert Shaw); 1 ♂, McLean Res., Tompkins Co., N. Y. (J. G. Franclemont); 1 ♂, Mt. Asnebhumskit, Paxton, Mass. (W. T. M. Forbes); 1 ♂, Mt. Wachusett, Princeton, Mass., above 1500 ft. (W. T. M. Forbes). Field specimens are all May and June records. Part of the Lakehurst and Horseheads specimens are bred specimens (April and May). These 97 paratypes are variously distributed in the U. S. N. M., Cornell University, Brower, Buchholz, Franclemont, and Rupert collections.

This species is named in honor of Lieutenant J. G. Franclemont, whose private collection, embracing long series of some of the species, has been completely available to me, and whose cooperation and assistance have been of greatest value to me in this work.

**Metarranthis apiciaria** (Packard)

*Endropia apiciaria* Packard, Mon. of Geom. Moths, 502; Plate XII, Fig. 9. 1876.

Upper surface pale yellowish gray; antemedial line of fore wings indistinct, sometimes almost obsolete, followed by an obscure slightly darker shade; postmedial line straighter than in any of the preceding species, brown, preceded by narrow reddish brown shade, with a sprinkling of this color throughout the median area; discal spots brown, distinct and usually present; subterminal shade rather inconspicuous when present at all; fringes reddish brown, at least at the base, and contrasting with the pale terminal area; outer margins of wings scarcely angulate. Under side pale gray with a variable scattering of yellow scales; postmedial line broad, bright reddish yellow. Expanse 1\(\frac{1}{8}\)–1\(\frac{3}{8}\) inches.
MALE GENITALIA.—Uncus shorter than in any of the preceding species, somewhat spatulate, bluntly pointed; left branch of furca moderately long, rather wide at the base, and tapering to a single fine sharp point, very slightly hairy; right branch similar but shorter. Both branches have a peculiar sinuate form not seen in any other species of the genus.

FEMALE GENITALIA.—Genital plate wide, not constricted in the middle, strongly upturned and pointed at the ends; pocket-like formations large, very ragged along the inner edge.

I have no knowledge of the early stages.

Apiciaria is apparently one of the less common species of Metarranthis in collections but it is known to occur in Maine, Massachusetts, Rhode Island, and New York, and even as far west as Indiana. Structurally it is a very distinct species, and seems, in general, intermediate between the obfirmaria group, comprising the preceding five species, and the hypochraria group, comprising the following five species.

Metarranthis pilosaria (Packard)

Endropia pilosaria Packard, Mon. of Geom. Moths, 501; Plate XII, Fig. 8. 1876.

Upper surface rich brown; antemedial line of fore wings darker but rather obscure; postmedial line evenly curved, not distinctly angulate, preceded by a darger shade and followed by a paler line; discal spots small but distinct on all four wings; subterminal row of dark spots usually present; outer margins of wings curved without obvious indentations between the veins. Under side orange red to brick red, not obviously flecked; postmedial line narrow, dark brown, followed by a purplish shade. In general pilosaria is the stoutest and heaviest species of Metarranthis. Expanse 1½—1¾ inches.

MALE GENITALIA.—Wider, with rounder valves than apiciaria; left branch of furca very stout, blunt, strongly recurved at the tip, with many sharp, pointed processes, mixed with some hair; right branch similar, but shorter and sharper.

FEMALE GENITALIA.—Unlike any of the preceding species in that they lack the pocket-like formations beside the ostium. The genital plate is wide, uniform in width, and rounded at the ends.

EARLY STAGES.—For what I know of these I am indebted to
the late Mr. Frederick Lemmer who sent me a single full grown larva from Lakehurst, N. J. This larva resembles that of *hypochraria* in shape and structure, but is of a completely uniform dark brown color without mottling or stripes. Mr. Lemmer also wrote regarding the newly hatched larva that it "has 6 rings white, the last one about twice as wide as the rest, and the first one further away from the head than the space between the others." He reports white birch as the food.

All the specimens I have seen of *pilosaria* have come from New Jersey, but it probably has a wider range.

**Metarranthis lateritiaria** (Guenée)


The identity of *lateritiaria* has been one of the most puzzling questions in connection with the study of the genus. The type is supposedly in the Paris Museum and hence at present quite inaccessible. I have examined a photograph of it in the United States National Museum, and have carefully studied Guenée’s description, which is none too definite. Either of two conclusions seems reasonable. One is that the name *lateritiaria* is properly applicable to the species described by Packard as *pilosaria*; the other, which I am tentatively accepting, is that it applies to the species described below, which has commonly passed as *lateritiaria* in collections.

Upper surface usually redder than *pilosaria*, postmedial line somewhat variable in the degree of angulation, more angulate than in *pilosaria*, less so than in any of the three following species; subterminal shade present, distinct, quite uniform in width and intensity. Beyond the subterminal shade the wings are paler, often giving the effect of a pale border across all four wings, with the veins finely outlined darker. Under side, somewhat paler than *pilosaria*, smooth orange red, very sparsely flecked darker, and with the dark brown and purple postmedial line more sharply defined. The moths average smaller and slighter than *pilosaria*, and are quite variable in the depth of the marginal indentations between the veins. In the specimen figured they are quite deep; but in other specimens the margins
are as even as in pilosaria; more often they are intermediate between the two. Expanse 1–1\(\frac{1}{4}\) inches.

**Male Genitalia.**—Uncus short and spatulate as in the two preceding species; left branch of furca variable in length, sometimes no longer than the right branch; both branches rather sharp with few pointed processes, at the tips only. The two or three processes at the tips are long and slender, accompanied by little or no hair.

**Female Genitalia.**—Similar to those of pilosaria.

I have seen this species from Maine, New Jersey, and intermediate localities, but its range does not apparently extend far inland. It appears to be partial to acid soil localities. The early stages are quite unknown to me.

**Metarranthis homuraria** (Grote)

*Endropia homuraria* (G. and R.), Walker, Can. Ent. IX, 89. 1877.  
*Endropia homuraria* (G. and R.), Grote, Papilio II, 100. 1882.  

Upper surface similar to lateritiaria in general color; postmedial line narrow, dark brown, and usually very distinct, with angulations much sharper than in lateritiaria, often sharper than are usual in hypochraria, not always followed by a paler line; subterminal shade inconspicuous and irregular, sometimes indicated merely by a dark smudge adjacent to the angulation of the postmedial line of the fore wing, and making this angulation appear more extreme than it really is; marginal indentations between the veins deeper than in any other species of the genus. Under side similar to lateritiaria.

**Male Genitalia.**—All the male genitalia examined (three in number, from different localities) have the furca symmetrical, with moderately sharp points, both branches tipped with a closely packed cluster of the ordinary pointed processes mixed with a considerable amount of hair. One specimen shows a trace of several other very short pointed processes along the edges just below the tips.
Female Genitalia.—The three female genitalia examined all show at each side, above the ends of the genital plate, a fold not found in any other species examined. There also seems to be a vague trace of the pocket-like formations beside the ostium in two of the specimens examined.

I know nothing of the early stages of homuraria. It seems more southern in range than any other Metarranthis, all the specimens I have seen having come from an area extending from Virginia to Georgia, and west to Tennessee and Mississippi. Strecker’s type of amethystaria is from Florida.

Metarranthis hypochararia (Herrich-Schäffer)


Endropia hypochararia (H.-S.), Packard, Mon. of Geom. Moths, 504; Plate XII, Fig. 12. 1876.


Endropia hypochararia (H.-S.), Hulst, Ent. News VI, 15. 1895.

Gonodontis hypochararia (H.-S.), Holland, Moth Book, 350; Plate XLV, Fig. 1, ♂. 1903.

Entire upper surface of wings, grayish brown varying in intensity and ruddiness; antemedial line of fore wings distinct, curved, dark brown, followed by a darker shade; postmedial line distinct, dark brown, sharply angulate at vein M₂ of fore wings, correspondingly angulate on lower wings, preceded by a dark brown shade. (Actually this postmedial line is a double line, the two lines practically superimposed except near the angulation, where the inner line is curved, and the outer line forms the angulation. Ordinarily the dark shade completely obscures the inner
line, but in occasional pale specimens, usually females, both lines are distinctly visible.) Subterminal shade of dark spots more or less distinct but usually not conspicuous; fringes concolorous with terminal area, often darker at the ends of the veins; discal spots blackish, distinct on all four wings; outer margin of all wings somewhat indented between the veins, more in some specimens than in others. Under side pale gray or yellowish, usually considerably flecked with deeper yellow or rusty red; postmedial line usually distinctly double, the inner line reddish brown and curved, the outer one purplish and angulate. A very red form of this species is seen occasionally, which strongly resembles homuraria, but is distinguishable by the less deeply indented wing margins, the smoother and less mottled appearance of the upper side, and by the difference in the coloring of the under side, which in hypochraria consists of red scales on a pale yellowish background, which is sometimes almost, but never completely, covered with the red scales, while in homuraria the background is red and the sparsely scattered scales are dark brown or purplish. Expanse 1½-1¾ inches.

Male Genitalia.—Uncus of medium length, somewhat spatulate but bluntly pointed; valves rounded with a slight excavation, or at least a straightening of the margin along the upper part of the outer edge; left branch of furca variable in length but longer than the right in all cases observed, rounded at the tip, with a fringe of many sharp pointed processes at the tip and for some distance along the edges below. These processes are longer than in any other species of this group except lateritiaria, and much more numerous than in that species. There are often a few hairs visible among these processes, but no distinct tuft. Right branch of furca shorter and sharper, similarly fringed with pointed processes, the two or three at the tip being longest.

Female Genitalia.—Similar to pilosaria.

Egg.—Similar to other species, laid singly and attached to the surface of leaves or stems. After two or three days they turn bright carmine.

Larva, first stage.—Black, with six bands of white spots, the first one slightly narrower than the others.
Mature Larva.—About 1½ inches long, more slender than the larvae of the *obfirma* group, dark brown, inconspicuously mottled, and bearing two small pale oval spots, side by side, on the upper side of the fifth segment. The eleventh segment has the two usual tubercles rather prominent. Underneath there are three indistinct discontinuous longitudinal darker stripes, extending from the first abdominal segment to the prolegs on the ninth segment. The outer stripes spread farther apart just before the middle of each segment, and the inner stripe widens accordingly. The face is speckled black on pale gray, and bordered grayish white. Larvae of this species seem subject to very little variation in color and pattern, at least in western New York. They will eat various *Rosaceae*, and seem to do particularly well on choke cherry. I have seen a series bred by Dr. McDunnough upon blueberry.

Range.—Quebec to North Carolina and westward at least to Illinois and Wisconsin.

*Metarranthis broweri* new species


Upper surface yellowish gray, varying in intensity, but rarely as dark as the palest *hypochraria*, and usually much paler; general pattern of the upper side similar to *hypochraria*; subterminal shade of yellowish brown spots usually present across all four wings. Fringes concolorous with terminal area, rarely darker at ends of veins, as shown in the male illustrated. Under side pale gray with a flecking of yellowish scales; dark transverse lines entirely missing or indicated only by a few brown or purple scales scattered along a paler band where the yellow flecking is interrupted; size and wing form similar to *hypochraria*.

Male Genitalia.—Similar to those of *hypochraria* except in the structure of the furen, which has much shorter pointed processes at the tip of each branch, and a distinct tuft of fine hairs at each tip, more prominent on the left branch than on the right one. There seems to be great variation in the length of the left branch of the furen, which is sometimes longer than in any *hypochraria* examined, and in other specimens no longer than the right branch. In this latter case, the male genitalia of this species strongly resemble those of *homuraria*, but the moths are so unlike in appearance that there is little danger of confusing them.

Female Genitalia.—Quite similar to those of *hypochraria*. 
Egg.—Similar to that of *hypochraria*, and similarly attached.

Larva, First Stage.—Similar to that of *hypochraria*, but with the first white band equal in width to each of the others. The head and prolegs tend to be whiter than in *hypochraria*, or in *franclemonti*.

Mature Larva.—About 1½ inches long, varying in color from pale straw yellow through rusty red to light molasses brown, sometimes with an elaborate pattern of markings on the upper side, or with a single dark stripe, or with no obvious pattern whatever. A great variety of colors and patterns sometimes occurs in the same lot of larvae, but I have rarely seen any as dark as the ordinary *hypochraria* larva. The pattern of the under side seems quite constant, its most prominent feature being five distinct, unbroken, longitudinal dark stripes, the two outer ones close together and of quite uniform width and intensity, the middle one wider and less uniform. I have successfully reared several lots of larvae on wild cherry. Dyar reported that they would eat persimmon, sassafras, and apple, but that they refused oak.

*Broweri* has consistently been mixed with *hypochraria* in collections, but it is very distinct not only in appearance, larva, and structure of male genitalia, but even in habits. In localities in western New York where both species are common, *broweri* appears regularly on the wing ten days or two weeks earlier than *hypochraria*. When I have kept pupae of both species over winter under identical conditions, the earliest *hypochraria* to emerge has always been later than the last *broweri*. For some time after I had become aware of the distinctness of the two species I had suspected the pale species of being *refractaria* Gn., but an examination of Guenée’s type convinced me that that type is just what it has been reported, a pale and rubbed *hypochraria*.

Holotype.—♂, Richmond Gulf, Sardinia, N. Y., May 29, 1938 (L. R. Rupert). In U. S. N. M. collection (ex Rupert coll.).

Allotype.—♀, Horseheads, N. Y., June 5, 1939 (L. R. Rupert). In U. S. N. M. collection (ex Rupert coll.).

Paratypes.—9 ♀♂, Sardinia, N. Y.; 37 ♀♂, 28 ♀♀, Horseheads, N. Y.; 37 ♀♂, 10 ♀♂, Ithaca, N. Y.; 2 ♀♀, Newtown Battlefield State Park, Chemung Co., N. Y.; 7 ♀♀, McLean Res., Tompkins Co., N. Y.; 1 ♀, 1 ♀, Rock City, N. Y.; 1 ♀, Crosby, N. Y.; 1 ♀, Black Brook, N. Y.; 1 ♀, 2 ♀♀, Bear Mt., N. Y.; 1 ♀, Mansfield, Pa.; 1 ♀, New Brighton, Pa.; 1 ♀, East New York, L. I.; 1 ♀, Plainfield, N. J.; 2 ♀♂, Orange Mts., N. J.; 1 ♀, 1 ♀, Passadumkeag, Me.; 1 ♀, Jefferson, Me.; 2 ♀♀, Augusta, Me.; 1 ♀, Crystal Bog,
Me.; 1♀, Chelsea, Ottawa Co., Quebec. Dates of field specimens range from May to early July; part of the Horseheads series are bred specimens in April. These 151 paratypes are variously distributed in the U. S. N. M., Cornell University, Brower, Buchholz, Franclemont, and Rupert collections.

This species is named in honor of Dr. A. E. Brower whose cooperation and assistance in supplying material for examination have been of great value in the preparation of this article.

I desire at this time also to express my appreciation of the assistance given by others, not previously mentioned, who have helped in this work, particularly Dr. W. T. M. Forbes of Cornell University, Mr. Otto Buchholz of Roselle Park, N. J., Dr. J. H. McDunnough of the Canadian National Museum, Mr. A. K. Wyatt of Chicago, Ill., and Mr. Paul Bruggemann of Furness, Sas’k.

**KEY TO THE SPECIES OF** *METARRANTHIS*

1. Postmedial line preceded by a distinct dark shade on upper side ........ 2
   Postmedial line not preceded by distinct dark shade on upper side .... 9

2. Postmedial line sharply angulate at vein M₂ of fore wings ........... 3
   Postmedial line bluntly angulate, at or just below vein M₂ of fore wing,
   or with a slight outward curvature at this position only ........... 5
   Postmedial line not angulate (may be almost straight or curved through-
   out its entire length) ................................................................ 7

3. Under side of wings smooth bright orange red with brown and purple
   lines and a scattering of dark brown or blackish scales.
   *homuraria* Grt.
   Under side not red; or, if red, only flecked or streaked with rusty scales
   on a paler background ................................................................ 4

4. Postmedial line distinct on under side, brown and/or purple.
   *hypochraria* H.-S.
   Postmedial line of under side absent or very obscure; entire moth pale.
   *broweri* new species

5. Under side of wings smooth bright orange red, with brown and purple
   lines and a scattering of dark brown or blackish scales.
   *lateritiaria* Gn.
   Under side not red; or, if red, only flecked with rusty scales on a paler
   background .................................................................................. 6

6. Upper surface light grayish brown, with contrasting darker pattern.
   *warneri* Harv.
   Upper surface smoky brown, with less contrasting pattern.
   *warneri* race *eappsaria* new race
7. Under side of wings bright uniform red, dark brown and purple transverse lines .................................................. pilosaria Pack.
Under side not red; or, if red, only flecked with rusty scales on a paler background .................................................. 8

8. Upper side pale yellowish gray; fringes darker, at least at the base; postmedial line almost straight .................................. apiciaria Pack.
Upper surface somewhat darker; fringes not contrasting; postmedial line strongly curved .......................... duaria race septentrionaria B. & McD.

9. Median area of all wings about the same color as rest of wings .................................. 10
Median area distinctly paler than rest of wings .................................. 11

10. Postmedial line uniform in width on all wings, complete, continuous, reddish, slightly angulate on all wings ........... franclemonti new species
Postmedial line broader near, but not at, inner margins of all wings, and/or incomplete, and/or broken at the veins, smoothly curved, grayish brown .................................................. duaria Gn.

11. Postmedial line straight, median area more or less bright orange yellow, basal and terminal areas of fore wings dark brown ...... obfirmaria Hbn.
Postmedial line curved or somewhat angulate .................................. 12

12. Both upper and lower surfaces of wings coarsely flecked with darker scales, giving the wings a speckled appearance .... angularia B. & McD.
Wings very finely flecked with darker scales, having a smoother, powdery appearance .................. franclemonti new species (an occasional specimen)

KEY TO THE SPECIES OF METARRANTHIS, BASED ON MALE GENITALIA

1. Both branches of furca ending in a single sharp, slightly hairy point .......................... 2
Both branches of furca tipped with more than one pointed process .................................. 3

2. Furca symmetrical .................................................. franclemonti new species
Left branch of furca much longer than right branch; both branches sinuate .................. apiciaria Pack.

3. Uncus distinctly spatulate, rather short .................................. 4
Uncus longer, and of more nearly uniform width .................................. 8

4. Furca with little or no hair at tips .................................. lateritaria Gn.
Furca with considerable hair at the tips .................................. 5

5. Left branch of furca strongly recurved at tip .................................. pilosaria Pack.
Left branch of furca only slightly curved at tip, or quite straight .................. 6

6. Furca symmetrical .............. homuraria Grt. (very rarely broweri new species)
Left branch of furca longer than right .................................. 7

7. Pointed processes long, with scattered hair .................................. hypochraria H.-S.
Pointed processes short, with hair usually in a distinct tuft, at least at tip of left branch .................................. broweri new species

8. Left branch of furca with distinct hair tuft; right branch with some hair .................................. angularia B. & McD.
Both branches of furca without hair at tip .................................. 9

9. Both branches with many pointed processes both at the tips and along the edges below .................................. duaria Gn.

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Pointed processes at the tips only .......................................................... 10
10. Two very sharp slender pointed processes, close together, at tip of each
    branch ............................................................................................... warneri Harv.
    Two shorter, stouter pointed processes, somewhat separated, at each tip,
    and often with a trace of other still shorter, blunter ones.

    obfirmaria Hbn.

Plate VII

Figure 1. *Metarranthis obfirmaria* Hbn., male genitalia; 1a, detail of left
    furca tip; 1b, detail of right furca tip; 1e, aedeagus.

Figure 2. *Metarranthis warneri* Harv., male genitalia; 2a, detail of left
    furca tip; 2b, detail of right furca tip.

Figure 3. *Metarranthis duaria* Gn., male genitalia; 3a, detail of left furca
    tip; 3b, detail of right furca tip.

Figure 4. *Metarranthis angularia* B. & McD., male genitalia; 4a, detail of
    left furca tip; 4b, detail of right furca tip.

Figure 5. *Metarranthis franclemonti* new species, male genitalia; 5a, detail
    of left furca tip; 5b, detail of right furca tip.

Figure 6. *Metarranthis apiciaria* Pack., male genitalia; 6a, detail of left
    furca tip; 6b, detail of right furca tip.

Figure 7. *Metarranthis lateritiaria* Gn., male genitalia; 7a, detail of left
    furca tip (two drawings); 7b, detail of right furca tip.

Figure 8. *Metarranthis homuraria* Grt., male genitalia; 8a, detail of left
    furca tip; 8b, detail of right furca tip.
PLATE VIII

Figure 1. *Metarranthis pilosaria* Pack., male genitalia; 1a, detail of left furca tip; 1b, detail of right furca tip.

Figure 2. *Metarranthis hypochraria* H.-S., male genitalia; 2a, 2b, details of left furca tips; 2c, 2d, details of right furca tips.

Figure 3. *Metarranthis broweri* new species, male genitalia; 3a, 3b, details of left furca tips; 3c, 3d, details of right furca tips.

Figure 4. *Metarranthis obfirmaria* Hbn., female genitalia.

Figure 5. *Metarranthis warneri* Harv., female genitalia.

Figure 6. *Metarranthis duaria* Gn., female genitalia.

Figure 7. *Metarranthis angularia* B. & McD., female genitalia.

Figure 8. *Metarranthis franelementi* new species, female genitalia.

Figure 9. *Metarranthis apiciaria* Pack., female genitalia.

Figure 10. *Metarranthis pilosaria* Pack., female genitalia.

Figure 11. *Metarranthis lateritiaria* Gn., female genitalia.

Figure 12. *Metarranthis homuraria* Grt., female genitalia.

Figure 13. *Metarranthis hypochraria* H.-S., female genitalia.

Figure 14. *Metarranthis broweri* new species, female genitalia.
Plate IX

Figure 1. *Metarranthis hypochraria* H.-S., ♀ (Horseheads, N. Y.).
Figure 2. *Metarranthis homuraria* Grt., ♀ (Richmond, Va.).
Figure 3. *Metarranthis apiciaria* Pack., ♂ (Elmwood, R. I.).
Figure 4. *Metarranthis warneri* Harv., ♀ (Augusta, Me.).
Figure 5. *Metarranthis warneri* race *cappasia* new race, ♂ Holotype (Ben- lah, Man.).
Figure 6. *Metarranthis broweri* new species. Larvae (Augusta, Me.).
Figure 7. *Metarranthis broweri* new species, ♂ (Horseheads, N. Y.).
Figure 8. *Metarranthis broweri* new species, ♀ (Horseheads, N. Y.).
Figure 9. *Metarranthis franelmonti* new species, ♂ (Horseheads, N. Y.).
Figure 10. *Metarranthis franelmonti* new species, ♀ (Horseheads, N. Y.).
Figure 11. *Metarranthis angularia* B. & McD., ♂ (Ithaca, N. Y.).
Figure 12. *Metarranthis obfirmaaria* Hbn., ♂ (Horseheads, N. Y.).
Figure 13. *Metarranthis lateritiaria* Gn., ♀ (Kittery Point, Me.).
Figure 14. *Metarranthis pilosaria* Pack., ♂ (Lakehurst, N. J.).
Figure 15. *Metarranthis duaria* Gn., ♂ (Horseheads, N. Y.).
Figure 16. *Metarranthis duaria* race *septentrionaria* B. & McD., ♀ (Aylmer, Que.).
Figure 17. *Metarranthis franelmonti* new species. Larvae (Horseheads, N. Y.).
BOOK NOTICE


This impressive book, embracing the results of many years’ work by a recognized authority, should be of interest to entomologists as it is the first comprehensive monograph on the subject that has appeared since Charles Darwin’s “Insectivorous Plants” of 1875. In fifteen chapters Professor Lloyd summarizes the history and present knowledge of insectivorous plants of which there are approximately 450 species in fifteen genera.

The treatment includes the geographical distribution of species and genera, habitats, general characters, morphology, anatomy and histology of certain plant parts, digestion and absorption of the prey and references to the literature. In addition the insect associates of certain carnivorous plants are mentioned at some length.

It is the trapping mechanisms that are of absorbing interest and the author, beginning with the pitfalls or passive traps of the pitcher plants, leads up to the active, complex and extraordinarily perfect trap of Utricularia, which he compares to an “elaborate, automatic, self-setting” mouse trap, including a disposal plant, which works in any position and at the same time under water.

Of extreme interest, are other devices such as viscid secretions, special glands, sensitive hairs and tentacles, waxy secretions, and the trapping loops, swelling ring cells and sticky discs of certain carnivorous fungi whereby eel worms, Amœba, etc., are captured. Professor Lloyd not only describes in detail these special organs for the capture and digestion of animal prey but also the plants as a whole, giving one an accurate and well balanced account of their variety and behavior. In our entomological texts, insectivorous plants get scanty attention in spite of the fact that this particular type of relationship between plants and insects is of extraordinary interest. I am glad to recommend this book to the attention of entomologists. It is a fascinating, scientific monograph with numerous, excellent, and mostly original illustrations. It deserves a place in every entomologist’s library.—H. B. WEISS.
NOTES ON MEXICAN BUTTERFLIES, I, PAPILIONIDÆ

By F. Martin Brown
Colorado Springs, Colorado

In recent years three collections of Mexican butterflies have come into my hands. These are specimens collected by the Second and Third Hoogstraal Expeditions in 1939 and 1940 and those collected by R. W. L. Potts in 1941. These collections supplement each other rather nicely. Potts’ material was collected earlier in the year than Hoogstraal’s, the former in April and May, the latter in June, July and August. Both parties collected down the main highway from Texas to Mexico City crossing country that until recently has been almost tierra incognita so far as its fauna is concerned. Potts collected the hot lowlands of both coasts and across the highlands on a line from Vera Cruz to Acapulco. Hoogstraal concentrated in the state of Michoacan and the western slopes. Neither penetrated the tropical lowlands in Southern Mexico.

Because the areas visited are those in which we might expect to find a residuum of the early North American Fauna forced southward by the Pleistocene period they are of particular interest to zoo-geographers. This is the only valid reason I have for presenting the data concerning these collections. Accurate data it not available in the literature for much material from the regions visited. The two collections contain 23 species of Papilio. I am using the numbers assigned the species in Hoffman’s list and giving references to three works only, Godman & Salvin (2) (G. & S.), Rothschild & Jordan (3) (R. & J.) and Jordan in Seitz’ (4) (J.). All three contain citations of the original description, etc.

Geographic Data
Acapulco, Guerrero, 16° 50' N., 99° 55' W., 100 ft.—
"It was still awfully dry here. (May). It’s normally dry country but it blooms quite a bit when the rainy season does hit."
September is supposed to be the best month in Acapulco for flowers . . . probably for insects, too.” Potts.

Apatzingan, Michoacan, 19° 10' N., 102° 20' W., 1050 ft.—

“Nowhere is there a humid tropical jungle, but along the Rio Tepaleatepec, at the spring of La Majada, around the swamps of Hda. California, and often bordering permanent and semi-permanent streams, the tropical deciduous forest is well developed. Leguminous and other thorn-studded trees from the more arid semi-desert are always present in these forests. . . . The deciduous forests away from the river are more arid in general aspect . . . tall fig trees (Ficus) are usually dominant. . . . Just north of Apatzingan . . . is a semi-desert with very widely scattered trees. . . .” Hoogstraal.

Arroyo del Calabezas, San Luis Potosi, 250 ft.—

“Slightly more open country, somewhat drier (than El Bañito, q. v.), with fields of grass dotted with acacias sparingly scattered through the ‘‘jungle’’ part of the region. . . . A single swing would have netted literally hundreds of yellows, mostly eubule.” Potts.

Arroyo de Meca, Tamaulipas, ca. 24° N., 99½° W., 1320 ft.—

“Cultivated slope, tall, undisturbed thorn bush on one side of road and along stream which was fairly large. Clayey, moist, butterflies at mud along stream.” Potts. Between Villagran and Victoria.

Chilpanzingo, Guerrero, ca. 17° 30' N., 99° 30' W., 1500 ft. ??

“Dry country . . . Thorn bush etc. but fairly decent cultivated ground . . . apparently at least more rain than to the south.” Potts.

El Bañito, Valle, San Luis Potosi, 22° 00' N., 99° 00' W., 100–150 ft.—

“Tall tree jungle, plenty of underbrush and grass around the edges, lots of moisture, and plenty hot! Collected down a road, deep mud, and along a small stream, and again found lots of butterflies on the stonework underneath a bridge.” Potts.
El Pujal, San Luis Potosi  

"El Pujal and El Banito are about ten miles apart... The weather was very hot and sticky. The grass and trees were taller; fewer thorny plants than at Jacala, more leafy plants; dense, thick jungle with much undergrowth." Hoogstraal.

El Sabino, nr. Uruapan, Michoacan, ca. 19°1/2 N., 102° W.,  

I have no information about this station. F.M.B.

El Sol, nr. Tamazunchale, San Luis Potosi, 21° 20' N., 98° 40' W.,  

"El Sol is really just a tourist camp and a banana plantation on the highway at a small stream. It is in the midst of a heavy, thick jungle country, with several awfully muddy trails leading off to nearby Indian villages. It is a couple of miles north of Tamazunchale. Where an edge of the banana plantation came down to the stream was very good collecting, as was the open ground near the filling station where they were doing a lot of cement work. Cement water seemed to have a great attraction for everything but the Morphos and a very few others." Potts.

Fortin, Vera Cruz,  

"Collected (V.3) a field grown rank from a year or two without cultivation beside a little stream. Next morning (V.4) collected at the bottom of the barranca just north of town (Moctezuma Bridge)... This is the center of the gardenia and orchid country, lots of trees, jungle and yet plenty of cultivated land as well." Potts.

Galeana, Nuevo Leon, 24° 50' N., 100° 05' W., 6500 ft.—

"Dry arroyo, most of the collecting in the shade under the trees lining the stream bed, and under the bridge. The flies were startlingly thick on the stones and could frequently be picked off with tweezers. Tall and heavy brush, thick, tall grass along the roadside." Potts.

Hda. Vista Hermosa, Villa Hermosa, Nuevo Leon, 25° 30' N., 100° 21' W., 1500 ft.—

Hoogstraal's collections were made in a variety of habitats at this station ranging from open dry fields to damp ravines. Some
of the material was taken in the shady gorge near Horsetail Falls and in the nearby thicket. The party collected up to 3000 ft. along the trail to Las Adjuntas.

Iguala, Guerrero, 18° 20' N., 99° 35' W., 2100-2500 ft.—
"Dry hillside, apparently partly under cultivation in good years, or perhaps at another season, scattered thorn bush. Hot." Potts.

Jacala, Hidalgo, 21° 00' N., 99° 15' W., 5200 ft.—
"The vegetation is all low and dry, except in the ravines where most of the butterflies were taken. The *hycænidae* were caught at the edge of the open meadow. . . . The season was extremely dry, much more than usual." Hoogstraal.

Linares, Nuevo Leon, 24° 50' N., 99° 15' W., ?
I have seen no notes on this station. F.M.B.

Monterrey, Nuevo Leon, 25° 40' N., 100° 20' W., 1800 ft.—
Potts' description is for his station 4.5 miles north of the city.
"Bushy-vine' roadside, small acacias. Hot. It had rained the day before but it was already as dry as a bone. Very few flowers. Flat country, and apparently under cultivation a long time."

Ojo d'Agua, Vera Cruz, ca. 19° N., 97° W., 1600 ft.—
"This is undisturbed jungle along the sides of the hills that frame the Atoyac Valley. On the plains it has been intensively cultivated since before the 16th century. This spot is about 3 mi. from the Hda. Potrero Viejo. Collected the trail through about a mile of jungle, banana plantation and along a small stream at the edge of a cultivated field. The 'eye' by the way is the birthplace of the Atoyac River, 30 or 40 yards across and 10 or 15 feet deep." Potts.

Potrero Nuevo, Vera Cruz, ?
See Ojo d'Agua, which description applies equally well to this station.

Rio Blanco, Vera Cruz, ? 2200 ft.—
"Actually a couple of miles short of the crossing of the river by the Vera Cruz highway. An isolated patch of jungle, perhaps
100 acres or so surrounded by cane fields for the most part. It is an exceedingly fertile orchid hunting ground, penetrated only with a machete in parts. A stream along one edge. In spite of the isolation appears to have everything that is found in the region in abundance.'’ *Potts.*

Sabinas Hidalgo, Nuevo Leon, 26° 30’ N., 100° 10’ W., 960 ft.—

Collections were made up to 1500 feet. The country is semi-arid with shrub-bordered streams.

Santiago, Nuevo Leon, 25° 30’ N., 100° 10’ W., ?

I have no notes on this station. *F.M.B.*

Tancitaro, Michoacan, 19° 10’ N., 102° 20’ W., 6000 ft.—

“Suffice it to say here that this flora and fauna is almost wholly temperate (Nearctic) in aspect . . . pine-oak forest.’’ *Hoogstraal.*

Tule, Oaxaca, ca. 16° 45’ N., 96° 30’ W., 5000 ft.—

Near Mitla.

Victoria, Tamaulipas, 23° 45’ N., 99° 10’ W., ?

I have no data for this station. *F.M.B.*

Villagran, Tamaulipas, 24° 30’ N., 99° 30’ W., 1160 ft.—

“Collected in two arroyos, one fairly dry, the other with a pretty good stream. Still acacias, but a great deal more moisture here (than around Monterrey), grassy and fairly heavily underbrushed. Ground moist. Cultivated country nearby, but streams seem pretty well undisturbed. Big trees along the stream, and sort of meadowly along one side. More flowers, but butterflies not particularly attractive.’’ *Potts.*

**Papilioninæ**


G. & S. ii, p. 197.

R. & J. p. 444.

J. p. 13, pl. 1a.

El Sol, Tamazunchale, San Luis Potosi, 400 ft., 1 ♂ iv. 31.41, 9 ♂♂ 8 ♀♀ v.28.29.41 (R.P.).


Apatzingan, Michoacan, 1050 ft., 2 ♂♂ 1 ♀ viii.2.40 (H.H.).

El Sabino, Uruapan, Michoacan, 1 ♀ vii.15-30.35 (H. D. Thomas).

The material from the three eastern stations in San Luis Potosi is distinctly smaller than that from the western slope in Michoacan. The length of the left forewings measured from the center of the thorax to the apex for these two groups is presented in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
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<tr>
<td></td>
<td>No.</td>
<td>Mean</td>
</tr>
<tr>
<td>Eastern</td>
<td>13</td>
<td>37.3</td>
</tr>
<tr>
<td>Western</td>
<td>2</td>
<td>45.0</td>
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</table>

There are other differences between these two series. The tails of the eastern specimens tend to be longer than those of the western specimens, this is especially noticeable in the females. In this sex the tails are almost obliterated. The red spots of the western specimens are larger than those on the eastern specimens. In the case of the El Sabino ♀ they are very large and almost coalesce.

The condition of the eastern material ranges from practically fresh to badly battered in Potts' series. Those of Hoogstraal's are slightly worn. It looks as though a fresh brood emerges at the end of May. The western material is relatively fresh indicating a brood emerging at the end of July. The differences noted above may be brood differences or range differences. R. & J. (p. 445) suggest that the differences pointed out are related to north and south range, with the more boldly marked, short tailed specimens coming from the south. Michoacan is south of San Luis Potosi but I feel that east slope and west slope ranges may be a little more important to zoo-geography.
9. **P. arcas mylotes** Bates.

G. & S. ii, p. 198, pl. 65, f. 9, 9a.
R. & J. p. 504.
J. p. 19, pl. 5d.
Ojo d’Agua, Vera Cruz, 1600 ft., 1 ♀ v.12.41 (R.P.).

Of this station Potts says, “This is undisturbed jungle along the sides of the hills that frame the Atoyac Valley.” This is about as far north as the species flies. Salle took it at Cordoba, V. C. (G. & S. p. 199), not far distant from Potts’ station. Hoffman (p. 649) reports its Mexican range as “Tierras caliente y templado-cálida del Sur y Oriente del país.”—Tropics and sub-tropics of the South and East.—

10. **P. philenor** Linnaeus.

G. & S. ii, p. 204.
J. p. 20, pl. 6a.
Sabinas Hidalgo, Nuevo Leon, 960 ft., 1 ♀ vi.18.39 (H.H.).
35 km. W. of Linares, Nuevo Leon, 1 ♂ viii.7.39 (H.H.).
nr. Villagran, Tamaulipas, 1160 ft., 1 ♂ 1 ♀ iv.28.41 (R.P.).
El Sol, Tamazunchale, San Luis Potosi, 400 ft., 1 ♀ iv.30.41, 1 ♂ 1 ♀ v.28–29.41 (R.P.).
Tancitaro, Michoacan, 6586 ft., 1 ♂ vii.20.40 (H.H.).
Acapulco, Guerrero, 100 ft., 5 ♂♂ v.23–25.41 (R.P.).

None of these specimens has the tail reduced. They are the same “race” as is found in the eastern part of North America. Among some North American lepidopterists there has developed the idea that Mexican *philenor* are short-tailed and should be
designated "race" acauda Oberthür. (McDunnough lists acauda as a race in Mem. So. Cal. Acad. Sci., I, p. 5, 1938.) "Tailless" specimens from Mexico are just as rare as from the United States. There are two areas in Mexico where the tailless form is common: the Tres Marias Islands off the west coast of Nayarit where the form is designated philenor orsua Godman & Salvin; and in Yucatan where I have taken it only at Uxmal and at Valladolid where Gaumer took the type of corbis Godman & Salvin. If orsua is worth raising to subspecific status so is corbis. The Yuca-
tecan populations are unmixed. Whether Oberthür's name should be used for this population or not is debatable. His type specimen is without locality data, thus it might be one of this pure popula
tion of "tailless" philenor from Yucatan or it may be one of the rare aberrant specimens found among the tailed populations. Its range is separated from that of the North American form by the humid lowlands. It occurs in the arid eastern part of the peninsula of Yucatan.

In general the northern specimens listed above are larger than those from the southern localities. The northern and west coast specimens are much greener than the specimens from San Luis Potosi, which are truly blue. Almost 50 per cent of the males have a well defined series of submarginal spots on the forewings.

On the basis of conditions I should say that in Nuevo Leon there is a brood that emerges late in July, in San Luis Potosi fresh material flies at the end of April and two months later in June. The Acapulco material from the middle of May is fresh as is the mid-July specimens from Tancitaro. The Villagran specimens are worn indicating a brood in early April. There is probably a brood between this one and the late July brood indicated by the Nuevo Leon specimen.

11. P. polydamas polydamas Linnaeus.
  R. & J. p. 520.
  J. p. 20, pl. 6b.
  El Sol, Tamazunchale, San Luis Potosi, 400 ft., 1 ♀ v.29.41 (R.P.).
Fortin, Vera Cruz, 1600 ft., 1 ♂ v.3.41 (R.P.).
El Sabino, nr. Urnapan, Michoacan, 2 ♂♂ 2 ♀♀ vii.15–30. 36 (H. D. Thomas).
Apatzingan, Michoacan, 1200 ft., 1 ♂ viii.5.40 (H.H.).

There is nothing remarkable about these specimens except that the series is so short. The Arroyo del Calebezas specimen does bear unusually large, silvery dashes on the forward end of the red, submarginal spots on the underside of the hindwing in spaces R₃–M₁, M₂–M₃ and M₃–M₄.

The El Sabino specimens are rather battered and the ♂ from Apatzingan is very fresh. From this I deduce that there is a brood emerging in the first days of August in Michoacan. The east coast material is in better condition and I am led to believe that it belongs to a brood that emerges around the end of April and beginning of May.

12. **P. eracon** Godman & Salvin.
   G. & S. ii, p. 728, pl. iii, ff. 11, 12.
   R. & J. p. 528.
   J. p. 21, pl. 6c.
   Apatzingan, Michoacan, 1050 ft., 1 ♂ viii.2.40 (H.H.).

Apparently this is a rather rare species in collections. This specimen is fresh. The species is found only in southwestern Mexico, Guerrero, Colima and Michoacan (Hoffman, p. 649). It was described from a single male from Colima in the Staudinger collection. R. & J. knew of only 2 ♂♂ at Tring, from "Guerrero" and 4 ♂♂ 1 ♀ at the British Museum without definite locality labels.

16. **P. ajax ajax** Linnaeus.
   G. & S. ii, p. 242 (as *polyxenes* Fab.).
   R. & J. p. 540 (as *polyxenes asterius* Cramer).
   J. p. 23 (as *polyxenes asterius* Cramer).
   Monterrey, Nuevo Leon, 1800 ft., 1 ♀ iv.27.41 (R.P.).
Fortin, Vera Cruz, 1600 ft., 2 ♂♀ vi.4.41 (R.P.).

This is a very variable species in Mexico. I wish that I had several hundred specimens from many more localities than I have. However, all are referable to the race ajax. Repeated erroneous references to Mexican and North American specimens to the race americus Kollar are made. The race americus is restricted to the mountains of northwestern South America. Between its range and that of ajax lies the range of race stabilis R. & J. Occasionally specimens that approach americus are met with in Mexico and North America but these cannot be called americus. If these aberrant specimens must bear a special name they may be called ab. pseudo-americus.

All three names for male varieties of this race accepted by R. & J. (p. 546) are present in this small series, in fact the three males from Galeana each represent a different form.

**TABLE II**

<table>
<thead>
<tr>
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<th>♂ f. asterius</th>
<th>♂ f. curvifusca</th>
<th>♂ f. ampliata</th>
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<td>Galeana</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ojo d'Agua</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Jacala</td>
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<td>Fortin</td>
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<td>1</td>
<td></td>
</tr>
<tr>
<td>El Sabino</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The material from Fortin and from El Sabino is fresh indicating broods emerging in early May and late July respectively.


G. & S. ii, p. 223, pl. 69, f. 4 (as thoas).
I was surprised to find only four specimens of this species in the mixed *thoas-cresphontes* series of 28 specimens. The basis for the separations was the male genitalia, the only valid method I know of for certainly separating these two species. Three of the specimens show much reduced submarginal spots continuing beyond M₃. The El Sol male lacks these. This specimen also lacks the yellow margined crescent on the hindwing and has none on the forewing. The El Bañito female has a cell spot as large as those usually found on *neacles* R. & J. from western Ecuador. These two races, *autoecles & neacles*, are very poorly differentiated.


G. & S. ii, p. 223 (as *thoas*).
J. p. 24, pl. 7a.
Jacala, Hidalgo, 4500 ft., 1 ♀ vi.29.39 (H.H.).
Arroyo de Meco, Tamaulipas, 1320 ft., 4 ♀♂ iv.28.41 (R.P.).
Rio Blanco, Vera Cruz, 2200 ft., 1 ♂ v.16.41 (R.P.).

The condition of the specimens would indicate fresh material on the wing in the last week of April and the same week of July in San Luis Potosí and late May in Nuevo Leon.

22. *P. ornythion* Boisduval.

G. & S. ii, p. 227, pl. 69, f. 7, 8.
J. p. 25, pl. 7b.
35 km. W. of Linares, Nuevo Leon, 1 ♂ viii.7.39 (H.H.).
Galeana, Nuevo Leon, 6500 ft., 1 ♂ vi.15.39 (H.H.).
The condition of these specimens indicates that the brood emerged about the middle of May. The Galeana male is duller than the others and the broad yellow submarginal band on the underside of the hindwings is narrower than usual and more or less broken into larger spots by rows of dark scales along the veins. It is interesting to note the increase in our knowledge of this species since G. & S. They doubted that the species hailed from Mexico; R. & J. gave Yucatan and W. Mexico as the range. Hoffman (p. 650) extended the range north to Jalisco in the west, through the Central Mesa and north to Tamaulipas on the east coast. G. & S. did not see a specimen and R. & J. reported only a pair at Tring!

23. **P. lycophron pallas** Gray.

   G. & S. ii, p. 225, pl. 69, f. 5, 6.
   R. & J. p. 574.
   J. p. 25.
   Victoria, Tamaulipas, 1 ♂ vi.26.35 (H. A. Freeman).
   Rio Blanco, Vera Cruz, 2200 ft., 2 ♀♂ v.10.41 (R.P.).
   Apatzingan, Michoacan, 1200 ft., 1 ♀ viii.5.40 (H.H.).

The Apatzingan specimen extends the west coast range of this species. Hoffman (p. 650) notes its occurrence in northern Chiapas on the west, Oaxaca in the Central Mesa and as far north as southern Tamaulipas on the Gulf. The Victoria and Rio Blanco specimens are worn, all others are fresh.

26. **P. daunus** Boisduval.

   G. & S. ii, p. 240, pl. 72, f. 9.
   J. p. 26, pl. 9c.

The Nuevo Leon specimens are similar to those that fly in Colorado. The Michoacan specimens are gigantic (radius of
forewing: ♂ 68 mm., ♀ 71 mm.), and very dark in color. The "yellow" ground color of these west coast specimens is like that of glaucus f. australis Maynard or rutulus f. ammoni Behrens. I agree with R. & J. (p. 590) that these forms do not need varietal names, at least until their cause is known.

   G. & S. ii, p. 241, pl. 72, f. 6, 7 (P. alexiaraes).
   J. p. 27, pl. 9b.

   This species is so close to glaucus that it may easily be confused with that species by U. S. collectors touring Mexico. The underside of the hindwings bear large burnt orange splashes between the cell and the dark marginal band toward the anal angle. My specimens are fresh.

29. **P. pilumnus** Boisduval.
   G. & S. ii, p. 241, pl. 72, f. 10.
   R. & J. p. 593.
   J. p. 27, pl. 9e.
   Victoria, Tamaulipas, 2 ♂♀ vi.10.35 (H. A. Freeman).
   Galeana, Nuevo Leon, 6500 ft., 3 ♂♀ viii.1.39 (H.H.).
   35 km. W. of Linares, Nuevo Leon, 1 ♂ vii.7.39 (H.H.).

   All these specimens are reasonably fresh.

   R. & J. p. 599.
   J. p. 27, pl. 8e.
   Villa Santiago, Nuevo Leon, 1500 ft., 1 ♂ viii.8.39 (H.H.).
   35 km. W. of Linares, Nuevo Leon, 1 ♂ vii.7.39 (H.H.).

   With exception of the Villa Santiago specimen and one of the Hda. Vista Hermosa males these compare very favorably with the
original description of the race. The Villa Santiago specimen has large spots composing the inner of the two submarginal rows on the forewing—3 to 4 times as large as the outer row. The other specimen noted has orange-yellow rather than lemon-yellow spots.

31. **P. pharnaces** Doubleday.

G. & S. ii, p. 231, 730 (pl. 70, f. 10 as *polycharmus*).
J. p. 28, pl. 10c.

These specimens extend the range of the species considerably to the north of the limit on the east coast noted by Hoffman, Southern Puebla (p. 651). The tail is prominent on each of my specimens. I should say that the material had been flying about ten days when these specimens were caught. The females are in much better condition than the males.

34. **P. anchisiades idaeus** Fabricius.

G. & S. p. 230, pl. 70, f. 6, 7, 11 (as *pandion*).
J. p. 28.
Fortín, Vera Cruz, 1600 ft., 1 ♀ v.4.41 (R.P.).
Victoria, Tamaulipas, 2 ♂ ♀ vi.25–26.35 (H. A. Freeman).

The two northern specimens have lost the last vestige of the whitish transverse band on the forewings. It is obsolete on the southern male and reduced on the female. I believe that Felder’s name (Reise Novara, Lep. p. 79. 1865) *pandion* is available for the specimens lacking the light sub-apical area if necessary. Potts’ material is fresh, Freeman’s slightly flight-worn.

38. **P. garamas** Huebner.

G. & S. ii, p. 238 (as *asclepius*).
J. p. 33.

R. & J. record three subspecies from Mexico; abderus Hopffer from the east coast, garamas Huebner from the central valleys and baroni R. & J. from the west slope. These four specimens vary from typical garamas to baroni, thus I am led to agree with Hoffman (p. 652) that baroni had best be retained only as a minor variation of garamas. Hoffman considers that abderus is a separate full species. Two of my specimens are fresh, one typical garamas the other typical baroni, the other two are battered.

   G. & S. ii, p. 211.
   R. & J. p. 661.
   J. p. 36.
   El Sol, Tamazunchale, San Luis Potosi, 400 ft., 7 ♂ ♀ 1 ♀ v.29.41 (R.P.).
   Galeana, Nuevo Leon, 6500 ft., 1 ♂ iv.29.41 (R.P.).

Of these twelve specimens eleven, all except the female from El Sol, are f. eridamus Reakirt, the exception is f. pharax G. & S. The Galeana specimen taken by Potts extends the range of species far to the north of that recognized by Hoffman,—Vera Cruz (p. 652).

40. P. branchus Doubleday.
   G. & S. ii, 207.
   R. & J. p. 676.
   J. p. 38, pl. 14b.
   nr. Potrero Nuevo, Vera Cruz, 1500 ft., 1 ♂ v.5.41 (R.P.).

42. P. thymbraeus aconophos Gray.
   R. & J. p. 678.
### TABLE III

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† Te. Temperate.
ST. Sub-tropical.
Tr. Tropical.

J. p. 38.
N. of Iguala, Guerrero, 2100 ft., 1 ♂ v.22.41 (R.P.).
El Sabino, Uruapan, Michoacan, 1 ♂ vii.15–30.35 (H. D. Thomas).

Both specimens are typical of the subspecies. Both are battered.

44. P. philolaus Boisduval.
R. & J. p. 693.
J. p. 39, pl. 14d.
Río Blanco, Vera Cruz, 2200 ft., 3 ♂♂ v.10.41 (R.P.).
Two of the El Bañito females are f. niger Eimer. The condition of the material indicates that there is a late April brood and another in early July in San Luis Potosi. I have seen this species so abundant in Yucatan in April that over a hundred specimens might be trapped with a net at one time on a mud puddle.

45. P. epidaus epidaus Doubleday.
   G. & S. ii, p. 221, pl. 68, f. 15.
   J. p. 40, pl. 15c.
   Rio Blanco, Vera Cruz, 2200 ft., 2 ♂♂ v.10.41 (R.P.).
   Arroyo del Calabezas, San Luis Potosi, 1 ♂ iv.30.41 (R.P.).
   Tule, Oaxaca, 5000 ft., 1 ♂ v.18.41 (R.P.).

45a. P. epidaus fenochionis Godman & Salvin.
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Both specimens are typical of the subspecies. Both are battered.

44. P. philolaus Boisduval.
   R. & J. p. 693.
   J. p. 39, pl. 14d.
   El Bañito, Valles, San Luis Potosi, 150 ft., 8♂♀ iv.30.41 (R.P.); 1♂♀ 7♀ vi.26—29.40 (H.H.).
   Rio Blanco, Vera Cruz, 2200 ft., 3♂♀ v.10.41 (R.P.).

45. P. epidaus epidaus Doubleday.
   G. & S. ii, p. 221, pl. 68, f. 15.
   J. p. 40, pl. 15c.
   Río Blanco, Vera Cruz, 2200 ft., 2♂♀ v.10.41 (R.P.).
   Arroyo del Calabezas, San Luis Potosi, 1♂ iv.30.41 (R.P.).
   Tule, Oaxaca, 5000 ft., 1♂ v.18.41 (R.P.).

45a. P. epidaus fenochionis Godman & Salvin.

Two of the El Bañito females are f. niger Eimer. The condition of the material indicates that there is a late April brood and another in early July in San Luis Potosi. I have seen this species so abundant in Yucatan in April that over a hundred specimens might be trapped with a net at one time on a mud puddle.
J. p. 40.
Apatzingan, Michoacan, 1200 ft., 1 ♀ viii.2.40 (H.H.).
El Sabino, nr. Uruapan, Michoacan, 1 ♀ vii. 15–30.35
(H. D. Thomas).

46. **P. agesilaus fortis** Rothschild & Jordan.
G. & S. ii, p. 219 (neosilas in part).
J. p. 40.
This specimen is intermediate to race neosilas Hopffer.

47. **P. protesilas penthesilas** Felder.
G. & S. ii, p. 214, pl. 68, f. 7.
J. p. 41.
El Sol, Tamazunchale, San Luis Potosi, 400 ft., 1 ♂.
v.29.41 (R.P.).
A beautiful fresh specimen.

**Baroniinæ**

52. **Baronia brevicornis** Salvin.
J. p. 45, pl. 17c.
Acahuato, Michoacan, 3000 ft., 1 ♂ viii.2.40 (H.H.).
Collected at flowers along the trail on the edge of the plateau
above Apatzingan.

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2. **Godman, F. D., and Osbert Salvin**, Biología Centrali-americana: In-
secta; Lepid.-Rhop., Vol. 1, 2, 3. 1887–1901.
1906.
4. **Jordan, Karl in Seitz’ Macrolepidoptera of the Earth, 5: 11–45. 1907–
08. (Eng. Ed.).**
A STUDY OF A GYANDROMORPH OF MELANO-PLUS MEXICANUS MEXICANUS (SAUSS.) (ORTHOPTERA)

By H. C. Severin
South Dakota State College, Brookings, South Dakota

Gynandromorphs have been reported as occurring quite frequently in some orders of insects, while in other orders this condition has not been reported at all or only occasionally. The scarcity of reports of gynandromorphs in some orders may, however, be due to the fact that sexual differences in these orders are not striking and, therefore, the gynandromorphs, if they occur, are not readily detected, or it may be due to the fact that the members of these orders are less frequently collected and less critically studied.

The order, Lepidoptera, has furnished about 1000 cases of gynandromorphs, or more than any other order of insects or other group of animals. Since Drosophila melanogaster Meig. has been so extensively used in genetical studies and since untold thousands of these flies (hybrids and non-hybrids) have been minutely examined in these studies, it is not surprising to find that more gynandromorphs have been found in this species of animal than in any other. T. H. Morgan (4) in discussing the frequency of occurrence of gynandromorphs in Drosophila melanogaster Meig. stated that the observed ratio was 1 gynandromorph in 2200 flies, but it should be remembered that this ratio is based largely upon data gathered from hybrid flies. Folsom (3) writes that Speyer estimated that in Lepidoptera only one individual in thirty thousand is hermaphroditic.

Dr. H. Hagen in 1861 (1) reviewed the literature dealing with insect gynandromorphs and while he makes no claim that his investigations cover the field completely, he listed 119 reported cases of gynandromorphs. He added, however, that some of these reported cases were not true gynandromorphs, but de-

1 Approved for publication by the Director of the South Dakota Agricultural Experiment Station as Journal Series No. 175.
formed individuals. Of the 119 cases listed, 99 were Lepidoptera, 15 were Hymenoptera, 3 were Coleoptera, 1 was a Dipteran and 1 an Orthopteran. The Orthopteran listed was a specimen of *Acridium dispar* Bris = (*Chrysochraon dispar* Germ) reported in 1848 by Brisant de Barnville.

In 1889 Ph. Berthau (2) published a paper in which he stated that there were 225 known cases of hermaphroditic insects. These were grouped as follows: 255 Lepidoptera, 51 Hymenoptera, 9 Coleoptera, 8 Diptera, and 2 Orthoptera.

In October 1941 L. C. Paul (5) published a paper in the Canadian Entomologist in which he described and excellently figured a gynandromorphic specimen of *Camnula pellucida* Scudder. While gynandromorphism is now recognized as not being as rare as it was once believed to occur, we still do not know its frequency of occurrence in various groups of animals that were produced in the out-of-doors, free from the control of man.

**SECONDARY SEXUAL DIFFERENCES BETWEEN MALE AND FEMALE SPECIMENS OF *MELANOPPLUS M. MEXICANUS* (SAUSS.)**

The characters that are ordinarily used to distinguish male from female specimens of *Melanoplus m. mexicanus* (Sauss.) are those of the external genitalia and the abdominal segments and structures associated with the genitalia. There are other characters, however, that are limited to one or the other sex. These characters may be briefly described as follows:

A. Lateral carinae of fastigium prominent in males, less so in females. Fastigial depression deeper in males than in females. Interocular space narrower in males than in females. Antennæ longer in males than in females.

B. Space between mesosternal lobes into which a tongue of the metasternum dovetails, wider in females than in males. Space between metasternal lobes into which a tongue of the first abdominal sternum dovetails wider in females than in males.

C. Tubercle on mesosternum prominent in males; absent in females.

D. First and second pair of legs: In the male, the femora and tibiae are considerably heavier than they are in the female.
The distal segment of the tarsus is heavier and longer in the male than it is in the female. The tarsal claws (ungues) and the arolia are heavier and larger in the male than they are in the female.

E. Third pair of legs: The most evident differences between the third pair of legs of the male and female are to be found in the last tarsal segment, the tarsal claws and the arolium. These differences are like those already described for the first and second pair of legs.

DESCRIPTION OF GYNANDROMORPH SPECIMEN OF M. M. MEXICANUS (SAUSS.)

The specimen was collected by the writer near Miller, in Hand County, South Dakota, August 13, 1939.

The gynandromorph is typically male in structure in the dorsal half of the body and in the left half of the ventral half of the body. In the ventral right half of the body the gynandromorph is typically female in structure except for a few details that will be pointed out hereafter.

The head characters, with the exception of the antennae (see paragraph A. under Secondary Sexual Differences) are typically male. The left antenna is like that of a male, while the right antenna is shorter, like that of a female.

The space between the mesosternal lobes (see paragraph B) is typically like that of the female on its right portion and like that of the male on its left. The same is true of the space between the metasternal lobes. In other words these spaces are not bilaterally symmetrical.

The tubercle (see paragraph C) is only found on the right side of the mesosternum and is reduced in size. It is absent on the left side.

The three legs of the left side of the body are typically male in structure, while those of the right side of the body are typically female (see paragraphs D and E).

The dorsal half of the abdomen is typically male in structure, including all of the terga, the supra-anal plate, the paraprocts, the furcula and the cerci. The ventral half of the left side of the abdomen is also typically male, including the sterna and the
subgenital plate. The ventral half of the right side of the abdomen is typically female except for certain characters at the posterior end. Only one valve of an ovipositor is present and that happens to be the lower right valve. Posterior and dorsal to this valve are two sclerites which appear to be a distorted half of a ninth male sternum and a distorted half of a male subgenital plate. Other distortions present in the abdominal sterna can be readily seen by studying Figure 3.

The specimen was not dissected to study the gonads, ducts, glands, etc.

LITERATURE CITED


PLATE X

Gynandromorph of Melanoplus m. mexicanus (Sauss.)

1. Dorsal view of posterior part of abdomen; 2. lateral aspect of right side of posterior part of abdomen; 3. ventral view of posterior part of abdomen: c, cercus; f, furcula; p, pallium; rv, right ventral valve of ovipositor; sa, supra-anal plate; sg, subgenital plate; ixs, ninth abdominal sternum; xt, tenth tergum.
TWO WAYS OF SONG COMMUNICATION AMONG OUR NORTH AMERICAN CICADAS

By Wm. T. Davis
Staten Island, N. Y.

It has been stated that all our North American male cicadas can sing, and that they, as well as the females, possess a well-developed auditory apparatus, which is reduced in size in the female. The sound-producing organs of the males in most of the genera, are highly complicated mechanisms, while in other genera the insects click their wings and thus attract one another after the manner of some Orthoptera. This has been more or less a matter of observation for a considerable number of years, but additional interesting evidence can now be offered.

Platypedia areolata was described as Cicada areolata by P. R. Uhler in Proceedings of the Academy of Natural Sciences of Philadelphia, 1861, p. 285, and it is there stated that: "the drums and sonory apparatus are merely rudimental. Length 21 millims, Alar expanse 50 millims. Found east of Fort Colville in Washington Territory. This species is very remarkable from the abortive appearance of the drums, and it is highly probable that the species is without a note. In the specimens noticed and captured, no note was observed to be produced."

Cicada putnami Uhler, was described in Bull. U. S. Geological and Geographical Survey of the Territories, 1877, p. 455, from specimens collected near Clear Creek, Colorado, July 2, 1872, by J. Duncan Putnam, who, at the meeting of the Davenport Academy of Natural Sciences of January 31, 1879, stated that it occurred in considerable numbers on some small aspen trees growing close to the water. He added: "The male makes a very faint chirp, differing entirely from any other cicada I have ever heard."

In Entomologica Americana, vol. IV, p. 23, 1888, P. R. Uhler described the Genus Platypedia, with areolata as type, and mentioned putnami and minor (p. 88) as other members of the new genus. "Sonorous valves of the male rudimentary inconspicuous," is given as one of the characters of the genus.
Since 1888 a considerable number of cicadas belonging to the genus Neoplatsypedia, and the related genus Neoplatsypedia, have been described from the western portion of the United States and from Mexico. Some of the named forms may ultimately be considered geographic races or color forms. During the past 35 years or more, the writer has accumulated a considerable collection of Neoplatsypedia, and many of the collectors, who kindly sent the specimens, have noted the clicking sounds produced when the insects were active. It may be of value to refer to some of these observations by way of arousing an interest in a matter that should receive further attention.

On June 16, 1913, Prof. C. H. Kennedy, collected five Neoplatsypedia areolata, which he wrote were taken on alder sumach and balsam trees along Logy Creek, Yakima County, Washington. "Their call is not like the 17-year form, nor like the eastern harvest flies, but consists of just a few clicks. Until I stumbled onto one clicking it had not occurred to me that they were cicadas."

In his "Preliminary Review of the West Coast Cicadidae," Journal, N. Y. Ent. Soc., March, 1915, Mr. E. P. Van Duzee refers to Neoplatsypedia vanduzeei Davis, identified by him at the time as P. minor Uhler, as follows: "This distinct little species seems to be confined to the southern portion of the state (California), where it is very abundant at times. It is found on grassy hillsides from the last of March to about the first of July, where it may generally be found resting on the stems of the sage brush. It has a short peeping note which is difficult to locate."

On June 15, 1918, Mr. Warren Knaus collected two male and five female Neoplatsypedia mohavensis Davis, 4 miles S.E. of Santa Fe, N. M., on the old Santa Fe Trail, 7,000 feet, on scrub pine and cedar. He stated that they: "did not attempt to fly, except an occasional short flight; did not sing, but made a snap, snap, snap, snap, snap noise."

Dr. Frank E. Lutz collected on June 13, 1919, thirteen males and nine females of Neoplatsypedia putnamii at Starkville, Colorado, about 6,800 feet, and noted that their song was a: "clicking sound; about eight clicks, rapid at first but slowing."

Dr. B. B. Fulton wrote concerning Neoplatsypedia areolata Uhler, collected by him at Ashland, Oregon, June 11, 1922, that it:
"makes a very insignificant sound, a faint ticking sound repeated 6 or 7 times, and sounds very much like snapping the thumb nails one off the other. They were in the dense brush of Manzanita, etc., and very hard to get close to."

Mr. Douglas K. Duncan, writing of Platypedia putnami var. lutea Davis, that he collected along Horton Creek, 22 m. north of Payson, Arizona, 6,000 feet, June, 1927, stated that: "they did not sing but made a funny clicking noise, not very loud, but with thousands, there was a very noticeable noise." They were mostly taken on cedar trees although in the hot part of the day they appeared to be on most anything and hard to take. As the sun dropped and the chill of night came on, they came down and were in numbers on the small cedar trees or brush, sometimes five or six on a single tree clinging to the main trunk. They could then be picked off of the trunk, and if missed they would merely drop to the ground and make no attempt to fly.

Professor Sherman C. Bishop, writing of Platypedia mohavensis Davis, collected 5 m. west of Ojo Caliente, N. M., June 21, 1930, stated that the little fellows: "make a ticking sound—tick-tick-tick-tick, that can be closely imitated by tapping a dime on a nickel."

Mr. Alonzo C. Davis collected Platypedia laticapitata Davis, at Pasadena, Calif., June 22, 1930, and Platypedia vanduzeei at San Juan Capistrano, Calif., June 4, 1930, and stated: "The Platypedia I found very wary. They sound exactly like some one winding a watch."

Dr. Raymond H. Beamer, who has kindly sent many cicadas for examination, wrote of the Platypedia putnami found along Poudre River, 35 miles from Fort Collins, Colorado, in June, 1931, that he found many nests freshly made in green twigs. Mating pairs were seen. Females predominated five or six to one. Sang from five-thirty A.M. to eight P.M. in all kinds of trees about camp. "Song is even in pitch—just clicking sound. Both sexes easily taken with fingers by approaching limb slowly." Later putnami was taken on sagebrush-covered hillside instead of by the river.

Mr. R. T. Kellogg sent 9 males and 22 females of Platypedia putnami, taken at Indian Creek, north end of Animas Mountains,
N. M., June 5, 1935, Alt. 6,000 feet. They were feeding on Mountain Mahogany, Oak and other cañon vegetation. The only sound he could detect: “was a faint click-click.”

Mr. Franklin T. Scott, collected 8 males and 2 females of Platypedia scotti Davis, at Kaweah, Tulare County, Calif., May 25, 1937, and wrote that they were hard to catch as they were in thick brush and made only: “a small clicking sound.”

Dr. John W. Sugden on July 2, 1931, wrote concerning Platypedia mohavensis, collected at Mt. Carmel, Utah, June 5, 1931, that they were in large numbers, and that: “Both sexes would make a clicking sound by flicking the wings.”

In his interesting observations on “Characteristics of Certain Western Cicadas, Journal, N. Y. Ent. Soc., June 1940, Dr. Sugden again states that both sexes of Platypedia mohavensis make: “a clicking sound by flicking the wings, and because of the large number, the sound resembled a shower of hail or shot dropped on wrapping paper. These insects were not singing.”

On page 125, he also records that: “Both Platypedia putnami lutea and Neoplatypedia constricta were collected in South Willow Creek Canyon, Tooele County, Utah. On May 24, 1931, only the former had emerged, and the next month (June 14, 1931) both were present. The songs were similar, not loud, and: “both sexes of both species were making the wing-clicking sounds.”

On June 27, 1919, Dr. F. E. Lutz collected 15 males and 22 females of Neoplatypedia constricta at Bondad, Colorado, and noted at the time that the song was a zip, zip, zip, continued for a long time. (Journal, N. Y. Ent. Soc., June, 1920, p. 124, and March, 1921, p. 55.)

In the March, 1943, number of the Journal N. Y. Entomological Society, Dr. Kan-Fan Chen, in writing of Chinese Cicadas, adds: “In the more primitive genera Platypedia and Neoplatypedia of the Nearctic Region, the tympanum is absent, the metepimeron is not prolonged posteriorly to form the operculum, the abdomen is attenuated and the genital plate of the male is lengthened.”

It will be noted from the foregoing that Uhler in 1861, thought it probable from the rudimentary character of the drums, that his
Cicada areolata, placed by him in 1888 in his genus Platypedia, was unable to sing.

Over the years we have evidence that both the males and females of the Genera Platypedia and Neoplata millennia flit or crackle their wings, and several of the observers cited above definitely state that they do not sing in the same way as do other cicadas, but that their method of communicating one with the other, resembles that of many species of Orthoptera, and some insects of other orders.

In: "Insect Singers—A Natural History of the Cicadas," p. 79, Dr. J. G. Myers states, that the sound-organs usual in cicadas are confined to the males, but that in Melampsalta cingulata of New Zealand, and M. strepitanus: "there is a wing-clicking produced by both sexes and additional to the males’ song. It results from a rapid lateral movement of the wings from the roof-like resting position to one at an acute angle with the body; but the movement is so quick that one cannot be sure whether the noise is produced by friction between tegmina and hind-wings on each side or between one or both pairs and the body. If the latter, then the development of the stridulating areas on the mesonotum of the Tettigadinae is only a further step in the same direction." On page 213 Dr. Myers continues: "We have seen that Melampsalta cingulata and M. strepitanus females are able to make a wing-clicking sound like that of the males, while the members of the sub-family Tettigadinae possess a special accessory stridulating organ common to both sexes. There is some evidence that the male is attracted by the female’s wing-clicking in the two above New Zealand species."

In the eastern United States it is not an uncommon observation to note the uneasy flutter of the wings when any of our cicadas approach each other, often while singing, as on a limb for instance, and among western species the habit appears to be even more pronounced.

On January 9, 1936, Dr. R. H. Beamer wrote of the Clidophleps taken in California the previous summer, when what was later described as Clidophleps beameri Davis, was found on Cuyama Ranch along the river of that name. The party collected several species of Clidophleps, and referring to their experience
with one of them, Dr. Beamer stated that it had what they took to be two songs. "For a long time it had us fooled into thinking there were two species. They start with a clicking, and then run into a rattle or whir, which is made by the drumming of the wings." His son Jack was able to observe this, until he was satisfied that the apparently two songs were made by the same individual.

In *Clidophleps* the sound-organs are well developed and they can sing after the manner of most of our male cicadas, but the presence of tymbals in *Clidophleps* need not preclude the wing-clicking habit, for we have seen that in *Melampsalta cingulata* there is a wing-clicking produced by both sexes in addition to the males' song.

If the end of the abdomen is missing from a *Platypedia*, it is not always easy to determine the sex of the specimen. If the abdomen is cut off at about the third segment, an interior view of the auditory capsule and accompanying membrane may be had in both sexes. The capsules, as described and figured by Dr. Myers, are on either side of the abdomen in both sexes. Both male and female cicadas can certainly hear, and it is quite an easy matter to note the effect of the music on the insects. However, additional observations on their manner of singing is desirable, especially in the genera *Clidophleps* and *Platypedia*. 
A CATALOGUE OF OREGON COCCINELLIDÆ*

By Borys Malkin

The present list contains 78 species and 15 varieties of Coccinellidæ from Oregon, a total of 93 forms. It may be considered as a fairly good representation of Oregon "ladybird" beetles when compared to other local lists from the coleopterologically well-explored states. Thus, from New York state¹ 95 forms are listed, from Washington 70 and from North Carolina 72.

The arrangement of this catalogue is rather conservative and practically no attempt has been made to revise any group although I feel that the position of several species, particularly in the genus Scymnus, will be changed and some of these will undoubtedly be degraded to varietal or even lesser rank. I contend, however, that such changes prior to any publication of the findings will result in confusion; therefore, as inadequate as it may be, Casey's arrangement of the genus has been followed.

The following collections have been examined: Oregon State College in Corvallis which contributed 70 forms, Mr. L. G. Gentner of Medford (24), Mr. and Mrs. Kenneth Fender (62), Mr. J. Shuh of Corvallis (62), Mr. James Baker (42), Forest Insects Station in Portland (12), Filbert Agricultural Experiment Station in Eugene (6), and that of the author (36). In addition Mr. F. T. Scott of Visalia, California, has kindly sent me a list of Coccinellidæ records in his collection, totaling 46 forms, and Mr. L. P. Rockwood a list of 30 species in the collection of the Agricultural Experiment Station in Forest Grove. I am also indebted to several friends for many specimens, particularly to Dr. Lawrence Townsend, a government ichthyologist in Eugene, to Mr. William Buell, a student at the University of Oregon, and to Dr. L. L. Jones of the University Zoology Department.

Records followed by: (S) are those of Mr. Scott's collection,

* This paper was prepared in the Zoological Laboratory of the University of Oregon, 1942.

by: (FS), from the collections of all Agricultural Stations in Forest Grove.

The list is considered to some extent as supplementary to the existing lists of northwestern "ladybird" beetles and to the monograph of Washington species which is being prepared by Dr. M. H. Hatch.

10873. *Hyperaspis montanica* Csy. Harney Co. (S), Baker (S). (Dobz. 1941, l.c., p. 17.)


10900. *H. taeniata* Lee. Harnet Co. (S). (Dobz. 1941, l.c., p. 44.)

10903. *H. nevadica* Csy. Redmond VII, VIII, Hart Lake VIII, Umatilla VII.

10905. *H. dissoluta* Cr. Redmond V, VIII.

10906. *H. dissoluta coloradana* Csy. (Dobz. 1941, l.c., p. 59.)

The record cited is probably erroneously labeled; the occurrence of the species in Oregon is doubtful.


——. *H. sp. nr. postica* Lee. Scappoose IV, V.

10917. *H. nunenmacheri* Csy. Chewaucan River nr. Valley Falls VIII. (Dobz. 1941, l.c., p. 40.)

10918. *H. oculaticauda* Csy. (Dobz. 1941, l.c., p. 41.)

10919. *H. effeta* Csy. (Dobz. 1941, l.c., p. 42.)

10930. *H. undulata* Say. 14 m. e. of Sisters.

——. *H. obscura* Malkin. Lake of the Woods (type), Diamond Lake.


—. *H. sp. nr. annexa* Lee. Union.

10935. *H. revocans* Csy. Redmond VII.

—. *H. oregona* Dobz. Harper VII (S), Harney Co. (S).

(Dobz. 1941, l.e., p. 76.)

—. *H. oregona borealis* Dobz. Cornelius IV.

10972. *Brachyacantha ursina* (Fab.). Redmond VI, Durkee VI.


11020. *S. marginicollis* Mann. Western Oregon, also Wasco Co., Lake Co., Wallowa Co., Deschutes Co. The most common representative of the genus in the state.

11044. *S. humboldti* Csy. Bear Springs V, Wallowa Lake VI.


11052. *S. ardelio* Horn. 22 m. sw. of St. Helens V, Silver Lake VIII, Chewaucan River nr. Valley Falls VIII, Goble V, Valley Falls VIII, Bear Springs V, VI, Ochoco N.F. VI, Baker Pine Creek VI, Wallowa Lake VI, Camas Valley VI.

11058. *S. weidti* Csy. Bear Springs V, Malheur Lake VI.

11067. *S. calaveras* Csy. McMinnville V, Nimrod VII.


11076. *S. coniferarum* Cr. Diamond Lake VI.

11079. *S. nanus* Lee. 10 m. s. of Dalles V, Deschutes River nr. Redmond VII.

11082. *S. americanus* Muls. Redmond IV, 20 m. w. of St. Helens VI.

11083. *S. caurinus* Horn. Goble V, Prineville VII, Summit Prairie VIII, 22 m. w. of St. Helens V, Redmond IV, Weston

11084. *S. nevadensis* Ws. Corvallis, Forest Grove V, Camas Valley VI.

—. *S. fenderi* Malkin. Camas Valley (type).


—. *S. strenuus* Csy. McMinnville, Redmond IV, VI, VIII, Goble IV, 10 m. w. of Bend, Chewaucan River nr. Valley Falls VIII, Sand Creek, el. 4700, VII, Weston-Lincoln Mt. VII, Mosier, V, Scappoose V, Valley Falls VIII, Parkdale V, Forest Grove IV–V, 27 m. e. of Prineville VII, Summit Prairie VII, 5 m. s. of Dufur VI, Corvallis V.

—. *S. sp. nr. subsimilis* Csy. Medford VII.

11140. *Scymnillus aterrimus* Horn. (Leng, l.c., p. 214.)


11150d. *Psyllobora vigintimaculata tectata* Lee. Western Oregon up to 2800 ft.; also Sherman Co. III–VIII. Often on *Pinus contorta*.

11154. *Anisostica bitriangularis* Say. Corvallis, Portland VI, Gaston V, Forest Grove V (FS), McMinnville, Scappoose IV, Grant Co. (S), Baker.


11162. *Hippodamia tibialis* (Say). Forest Grove IV (FS),
Corvallis IV, X, Portland V, Santiam N.F., Hillsboro (FS), Yamhill (FS), Blue Mts. (S), Dayton, McMinnville.


11164a. *H. lunatomaculata apicalis* Csy. Generally distributed throughout the state. From January to August. Taken by the writer on Mt. Hood at the altitude of 9700 ft. on snow.


19761. *H. disjuncta* Timb. Redmond IV, Union, Juntura VII, Prairie City, Chewaucan River nr. Valley Falls VIII, Crater Lake VI, Eugene VII, Baker. According to Rockwood (in correspondence), this species is common throughout the eastern portion of the state.

11165b. *H. disjuncta complex* Csy. McMinnville, Amity, Charleston V, Eugene and Spence’s Butte up to 2050 ft., IV–V, IX.


11173. *H. convergens* Guér. Generally in all parts of the state.


11174d. *H. lecontei utcana* Csy. Mt. Hood VIII.


—. *H. quinquesignata obliqua* Csy. Western part of the state. Mt. Hood.


—. *H. washingtonia* Timb. Tollgate Road, Blue Mts. VII (S), Motte T. R. Station, Blue Mts. (S).

11184a. *Coccinella novemnotata degener* Csy. Fossil (FS), La Grande (FS), Ontario (FS), Junction City (FS), Manzanita (FS).

—. *C. johnsoni* Csy. (Dobz. 1931, l.c., p. 14.)

—. *C. prolongata* Cr. Echo 640 ft., Whitman N.F., Summer Lake VI, 10 m. w. of Bend VII, Redmond VII.

—. *C. californica* Mann. Very common in the Willamette River Valley, also Wasco Co. V–X (Dobz. 1931, l.c., p. 13). Often found in the sea drift. Taken by the writer from *Pinus ponderosa*.

11185. *C. transversoguttata* Fald. Generally distributed throughout the state up to 8000 ft.

11185b. *C. transversoguttata nugatoria* Muls. (Dobz. 1931, l.c., p. 17), the only specimen examined was from Dayton.

—. *C. nivicola monticola* Muls. North Powder VI (FS), Union VI (FS), Baker VI (FS).

—. *C. nivicola alutacea* Csy. Counties: Baker, Malheur, Union, Lake, Umatilla, Klamath (Odell), Deschutes, Benton, Crook, Wasco, Jackson, Douglas.

—. *C. difficilis* Cr. Lake of the Woods, Juntura VI, Ochoco N.F., Mt. Hood VII, el. 9200.

11181. *C. trifasciata* L. Corvallis IV–VI, XII, Mary’s Peak VII, Crescent Lake, Blue Mts. (S), Medford, Baker VII, Baker Pine Creek. This species replaces *C. perplexa* Muls. This form and the two following varieties taken by the writer from *Pinus contorta, P. ponderosa, Tsuga heterophylla, Picea engelmani*.

11181b. *C. trifasciata juliana* Muls. "Oregon" (S), Devil's Lake (in Lincoln Co.), Corvallis, McMinnville, Eugene VI, Spencer's Butte IX, Forest Grove VII.

11181c. *C. trifasciata subversa* Lec. Very common throughout western part of the state. March to July and October.

——. *C. sp.?* Diamond Lake VI.

11190a. *Cycloneda munda polita* Csy. Generally distributed throughout the western part of the state; also counties: Sherman, Deschutes, Union, Baker, up to 3500 ft. From February to December. On *Pinus contorta* and *Quercus californica*.

11192. *Olla abdominalis* Say. Ashland II.

11193. *Adalia bipunctata* L. Generally distributed throughout the state all year.

——. *A. bipunctata quadrimaculata* Scop. Forest Grove IX (FS).


——. *A. frigida melanopleura* Lec. Corvallis IV–V, Forest Grove (S), Tygh Valley, McMinnville, Clackamas VII, Eugene VI, from *Pinus ponderosa* (Malkin), Union III, Baker, also *Q. garryana* and *Q. californica*.


11200. *Anisocalvia duodecimguttata* Gebl. Parkdale VII, Manzanita Beach VI, in sea drift (S), Devil’s Lake (in Lincoln Co.), Dayton III, Marchfield V, Trout Camp 6 m. se. of Cascadia, Baker Pine Creek.
11201c. Anisocalvia quatuordecimguttata victoriana Csy. Corvallis V, Trout Lake Camp 6 m. e. of the Cascade Line, McMinnville, Boyer, Squaw River, Dayton V, Springfield V, Baker Pine Creek V.

11203. Anatis rhatvoni Lee. Western part of the state up to 9500 ft. Also counties: Wasco, Umatilla, Union, Wallowa, Baker, Grant, Klamath.

——. A. ocellata mali Say. Portland IV-V (on cut leaf of birch, Shuh & Gray), Dayton.


11214. Axion plagiatum Oliv. Corvallis V, VII, Alsea, McMinnville, Baker Pine Creek, Eugene VI, VII.

11217. Chilocorus bivalnerus L. Common throughout the western part of the state. Also: Klamath Co., Crook Co., and Wallowa Co. Q. californica.

11220c. Exochomus marginipennis californicus Cr. Wapinitia V, Prineville VII, 10 m. w. of Bend VI, 5 m. w. of Sisters VI, Corvallis V–VI, Bear Springs, Diamond Lake.


The following 3 species may be found within the state:


11156. Macronemia episcopalis (Kby.). Generally distributed throughout U. S. (Leng, l.c., p. 215).

11158. Ceratomegilla fuscilabris (Muls.). As above.

**BIBLIOGRAPHY REFERRED TO IN THE LIST**


RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), XVI

BY CHARLES P. ALEXANDER
AMHERST, MASSACHUSETTS

The preceding part under the above general title was published in September, 1942 (JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, 50: 251–262). The very interesting species discussed herewith are all from Ecuador, where they were collected by Mr. David Laddey in the Provinces of Manabi and Santiago-Zamora (southern Oriente). I wish to express my deep thanks to Mr. Laddey for his conscientious collecting of these flies, the types of which are preserved in my personal collection.

Genus Brachypremna Osten Sacken

Brachypremna quasimodo new species.

Mesonotal prescutum unusually high and gibbous to produce a hump-backed appearance; mesonotum handsomely patterned with dark brown on an obscure yellow ground; femora obscure brownish yellow, the tips broadly and conspicuously blackened; wings brownish yellow, patterned with darker brown and whitish subhyaline, the latter occurring as a conspicuous submarginal band in the outer medial field; veins \( R_{1+2} \), \( M_1 \) and \( M_2 \) all strongly decurved at margin; a strong spur of a vein from \( R_{1+2} \) jutting into cell \( R_5 \) at near two-thirds the length.

MALE.—Length about 15–16 mm.; wing 19–20 mm.

Frontal prolongation of head unusually deep and conspicuously bulbous, pale yellow, with a narrow dark line on side; nasus distinct; palpi with basal three segments and proximal end of fourth yellow, the remainder of fourth black with the exception of the very restricted orange tip. Antennæ with scape yellow; pedicel and basal two or three flagellar segments white, the outer segments passing into dark brown. Head buffy yellow, the posterior vertex with a brown line back from each eye on either side of a slightly wider median ground line.

Cervical sclerites conspicuously dark brown. Pronotum grayish yellow, narrowly infuscated above and on sides. Mesonotal prescutum very conspicuously gibbous to produce a strong hump-backed appearance; obscure yellow, conspicuously patterned with dark brown, including two intermediate stripes that are best-delimited at the cephalic margin and on posterior half of sclerite, and two transverse brown lines, one near the pseudosutural foveae, the other closer to the suture, the ends of the two areas more or less
united on the sides of the sclerite to form a more or less distinct U-shaped marking; median area of praeascutum behind clearer yellow, crossing the suture and becoming wider on the mid-area of the scutum; scutal lobes conspicuously dark brown, somewhat paler toward the wing-root; scutellum and mediotergite testaceous, with a nearly continuous median brown stripe; pleurotergite pale, more or less darkened above and the suture between it and the mediotergite. Pleura yellow, restrictedly but conspicuously patterned with dark brown on the various sclerites, including the anepisternum, sternopleurite, pteropleurite and meron. Halteres elongate, stem and apex of knob yellow, base of knob dark brown. Legs with coxae testaceous, patterned at and near apex on outer face with black; trochanters yellow; femora obscure brownish yellow, the tips broadly and conspicuously blackened; tibiae dark brown, the extreme bases narrowly whitened; tarsi brown, the terminal segments paling to obscure yellow. Wings brownish yellow, patterned with darker brown and whitish subhyaline; prearcular and costal fields more uniformly darkened; wing-apex and cells beyond cord strongly infuscated; a conspicuous whitish stripe involving the central portion of cell R₂ and adjoining part of R₃; a conspicuous stripe extending from cell 1st M₂ across the bases of cells 2nd M₂ and M₁ into the subapical portion of cell R₅; cells M, Cu and 1st A somewhat whitened, interrupted by a continuous brown seam in cell M adjoining vein Cu; cell 2nd A somewhat uniformly darkened; veins brown. Venation: Compared with the normal venation of the genus, vein R₅ more strongly upcurved at apex and veins R₄+₅, M₁ and M₂ more strongly decurved; in virtually all specimens, vein R₁+₂ at near two-thirds the length sends a short spur into cell R₅.

Abdominal tergites chiefly light brown, the segments with a relatively narrow subbasal dark brown ring; basal ring of second tergite with a conspicuous oblique black dash near lateral margin; sternites brownish yellow, each with an oval black median dash, these more elongate on the outer segments; subterminal segments more uniform medium brown; hypopygium brownish yellow.


The name, quasimodo, is from the hero of the same name in Victor Hugo’s, “Notre Dame de Paris.” The strongly hunch-backed condition of the fly is not even approached in the approximately 15 other regional species so far made known.

Genus Tipula Linnaeus

**Tipula** (**Nephrotomodes**) _intemperata_ new species.

Allied to _temperata_; general coloration brownish gray, the mesonotal praeascutum with four darker brownish gray stripes; antennae (male) elongate,
bicolored, yellow with the basal enlargements of segments black; wings heavily patterned with brown; r-m short; male hypopygium with the apical armature of ninth tergite consisting of elongate black setae; appendage of ninth sternite a broad flattened spatula, its apex weakly pointed.

**MALE.**—Length about 11 mm.; wing 11 mm.; antenna about 6 mm.

Frontal prolongation of head brown, with abundant black setae; nasus stout; palpi obscure testaceous yellow. Antennae (male) exceeding one-half the length of wing; basal three segments yellow; flagellar segments beyond the first conspicuously bicolored, yellow, with the basal enlargement black; verticils relatively short. Head brownish gray, the front clearer gray; orbits with conspicuous black setae.

Pronotum brownish gray. Mesonotal præscutum and scutum dull gray, the former with four darker brownish gray stripes, the narrow intermediate pair widely separated by a poorly indicated pale median area; scutum almost uniformly brown; scutellum and mediointergite abruptly testaceous yellow, parascutella darker. Vestiture of mesonotal præscutum reduced to numerous microscopic setulae on the interspaces. Pleura and pleurotergite, including dorsopleural membrane, testaceous yellow. Halteres weakly infuscated. Legs with the coxae yellow, very sparsely pruinose; trochanters yellow; remainder of legs yellow, the outer tarsal segments passing into brown. Wings with basal cells weakly tinged with brown, the outer cells more whitish hyaline; membrane heavily and conspicuously patterned with dark brown, including a broad costal darkening that involves the preapical field, cells C and Sc, with more than the cephalic half of R, and the outer radial field; stigma short-oval, even darker brown; narrow but conspicuous dark brown seams on anterior cord, m-cu, outer end of cell 1st M₂ and fork of M₁, the darkening continued as even narrower seams on the outer medial veins; dark area on m-cu conspicuous, especially on posterior portion, sending a more or less distinct seam along the distal section of Cu₂ to the margin; veins yellow, darker in the clouded areas. Squama with one or two strong setae. Venação: R₁ preserved; Rs short, angulated and weakly spurred near origin; basal section of R₁ long, r-m correspondingly reduced; cells M₁ and 2nd A wide.

Basal abdominal tergites obscure yellow, the lateral margins broadly darkened, the outer segments more uniformly dark brown; incisures of more basal tergites narrowly but conspicuously yellow; sternites yellow; subterminal segments blackened; hypopygium yellow. Male hypopygium with the tergite slightly narrowed apically, the caudal margin very shallowly bilobed by a median emargination; lobes set with elongate black setae, directed caudad and slightly mesad; ventral tergal lobe stout. Basistyle with the basal caudal portion produced dorsad into a conspicuous lobe. Both dististyles heavily blackened apically, the outer style subaeate at apex, with a low black flange near midlength; inner style with the entire posterior half provided with abundant long coarse setae. Lobe of ninth sternite spatulate, gently pointed at apex, the length about one-half greater than the width; surface with abundant pale setae, longer and more conspicuous at apex. Eighth ster-
nicate relatively short, the caudal border gently convex, with three groups of elongate setae, the median group more numerous, separated from the lateral pair by glabrous sublateral spaces.

Holotype, ♀, Palmar, Rio Maizito, Manabi, altitude 200 meters, May 5, 1941 (Laddey).

*Tipula* (*Nephrotomodes*) *intemperata* is well-distinguished from the very numerous regional species of the subgenus by the structure of the male hypopygium. The nearest ally is the Mexican *T.* (*N.*) *temperata* Alexander, which differs in the body-coloration, stouter antennae of male, details of wing-pattern, and the details of the hypopygium, as the broader tergal lobes that are armed with abundant blackened pegs, the dististyles, and the even broader and more spatulate appendage of the ninth sternite.

*Tipula* (*Nephrotomodes*) *jivaronis* new species.

Allied to *parishii*; general coloration of mesonotum reddish brown, the praeascutum and scutum with darker brown interspaces; antennæ (male) elongate, approximately two-thirds the length of body; proximal flagellar segments bicolored, yellow with small darkened basal swellings; legs yellow, the outer tarsal segments darkened; wings conspicuously patterned with dark brown, grayish subhyaline and whitish areas, the darkest color including the costal border and outer radial field, with narrower seams on certain of the veins; the white markings very conspicuous, forming a major area in the vicinity of the cord and in the outer medial field; *Rs* square and spurred at origin, cell *M*ₗ short and broad; abdomen yellow, the basal segments patterned with dark brown; a conspicuous black subterminal ring; hypopygium yellow; male hypopygium with the tergal region produced into a median lobe that is distinctly furcate at apex, the shallow fork provided with conspicuous black setae.

**Male.**—Length about 9 mm.; wing 10 mm.; antenna about 6 mm.

Frontal prolongation of head brown, darker medially at base; nasus apparently lacking; palpi black, the second segment a little paler; terminal segment broken. Antennæ (male) elongate; scape, pedicle and first flagellar segment pale yellow; succeeding flagellar segments bicolored, yellow, the small basal enlargements a little darker; on the outer segments the dark color becomes more and more extensive, the distal two or three segments uniformly darkened; verticils shorter than the segments. Head brown, the front and very narrow orbits gray; anterior vertex narrow, only a little more than twice the diameter of scape, without a vertical tubercle.

Pronotum dark testaceous brown. Mesonotal præascutum and scutum chiefly reddish brown, the former with indications of darker lines occupying the usual interspaces, leaving four poorly indicated reddish brown stripes; scutum darkened, the centers of the lobes similarly reddened; scutellum brown; medioutergite more yellowish brown, pleurotergite darker. Pleura
behind chiefly brownish testaceous, the anterior selerites clearer yellow. Halteres with stem pale, knob weakly darkened. Legs with coxae and trochanter yellow; femora, tibiae and basitarsi yellow, the outer tarsal segments more darkened; claws with a conspicuous tooth. Wings relatively broad, conspicuously patterned with dark brown, grayish subhyaline, and whitish areas; the darkest pattern occupies the entire costal border, pre-arcular field and outer radial field, the first area continued caudad to involve the cephalic portion of cell R; cell Sc being somewhat more yellowish than cell C; conspicuous dark brown seams on cord, outer end of cell 1st M sub and the veins beyond cord, being largest and most conspicuous along m-cu and in outer end of cell M; the grayish areas include almost all of basal half of wing behind the costal border, as well as marginal and central darkening in all outer medial cells; the white areas are unusually conspicuous and form an almost continuous marking in the outer fourth of cell R, cell R sub before the stigma, cell 1st M sub, and adjoining portions of cells B and all outer medial cells, as well as a slightly less distinct whitening in cell M just basad of the dark mark at m-cu; stigma scarcely darker than the remainder of costa; outer third of cell B, a little more yellowish; bases of cells M, Cu, 1st A and 2nd A a little brightened; veins brown. Venation: Rs square and long-spurred at origin; r-m obliterated by fusion of Rs+2 with M+2; cell M sub short and wide; m-cu more than two-thirds the length of Rs, placed before midlength of M+2; cell 2nd A relatively wide.

Abdomen obscure yellow, the tergites conspicuously patterned with dark brown, especially laterally; sternites less distinctly patterned with brown; conspicuous subterminal black ring that involves both the tergites and sternites; hypopygium yellow. Male hypopygium with the tergal region produced into a relatively narrow median lobe that is distinctly but shallowly furcate at apex, the outer margin of fork with numerous strong black setae; ventral tergal appendage entirely pale, strongly compressed, its more slender dorsal lobe densely provided with pale setae. Dististyles complex; outer dististyle a flattened pale blade, subrectangular in outline, the outer margin narrowly bordered by a blackened rim; inner dististyle with the main body suboval, densely provided with moderately long yellow setae and a few long black bristles near the beak; rostrum blackened, long and slender, exceeding twice the length of the irregular blackened subventral lobe that is truncated at apex. Median appendage of ninth sternite a depressed pale plate that is densely covered with setae, the appendage slightly widened outwardly and produced laterad into weak horns; caudal border subtruncate or with a very shallow median notch. Gonapophyses unusually appressed to the aedeagus, the small free caudal portion obtuse at apex; penis exceedingly long and filiform.

Holotype, ♂, Zumbi, Rio Zamora, altitude 700 meters, October 30, 1941 (Laddey).

Most similar to species such as Tipula (Nephrotomodes) intemperata Alexander, T. (N.) smithi Alexander, and T. (N.) tem-
perata Alexander, differing in the structure and pattern of the antennæ, the pattern and venation of the wings, and, especially, in the very different structure of the male hypopygium.

Genus Limonia Meigen

Limonia (Limonia) somnifica new species.

General coloration brown; antennæ (male) conspicuously nodulose, the basal swellings of the flagellar segments heart-shaped, the apical pedicels abrupt; wings with a strong brown tinge, stigma small, a little darker; Sc very long, cell 1st M₂ small, about one-half as long as vein M₂ beyond it; male hypopygium very complex in structure, especially the basistyle and dististyle; caudal margin of tergite with a deep U-shaped notch.

**Male.**—Length about 5.5 mm.; wing 6 mm.

Rostrum brownish black; palpi black. Antennæ black throughout, relatively long; flagellum very conspicuously nodulose, the individual segments expanded into subtriangular or heart-shaped enlargements that are wider outwardly, the glabrous apical pedicels abruptly narrowed; pedicels unusually long, exceeding two-thirds the segments. Head dark brown; anterior vertex reduced to a linear strip that is only about as wide as a single row of ommatidia.

Thorax almost uniformly brown, the pleura a trifle darker, the lateral portions of the prescutum slightly more yellowish. Halteres dark brown, the base of stem restrictedly pale. Legs with the coxae pale brown, the fore pair darkened; trochanters obscure brownish yellow; remainder of legs broken. Wings with a strong brown tinge, the costal border and small stigma a trifle darker brown; veins and macrotrichia dark brown. Venation: Sc very long, Sc₁ ending opposite fork of Rs, Sc₂ at its tip; Rs nearly twice the basal section of R₄-₅; cell 1st M₂ small, rectangular, about one-half of vein M₂ beyond it; m-cu at or very close to fork of M; cell 2nd A wide.

Abdominal tergites and hypopygium brownish black; sternites, especially the more basal ones, yellowish. Male hypopygium with the caudal border truncate, with a deep U-shaped notch; subapically with a dusky ridge provided with unusually abundant and elongate setae, those on the lateral ends of row on more or less distinct tubercles. Basistyle with ventro-mesal lobe relatively large, at apex with several very strong and powerful setae of unusual length, the innermost setae with their margin transversely ridged or provided with low denticles on basal half; on inner margin of lobe at near midlength with a further dense group of shorter setae; extreme apex of basistyle with another complicated outgrowth of lobes and blades, one of the latter bilobed at apex and here provided with about ten flattened spinous blades, three on one arm, seven on the other. Dististyle very complex, the entire mesal face blackened and microscopically corrugated, the posterior portion produced caudally into a relatively slender, free lobe that is similarly corrugated to the very apex; main body of style a relatively small yellow lobe, shorter than the blackened mesal face; rostral portion of style a
darkened cultrate blade that terminates in an acute point; just caudal of base of rostrum with a more slender elongate blackened lobe. Gonapophyses with mesal-apical lobe relatively stout, blackened. Aedeagus long and slender.

Holotype, ♂, Zumbi, Rio Zamora, Santiago-Zamora, altitude 700 meters, October 30, 1941 (Laddey).

Limonia (Limonia) somnifica is entirely different from all other regional members of the subgenus. The relatively long, strongly nodulose antennae are somewhat as in certain Old World species of Limonia but entirely distinct from the Neotropical forms hitherto made known. Furthermore, the unusually complicated male hypopygium is very different from that of other members of the subgenus Limonia, more suggesting that of approximately a score of species in the allied subgenus Diceromyia yet very different in all details.

Limonia (Rhipidia) turritella new species.

Allied to punctoria; mesonotal præscutum produced dorsad into a strongly developed cone, the cephalic and lateral portions of which are brownish yellow, the posterior portion and most of the posterior sclerites of the notum, as well as the pleura, abruptly blackened; legs chiefly yellow; wings brownish yellow, sparsely spotted with dark brown and with abundant paler brown dots in all the cells; Sc, ending about opposite two-thirds the length of Rs; m-cu close to the fork of M; abdomen dark brown, the outer segments somewhat brighter brown.

Female.—Length about 7 mm.; wing 7.8 mm.

Rostrum small, yellow; palpi brown. Antennae with scape, pedicel and first flagellar segment yellow; flagellum with basal swellings of remaining segments dark brown, the glabrous apical pedicels yellow; flagellar segments subtriangular in shape, slightly more produced on the lower face. Head buffy yellow, darker behind.

Pronotum buffy. Mesonotum with præscutum produced dorsad into a strongly developed conical point, about intermediate in height between the normal condition in the subgenus and the very strongly developed spinous point found in conica and allies; cephalic and lateral portions of præscutum brownish yellow, the entire posterior surface, as well as the scutum, scutellum and cephalic portion of the mediotergite uniformly brownish black, unpatterned; remainder of mediotergite reddish brown. Propleura light brown; mesopleura, metapleura and pleurotergite conspicuously and abruptly blackened. Halteres with stem yellow, knob weakly darkened. Legs with fore coxae brown, middle and hind coxae brownish black; trochanters obscure yellow; remainder of legs yellow, the terminal two tarsal segments, with the apex of the third segment, abruptly blackened; a scarcely evident subterminal darkening on femora. Wings with the ground color
brownish yellow, with a conspicuous dark brown and pale brown spotted and
dotted pattern; the darker brown areas occur as larger spots at origin of
Rs, fork of Sc, the restricted stigmal area at R2 in cell 1st A near outer end
of vein 2nd A, and as narrow seams along cord and outer end of cell 1st M2;
the dots occur in all cells, small but abundant, in part confluent; axillary
region clouded with brown; preapical and costal fields somewhat more
saturated yellow than the remainder of ground; veins yellow, darker in the
infused areas. Venation: Sc relatively long, Sc1 ending about opposite
two-thirds the length of Rs, Sc2 at its tip; Rs angulated at origin; inner
ends of cells R3 and 1st M2, especially the former, arcuated, lying conspicu-
ously more basad than cell R3; cell 1st M2 relatively long, subequal to or
longer than vein M1,2 beyond it; m-cu at or just beyond the fork of M, sub-
equal in length to distal section of vein Cu2; vein 2nd A near outer end
weakly angulated or with indications of a weak spur jutting into cell 1st A
at the place of the dark spot above described.

Abdomen dark brown, the sides of the first tergite slightly brightened;
outer segments light brown; both cerci and hypovalvae reddish, their tips
acute.

Holotype, ♀, Zumbi, Rio Zamora, Santiago-Zamora, altitude
700 meters, October 28, 1941 (Laddey).

Mr. Laddey informs me that the present fly, as well as rather
numerous interesting species discussed in this and other papers,
were taken in a very restricted area near the military outpost of
Zumbi in Jivaro Indian country. It was particularly noted that
although crane-flies were unusually numerous in this small area
that otherwise apparently identical locations were quite devoid of
these flies. It is further to be noted that there is a station
"Zumba," likewise in the Province of Santiago-Zamora, that is
entirely distinct from the present one. This latter is described
and figured (Map 9) in Brown's paper on "Entomological Sta-

The closest relative of the present fly is Limonia (Rhipidia)
punctoria Alexander, which has the development of the prescutal
tubercle about the same but which differs very conspicuously in
the pattern of the body and wings, the latter lacking the abun-
dant dots in all the cells as found in the present fly.

Genus Austrolimnophila Alexander

Austrolimnophila (Austrolimnophila) nympha new species.

General coloration of mesonotum pale brown, the præscutum with four
more or less distinct darker brown stripes; antennæ with scape yellow;
Alexander, cell stigma m-cu abdominal cell wing Crane-flies Es, Zumbi, tibiae; lobes hypopygium narrow; long, relatively black, beyond than phila) curved opposite brown, black. subhyaline, 700 on brown scutal three light and outer basistyle hypopygium tergites patterned m-cu halteres the Pronotum Abdominal male. The Holotype, 2, the last pattern narrowest on fore legs, very extensive on posterior tibiae; tarsi yellowish white. Wings narrower than in persessilis; whitish subhyaline, very restrictedly patterned with pale gray clouds at origin of Rs, along cord and at fork of R3,4; stigma small, oval, only a trifle darker than the remaining pattern; veins dark brown. Venation: Sc ending about opposite two-thirds Rs, Sc much longer, near the extreme tip of Sc; Rs long, weakly angulated at origin; R3,4 more than twice R1,2 cell 1st M2 narrow; cell M1 very short-petiolate; m-cu more than one-half its own length beyond the fork of M.

Abdominal tergites dark brown, the extreme posterior borders pale; sternites obscure yellow; segment eight and tergite nine conspicuously brownish black, the basistyles of the hypopygium again conspicuously pale. Male hypopygium with the tergite conspicuously notched medially, the lateral lobes narrowly obtuse at tips. Basistyle with interbases produced into a long blade that is conspicuously twisted, the tip acute. Outer dististyle relatively narrow, the apex a strongly curved black hook; surface with scattered strong setae, some of unusual length. Inner dististyle longer, strongly curved to feebly angulate at near middle; basal half wider, its outer margin densely set with short setae.

Holotype, male, Zumbi, Rio Zamora, Santiago-Zamora, altitude 700 meters, November 2, 1941 (Laddey).

The most similar species is Austrolimnophila (Austrolimnophila) persessilis Alexander, which is well-distinguished by the
broader wings, different body-coloration, and in the details of structure of the male hypopygium, more especially of the tergite, interbase and inner dististyle.

**Austrolimnophila (Limnophilella) inquieta** new species.

General coloration of notum brownish yellow, the anterior portion of praeascutum more darkened; pleura uniformly pale yellow; halteres with stem pale yellow, knob brownish black; femora pale yellow, the tips narrowly blackened; wings subhyaline, heavily patterned with brown; a supernumerary crossvein in cell R₅ at near midlength; male hypopygium unusually complex in structure.

**MALE.**—Length about 9 mm.; wing 9 mm.

**FEMALE.**—Length about 10 mm.; wing 11 mm.

Rostrum and palpi brownish black. Antennae with scape and pedicel brownish black, flagellum much paler, brownish yellow; flagellar segments long-cylindrical, with very long conspicuous verticils. Head with front, anterior vertex and posterior orbits light brown, remainder of head pale brown, pruinose; eyes large in both sexes, the anterior vertex unusually narrow, not exceeding two-thirds the diameter of scape.

Pronotum dark brown medially, paling to yellow on sides. Mesonotal praeascutum brownish yellow, the anterior portion more darkened; scutum and adjoining portion of praeascutum slightly infuscated; scutellum testaceous yellow; mediotergite testaceous yellow, narrowly infused on lateral portions. Pleura uniformly pale yellow. Halteres elongate, stem pale yellow, knob brownish black. Legs with coxae and trochanters pale yellow; femora pale yellow, the tips rather narrowly but conspicuously blackened, the amount subequal on all legs; remainder of legs white. Wings subhyaline, heavily and handsomely patterned with brown, as follows: A very extensive area in cells C and Sc, including approximately one-half the length of the cells; pre-areolar field and an adjoining cloud at areolus; major areas in outer radial and medial fields, subequal in degree to the pale interspaces, cell 1st M₂ and base of R₅ of this latter color; extensive darkenings in cells M₁ and Cu immediately behind cell 1st M₂ and in cell Cu immediately behind m-cu, further extended to margin at end of vein 2nd A; veins brown, the costal interspaces more yellow. In the allotype, the central portions of the dark areas in outer radial field paler, narrowly bordered by dark brown. Venation: R₁+₂ longer than R₂+₃+₄; a supernumerary crossvein in cell R₅ at near midlength of cell, behind connecting with vein M₄ shortly beyond the origin; cell M₁ short-petiolate; m-cu from one to one and one-half times its own length before the fork of M.

Abdominal tergites dark brown, the posterior borders of the segments narrowly but conspicuously pale; basal sternites obscure yellow, more or less distinctly ringed subbasally by dark brown; in male, the subterminal segments more uniformly pale, the eighth and ninth segments black. Male hypopygium complex in structure; ninth tergite deeply notched medially,
each adjacent angle produced into a conspicuous bispinous structure, one
spine directed caudad, the other cephalad. Basistyle bearing a large con-
spicuous fleshy lobe on face; also on mesal face with a shorter lobe provided
with a dense brush of yellow setae; interbasal hooks very strong and power-
ful, directed cephalad. Outer dististyle conspicuously bilobed, the lobes
very unequal, the outer ones shorter and digitiform, provided with very long
yellow setae that are conspicuously scabrous, inner lobe much larger, bulbous,
with shorter, more normal setae. Inner dististyle broad at base, the lower
basal margin bearing a low cushion set with abundant microscopic spines; a
somewhat similar but higher crest or flange on outer face of style back from
apex, set with abundant microscopic spinules and short setae. Phallosome a
broad subquadrate structure produced into several spinous points.

Holotype, ♂, Zumbi, Rio Zamora, Santiago-Zamora, altitude
700 meters, October 28, 1941 (Laddey). Allotopotype, ♀, Octo-
ber 31, 1941.

On the basis of structure of the unusually complex male hypopygium, the present fly is closest to Austrolimnophila (Limno-
philella) multipicta Alexander, of southeastern Brazil. It is
very different from all known members of the genus, not only in
the structure of the male hypopygium, but also by the presence of
a supernumerary crossvein in cell M₃ of the wings.

Austrolimnophila (Limphilella) inquieta retractior new subspecies.

Female.—Length about 10 mm.; wing 10.5 mm.

Like the typical form but with m-cu lying far basad, about opposite the
proximal fifth or sixth of Rs, the dark seam along m-cu thus in transverse
alignment with the area at origin of Rs. In the typical form this area lies
closer to the darkened seam along the cord of wing.

The degree of retraction of m-cu in the present fly represents the extreme
condition so far found in the Hexatomini, m-cu lying approximately four
times its own length before the fork of M or before two-thirds of the total
length of vein M. It scarcely seems possible to me that such a range in
venation can lie within the restricted field of the species and I prefer to
consider the present fly to represent a subspecies.

Holotype, ♀, Zumbi, Rio Zamora, Santiago-Zamora, altitude
700 meters, October 30, 1941 (Laddey).

Genus Ctenolimnophila Alexander

Ctenolimnophila (Campbellomyia) severa new species.

General coloration of mesonotum brown, the prescutum more reddish
brown, more blackened laterally; antennae short, black throughout; thoracic
pleura yellow with a conspicuous black longitudinal stripe; legs brownish
black; wings with a very strong blackish suffusion; Rs long, arcuated at
origin, fully three times $E_{2+3+4}$; cell 1st $M_2$ long and narrow; male hypopygium with the interbasal rods very long and slender, strongly curved, with setae at and near their tips.

**MALE.**—Length about 5.5 mm.; wing 5.5 mm.; antenna about 0.85 mm.

Rostrum and palpi black. Antennae black throughout, unusually short; flagellar segments short-oval, the outer ones more elongate and provided with much longer verticils, these exceeding twice the length of the segments. Head brownish black, the front and narrow posterior orbits more pruinose.

Pronotum obscure yellow above, blackened on sides. Mesonotal prescutum obscure reddish brown, restrictedly patterned with blackish, especially evident as a broad lateral border; posterior sclerites of notum somewhat darker brown. Pleura light yellow, with a conspicuous longitudinal black stripe extending from the cervical region and propleura, reaching the abdomen, passing beneath the root of the halteres; dorsopleural area, including the wing-root and parts of the pleurotergite and mediotergite, similarly yellow, more obscure behind. Halteres infuscated, the extreme base of stem obscure yellow. Legs with the coxae and trochanters obscure yellow; remainder of legs brownish black; tibial spurs small but distinct; claws long and simple. Wings with a very strong blackish suffusion, the preareolar and costal fields, together with the stigma and a seam along vein Cu, a trifle darker; veins brown. Veins basad of cord without trichia or virtually so. Venation: $Sc_1$ ending about opposite one-third the length of $R_{2+3+4}$, $Sc_2$ at its tip; $Rs$ long, arcuated at origin, fully three times $R_{2+3+4}$; $R_{2+3+4}$ subequal to or a little longer than $R_{2+3}$; $R_{2+3}$ about one-half $R_{2+3+4}$; cell 1st $M_2$ long and narrow, subequal in length to vein $M_2$ beyond it; $m$ shortened; $m-cu$ about opposite one-third the length of cell 1st $M_2$.

Abdomen, including hypopygium, black. Male hypopygium with the outer dististyle short and compact, curved at apex, the outer face of distal half with long subappressed spines. Interbasal rods very long and slender, strongly curved, the distal half and apex with microscopic pale setae; apex decurved to an acute point, the setae longer and more conspicuous.

Holotype, $\delta$, Zamora, Santiago-Zamora, altitude 1,000 meters, December 20, 1941 (Laddey).

*Ctenolimnophila (Campbellomyia) severa* is entirely distinct from the other described species of the subgenus, differing conspicuously in the coloration of the body and wings, and in the venation.

**Genus Gonomyia Meigen**

**Gonomyia (Lipophleps) ramus** new species.

Belongs to the *manea* group; antennæ black throughout; mesonotum plumbeous gray, the posterior border of scutellum obscure yellow; legs brownish black; wings with a pale brown tinge, the diffuse stigma a very little darker; $Sc_1$ ending about opposite the origin of $Rs$; male hypopygium
with the basistyle produced caudad beyond the apex of the dististyle as a fleshly lobe; dististyle a yellow blade, on outer margin bearing a long strong rod; phallosome complex, produced into two blackened points and two paler blades.

**MALE**—Length about 3.3–3.5 mm.; wing 3.8–4 mm.

Rostrum obscure yellow to testaceous; palpi black. Antennae black throughout; flagellar segments elongate, with very long erect setae and the usual longer verticils. Head gray.

Pronotum dark; pretergites pale yellow. Mesonotal præscutum and scutum uniformly dark plumbeous gray, the median area of scutum obscure yellow; posterior margin of scutellum broadly obscure yellow; postnotum paler brown, darker posteriorly. Pleura brown, with a longitudinal whitish stripe, the selerites above this band darker than the ventral ones. Halteres brownish black. Legs with the coxae pale brown, the fore pair a trifle darker; trochanters obscure brownish yellow; remainder of legs brownish black. Wings with a pale brownish tinge, the diffuse stigma a very little darker; præcucular and costal regions slightly more yellow; veins pale brown. Venation: Sc, ending approximately opposite the origin of Rs, Sc₂ a short distance back from its tip; m-cu close to fork of M.

Abdominal tergites dark brown, sternites and hypopygium more yellowish. Male hypopygium with the basistyle produced beyond the level of apex of dististyle as a long fleshly lobe that is easily broken. Dististyle a yellow blade that terminates in a blackened spinous point; on outer margin at near midlength with a long, strong, dark-colored rod, the tip acute; a more or less well-developed spinelet at base of rod; lower margin of blade with a series of strong setae, the two outermost longer and stronger but scarcely fusciculate. Phallosome complex, including two blackened points and two paler blades; longest element pale, flattened, the margin incised; second pale element much shorter and more slender; longest blackened point slender, curved to the acute point; shortest element a small blackened spine that terminates a broadly flattened yellow blade.

Holotype, ♂; Zumbi, Rio Zamora, Santiago-Zamora, altitude 700 meters, November 2, 1941 (Laddey). Paratopotype, ♂; October 28, 1941.

The present fly is most similar to species such as *Gonomyia (Lipophleps) anduzeana* Alexander and *G. (L.) tribulator* Alexander, differing conspicuously in the structure of the male hypopygium.

**Genus Toxorhina** Loew

**Toxorhina** (Ceratocheilus) *attribarsis* new species.

General coloration of thorax reddish brown, without evident markings; halteres with brownish black knobs; legs black, including all tarsi; wings with a strong blackish tinge; anterior branch of Rs elongate; cell 1st M₂
rectangular; male hypopygium with the basistyle simple at apex; a conspicuous interbasal plate that is produced into a single powerful spine; outer dististyle terminating in two slightly unequal spines; aedeagus with the arms elongate.

**MALE.**—Length, excluding rostrum, about 6.5 mm.; wing 6.5 mm.; rostrum about 3.9 mm.

Rostrum black throughout, exceeding one-half the length of remainder of body. Antennae black, the short scape a little paler. Head dull grayish black; anterior vertex relatively narrow, a trifile less than the diameter of scape.

Pronotum reddish brown. Mesonotum reddish brown, without evident markings, the sides of the mediotergite a trifile darker. Pleura uniform reddish brown, unpattered except for a very slight darkening on the anepisterna and adjoining portions of the dorsopleural region. Halteres with stem obscure brownish yellow, knob brownish black. Legs with coxae reddish brown; trochanters yellowish brown; remainder of legs, including all tarsi, black. Wings with a strong blackish tinge, the prearcular field restrictedly more whitened; cells C and Sc still deeper in color; veins brownish black. Venation: Sc₁ ending a short distance before the fork of Rs₁ Sc₂ some distance from its tip, about opposite two-fifths the length of Rs; anterior branch of Rs₁ elongate, for more than one-half its length extending nearly parallel to the posterior branch; cell 1st M₁ rectangular, nearly equal in length to vein M₅ beyond it; m-cu a short distance beyond fork of M₁.

Abdominal tergites dull black, the extreme posterior borders of the segments pale; basal sternites more dimidiate, the proximal half of each segment dark brown, the outer portion obscure brownish yellow, on the intermediate sternites the segments uniformly darkened; hypopygium chiefly pale, the basistyles a trifile darker. Male hypopygium with the basistyle simple at apex, without terminal spine; conspicuous interbasal structures appear as flattened pale blades, each terminating in a powerful spine. Outer dististyle broad-based, rapidly narrowed to apex which terminates in two curved, slightly unequal, darkened spines; outer margin of style on distal half with a group of long erect setae. Inner dististyle a little longer, appearing as a uniformly pale yellow cultrate blade. Aedeagus with the two arms elongate, each a little expanded and pale on distal portion.

Holotype, ♂, Zumi, Rio Zamora, Santiago-Zamora, altitude 700 meters, November 4, 1941 (Laddey).

**Toxorhina** (*Ceratocheilus*) *atritarsis* is most similar in venation and in general appearance to *T. (C.)* *leucostena* Alexander and *T. (C.)* *niveitarsis* (Alexander), both of which are well-distinguished by the snowy white tarsi.
EFFECT OF MILKY DISEASE ON TIPHIA PARASITES OF JAPANESE BEETLE LARVAE

By R. T. White

Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, United States Department of Agriculture

INTRODUCTION

Several species of Tiphia have been introduced from the Orient in the fight against the Japanese beetle, Popillia japonica Newm., and two have become particularly well established throughout the older beetle-infested area. One of these, Tiphia vernalis Roh., has its active flight period during the spring months, whereas the other, Tiphia popilliavora Roh., is present late in the summer. Large collections of adult Tiphia females are made annually from a number of these colonies for further use in the colonization of other infested areas. The abundance of Tiphia in a number of the colonies ecologically similar to the more successful ones is not sufficient to warrant collection, and in some of these no satisfactory explanation of this condition has been offered. It seemed possible that milky disease, caused by Bacillus popilliae Dutky, in competition with Tiphia might be responsible for the failure to obtain strong colonies in areas where this disease was prevalent. Work was started in 1935 by the writer under the direction of the late G. F. White and was continued through 1937, both in the laboratory and in the field, to determine whether the milky disease does kill Tiphia larvae that feed on diseased hosts, and to clear up some of the questions on the interrelationships of these two biological factors when they occur in the same habitat.

EXPERIMENTAL PROCEDURE

In attempting to solve this problem it was essential to start with Japanese beetle larvae that were known to be healthy. Larvae were therefore collected in the field and held individually in 2-ounce tins of autoclaved soil for 3 weeks at a temperature of 75° F., and those not showing signs of disease at the end of this period were assumed to be healthy. Likewise, as Tiphia that had
not been exposed to the milky disease organisms were required, females only recently emerged from laboratory experiments were mated and used in these studies.

Experiments were conducted in which larvae parasitized by *Tiphia* females were inoculated with the disease organism at different periods of development to determine whether the parasite would develop on diseased larvae. The inoculation of the host larvae was accomplished by simply puncturing them with a needle previously dipped in the blood of diseased larvae. In some of these experiments the larvae were inoculated and parasitized on the same day, while others were inoculated from 2 to 15 days prior to parasitization. Other series were conducted in which the host larvae were inoculated from 2 to 15 days following parasitization. Still other larvae were parasitized and held in infectious soil for a varying number of days prior to cocoon formation. Similar experiments were also conducted in 1936 with both *T. popilliavora* and *T. vernalis*.

**RESULTS**

In some of the earlier experiments *Tiphia* larvae examined immediately after they had spun cocoons were found to be infected with milky disease. Other cocoons from these same series, examined 2 weeks later, showed no signs of disease in the enclosed larvae. Further investigation showed that the recently voided meconium present in the posterior end of the cocoons was often laden with viable spores of the agent causing milky disease. It was found that after the meconium had been voided there was no evidence of disease in the larva, indicating that the spores had been voided along with the meconium, with no ill effect on the parasite itself.

Table 1 gives a summary of the results obtained in examinations of *Tiphia vernalis* cocoons during 1935 and 1936, including only cocoons in which the meconium was examined. In this work the meconium is spoken of as being positive if it was found to contain spores of the milky disease.

From these data it seems unlikely that *Bacillus popilliae*, the organism causing milky disease, has any effect on the mortality of *Tiphia* larvae within the cocoon, as 74 per cent of the larvae within cocoons formed in the check experiments were dead after
2 months, as compared with 52 per cent of those formed in experiments in which the hosts were exposed to the disease agent. Also, only 3 per cent of the cocoons containing dead larvae in the checks contained positive meconium, as compared with 36 per cent of those exposed to disease, indicating that the presence of the milky disease agent was not the direct cause of mortality.

In one series of experiments, all host larvae inoculated with milky disease 10 and 14 days prior to parasitization by *Tiphia* died before the parasite larvae could complete their development.

### TABLE I

**Summary of *Tiphia vernalis* Cocoon Examinations Made 2 Months After Cocoon Formation, 1935 and 1936**

<table>
<thead>
<tr>
<th>Treatment of host larvae</th>
<th>Cocoons formed</th>
<th>Cocoons containing dead <em>Tiphia</em> larvae</th>
<th>Cocoons of dead <em>Tiphia</em> containing positive* meconium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per cent</td>
<td>Per cent</td>
</tr>
<tr>
<td>Exposed to disease</td>
<td>181</td>
<td>52</td>
<td>36</td>
</tr>
<tr>
<td>Not exposed to disease</td>
<td>104</td>
<td>74</td>
<td>3</td>
</tr>
</tbody>
</table>

* Containing spores of *Bacillus popilliae*.

However, only 37 per cent of such larvae inoculated 2 days after parasitization died before the parasite larvae completed development and spun cocoons. Although excessive mortality of the host larvae caused directly by milky disease occurred in these experiments, a large percentage of the cadavers when examined still had living *Tiphia* larvae attached to them, indicating that ultimate death of the parasite was due to lack of a living host and not to the direct effect of the disease on the parasite.

Experiments comparable to those previously described were conducted with *Tiphia popylliavora* during the fall of 1936. A portion of the cocoons from these experiments were set aside for possible emergence. Examination of a large number of the cocoons 30 days after formation (Table 2) showed that approximately the same mortality of enclosed *T. popylliavora* larvae occurred, regardless of whether the hosts had been exposed to the disease.

As only a small series of cocoons was held in storage, very little emergence resulted. Emergence of both male and female *Tiphia*
was obtained, however, and examination of the meconium remaining in the cocoons after emergence showed the presence of milky disease spores. This is conclusive proof that *Tiphia* parasites can and do complete development on, and emerge from, host larvae infected with milky disease, provided the host does not die before the parasite completes its development on it.

Some evidence that *Tiphia* may aid in the spread of milky disease was observed during the course of these experiments. *Tiphia*

### TABLE II

**Summary of *Tiphia popilliavora* Cocoon Examinations 30 Days After Cocoon Formation, 1936**

<table>
<thead>
<tr>
<th>Treatment of host larvae</th>
<th>Cocoons formed</th>
<th>Cocoons containing dead <em>Tiphia</em> larvae</th>
<th>Cocoons of dead <em>Tiphia</em> containing positive* meconium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per cent</td>
<td>Per cent</td>
</tr>
<tr>
<td>Exposed to disease ......</td>
<td>142</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Not exposed to disease ...</td>
<td>104</td>
<td>45</td>
<td>4</td>
</tr>
</tbody>
</table>

* Containing spores of *Bacillus popilliae*.

adults were removed at various times from infectious soil and examined externally for disease spores. From a total of 71 examinations, 22 *Tiphia* adults were demonstrated to be carriers of spores.

A number of well-established colonies of *Tiphia* occur in areas in which milky disease is also present. Surveys conducted at several of these sites have been made and data from one such survey are given below. Newly formed cocoons found at the time of this survey were cut open and an examination made of the voided meconium to determine whether the respective hosts had been diseased. An average population of 12 Japanese beetles, including all stages, per square foot was found, as follows:

Number of holes dug .............................................. 36
Total population (includes larvae, adults, and pupae of the Japanese beetle and *Tiphia* cocoons) .................. 434
Total hosts parasitized ........................................ 210 (48.4 per cent)
Total hosts diseased ............................................ 167 (38.5 per cent)
Hosts both parasitized and diseased .......................... 63 (14.5 per cent)
Hosts neither parasitized nor diseased ....................... 120 (27.6 per cent)
Total hosts killed either by disease or parasitization 314 (72.4 per cent)
It is evident that there was an overlap of 14.5 per cent between hosts that were parasitized and those that were diseased, i.e., 63 hosts were parasitized as well as diseased. This condition was in effect superparasitism, because death of the host would have resulted from either biological agency. The combination of disease and parasitization at this location accounted for 72.4 per cent of the total population present during June 1936. In the examination of the cocoons from this survey it was found that 8 of the cocoons containing dead *Tiphia* larvae and 2 of those containing living parasite larvae had meconium with viable milky disease spores. The larvae in the last two cases had successfully voided the spores with no apparent ill effect. In no case after a living *Tiphia* larva had voided its meconium were milky disease spores found in the larva itself.

CONCLUSIONS

From observations both in the field and in the laboratory, it is evident that some of the progeny of *Tiphia* do fail to complete their development, owing to the death of the host through disease but not to the disease directly. The greatest loss of hosts occurs when the disease is well advanced at the time of parasitization. On the other hand, during May, when *Tiphia vernalis* is actively ovipositing, the soil temperature in the Moorestown, N. J., area rarely exceeds 65° F., a temperature not favorable for the rapid growth of the disease organism. The ability of *T. vernalis* to persist in such areas is borne out further by the fact that this species may still be collected by the thousands in areas in which the incidence of disease has been rather consistently high since 1936. It seems more probable that a species such as *T. popillia-vora*, which is active in the latter part of August, will suffer most, because at that time the soil temperature ranges generally somewhat above 70° and is more favorable to disease development.

It is not likely that either of these biological agents can completely eradicate its host. Both will therefore persist in varying degrees, and no doubt some *Tiphia* colonies, which might otherwise have become sufficiently populous to serve as collecting centers, will suffer reductions in population owing to the effect of the disease on the host. It is also possible that *Tiphia*, acting as
a vector of viable spores, may be assisting in the dispersal of the disease.

As data conclusively show that *Tiphia* parasites can complete their development on hosts infected with milky disease, it is the writer’s opinion that these two biological agencies are compatible as control factors within the same area.
A NEW AXIOCERSES FROM WEST AFRICA
(LEPIDOPTERA, LYCAENIDÆ)

By Harry K. Clench

Cambridge, Mass.

A small collection of Liberian Lycaenidae sent me contained a female of a new subspecies of Axioerces harpax Fabricius.¹ The specimen has been deposited in the collection of the Museum of Comparative Zoology.

**Axioerces harpax piscatoris**, new subspecies

**Upperside:**

*Female. Fore wing* brownish black with a fulvous glint in certain lights. Two bars of bright orange, one discal and one post-discal, cross the wing, the former from M₃, just beyond the cell-end, to Cu₃, and the latter from M₁ to 2A. Both are roughly parallel to the outer margin, a little over 1 mm. apart from each other, and the latter about 2 mm. from the outer margin. Veins narrowly black where they cross these bands. *Hind wing* orange, with the costa to M₁, the entire cell, the inner margin, and the basal half of the space between the lower discocellular and 2A black. Parallel with the outer margin are two central lines of black, the inner one (just beyond the cell-end) the heavier, and the outer one thinner and somewhat obsolescent. Basal to the inner one the small amount of orange appears more as a suffusion than as a definite region of color. Veins between the two lines and faintly marginal to the outer one are black pencilled. On the outer margin is a very narrow black line. Anal lobe marked with metallic. *Fringe* of both wings gray. (Presumably this subspecies has a tail as in the typical subspecies. This region is nicked in the only specimen available, however, and therefore none is present.)

**Underside:**

*Female. Fore wing* pale orange-brown with a reddish tint, towards inner margin becoming nearly pure orange, and ultimately (outward of 2A) gray. Cell crossed by three metallic bars, each surrounded by black; one in the base, one in the center, and one across the cell-end. Below the last, in the base of the Cu₁–Cu₂ interspace is a spot of similar metallic, similarly surrounded with black (most heavily basad and marginad). A discal row of five spots, connected, but slightly dislocated, crosses the wing from M₁ to 2A, all but the last (Cu₁–2A) being similar in type to the foregoing. In this last one the metallic center is replaced by gray. A submarginal row of small spots proceeds from apex to inner angle; the apical spot is displaced marginad and

is just at the apex; the remaining are parallel to the outer margin, and all but
the last two consist of fine metallic points with black circumscriptions. On
the apical one the black is so minute as to be hardly noticeable. The base of
the Cu_{2}-2A interspace adjoining the cell is black. On the costal margin,
commencing one-third out from the base, is a row of fine spots, small, but
similar in construction to the majority on that wing. They proceed marginad
on the costa for about one-third its length. *Hind wing* with ground color
brownish red. Basal half of wing strewn with metallic spots, each ringed
with black, as follows: one in the base of the cell, one in the center, and two
closing the end; two on the costa (one at the center and one near the base);
two on the inner margin (one at the base and one just basad of the center);
one at the base between the lower De and 2A; one one-third out in this
same interspace; one below the lower cell-end; one in the Cu_{1}-Cu_{2} interspace;
a discal row of them running from the costa to the inner margin, the costal
displaced outwardly. The M_{1}-M_{2}; M_{3}-Cu_{3}, and those in Cu_{2}-inner margin
(all run into an elongate bar) all displaced inwardly. On the inner margin,
two-thirds out, is a long bar of metallic scales bordered with black that starts
on the inner margin and curves evenly and shallowly outward along the
margin. A submarginal dark, broad, hazy line crosses the wing, at the apex
and in the Cu_{2}-Cu_{2}-2A interspaces dully crosses the wing, at the apex
and in the Cu_{2}-Cu_{2}-2A interspaces dully bordered outwardly with metallic.
Anal lobe also marked with metallic.

Length of fore wing, female, 13 mm.


Remarks. Differs (in the female) from eastern and southern *harpax* in the great amount of black, particularly in the base,
above, on both wings. In the typical subspecies this surface is
largely orange, while in *piscatoris* it is predominately black-brown, with the remaining orange darker than in the typical.
Below the metallic spots are larger, the ground color (especially
on the hind wing) darker and ruddier.

Comparisons have been made with females from the following
localities: Kilossa, Tanganyika Territory; Rabai, Kenya Colony;
Zanzibar; Victoria Falls, Rhodesia; Natal; Cape of Good Hope,
South Africa. These are all in the Museum of Comparative
Zoölogy, and all, apparently, represent typical *harpax*. 
A NOTE ON THE ARIZONA ERORA (LEPIDOPTERA, LYCÆNIDÆ)

BY HARRY K. CLENCH

CAMBRIDGE, MASS.

In 1940, Mr. C. F. Dos Passos described a subspecies (sanfordi) of Erora latæ Edwards, basing his description on specimens mainly from Arizona. A year later Mr. W. D. Field, in a detailed and lengthy discussion of the two forms, synonymized sanfordi in favor of Erora quaderna Hewitson, and pointed out that the two were not subspecies, but were worthy of full specific separation. Field, however, unfortunately acted without seeing any topotypical (or even approximately topotypical) quaderna, his concepts of that species being formed solely on Hewitson's descriptions and figures, and on the description of Godman & Salvin in the "Biologia." This has rendered incomplete and inaccurate what might have been a thorough and conclusive piece of work, and has made necessary the present paper.

Among a number of Lycaenidæ recently acquired by the Museum of Comparative Zoology are two females of what is apparently true quaderna. These specimens (data: Tancitaro, Michoacan, Mexico, 7800 feet, June 30, and July 8, 1941, resp.; H. Hoogstraal and R. Haag, collectors) coincide quite well with the descriptions and figures of Hewitson, and may be taken as typical. These, when compared with a number of Arizona "quaderna" showed that the name sanfordi is not to be synonymized, but rather retained for a valid race. The affinities of this Arizona subspecies are, however, with quaderna and not with latæ, so the name must be transferred. These conclusions were kindly verified for me by Mr. F. W. Goodson, at the request of Dr. N. D. Riley. He examined the specimens in the British Museum collection and his report is quoted in part as follows:

"In the B. M. collection there are seven females of latæ Edw., and five females of quaderna Hewitson. . . . The Rothschild collection contained a male from South Arizona (Poling)
and a female from the Huachuca Mts., Arizona (Oslar) which agree well with \textit{laeta sanfordi} dos Passos. \textit{Laeta} and \textit{laeta sanfordi} undoubtedly differ from \textit{quaderna}. On the upperside the ground colour of \textit{laeta} and \textit{sanfordi} is brown, in \textit{quaderna} black; the blue of the former more restricted on both wings, and is more violet than \textit{quaderna}. ... The specimen described by Godman and Salvin is a female, not a male, and differs in the underside being much greener, but it is a very fresh specimen which may account for it."

Mr. Goodson, in another part of his report, even goes so far as to coincide with dos Passos in that \textit{laeta} and \textit{sanfordi} are races together, specifically distinct from \textit{quaderna}; but granting Field's drawings of male and female genitalia of both to be accurate (and they certainly appear so), such a conclusion cannot hold. There are too many profound differences which point to long isolation and full specific distinction between them. Furthermore, the patterns of \textit{sanfordi} and \textit{quaderna} are much more closely allied than those of \textit{sanfordi} and \textit{laeta}.

There appears to be no known record of \textit{quaderna} closer than a rough thousand miles to Arizona, all the known localities lying south of an imaginary line drawn from Tuxpan, on the Caribbean Sea, to Colima, near the Pacific Coast. This makes rather pointless one of Field's arguments for his synonymizing of \textit{sanfordi} and \textit{quaderna}. He says in the introduction of his paper (p. 303): "It seems less surprising, however, to find that this southwestern species is really a species found in nearby Mexico than a New England and eastern Canadian species not known to occur in any locality nearer than fifteen hundred miles distance."

The species concerned may be listed with the following synonymies:

\textbf{Erora laeta} Edwards

\textit{Erora laeta}: Field, 1941, Annals Ent. Soc. America 34, p. 309, pl. 1, figs. 1, 2, 3, 7; pl. 2, figs. 1–4; pl. 3, figs. 9, 10.
To the localities given by Field may be added the following, based on a female in the Museum of Comparative Zoölogy: Lake St. Joseph, Portneuf County, Quebec (June 1932, G. B. Fairchild).

**Erora quaderna quaderna** Hewitson

*Thecla quaderna* Hewitson, 1868, Deser. Lycænidae, p. 35.


**Erora quaderna**: Field, 1941, Annals Ent. Soc. America 34, p. 303, pl. 1, figs. 4, 5, 6, 8; pl. 2, figs. 5–8; pl. 3, figs. 11–13:

(In part). (Figures all represent sanfordi, not quaderna.)

The type locality is here selected as Tancitaro, Michoacan, Mexico. The type female, with no accurate data, is in the British Museum. The only insight we have to the habits of this species are the notes on the two specimens in the M. C. Z. They read, respectively: "Resting on lupine at nightfall," and "Swept from mt. meadow."

**Erora quaderna sanfordi** dos Passos

*Erora lata*: of authors.


**Erora quaderna**: Field, 1941, Annals Ent. Soc. America 34, p. 303, pl. 1, figs. 4, 5, 6, 8; pl. 2, figs. 5–8; pl. 3, figs. 11–13.

Complete bibliographical references to all forms here discussed are to be found in Field’s paper.
NEW RECORDS (LEPIDOPTERA)

Among a few specimens captured by Mr. Ropért May at Cape Wolstenholme, P. Q., Lat. 62° 25' Long. 66° 14' are:


138. *Oeneis melissa sempiei* Holland. ♂, 10 July, 1941 at sea level.


This subspecies was described from Southampton Island. These specimens from across the bay are marked more heavily than topotypical specimens but are still much less heavily marked that Labrador *aquilo.*—Wm. P. Comstock.
THE GENUS MELECTA IN EASTERN NORTH AMERICA AND PORTO RICO (HYMENOPTERA, ANTHOPHORIDÆ)

BY E. GORTON LINSLEY
UNIVERSITY OF CALIFORNIA, BERKELEY

In 1939 the writer commented on the remarkable fact that the genus *Melecta*, known by some twenty or more species and subspecies in western North America, was unknown east of the Mississippi River. This situation posed a very difficult problem in distribution since no good explanation for the apparent fact was evident. It is with considerable satisfaction, therefore, that the writer is now able to record the presence of at least one species on the Atlantic Coast of North America and another in Porto Rico. The presence of the former, a species assignable to the subgenus *Melecta* s. str. in Georgia suggests the possibility that the group may yet prove to be fairly widely distributed in eastern North America, since this subgenus clearly appears to be of northern origin. The occurrence of a species of the subgenus *Melectomorpha* in Porto Rico is even more significant, suggesting that this latter group may be of southern origin and, if so, probably entitled to generic rank. A need for revisonal studies of Neotropical melectine bees is clearly indicated and must be undertaken before the distribution of the North American forms can become fully intelligible.

**Melecta (Melecta) atlantica** Linsley, new species

Female: Form robust; integument black, pubescence black except that of dorsum of thorax which is ochraceous. *Head* with face densely clothed with long, erect, black hairs, sparser on elypeus and vertex; upper vertex and occipital area with a patch of erect, pale hairs; upper frons dullish, except sutures, closely, moderately coarsely punctate; elypeus shining, moderately coarsely punctured at base, more finely toward apex which has a smooth impunctate margin; labrum with surface concave, shining, coarsely, irregularly punctured with finer punctures intermixed, irregularly clothed with coarse, erect black hairs; antennæ black, first flagellar segment longer than second

segment; mandibles with a distinct inner tooth. Thorax densely clothed with long, erect hairs, those of pronotum, mesoscutum, mesoscutellum, metanotum and propodeum ochraceous, the latter area with some black hairs at side; pubescence obscuring punctuation; mesoscutellar lobes acute or armed with a short tooth; mesepisterna more or less opaque, coarsely closely punctate, pubescence dense but not completely obscuring surface. Wings lightly infuscated; marginal cell rounded at apex. Legs black, clothed with black pubescence, especially long and dense on posterior faces of femora and tibiae; inner ramus of intermediate and posterior tarsal claws long, slender. Abdomen moderately shining, finely punctured, clothed with black pubescence, long and erect on basal declivity, short, depressed on posterior of first tergite and over most of second tergite, longer, suberect on tergites three, four and five, fifth tergite with a broad, smooth, median impunctate area at apex; pygidial plate long, slender, liguliform, apex narrowly rounded; sternites clothed over most of basal half with long, coarse, suberect black hairs. Length 13 mm. anterior wing 10 mm.

Holotype: female (collection of P. W. Fattig), from Kennesaw Mt., Georgia, April 26, 1936, collected by P. W. Fattig, to whom I am indebted for the privilege of studying the specimen.

This species may be distinguished at once from all other known North American species of Melecta s. str. by the absence of erect pale hairs from the first abdominal tergite, the dense apical abdominal pubescence, and the long, slender pygidial plate. Superficially it resembles Melecta (Melectomimus) edwardsii Cresson but may be separated by the very short scutellar spines and narrow pygidial plate. It is also suggestive of Anthophora abrupta (Say), with which it may be confused in collections. This is the only known species of Melecta s. str. from east of the Mississippi River.

Melecta (Melectomorpha) pentalon (Dewitz), n. comb. Crocisa pentalon Dewitz, 1881, Berl. Ent. Zeitschr., 25: 198, pl. 5, fig. 2.

Female: Form elongate; color black, with patches of whitish or brownish pubescence on the head, thorax and abdomen. Head with long, depressed white pubescence at middle and sides of face and upper cheeks behind apex of eyes, lower cheeks and area immediately above antennal bases clothed with long dark brownish pubescence; vertex opaque, closely punctate; antennæ with first flagellar segment longer than second; clypeus subglabrous,
closely punctured, interspaces shining; mandibles with inner margin bidentate. Thorax sparsely pubescent; mesoscutum with a narrow, median, longitudinal band of appressed white hairs and a small oval patch on each side of middle at level of anterior margin of tegulae, surface closely punctate, interspaces shining; tegulae rufo-piceous; mesoscutellum strongly biconvex, dorsal lobes prominent, acute, surface punctured similarly to mesoscutum, median line with a band of appressed white pubescence. Wings tinted with fuscous, cellular area pale. Legs reddish, with irregular patches of appressed, plumose white pubescence. Abdomen black, dull, tergites three and four with a broad, irregular, smooth apical margin; first tergite with an arcuate band of appressed white pubescence along lateral and latero-apical margin, widely broken at middle, second tergite with a similar but a little less extensive band, third tergite with apical band reduced to a small, barely transverse patch on each side of middle; pygidial plate rather broadly triangular, dull; sternites shining, finely punctate, polished apical margin very wide at middle on sternites three, four and five, punctate area clothed with appressed white hairs. Length 11 mm., anterior wing 9 mm.

Redescribed from a specimen collected at Lares, Porto Rico, Nov. 3, 1922 (Sein), and kindly submitted for identification by Dr. Krombein of the Bureau of Entomology and Plant Quarantine, Washington, D. C.

This species is more slender than any of the other known members of the subgenus Melectomorpha but otherwise seems to agree well. It may perhaps be best compared with M. (M.) interrupta Cresson from Texas from which it differs in the prominent, acute mesoscutellar lobes, paler wings, and arrangement of the pubescent pattern of the head and thorax.

Melecta (Melectomorpha) californica Cresson

Mr. W. R. Enns has very kindly submitted for study specimens that I am unable to separate from M. (M.) californica californica Cresson. These were reared from nests of Anthophora abrupta (Say) along the bank of the Mississippi River, Cape Girardeau, Mo., June 1, 1942. This record provides the easternmost extension of the range of this species and its subgenus on the North American continent.
AN INSECT LODGING HOUSE

By H. T. Fernald
Winter Park, Florida

Early in July, 1942, I tied a small, white cord one eighth of an inch in diameter to a branch of a live oak tree and by chance left one piece two feet three inches long hanging down, the end being four feet two inches above the ground. The shade from the tree and nearness to a house kept the cord from being in bright sunlight at all times of day. The cord itself was of a kind called "chalk line" and consisted of three tightly twisted strands which in turn were tightly twisted together, making the cord quite firm.

No notice was taken of the cord until soon after sunset July 31 when I chanced to see on it about 40 small wasps, later identified by the United States Bureau of Entomology as Myzine maculata (F.). How long the cord had already been used as a sleeping place is of course unknown.

At first it was assumed that the gathering of the wasps at that place was only incidental and that after a few days they would disappear, but daily observations showed the wasps there every night and the cord was watched each day thereafter, both in the morning and during twilight and continually until November 10, the last wasp seen being on October 31, a total period of three months. All the wasps were males. Their abundance during this period varied greatly, but from August 26 to September 11, except for four days, none were present in the evenings. This may have been due to the appearance on the cord during these days in that period of adult ant lions whose presence before leaving for the night may have driven the wasps away. This condition is discussed below.

After the last ant lion disappeared the wasps began to gather again and were present in fair though varying numbers until October 11; thereafter four was the largest number seen at one time and there were days when none was present.

Observations apparently chanced to begin during an abun-
dance period of the wasps, followed by a reduction in numbers about August 20. Then came the ant lion period with their presence and with the wasps practically absent. On the morning of September 11 there were eight ant lions and no wasps on the cord. I was obliged to be absent from then until the evening of September 24 when 40–50 wasps and no ant lions were on the cord. After a few days of abundance they reduced to about eleven with a slight increase the first week in October, after which there were fewer, varying from one to four, until the end, with an occasional day's entire absence during that time. It would seem that there were two periods of greatest abundance, about the first of August and again about September 22, but with ten or more often present at times both between these dates and afterwards.

Almost without exception more wasps were present at the evening observation time than on the following morning. Evening observations were made when it was almost dark or later, then with the aid of a light. Morning observations were usually about 8:00 A.M., when it had been light for some time and perhaps some wasps had already gone away for the day.

Wasps began to gather singly at the cord even before sunset in some cases, but most of them appeared between sunset and dark, even when it was quite dark. They were slower to come after afternoon showers and often their number was less. On cloudy mornings they were slower to leave the cord than on clear days. At night while it was still quite light they were restless when observed and would often fly away; after dark a light would disturb them and they would move about uneasily.

As a whole they rested head up on the cord though sometimes many would be head down and in one or two instances all were heading down while on several occasions some were seen to reverse their positions. In resting on the cord the body was against it and the claws were used in holding on. I could not make out whether the jaws were also used for this purpose as with the light necessary to see this they would move about.

On one or two occasions wasps were also present on small twigs of the tree close to the cord.

The diameter of the cord was sufficient to permit two wasps to rest opposite each other, but hardly more. On some evenings
when the cord was crowded some of the insects would try to push their way between two others but would succeed only in getting part way between them.

Why the wasps selected the cord rather than tree twigs of about the same size to rest on may possibly have been because the bark of the twigs is smooth and hard while the cord was of a texture which permitted the claws of the insects to more easily obtain a firm grasp. During September other groups of these wasps were observed gathered on Spanish moss hanging from trees some distance from the one under observation. Unfortunately it was not possible to learn if these were at all permanent sleeping places.

With the first appearance of the ant lions (which were identified at the United States Bureau of Entomology as *Myrmeleon mobilis* Hagen) the morning of August 25 the wasps practically disappeared. Possibly the ant lions arriving early in the morning for their daylight sleep disturbed the wasps, driving them away, and if still there when the latter began to come in for the night forced them to seek some other place. Each ant lion was large enough to occupy the space on the cord required to accommodate ten or twelve of the wasps. The ant lions like the wasps rested head up, their bodies hanging down in contact with the cord and with their wings closed. When disturbed they would sidle around the cord so as to place this between them and the observer, and with one eye on each side of the cord watch for further developments.

Several papers on sleeping insects have mentioned the gathering of an allied species, *Myzine sexcincta* (F.) at the same place "night after night" (Banks, *Jour. N. Y. Ent. Soc.*, X, 209, 1902), but I have not found any record of such a prolonged residence as here given or of any such habits of any ant lion.

In this connection it may be permitted to say that one morning while many of the wasps were still present a blue jay perched on a branch about a foot above the cord and examined it carefully from there. Then it suddenly swooped downward brushing along the cord with one wing and giving one of its disagreeable shrieks as it went. It made no attempt to catch any of the wasps but they lost no time in departing in all directions.
NOTES ON THE PARASITIC HABITS OF MUSCINA STABULANS (FALL.) (DIPTERA, MUSCIDÆ)

BY A. F. Satterthwait

United States Department of Agriculture, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine

The record of parasitic habits of Muscina stabulans (Fall.) published in the Journal of the New York Entomological Society for December 1942 invites the publication of certain observations made by the writer in his studies of the armyworm and of sunflower insects.

Two male and two female Muscina stabulans adults were reared on August 1, 1915, from Cirphis unipuncta (Haw.) larvae collected by the writer at Lafayette, Ind., June 7, 1915. One male was determined by J. M. Aldrich; the other three were determined by the writer by comparing them critically with the male determined by Dr. Aldrich. One female not of parasitic origin was also determined by Dr. Aldrich.

One male and one female Muscina stabulans were reared from Cirphis unipuncta larvae collected at Florissant, Mo., June 9, 1919. These issued on June 27 and June 23, respectively. Armyworm larvae collected from the same area on June 10, 1919, yielded one male and two female M. stabulans by June 28. The hosts of the Florissant specimens continued alive for some days after capture.

Four male and three female Muscina stabulans issued June 26, 1919, from Cirphis unipuncta larvae collected a few days earlier in the St. Louis County and Lincoln County area.

On July 28, 1927, the writer found four Muscina stabulans puparia in a pupal cell of the cocklebur weevil, Rhodobacnus tredecimpunctatus Ill., in a sunflower stalk collected at New Madrid, Mo. Determinations were made from the puparia and from an adult which had not successfully issued. The absence

of foreign matter in the cell indicated that the maker of the exca-
vation alone was host of these four flies.

A parasitized pupa of the sunflower budworm, *Suleima heli-
anthana* Riley, was found in a sunflower stalk in the same field on
July 28, 1927. The parasite larva changed to a puparium
subsequent to August 11, at which time it was observed free from
the host. By August 26 it was a puparium. It did not yield its
adult, but the determination was made from the puparium.

On September 29, 1928, a larva of *Suleima helianthana* was col-
lected in the main stem of a sunflower at Sikeston, Mo. Subse-
quent to October 23, a parasite issued as a larva and formed its
puparium by November 19. The adult issued subsequent to
March 18, 1929, and proved to be *Muscina stabulans*.

M. T. James, of the Division of Insect Identification, Bureau of
Entomology and Plant Quarantine, has kindly examined all adult
specimens of *Muscina stabulans* involved in this paper and has
corroborated the determinations; and C. T. Greene examined the
puparia on April 14, 1943, and pronounced them to be those of
the species above named.
PROCEEDINGS OF THE NEW YORK
ENTOMOLOGICAL SOCIETY

MEETING OF OCTOBER 6, 1942

A regular meeting of the New York Entomological Society was held on October 6, 1942, in the American Museum of Natural History; President Weiss in the chair; nineteen members and visitors present.

Dr. Charles D. Michener and Mr. G. C. Furness were proposed for membership.

There were reports of summer experiences by the members and visitors present. On the whole little insect collecting had been done, due mainly to war activities and transportation difficulties.

MEETING OF OCTOBER 20, 1942

A regular meeting of the New York Entomological Society was held on October 20, 1942, in the American Museum of Natural History; President Weiss in the chair; 18 members and visitors present.

Dr. Charles D. Michener of the American Museum of Natural History, and Mr. G. C. Furness of the National Carbide Co., were elected members of the Society.

It was announced that Dr. L. O. Howard, Honorary Member of the Society, was to be in New York this winter.

Dr. H. T. Spieth presented a paper on the "Application of Some Statistical Methods to the Systematics of Stenonema," showing how frequency distributions, means, and standard deviations can help in the interpretation of some taxonomic problems of mayflies.

MEETING OF NOVEMBER 17, 1942

A regular meeting of the New York Entomological Society was held on November 17, 1942, in the American Museum of Natural History; President Weiss in the chair; thirty-nine members and visitors present.

After a discussion of whether to hold one or two meetings a month in 1943, it was decided by a vote to continue meeting twice a month.

Mr. Weiss read a letter from the Science Press announcing an increase of five per cent in the cost of printing the JOURNAL for next year.

It was announced that the meetings of the Eastern Branch, American Association of Economic Entomologists would be held in New York on November 19 and 20.

Dr. T. C. Schneirla told of a field study of an "instinct" problem: the migration and raiding in army ants as observed by him on Barro Colorado Island. Abstract appended.
THE ARMY ANT BEHAVIOR PATTERN

The unique behavior pattern of ants in the subfamily Dorylinae involves daily predatory expeditions and periodic migrations to a new nesting site or bivouac. In the American genus Eciton, through more than 200 known species and sub-specific groups, there are wide variations in behavior from the terrestrial raids and bivouacs of Eciton s. str. species to the almost exclusively hypogaeic activities and nesting of Labidus species such as E. coevum. The former genus is best known in most respects. Its colonies number more than 40,000 workers, stably polymorphic with the frequency skewed toward the smaller sizes. The intermediate workers are most prominent in the actual raiding. In E. hamatum and E. burchelli the raids are light-aroused in the early morning and develop through the day, generally expanding to a distance of more than 200–300 yards from the bivouac. When the raids are large and well-developed (e.g., a condition marked in E. hamatum by 2–3 principal trail systems), the activities of the day terminate in a migratory movement which carries the entire colony over one of its principal raiding trails to a new bivouac site somewhere on the margin of the raided zone. Thus a migration does not occur haphazardly, but ends a day of raiding. However, in the rainy season these species exhibit a regular cyclic routine of activities. In E. hamatum, for instance, maximal raiding and daily migration occurs daily in a given colony for about 18 days (nomadic period), then during the following period of about 18 days the colony remains bivouacked in the same spot with its daily raids much less developed (statary period). This is also the case for the swarm-raiding species E. burchelli, although the time relations of the nomadic-statary cycle are somewhat different in its case. The solution lies in the effect of a developing brood upon colony activity. Invariably, when a colony is found in the nomadic period, it proves to have a brood which is going through the larval stage, increasing in “mass activity” and voraciousness as it develops. This suggests that larval activity stimulates the workers tactually and chemically and greatly increases “social stimulation,” indirectly accounting for highly developed raids which reach the point of complexity at which migration must occur. The stimulative effect of the larvae upon workers is readily established in laboratory tests and observations; the direct relationship between maximal raids and migration has been worked out as a special problem. A critical control is the fact that in scores of observed cases, without exception, colonies have been found to cease the daily migrations and become statary at the point when their brood terminates its larval period and becomes enclosed in cocoons. The pace-maker of the entire behavior pattern is the Eciton queen (dichthadiignite), whose physiological properties permit her to lay huge batches of eggs at regular intervals (ca. 36 days in the Eciton s. str. species). It is highly important that each clutch of eggs is laid within a few days, so that the many thousand young develop nearly in pace with one another and hatch into further stages at about the same time. As a consequence the brood exerts a homogenously and summative effect upon the workers of the colony, and thereby indirectly influences the critical changes in the colony behavior pattern in an all-or-none manner. Hence the Eciton behavior pattern is a complex resultant of several biological factors contributed in diverse incidental ways by the various component classes of individuals in the colony, interacting with extrinsic factors (e.g., light) contributed incidentally by the environmental situation.—T. C. SCHNEIRLA.

MEETING OF DECEMBER 1, 1942

The Fiftieth Anniversary meeting of the New York Entomological Society was held on December 1, 1942, in the American Museum of Natural History; President Weiss in the chair; 45 members and visitors present.
Pictures of past presidents, early account books and minutes of the first meetings of the Society were exhibited.

Mr. Teale read the minutes for the meeting held on Dec. 7, 1892.

Mr. Weiss read the list of past presidents of the Society, twelve out of the 26 were present:—presidents Bell, Bird, Curran, Davis, Groth, Kisliuk, Melander, Moore, Ruckes, Schwarz, Sherman, and Weiss.

As Editor of the JOURNAL, Mr. Weiss presented a paper on the biographies of former editors of the JOURNAL, and the members of the first publication committee; and he also gave statistics on fifty volumes of the JOURNAL.

Mrs. Bell and Mrs. Sherman were presented with "badges" as awards for faithful attendance at the meetings.

Mr. Weiss read a letter from our honorary member, Dr. L. O. Howard.

The list of those who have been members of the Society for twenty years or longer was read, and four of our "oldest" members spoke about the early days of the Society. Mr. Groth who was a member of the incorporation committee in 1893 told of meetings before the Society was organized. Mr. Bird stressed the accomplishments of the Society in fifty years, spoke of some of the early members, and concluded with some humorous comments on heredity. Mr. Davis told of former members about whom obituary notices had been published and the prominent place they had in the activities of the Society and in Entomology in general. Mr. Comstock spoke about the collections of insects that came to the Museum through Society members, and of the active part played by members of the Society in building up the Museum's collection from 300,000 specimens as reported by Beutenmüller in 1898 to its present size—approaching two million.

Mr. Furness and Dr. Michener, our "youngest" members, expressed their appreciation of being members of the Society that had played such a prominent part in Entomology.

**Meeting of December 15, 1942**

A regular meeting of the New York Entomological Society was held on December 15, 1942, in the American Museum of Natural History; President Weiss in the chair; 22 members and visitors present.

Dr. H. C. Huckett of Riverhead, New York, was proposed for membership. The by-laws were suspended and he was then elected a member of the Society.

Mr. Weiss appointed the following committee to nominate the officers of the Society for the year 1943: Mr. Schwarz, Chairman, Mr. Soraci and Dr. Michener.

Dr. Charles M. Wheeler of the Rockefeller Foundation Laboratory spoke on "The Ecology of Bubonic Plague in the Western United States."

After considerable discussion of the paper, the meeting adjourned at 9:30.

**ANNETTE L. BACON, Secretary.**
NEW SPIDER RECORDS FROM NEW YORK NO. 2

Among spiders recently collected by the writer in the New York area, six are new additions to Long Island records while one species supplies the State List.

All species listed beneath were determined by Dr. W. J. Gertsch. The records are as follows:

*Amaurobius benneti* Blackw. Manhasset, L. I., May 7, 1941, 1 immature female.

*Amaurobius ferox* Blackw. Alley Pond, L. I., Nov. 3, 1940, 1 female.

*Enoplognatha marmorata* Hentz. Montauk, L. I., May 18, 1941, females.

*Xysticus luctans* C. Koch. Montauk, L. I., May 18, 1941, male.


*Lycosa gulosa* Walck. Manhasset, L. I., May 7, 1941, a male and female.

*Lycosa modesta* Keys. Pelham Bay Park, April 17, 1941, two females. New Rochelle, May 1, 1941, female. New to the state. Apparently missing in the list, as many others. This species is quite common on Long Island (Gertsch).

BORYS MALKIN, Eugene, Oregon.
The
New York Entomological Society
Organized June 29, 1892—Incorporated June 7, 1893
Reincorporated February 17, 1943

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 p. m., in the AMERICAN MUSEUM OF NATURAL HISTORY, 79th St., & Central Park W., New York, N. Y.
Annual dues for Active Members, $3.00; including subscription to the Journal, $4.50. Members of the Society will please remit their annual dues, payable in January, to the treasurer.

Honorary President, WILLIAM T. DAVIS

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COMMON INSECTS ON PINYON (PINUS EDULIS)

By Elbert L. Little, Jr.¹

While studying forest management of pinyon (Pinus edulis) in Arizona and New Mexico, Dr. Little made observations as to insect life on the foliage, in the bark, and in the cones and the large, edible seeds. He names and describes insect species observed on this tree and tells what sort of damage is known to be caused by individual species under usual and under exceptional conditions.

INTRODUCTION

Field work on Pinus edulis was centered at an experimental plot, named the Walnut Canyon Pinyon Plot, located in Sec. 30, T. 21 N., R. 9 E., about 12 miles east of Flagstaff on the Coconino National Forest in Coconino County, northern Arizona. The pinyon-juniper woodland here, at an elevation of 6,500 feet, is near its upper altitudinal limit. During the field seasons of 1938, 1940, and 1941 the author visited this plot at least once or twice weekly from April or May to September or October. Notes were recorded on the common insects found on various parts of the trees, and specimens² were collected. Further observations

¹ Dendrologist, Forest Service, United States Department of Agriculture, Washington, D. C. This investigation was made at the Southwestern Forest and Range Experiment Station, which is maintained by the Forest Service for the States of Arizona, New Mexico, and West Texas, with headquarters at Tucson, Ariz.

² Acknowledgment is due the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, for determinations of the insect collection, which has been deposited with that bureau. The Division
were made in field trips over New Mexico and Arizona during the pinyon nut harvests each fall. The Forest Service annual reports on insect control within the national forests of Arizona and New Mexico for the period from 1922 to 1940 have contributed data on insect epidemics on pinyon trees.

Because pinyons are of only slight importance for lumber, the insects attacking them have not attracted much attention. Blackman (1, p. 149) listed 11 species of bark beetles (10 of *Pityophthorus* and 1 of *Pityophilus*) on *Pinus edulis* and 4 species on the related single-leaf pinyon (*P. monophylla*). Keen (5, pp. 106–107) recorded 7 species of insects feeding on *P. monophylla*. Several insect species on *P. edulis* including some not collected by the author but cited here also were mentioned by Keen (6). As apparently no previous summary of the common and destructive insects on *P. edulis* has been published, the author’s personal observations are presented here. It is realized that additional study of the insects of this host species over its entire range and over a longer period would be desirable. Insects which seem to be of slight importance might become epidemic and cause considerable damage at some future time. The insects observed on pinyon trees may be grouped for convenience in reference into three classes according to the parts of the host trees attacked: (1) insects on foliage; (2) insects in bark; and (3) insects in cones and seeds.

**INSECTS ON FOLIAGE**

The main insects on the foliage may be listed as follows: (1) pine tip moths; (2) scale insects; (3) aphids; (4) caterpillars; (5) gall makers; (6) cicadas; and (7) ants. A few insects of various other kinds occasionally are found on the foliage but apparently are not injurious or only slightly so, or else feed on other insects. In addition to the insects on the foliage discussed of Forest Insect Investigations of that bureau kindly has handled the collection. The author is greatly indebted to the following specialists of the Division of Insect Identification for making the determinations: W. H. Anderson, H. G. Barber, M. W. Blackman, R. F. Blackwelder, L. L. Buchanan, E. A. Chapin, J. C. Crawford, R. A. Cushman, W. S. Fischer, C. T. Greene, A. B. Gurney, Carl Heinrich, P. W. Mason, H. Morrison, C. F. W. Musebeck, P. W. Oman, and M. R. Smith. Helpful suggestions for the manuscript have been given by F. P. Keen and J. E. Patterson, of the Division of Forest Insect Investigations.
here, a pine louse (*Pineus coloradensis* Gill; Phylloxeridae) has been reported on pinyon (6, p. 49) and a roundheaded borer (*Oeme costata* Lec.; Cerambycidae) on twigs of pinyon (6, p. 37). A needle miner (*Recurvaria* sp., near *R. milleri* Busck; Gelechiidae), which became epidemic on *Pinus monophylla* in California, may be looked for on *P. edulis*, according to J. E. Patterson.

Pine Tip Moths

Pine tip moths (*Dioryctria* sp.; Phycitidae, known also as Pyralidae) are common on pinyon trees and often abundant near the lower altitudinal limit. The whitish caterpillars become \(\frac{3}{8}\) to \(\frac{5}{8}\) inch long, and the gray adult moths have a length of less than \(\frac{1}{2}\) inch. The larvæ, which are active mainly in May and June, kill leaders, other terminal shoots, and terminal buds in the upper parts of mature as well as smaller trees. Pine tip moths may tend to increase the branching and crooked limbs but the deformation caused is not conspicuous or very serious, as the low, spreading, much-branched pinyons seldom are used for lumber. There is a slight retardation in height growth when the leader is killed, but a shorter lateral shoot becomes a leader. Some indirect loss of cones is due to pine tip moths, because a few attacked shoots bear young cones.

J. E. Patterson suggests that another pine tip moth (*Rhyacionia neomexicana* Dyar; Eucosmidæ), which kills the tips, reduces the cone crops, and is very damaging to *Pinus monophylla*, might be found also on *P. edulis*.

Larvae of pitch midges (*Retinodiplosis* sp., possibly *R. resinica* O. S.; Itonidæ) were collected in masses of pitch on young shoots of the related species, Mexican pinyon (*Pinus cembroides* Zucc.), in the Patagonian Mountains, Coronado National Forest, southern Arizona.

Scale Insects

The pine needle scale (*Chionaspis pinifolia* Fitch; Coccidae), which is common and widely distributed on the foliage of pines and other conifers throughout the United States, apparently is relatively uncommon on pinyon needles. The mature scale is white and almost \(\frac{1}{8}\) inch long. Heavily infested needles may die
and fall prematurely, or a few trees may be killed. Recorded from Cibola, Coconino, and Gila National Forests.

Another species, the pinyon needle scale (*Matsucoccus acalyptus* Herbert; Coccidae) is generally infrequent on pinyon needles. The brownish or blackish body is about $\frac{3}{4}$ inch long, but the stage more often seen is dark brown and only about $\frac{1}{64}$ inch in length. Needles of the current year become dotted with many small scales and turn yellow and brown as they are killed. In severe attacks the needles drop off after the first year, leaving thin foliage composed of only the needles of the current year.

A number of trees at their lower limit on the Coconino National Forest in this area were killed in 1940 by heavy infestations of this species. In 1924 pinyon trees of all sizes and ages in the vicinity of Fort Bayard, Gila National Forest, New Mexico, were killed by pinyon needle scales. Noted also on Cibola National Forest. Other hosts and localities recorded in literature include single-leaf pinyon in California (2, p. 376) and in southern Idaho (3, p. 270).

Two additional species, *Matsucoccus paucicatrices* Mor. and *M. monophyllae* McK. have caused twig injury on *Pinus monophylla* and might be found also on *P. edulis*, according to J. E. Patterson.

**Aphids**

Bark aphids of two species infrequent on pinyon twigs probably cause only slight injury. Specimens of *Cinara atra* Gill. and Palm. (Aphididae) were collected once feeding on new shoots at the Walnut Canyon plot. Associated with small black ants (*Lionetopum apiculatum* subsp. *luctuosum* Whlr.), aphids of the species *Cinara terminalis* (Gill and Palm.) were found on twigs on the Santa Fe National Forest, New Mexico. *Cinara edulis* Wilson has been recorded on pinyons in Colorado (6, p. 46).

**Caterpillars**

Caterpillars of several kinds, varying in length from $\frac{1}{2}$ to 1 inch or more, feed on the needles but usually are uncommon and attack only one or a few trees. Tent caterpillars, larvae of tiger moths (*Halisidota ingens* Hy. Edw.; Arctidæ), were observed forming webs on the foliage of pinyons in September and October
at the Walnut Canyon plot and on the Cibola and Santa Fe National Forests. This species is also recorded (6, p. 68) from Colorado. Other caterpillars collected on pinyon needles include Coloradia sp. (Saturniidae), at Walnut Canyon plot, and an undetermined one (Lasiocampidæ, presumably Gloveria sp.) from the Lincoln National Forest.

Sawfly larvae or "false caterpillars" (Neodiprion sp.; Diopri- nidae), which become \( \frac{3}{4} \) to \( \frac{5}{4} \) inch long, feed on the needles of pinyons. Infrequent on the Conconino and Kaibab National Forests. Neodiprion rowheri Midd. has been recorded (2, p. 338) on Pinus edulis in Colorado and P. monophylla in California, and on pinyons (6, p. 90) in New Mexico.

Gall Makers

Insect galls of a few kinds, formed mostly by gall midges (Cecidomyiïdæ, known also as Itonidæ), are found on needles and twigs of pinyons. While these galls are widespread and common in Arizona and New Mexico, apparently the destruction of only a very small portion of the needles by the gall-forming insects is not serious.

Galls of three shapes occur on spur shoots and cause swelling of the bases of growing needles. One or more pink, orange, or white larvae less than \( \frac{1}{10} \) inch long develop inside a gall. At the end of the season the spur shoot with gall and dead needles is shed. Seldom are more than two or three spur shoots of a twig attacked, but many twigs have galls.

In the commonest type, caused by the gall midge identified doubtfully as Janetiella coloradensis Felt (†), the pair of needles produce at their base a spherical, hard, almost solid brown swelling about \( \frac{1}{10} \) inch in diameter. Another kind is an oval-shaped gall similar to that described by Felt (4, p. 17; also 2, p. 391) on Pinus edulis and P. monophylla caused by the gall midge, Cecidomyia sp. The swelling at the base of the pair of needles is elongate or cylindrical, soft, and hollow, and becomes pale green and sometimes reddish. It is \( \frac{3}{4} \) to \( \frac{1}{4} \) inch long and less than \( \frac{1}{10} \) inch broad and contains several larvae. The third type is a conical gall about \( \frac{3}{4} \) inch long and \( \frac{3}{10} \) inch wide, produced by an unidentified gall midge (probably a species of Cecidomyiïdæ). In this type the needles do not elongate beyond the gall, and the
brown basal scales enlarge and cover the gall. Felt (4, p. 18; also 6, p. 53) reported that another species of gall midge, Thecodiplosis cockerelli Felt, produces kidney-shaped enlargements at the base of pinyon needles in Colorado.

Tips of shoots occasionally may be deformed by spreading laterally instead of elongating. The spur shoots and needles are borne in a rosette-like cluster about \( \frac{3}{4} \) inch broad at the base and covered with brown scale leaves. These galls apparently are the same as those reported on Pinus edulis by Felt (4, p. 17; also 2, p. 391) and caused by the gall midge, Cecidomyia sp. (Cecidomyiidae).

Cicadas

Cicadas of two species are common in pinyon woodlands. The larger cicadas (Okanagana magnifica Davis; Cicadidae) are commoner than the smaller ones, Putnam’s cicada (Platypedia putnami var. lutea Davis; Cicadidae). It is not known whether they injure the trees, but possibly the larvæ, which live underground several years, may feed upon the roots.

Adults of both species, which are active about a month, were observed on shrubs and pinyons at the Walnut Canyon plot in May and June, 1940 and 1941. Nymphs of Putnam’s cicada emerge from the ground about the first or middle of May, depending upon the season, and those of the larger species appear about two weeks later. Numerous split skins of the larvæ are left on twigs and trunks of pinyons, where they were noticed at various localities.

Ants

Small black ants (Liometopum apiculatum subsp. luctuosum Whir.; Formicidae), about \( \frac{3}{4} \) inch long or larger, occasionally are common on the twigs and trunks and may be associated with aphids. Carpenter ants (Camponotus sp.; Formicidae), large black ants about \( \frac{1}{4} \) inch long, are infrequent on the trunks and foliage of pinyon trees and may tunnel into the dead wood of living trees.

INSECTS IN BARK

Insects of several species are found in the bark of living and dead pinyon trees. Of all the insects on pinyons, bark beetles (Seolytidae) have attracted the most attention among foresters.
F. P. Keen has written that he found the Black Hills beetle (*Dendroctonus ponderosae* Hopk.) attacking *Pinus edulis* on the Kaibab National Forest during the epidemic of 1924 and 1925 and that *D. valens* Lec. and *D. barberi* Hopk. have been recorded on this host. Blackman (†, p. 149) listed these 11 additional species of bark beetles on *Pinus edulis* in New Mexico, Arizona, and Colorado: *Pityophthorus agnatus* Blackm., *P. comptus* Blackm., *P. deletus* Lec., *P. digestus* Lec., *P. immanis* Blackm., *P. infalatus* Blackm., *P. inquietus* Blackm., *P. mollis* Blackm., *P. ornatus* Blackm., *P. schwarzi* Blackm., and *Pityophilus barbatus* Blackm. However, four of these were not cited again for *P. edulis* in Blackman’s list of hosts of these insect species on pages 153 to 156.

**Bark Beetles**

The commonest bark beetles attacking pinyons are known as Ips or engraver beetles (*Ips* spp.). In New Mexico and Arizona the principal species on pinyons probably is the Arizona five-spined engraver (*Ips lecontei* Sw.; Scolytidae), collected on the Lincoln National Forest, New Mexico. Specimens collected at the Walnut Canyon plot were of a related species (*Ips* sp., near *Ips confusus* Lec., probably new variety or new species). These light to dark brown beetles less than 1/8 inch long appear to be mainly secondary, as they attack weakened, injured, and dying pinyon trees, especially those affected by drought or on poor sites. Except in infrequent epidemics, only a few trees are attacked at a time, the loss is not great, and control measures are not needed.

Nearly all the references to insects on pinyons contained in the annual reports on insect control on the national forests of Arizona and New Mexico during the period 1922 to 1940 are about bark beetles, or Ips. In 1925 and 1926 there was a serious infestation of Ips, attributed partly to drought, on Chupadera Mesa, Cibola National Forest, New Mexico. From 10 to 50 per cent of the pinyon trees in different places were killed, but only a few died in 1927. Considerable numbers of trees were killed by Ips and drought on the Apache National Forest, New Mexico, in 1925 also, but by 1926 the infestation was not serious.

A severe epidemic of Ips, starting from blown-down timber, killed from 50 to 75 per cent of the pinyon trees in a large area
along the west slopes of the Sacramento Mountains, Lincoln National Forest, New Mexico, in 1925. Drought-weakened trees on the shallow-soiled, dry western slopes were attacked also. The great bulk of the trees turned brown during the last of June and July, but a few died later and in 1926. Slight infestation was reported on this forest again in 1928.

Some damage from Ips on pinyons was noted in 1930 in the Zuni Mountains, Cibola National Forest; in the dry year 1934 east of the Sandia Mountains, Cibola National Forest; and in 1937 on Coconino National Forest, where the bark beetles apparently had spread from nearby slash. Slight loss of pinyon trees already injured by smelter smoke was reported on an area of the Prescott National Forest, Ariz., in 1938 and 1940. Some bark beetle infestation, thought to have spread from clearing of a road, was noted on the Sitgreaves National Forest, Ariz., in 1939. A heavy infestation, thought to be of bark beetles, killed 10 per cent of the pinyons on ridges of a mountain on the Crook National Forest, Ariz., in 1940, where 10 per cent of the trees were killed. A few pinyon trees attacked by bark beetles were observed on the Kaibab National Forest in 1940, also.

**Other Insects**

Insects of several kinds, both larvae and adults, are found in the bark of dying pinyon trees infested with bark beetles. These probably are secondary, do not cause death of the trees, and may not be injurious. Roundhead borers of two species (*Acanthocinus* sp., probably *A. spectabilis* Lec.; and *Monochamus* sp.; Cerambycidae) were common in the bark of dying trees attacked by Ips at the Walnut Canyon plot. These large white grubs become 3/4 to 1 1/2 inches long. Other white larvae about 3/4 inch long in the bark of these trees were ostomid beetles (*Temnochila* sp.), which may be beneficial in feeding upon bark beetles and other insects. Small adult beetles less than 3/4 inch long found in the tunnels of bark beetles under the bark of the same trees were identified as: *Aulonium longum* Lec. (Colydiidae); *Hypophloeus* sp. Tenebrionidae); and *Platysoma punctigerum* Lec. (Histeridae). Beetles of the last species feed on eggs and larvae of bark beetles (2, p. 203). A flatheaded borer (*Melanophila pini-*)
*edulis* Burke; Buprestidæ) has been reported on dead and dying pinyons in Colorado, Utah, and Arizona (6, p. 134).

**INSECTS IN CONES AND SEEDS**

While they do not kill the trees, the insects in the cones and seeds destroy large portions of the marketable crops of pinyon nuts each year. Fortunately, pinyon nuts are not attacked by insects after maturity and keep well for a few years, when stored in dry climates. It should be noted that many seeds die from other causes at various stages. Production of empty seeds, known as blighting or blasting, in cones not attacked by insects, sometimes is common.

**Insects Feeding on Young Cones**

The young cones emerging from the buds for pollination in June or May are soft and glandular for a few weeks until the cone scales form a hard surface. Miscellaneous insects feed upon these young cones and destroy a small portion. Though only a few scales may be eaten, the injured cone usually dies. A few June beetles (*Serica* sp., apparently undescribed; Scarabaeidæ) about \(\frac{3}{8}\) inch long and an unidentified measuring worm (Geometridæ) about \(\frac{1}{4}\) inch long were collected on the cones at this stage.

**Larvae in Cones, First Year**

According to observations at the Walnut Canyon plot, there is a high mortality of pinyon cones from insects the first year, though the loss is much less conspicuous than that of the larger cones the second year. Destruction of cones the first year is caused principally by larvae of unidentified gall midges (Cecidomyiidae, known also as Itonidæ). The cones are attacked after pollination and killed when less than \(\frac{1}{2}\) inch long. Eggs were found in a cone early in July. The white larvae, less than \(\frac{1}{4}\) inch long, are active in July and August but were found as late as September. They feed on the young seeds and soft tissues at the base of the cone scales. The infested cones usually die in August, shrivel slightly as they dry, and fall off when touched. When examined, they are usually hollow and show no evidence of insects.
A less common type of insect damage is that of abnormally swollen cones caused also by larvæ of gall midges (Cecidomyiidae, known also as Itonididae). In August or the last of July a few cone scales begin to grow more rapidly than the others and produce an asymmetrical cone with the larger scales protruding $\frac{1}{8}$ to $\frac{1}{2}$ inch. A whitish insect larva about $\frac{1}{8}$ inch long develops at the base of the enlarged scale and feeds upon the seed and scale.

Larvæ in Cones, Second Year

Great destruction of cones and seeds occurs the second year. Cones are killed both before and after they reach their full size of about $1\frac{1}{2}$ inches long early in July. Insect larvæ of four or five species of moths are especially active in the cones in June and destroy many cones and seeds in June, July, and August. These whitish to brown larvæ become $\frac{1}{2}$ to $\frac{3}{4}$ inch long. They bore into the green cones, and feed upon the soft tissues of the cone scales and upon the seeds.

A cone attacked by larvæ in June, when it is relatively soft, shrivels somewhat and turns brown. It may remain on the tree as a shrunken dead cone or may fall prematurely. The contents have been reduced to a powdery mass by the insect larvæ. Insect damage to cones attacked later in the season, as in July and August, may be less severe. At this time the tissues of the cone are becoming harder and the hard seed coats are forming. If most or all of the seeds are destroyed by the insect larvæ, the cone usually does not open at maturity but turns brown prematurely. Holes made by the larvæ and excessive secretions of resin are external evidences of insect work. If only part of the cone and seeds are destroyed, the cone may bear some normal seeds and open some scales at maturity.

For the most part these larvæ are caterpillars of pine cone moths (Eucosma boba Kearf. (?) ; Olethreutidæ). A few cones collected from the trees at maturity in September on the Lincoln National Forest, Otero County, New Mexico, were found to contain, among the scales, brown pupa cases about $\frac{3}{8}$ inch long, when the seeds were extracted in the laboratory in November. The following May small gray moths about $\frac{3}{8}$ inch long emerged in the laboratory. A chrysalis was found in one cone early in July.

Caterpillars were collected of two or three additional species of pine cone moths (two species of Dioryctria and apparently a
third species of a different genus of the same family; Phycitidae). To a certain extent these larvae attack both tips of young shoots and the developing cones. The pine tip moth of pinyons is a species of Dioryctria also. In one instance where a bag was placed over a twig in cross-pollination studies, later examination showed that the tip of the twig and a second-year cone had been killed by the same larva.

Larvae of small weevils (Conotrachelus sp.; Curculionidae) are common and destructive in pinyon cones in June and July. Several small white maggots less than \( \frac{1}{3} \) inch long (Oscinella sp.; Chloropidae) were found in insect-infested cones in August and September. A few specimens of braconids (Apanteles sp.; Braconidae), parasitic on lepidopterous larvae, were found in infested cones. Eggs of assassin bugs of an undetermined species (Reduviidae) were collected on scales of mature cones in September on the Lincoln National Forest.

Cone Beetles in Cones, Second Year

Pinyon cone beetles (Conophthorus edulis Hopk.; Scolytidae) are very destructive to the cones the second year but apparently do not cause as much damage as the caterpillars. The adults, small dark brown beetles less than \( \frac{1}{3} \) inch long, are active in the cones in June and July. They were observed to enter cones by boring into the stalk at the base. These beetles tunnel through the cone tissues and seeds and kill the cone. A cone with contents destroyed by pinyon cone beetles dies and turns brown early and does not open its scales in autumn. Usually work of pinyon cone beetles can be recognized by the presence of several small round holes about 1/32 inch in diameter formed on the outside of the cone when the beetles emerge. This species has been recorded on pinyon in Colorado, New Mexico, and Arizona (2, p. 115; 6, p. 16).

Insects in Staminate Cones

The great numbers of staminate cones, or male cones, which produce enormous quantities of pollen each year, are infested by numerous insects also, though the damage is relatively unimportant. Some staminate cones, a small portion of the total, become transformed into insect galls, oval-shaped structures \( \frac{1}{4} \) inch or more in length, each containing a white, undetermined
larva more than $\frac{1}{4}$ inch long. Larvae were detected in buds as early as September, but the galls are not visible externally until the next spring, when the cones become exposed. The adult emerges a week or two before the time the staminate cones mature and shed pollen, about the middle of June at the Walnut Canyon plot. In a second unidentified species (possibly a gall midge; Cecidomyiidae) forming galls from the staminate cones, the adult insect emerges earlier, about the last of May, when these cones and enclosing scales are less than $\frac{1}{4}$ inch long.

Numerous inconspicuous white larvae, about $\frac{1}{4}$ inch long, of xyelid sawflies (Xyelia sp.; Xyelidae) are found inside the staminate cones just before maturity. They feed upon the pollen without reducing the quantity noticeably. These larvae crawled out of the staminate cones in large numbers when the twigs bearing clusters of these cones, collected for samples of pollen, were spread out to dry. The specimens exhibited evidence of attack by at least four species of parasites, two ichneumonids, a chalcidoid, and a dipteran. *Xyela minor* Nort. is said to feed on the staminate cones of pine (2, p. 341).

Western thrips (*Frankliniella occidentalis* (Perg.); Thripidae), minute blackish insects about $\frac{1}{4}$ inch long, are common on the staminate cones at maturity, and apparently feed upon the pollen. A slightly larger, predaceous thrips (*Leptothryps* sp.; Phloeothripidae) was collected on staminate cones also.

**PRACTICAL ASPECTS**

Aspects of insect infestation of pinyon that merit practical attention include damage caused, possibilities of control, and bearing on crop prediction.

Certain insects attacking the foliage, particularly scale insects, and bark beetles commonly kill a few trees and in occasional epidemics kill a considerable number of the trees over large areas of forest. Bark beetles normally destroy only a few weakened trees, which probably are not good bearers of nuts, and their epidemics usually subside within a year or two. It is doubtful that control of these insects would be practicable in most instances.

The greatest economic losses are caused by insects which attack the cones and seeds (but do not kill the trees). For such insects no feasible means of control has been devised, and in any event
it appears improbable that control operations would be economically justifiable under forest conditions. However, it is possible that, when the best pinyon nut producing woodlands have been placed under intensive management, practical measures will be developed for controlling such insects on small areas of woodland.

It does seem desirable to make some allowances for probable destruction of cones and seeds by insects, when predictions or estimates of the pinyon nut crop are made a few months or longer in advance. At least a few young cones are formed by some trees in a locality each year, though in most years a particular locality has no commercial pinyon nut crop. When only a few cones begin development, mortality is proportionately high and the cone crop at maturity is a failure. Insects kill nearly all the cones of a light cone crop and destroy a smaller proportion of a heavy cone crop. Thus, if it is poor at the end of the first year, the cone crop almost certainly will be a failure at maturity a year later because of insect damage and other losses, such as blighting of seeds. Obviously, a commercial pinyon nut crop is not produced unless the total number of cones beginning development has greatly exceeded the number destroyed by insects before maturity and the total number of nuts ripening has greatly exceeded that eaten or stored by rodents before the crop could be harvested by humans.

SUMMARY

The insects observed on pinyon (Pinus edulis Engelm.) in Arizona and New Mexico along with research on pinyons by the author from 1937 to 1941 are discussed. Field work was centered at an experimental plot about 12 miles east of Flagstaff in northern Arizona.

Among the more injurious insects on the foliage are two scale insects, the pinyon needle scale (Matsucoccus acalyptus Herbert) and the pine needle scale (Chionaspis pinifoliae (Fitch)), which kill a few trees or more in epidemics.

Of the insects in the bark, the Arizona five-spined engraver (Ips lecontei Sw. and related species) is most destructive. Though generally only a few weakened trees are attacked, numbers of trees are killed over large areas in infrequent epidemics lasting only a year or two.
Insects in the cones and seeds of pinyons are, of course, those of greatest economic importance, even though they do not kill the trees, because the edible seeds or pinyon nuts are the most valuable product. Larvae of unidentified gall midges (Cercidomyiidae) kill many cones the first year, and caterpillars of pine cone moths (Eucosma bobana Kearf. (?)) and two species of Dioryctria), larvae of small weevils (Conotrachelus sp.), and pinyon cone beetles (Conophthorus edulis Hopk.) destroy numerous cones and seeds the second year. These insects together kill nearly all the cones of a light cone crop and destroy a smaller proportion of a heavy cone crop.

Control measures probably would not be economically justifiable under forest conditions, but it is possible that methods may be developed later for small areas under intensive management for pinyon nut production. As insects destroy a very high percentage of the cones when the number of cones is small, some allowances for probable losses should be made every year when advance estimates of the pinyon nut crop are made.

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THREE NEW SPECIES OF DIPTERA RELATED TO AGROMYZA PUSILLA MEIG.*

By S. W. Frost

The Pennsylvania State College

A number of species of Agromyza mining the leaves of clover, bean, pea, onion and other economic crops have been confused in literature during the past years. They have frequently been discussed under the name "serpentine leaf miner," *Agromyza pusilla*. Webster and Parks (1913) record this species from 25 hosts indicating that the larvae make linear or serpentine mines. However, *Agromyza pusilla* does not produce a serpentine mine. The larva may make a script-like trace at first but this soon becomes obscured by the formation of a small blotch mine. In Europe, according to Hering, De Meijere and others, this species makes blotch mines on the leaves of Euphorbiaceae. Apparently several species are included in the paper by Webster and Parks.

The present discussion deals with *Agromyza pusilla* Meig., and related forms and describes three new, closely related species. They can be distinguished readily by means of color markings, structure and habits. These species are placed in the genus Liriomyza by European workers and are separated from the genus Agromyza by the yellow scutellum and the fact that the subcosta terminates in the wing margin free from vein one.

The yellow and black markings used so frequently in separating Agromyzidæ are apparently dependable. When these insects are boiled in caustic potash, the yellow disappears leaving transparent areas; the black markings which are heavily sclerotized areas of the body wall, remain as brown spots identical with the original black areas of the body wall.

With the aid of considerable European material, determined by Dr. Martin Hering, and a long series of specimens reared from different hosts in this country, the writer has been able to separate some of the species which have been confused with *pusilla*.

* Authorized for publication on March 9, 1943, as paper No. 1169 in the Journal series of the Pennsylvania Agricultural Experiment Station.
From larvae making serpentine mines on nasturtium (Tropæolum), Crucifereæ and other hosts, a new species has been reared which the writer is calling subpusilla. Larvae from small blotch mines on clover, beet and other hosts have invariably yielded Agromyza pusilla. A small species, reared from linear mines on onion, is described as Agromyza allia. These and their closely related species can readily be separated by means of the following key.

**Key to North American Species of Agromyza Related to pusilla Meig.**

Frontal orbits narrowly glossy black along eye margins; antennae small; pleurae and abdomen almost entirely glossy black, Illinois, food plant unknown ................................................................................................................. deceptive Mall.

Frontal orbits chiefly yellow; antennae of moderate size; pleurae and abdomen largely yellow ........................................................................................................................................ 1

1. Mesopleura chiefly black or dark brown, only narrowly yellow above or below ................................................................................................................................. 2

Mesopleura distinctly yellow, at least a broad band of yellow along the upper edge, usually only a small dark spot below ........................................................................ 3

2. Legs black, only knees yellow, antennae wholly yellow, third segment darkened at the tip, palpi yellow slightly darkened at the tips, 4 orbitals, 4 rows of acrostichals, orbits broad below the eye margin. On aquatic plant, Europe, a leaf miner on *Pisum sativum*, Calif. *... orbona* Meigen Legs largely yellow, only tibiae and tarsi brownish, front coxae yellow; palpi and antennae entirely yellow, 4 orbitals, orbits narrow below the eye margin. A miner on *Equisetum*, Europe, Michigan, Kansas. *virgo* Zett.

3. Third antennal segment angulate above; last section of fifth vein three times as long as the preceding section, food plant unknown; S. D. *holti* Mall.

Third antennal segment not angulate at apex, last section of fifth vein usually shorter ................................................................................................................................... 4

4. Small species, legs principally yellow ............................................................................................................................................................................................................ 5

Larger species; legs usually black, knees only yellow; a linear miner on grasses; Eur., Calif., Ariz. ............................................................................................................. flavicola Fall (=seuclottata)

5. Three pairs of orbitals; mesonotum slightly dusted; third antennal segment distinctly pubescent; a blotch miner on clover, beet and *Lactuca*; Europe, Michigan, Kansas, N. Y., Pa., Calif., Ga., Ill. *... pusilla* Meig.

Four pairs of orbitals; mesonotum shiny black, third antennal segment not distinctly pubescent ............................................................................................................................... 6

6. Mesonotum very lightly dusted; orbits entirely yellow, the color extending completely around the eyes and not intercepted by the black of the occiput; no bristles in front of the presuturals; anterior humeral callosities broadly and posterior humeral callosities narrowly yellow. A linear miner on *Allium cepa*; Iowa, Mich., Kans. *allia* n. sp.
Mesonotum shiny black; orbits not entirely yellow, the color intercepted near the vertex by the black of the occiput 7.

7. Veins 2 and 3 much closer together than veins 3 and 4; vein 4 straight; yellow color of orbits only slightly intercepted by the black of the occiput; both vertical bristles arising from the yellow area; posterior humeral callosities yellow; acrostichals minute or absent; a small blotch miner on lima beans, N. J. 7. *Phacocolumata* n. sp.

Veins 2 and 3 spaced the same distance as veins 3 and 4, vein 4 distinctly curved; yellow color of orbits broadly intercepted by the black of the occiput; only the inner vertical bristle arising from the yellow area; posterior humeral callosities not yellow; acrostichals small but distinct; a linear miner on nasturtium, aster, milkweed, fern and certain Crucifera; Ariz., Calif., Colo., Id., Kans., Mich., N. Mex., N. Y., Pa., Tex. 7. *Subpusilla* n. sp.

*Agromyza subpusilla* n. sp.

A small species less than 1.5 mm long.

**Male:** Front, face, cheeks, palpi, proboscis and antennae entirely yellow; scutellum in the middle, pleuræ and legs largely yellow; ocellar triangle shiny black continuous with the black of the occiput; yellow of cheeks not extending completely back of eye but broadly intercepted at vertex by the black color of the occiput; only the inner vertical bristle arises from the yellow area; frontal orbits slightly darkened on the upper outer angles; third antennal segment small, rounded and distinctly white pubescent; arista brown, microscopically and sparsely pubescent; oral vibrissæ distinctly stronger than accompanying setæ extending along the lower margin of the cheek; setæ of palpi black; four distinct orbital bristles; upper two pairs strong, lower two pairs weaker; orbital hairs minute and sparse. Mesonotum shiny black, sides broadly yellow, anterior humeral callosities yellow each with a black spot, humeral bristle arising from the edge of this spot; four pairs of dorsocecntrals, the anterior two pairs shorter than the posterior two pairs; four or five rows of small but distinct acrostichals, more numerous in front of the transverse suture; presutural bristles arising from the edge of the black area of the mesonotum, a distinct but small bristle in front of the presutural bristle; sternopleura with a large triangular black spot below and a broad yellow band above, only one distinct sternopleural bristle, a minute seta in front of this; mesopleura with a small spot on the lower anterior edge, a small spot on the upper edge of the mesopleura, anterior supraalar bristle arising near this spot, mesopleura with one distinct bristle and three smaller, accompanying bristles; hypopleura with a large dark spot. Abdomen dark brown, incisesures narrowly yellow; male genitalia shiny brown, yellow below. Wings hyaline; third and fourth veins diverging distinctly, fourth vein distinctly curved, veins 2 and 3 spaced the same as veins 3 and 4, last section of fifth vein about four times the length of the penultimate section, anterior cross vein slightly beyond the middle of the discal cell, posterior cross vein about twice the length of the anterior cross vein. Legs chiefly pale
in color, femora yellow, tibiae and tarsi brown, no distinct preapical bristles. Halteres yellow.

**FEMALE:** Similar to the male; incesures of the abdomen conspicuously but narrowly yellow, last incesure more broadly yellow, genitalia shiny black.

**Holotype:** ♂ Manhattan, Kans., Oct. 14, 1933. Collected by C. W. Sabrosky. 67 paratypes from California, Colorado, Michigan, Kansas, Texas, Arizona, New Mexico, Idaho, Pennsylvania and New York. The larvae produce linear mines on the leaves of the following plants: Cruciferae, Eupatorium, Asclepias, Aster, Nasturtium (Tropaeolum), Plantago and fern. The record for nasturtium, Frost (1924) and Needham & Frost (1928) is *Agromyza subpusilla*.

**Agromyza phaseolunata** n. sp.
A small species less than 1.5 mm.

**MALE:** Front, face, cheeks, palpi, proboscis, antennae, scutellum in the middle, pleurae, legs largely and halteres yellow; ocellar triangle shiny black continuous with the black of the occiput; yellow of cheeks not extending entirely back of the eye but intercepted at the vertex by the black color of the occiput, both vertical bristles arising from the yellow area; frontal orbits entirely yellow; third antennal segment small rounded, sparsely pubescent; arista brown; orbital bristles moderately strong accompanied by a few weak bristles extending along the lower margin of the cheek; setae of palpi black, those of proboscis yellow; four distinct pairs of orbital bristles, upper pairs slightly stronger, orbital hairs minute and sparse. Mesonotum shiny black, sides broadly yellow, anterior humeral callosities broadly and posterior callosities narrowly yellow, anterior callosities each with a dark spot, the humeral bristle arises from the yellow area near this spot, four pairs of dorsocentral bristles, the anterior pair distinctly weaker than the posterior pairs; acrostichals minute or absent; presutural bristle arising from the edge of the black color of the mesonotum, a minute seta in front of the presutural bristle; sternopleura with a large triangular dark spot below and a broad yellow band across the top, only one distinct sternopleural bristle, a minute seta in front of the sternopleural bristle; mesopleura with a small spot on the lower anterior angle, similar to that of *subpusilla*; a small spot on the upper anterior angle of the mesopleura; anterior supraalar arising near this spot; mesopleura with one strong bristle and three small accompanying setae; a small irregular spot on the pteropleura at the base of the wing; hypopleura with a large dark spot. Abdomen shiny brown above; incesures narrowly yellow, the last incesure broadly yellow; sides and ventral surface of the abdomen yellow; ♂ genitalia shiny brown, yellow in center above. Wings hyaline, 3rd and 4th veins not diverging conspicuously at their tips; veins 2 and 3 approximated, veins 3 and 4 more widely separated; anterior cross vein slightly beyond the middle of the discal cell, posterior cross vein about one and a half times as long as
the anterior cross vein. Legs chiefly pale in color, femora yellow, tibiae and tarsi pale brown. Halteres yellow.

Holotype $\varphi$ reared from small blotch mine on lima bean collected at Bridgeton, N. J., August 24, 1942, by B. B. Pepper. Although only four specimens were available to describe this species it has well defined characteristics, especially the lack of distinct acrostichals and the approximation of veins 2 and 3. This species apparently caused considerable injury during 1942. The infestation covered 2000 acres and a large percentage of the leaves were infested. It is distinct from three other agromyzids known to attack beans, namely, Agromyza destructor Mall. of the Philippine Islands, Agromyza inaequalis Mall. of the West Indies and Agromyza (Melanagromyza) phaseoli Coq. from Australia and the Philippine Islands. All these species have the scutellum and the halteres dark brown or black in contrast to the yellow halteres and scutellum of Agromyza phaseolunata.

Agromyza allia n. sp.

A minute species approximately 1 mm. long.

**Male:** Front, face, cheeks, antennæ, palpi, proboscis, halteres, scutellum in center, legs and pleuræ chiefly yellow; front as wide as either eye, sides nearly parallel, four pairs of orbitals, the lower pair often weak; orbital hairs minute and sparse; 3rd antennal segment small, rounded at tip; arista brown, minutely and sparsely pubescent; hairs of palpi black, those of proboscis yellow; oral vibrissæ stronger than accompanying setæ along the lower margin of cheek; cheeks about one half eye height, slightly narrower in front than behind; yellow of cheeks continuing around eyes and joining yellow of frontal orbits, orbits in other words completely yellow; ocellar triangle shiny black, separated from the occiput by a narrow yellow line. Mesonotum eincereous black, sides broadly yellow; presutural bristle arising from yellow area of mesonotum; pleuræ chiefly yellow, sternopleuræ with a large triangular black spot below and a yellow band above, one strong sternopleural bristle with a minute seta anterior to it; mesopleura almost entirely yellow, a minute spot on upper anterior angle, one strong mesopleural bristle with 4 small accompanying bristles, pteropleura largely black; anterior and posterior humeral callosities yellow; scutellum yellow, darkened on the sides, especially at the base, four pairs of dorsocentrals, anterior pair weaker; acrostichals minute distinctly shorter than anterior pair of dorsocentrals; presutural and anterior humeral bristles arising from the yellow area of the mesonotum; spot on the anterior humeral callosity small and indistinct. Abdomen largely yellow, underside, 1st segment and incisures broadly yellow, only the basal portions of the upper sides of the segments brown, the brown spot on the second segment divided by a narrow central yellow line; $\varphi$ genitalia sub-
shiny brown. Legs chiefly yellow, tibiae and tarsi only weakly infuscated, no evidence of preapical bristles. Wings hyaline, 3rd and 4th veins nearly parallel at tips, apical section of 5th vein about three times the length of the preapical section, anterior cross vein at about the middle of the discal cell, posterior cross vein about one and a half times the length of the anterior cross vein. Calypteres and fringe and halteres yellow.

**FEMALE:** Similar to male but ovipositer shiny black.

Holotype ♂ Manhattan, Kans., June 9, 1934, C. W. Sabrosky. 27 paratypes from Iowa, Kansas, Michigan and Missouri. This species has been reared by H. M. Harris (1933) Ames, Iowa, from linear mines on onion.

This species can readily be separated from the European *Dizygomyza cepæ* Hering which also makes short linear mines on onion. The scutellum of this species is entirely black.

*Agromyza pusilla* Meigen.

Front, face, cheeks, palpi, proboscis, antennæ, pleuræ and legs chiefly, scutellum in center, sides of abdomen and halteres yellow; three pairs of fronto orbitals, the anterior pair weaker, orbital hairs minute and sparse; 3rd antennal segment rounded with microscopic but conspicuous white pubescence; arista brown; hairs of palpi black; those of proboscis yellow; oral vibrissae stronger than other setæ along the lower edge of the cheeks; yellow of cheeks not continuous back of eye but intercepted near the vertex by the black of the occiput; both vertical bristles arising from the yellow area; ocellar triangle shiny black and continuous with the black area of the occiput. Mesonotum black, slightly dusted; sides broadly yellow; presutural bristles arising from the black area of the mesonotum; pleuræ largely yellow, sternopleura with a large triangular black spot below and a yellow band above, one strong sternopleural bristle and a minute seta in front of this; mesopleura with a minute black spot on upper anterior angle, one mesopleural bristle and three minute accompanying setæ; pteropleura chiefly black; anterior and posterior humeral callosities yellow; anterior humeral bristle arising from the edge of the dark color of the mesonotum; scutellum yellow, darkened on sides especially at the base; presutural bristle distinct, no bristle in front of the presutural; four pairs of dorsocentral bristles, the anterior pair distinctly weaker; four
rows of conspicuous acrostichals before the transverse suture, as strong as anterior pair of dorsocentrals. Abdomen shiny brown above, incisures narrowly yellow, last incisure broadly yellow, sides and ventral surface of abdomen yellow, \( \delta \) genitalia shiny black. Legs chiefly yellow, tibiae and tarsi pale brown. Wings hyaline, veins 2, 3 and 4 equally spaced, anterior cross vein distinctly beyond the middle of the discal cell, posterior cross vein one and a half times as long as the anterior cross vein, 4th vein only slightly curved, cross veins not parallel. Halteres yellow.

The writer has before him 38 specimens of this species from California, Georgia, Missouri, Illinois, New York and Pennsylvania. They were compared with one specimen of *Agromyza pusilla* Meig from Prussia which was identified by De Meijere. They were also compared with a series of specimens from Dallas, Texas, in the National Museum and determined by J. R. Malloch.

The larva of *Agromyza pusilla* makes a small blotch mine on the leaves of clover, beet, Asclepias, and Lactuca. Hering (1927) states that in Europe this species mines the leaves of Euphorbiaceae.

*Agromyza orbita* Meigen.

Malloch (1913) placed this species as a synonym of *pusilla* Meig. European workers, especially De Meijere, Hendel and Hering recognize *orbita* as a distinct species. It is said to mine the leaves of an aquatic plant. This species has repeatedly been reared from the leaves of peas from California and has been frequently confused with *flaveola* Fall. *Orbita* differs, however, in having the pleure chiefly black.

A note on the genitalia of the Agromyzidae. The agromyzid genitalia is typical of the higher Diptera but even more highly specialized than that of the muscids. The ninth tergite is large, rounded and the most conspicuous part of the genitalia. It is heavily sclerotized, bears conspicuous setae and sometimes accessory hairs on the outer surface. The present status of the homologies of structures of genitalia is too poor to attempt to label them. The appendages of the ninth tergite bear the most specific characters. The number and position of the teeth on these are most valuable in separating the different species. *A. pusilla* and *A. phaseolunata* have but a single tooth at the end of this
appendage. *A. pusilla* has in addition a strong short spine on the inner surface of the ninth tergite. In *A. subpusilla* and *A. allia* there are two teeth on the appendage of the ninth tergite. The smaller tooth in *A. subpusilla* is situated near the middle of the appendage, in *A. allia* the two teeth are approximated at the tip of the appendage.

The ejaculatory apparatus is a conspicuous feature of the male sexual organs. It occurs on the left side of the body in the region of the 5th and 6th abdominal segments. The ejaculatory apodeme is a highly sclerotized, funnel-shaped structure which pierces the transparent, bulbous ejaculatory syringe. A short duct leads from the ejaculatory syringe to the base of the aedeagus.

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**PLATE XI**

Figure 1. Mine of *Agromyza pusilla* Meig. on *Lactuca scariola*.

Figure 2. Mine of *Agromyza pusilla* Meig. on clover.

Figure 3. Mine of *Agromyza subpusilla* Frost on nasturtium (*Tropaeolum*).

Figure 4. Mines of *Agromyza phaseolunata* Frost on lima bean.

Figure 5. Mesopleuron and sternopleuron of *Agromyza pusilla* Meig.

Figure 6. Mesopleuron and sternopleuron of *Agromyza subpusilla* Frost.

Figure 7. Mesopleuron and sternopleuron of *Agromyza orbona* Meig.
PLATE XII

Figure 1. ♂ Genitalia of *Agromyza pusilla* Meig.
Figure 2. ♂ Genitalia of *Agromyza phascolunata* Frost.
Figure 3. ♂ Genitalia of *Agromyza subpusilla* Frost.
Figure 4. ♂ Genitalia of *Agromyza allia* Frost.
SYNONYMY OF THE MEMBRACIDÆ OF FORMOSA

By W. D. Funkhouser

The study of a large number of Membracidæ from Formosa (Taiwan) which have accumulated in the author's collection over a period of many years, and especially some excellent collections made by Mr. J. Linsley Gressitt in 1932 and 1934, has made it possible to recognize most of the species which have been described or recorded from that island and to add a considerable number of new records.

According to Mr. Gressitt, the fauna and flora of the island of Formosa show a closer relationship to the forms on the eastern continental land mass of Asia than to those of the Philippines and this fact is indicated by the geographical distribution of the Membracidæ. Only two of the Formosan species have been recorded from the Philippine Islands while seventeen are found in China and on the island of Hainan.

The synonymy of the Membracidæ of Formosa has been in much confusion due largely to the work of Kato. Kato's descriptions are very unsatisfactory. Most of his descriptions of Membracidæ have been published only in the Japanese language, and while we have secured what we believe to be creditable translations of these papers, they leave much to be desired. His figures are practically worthless. Most of them are photographs which are very successful in concealing all of the important specific and most of the generic characters. Nevertheless, a careful study of these descriptions and figures, and particularly the comparison of these with what we consider to be a good representative series of the insects of the island, make it quite evident that he has placed species in the wrong genera, has described as new some species which are already well known, and has erected genera which are synonyms of previously established genera with which he apparently was not familiar.

More material would of course be desirable, but since it is unlikely that we shall see additional collections from this region for a number of years, this list is presented in the belief that it
represents a fairly accurate synonymy of the Formosan forms to date. This list includes all of the species of Membracidæ from Formosa which have been recorded in the literature of the family and all species from the island which we have observed in collections but which have not been previously recorded in publications. Most of these species we have seen; those which we have not seen are listed just as they were published.

Genus Bulbauchenia Schumacher
1. Bulbauchenia tiawanensis Schumacher

Genus Centrotoscelus Funkhouser
1. Centrotoscelus flava Kato
2. Centrotoscelus gracilis Kato
3. Centrotoscelus koshunensis Matsumura
4. Centrotoscelus marginatus Kato
5. Centrotoscelus nigra Kato
6. Centrotoscelus nigrifrons Kato
7. Centrotoscelus nitida Kato

8. Centrotoscelus shinthicuna Kato

   Genus Evanchon Goding

1. Evanchon variegatus Funkhouser
   1918. Anchonoides variegatus Funkhouser, Malayan Memb., 4, 8.

   Genus Gargara Amyot and Serville

1. Gargara botanshana Kato

2. Gargara brunnheidorsata Funkhouser

3. Gargara brunnneifasciata Funkhouser

4. Gargara castanea Kato

5. Gargara daviidi Fallou

6. Gargara elegans Kato

7. Gargara elongata Kato

8. Gargara fumipennis Kato

9. Gargara hainanensis Funkhouser

10. Gargara horishana Matsumura
11. Gargara hyalina Kato
12. Gargara kawakamii Matsumura
13. Gargara laticapitata Kato
14. Gargara matsumurai Kato
15. Gargara nigromaculata Funkhouser
16. Gargara nigronervosa Kato
17. Gargara nitidipennis Funkhouser
18. Gargara nodulata Funkhouser
19. Gargara nokozana Kato
20. Gargara picea Kato
21. Gargara piceola Melichar
22. Gargara sordida Funkhouser

23. *Gargara taihokunis* Kato

24. *Gargara takihashi* Kato

25. *Gargara tectiformis* Funkhouser

26. *Gargara zonata* Matsumura

Genus *Imporcitor* Distant

1. *Imporcitor laticornis* Kato

Genus *Kotogargara* Matsumura

1. *Kotogargara botelensis* Matsumura

Genus *Leptobelus* Stal

1. *Leptobelus sauteri* Schumacher

Genus *Leptocentrus* Stal

1. *Leptocentrus albolineatus* Funkhouser

2. *Leptocentrus formosanus* Kato

3. *Leptocentrus horizontalis* Kato
Genus *Lobocentrus* Stal

1. *Lobocentrus zonatus* Stal

Genus *Machærotypus* Uhler

1. *Machærotypus coreanus* Kato

Genus *Maurya* Distant

1. *Maurya nodosa* Funkhouser

2. *Maurya paradoxus* Lethierry

3. *Maurya siberica* Lethierry
   1934. *Xanthosticta siberica* Goding, Old World Memb., 475.

Genus *Melicharella* Goding

1. *Melicharella incultus* Melichar
Dec., 1943] Funkhouser: Membracid.e 271

Genus Pantaleon Distant

1. Pantaleon bufo Kato

Genus Sipylus Stal

1. Sipylus albifasciatus Kato

2. Sipylus guttulinervis Matsumura

3. Sipylus latifasciatus Kato

4. Sipylus lineatus Kato

5. Sipylus minutus Kato

6. Sipylus typicus Kato

Genus Tricentrus Stal

1. Tricentrus albipennis Kato

2. Tricentrus allabens Distant

3. Tricentrus basalis Walker
4. *Tricentrus biformis* Kato  

5. *Tricentrus castaneipes* Kato  

6. *Tricentrus fasciatus* Kato  

7. *Tricentrus fuscoapicalis* Kato  

8. *Tricentrus fuscolimbatus* Kato  

9. *Tricentrus gargaraformis* Kato  

10. *Tricentrus glochidiocae* Kato  

11. *Tricentrus gracilicornis* Kato  

12. *Tricentrus gracilis* Kato  

13. *Tricentrus hyalinipennis* Kato  

14. *Tricentrus kotoinsulanus* Kato  

15. *Tricentrus minuticornis* Kato  

16. *Tricentrus mushoensis* Kato  
17. Tricentrus naifunpoensis Kato

18. Tricentrus pallipes Kato

19. Tricentrus punctatus Kato

20. Tricentrus taipinensis Kato

21. Tricentrus takaoensis Kato

22. Tricentrus xiphistes Kato

Genus Xanthosticta Buckton

1. Xanthosticta akonis Matsumura

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BOOK NOTICE

Shelter Trees in War and Peace. By Ephraim Porter Felt, D.Sc., New York, Orange Judd Publishing Company, Inc. 1943. 8 x 5½ inches, 320 p., 53 figs. $2.50.

Although this is not a book on entomology, it deserves notice here because entomologists are interested in trees and because it has been written by our well-known entomologist, Dr. E. P. Felt, at present Director and Chief Entomologist of the Bartlett Tree Research Laboratories, and author of "Our Shade Trees" and "Pruning Trees and Shrubs," as well as numerous entomological books and papers.

Dr. Felt's latest work of 18 chapters deals with trees and man, trees and nature, protection afforded by trees, shelter trees and economics, engineering and trees, tree parts, tree growth, shelter trees and war, effect of construction work on trees, tree troubles, the care and selection of trees and shade tree policy. In addition, it is illustrated by 53 good photographs.

This book, which is dedicated to the better use of trees, is concerned with the relation of trees to nearly every type of human activity and economy. Sound and thoughtful information is presented on such numerous topics as trees and their bearing upon health, roads, national defense, camps, public utilities, industrial plants, parks, housing projects, playgrounds, streets, etc. The importance of trees in protective concealment and the need for a stable tree policy are stressed. The extensive section dealing with the characteristics and suitabilities of certain species for various sections should be of interest to many individuals and agencies. This book should be read by those who take trees for granted. Most of us do not have a well-proportioned view of the significance of trees as a whole and this is what Dr. Felt gives us.—H. B. W.
BOOK NOTICE

Practical and Theoretical Aspects of the Species Problem


Dr. Mayr begins his preface with the statement that "During the past fifty years animal taxonomy has undergone a revolution almost as fundamental as that which occurred in genetics after the rediscovery of Mendel's laws." This has mainly to do with the recognition of polytypic species: groups of populations which are visibly or recognizably different, but intergrade with others, forming a series of subspecies. The changed "species concept" of the modern systematist has resulted largely from increased knowledge and opportunity. To one who used to correspond constantly with W. H. Edwards, who knew Wallace very well indeed, and even saw Westwood preside (for the last time) at a meeting of the Entomological Society of London, the limitations of those earlier days seem to explain and justify the taxonomy of the period. When Edwards received a new butterfly from the west he described it as a species. This was the only practical thing to do; to call it a subspecies of something else was to assert what he did not and could not know, and of the group of perhaps a dozen members of a "polytypic species," as we understand the matter today, probably only two or three were then present in collections.

In the case of the birds, it may be said that the species and subspecies are mainly known, and yet supposedly new subspecies have been described from Britain very recently. In the case of the insects, even the butterflies, the large collections extant are not yet fully adequate, and some day the present time will be looked upon as one of relative ignorance.

I knew Lang at the time when he was preparing his book on the butterflies of Europe (he, being a clergyman, used to go out on Sundays with what appeared to be a bulky umbrella, but on
reaching the collecting ground it turned into a collecting net). It was supposed that the European butterflies were sufficiently known to be set forth in a manual, and for some years this satisfied the needs of collectors. But there came a time when very large series from many localities were collected, and it was realized that the species could be broken up into numerous races or subspecies, which at once became desiderata for collectors. One could take a brief holiday on the Continent, going to the Pyrenees or to the Tyrol, and perhaps come back with a new race of some well-known species of butterfly. However, as Mayr points out, this sort of thing could easily be carried to extremes. Almost any population, closely studied, was found to have some characters of its own, and the number of subspecies or micro-subspecies could be increased almost indefinitely. Thus the genus *Erebia* was very recently monographed so elaborately, with so many illustrations, that nothing seemed lacking; yet just the other day a race from Scotland was described as new.

On the other hand, when the taxonomist is accused of emphasizing very small differences, it may be replied that the geneticist has done exactly this, with the most brilliant results. It was a mistake of the entomologists, conchologists and botanists to mix up individual and racial differences, so that the term "variety" stood for quite different things. But I think Mayr is wrong in stressing subspecies (populations), though poorly defined, but objecting to the naming of variations occurring within a population. In the Staudinger Catalogue of European Lepidoptera we used to read in certain cases "Var. et ab.," meaning that a particular form occurred in some regions as a race, in others as a variation (aberration) in the normal population.

Mutations, the materials out of which subspecies are built, are extraordinarily varied, as the work with *Drosophila* has shown. For the most part they are disadvantageous, and little suited to be the foundations of new subspecies. But, as has been shown especially in the case of plants, a population limited by climatic conditions may produce a mutation actually unsuited to the locality, but suited to a neighboring locality, into which it spreads. This, however, cannot often occur, in view of the numerous zonal species in the mountains, whose scattered seeds are every year
washed to lower levels, without producing a series of adjacent subspecies. I have found similar phenomena in the marine fauna of southern California.

Although birds and butterflies are so little related they have certain features in common in respect to their variations. They vary conspicuously in size, color and pattern. These diversities are more strongly marked in butterflies, which even show seasonal variation in many species. Among the moths, the most amazing exhibit I ever saw was that of Rothschild's collection of *Abraxas grossulariata*, the Currant Moth. Any one not informed concerning the origin of this series might easily have believed that he was looking at a group of several genera and numerous species. The genus *Abraxas* includes several additional genuine species, and some subspecies, but they are relatively commonplace. There is not, in the world, room for such diversity among the birds, but we do not know much about their individual variations except among domestic species, such as fowls and pigeons, which show many extreme types, for the most part unfitted for survival in the wild.

Since the characters so generally used to distinguish races of birds and butterflies are not present, or hardly indicated, in many groups of animals, the question arises whether there are in fact numerous cryptosubspecies, differing in ways not appreciable in cabinet specimens. Mayr cites such cases, and I could add several others, relating to food plants, relating to parasites, and other diversities among insects, which are often of practical importance to the economic entomologist and so are receiving increasing attention. These considerations tend to increase our belief in the frequency, one may say the normality, of polytypic species.

There are, however, notable exceptions. Last spring, my wife and I were in charge of the little Desert Museum at Palm Springs, but the Museum shut up for the summer on May 15 on account of the tropical heat of the summer months in that locality. Shortly before this I saw every morning a handsome butterfly flying before my front door. Was it some California species, or perchance a visitor from Mexico? By no means, it was *Euvanessa antiopa*, the Mourning Cloak, or the Camberwell
Beauty of English collectors, who esteem themselves fortunate to catch one in England in a lifetime. In central Africa I found the Painted Lady, Pyrameis cardui, precisely the same butterfly as occurs in Europe and the United States. Diversity of environment is slow to act in many cases. Thus the Cabbage Butterfly, Pieris rapae, introduced into America not much less than a century ago, is singularly uniform, and decidedly less variable than it is in Europe.

Mayr discusses all these matters in relation to birds, with many interesting examples. On page 231 he cites the case of the Hornbill, Dichoceros bicorns. It abounds in the tropical forests of Burma, Siam and a narrow strip in north India, but all of central India is unsuited for it yet it appears again quite unmodified, in a strip of forest country parallel with the coast from Bombay southward. Mayr does not suggest such a thing, but from seeing these birds flying strongly over the trees in Siam, I can imagine that they might sometimes cross India and join the southern colony.

A much disputed question has to do with the taxonomic status of similar forms, apparently of subspecific rank, but kept separate by physical barriers. Thus, for instance, in various groups of islands there are closely allied birds and mammals, sufficiently different to be recognizable, yet differing only in very minor characters. Such, for example, are the foxes on the islands off the coast of California. The yellow Columbine, Aquilegia chrysanthe, is universally considered a good species by botanists, yet in gardens it crosses freely with the blue Columbine, A. caerulea, producing fertile hybrids. No one doubts that if these two species were not separated by a physical barrier, they would soon cease to be specifically separable. Mayr holds that we must use our judgment in all such cases, and are justified in recording forms as subspecies, though we have no direct evidence of mixing.

Mayr gives a very interesting discussion of what he calls sibling species. These are good species, in the sense of being biologically isolated, which nevertheless show few or practically no external diagnostic marks. In Lepidoptera such cases are occasionally found; thus in Britain we have two species of Acronycta, so similar that it is doubtful whether the ablest experts can distinguish
them, yet undoubtedly distinct species, as the larvae are quite distinct. Mayr cites at some length the sibling birds, some of which caused great confusion until their nature was understood. Some of the examples of siblings in other groups I should not so consider—for example, *Pieris napi, rapae* and *brassicae*. The "biological races" of the malaria mosquito, *Anopheles maculipennis* are considered sibling species, distinguished principally, but by no means entirely, by the character of their egg-floats. It is obvious that the existence of siblings may be of great consequence to economic entomologists. Thus the common mussel scale has a form which attacks apples, while another does not; the red scale has a form which does not attack citrus plants, as I observed in Jamaica all such cases must be critically studied, and no doubt siblings will be shown to exist, sometimes when the morphological differences are so slight that no one has ventured to give them any taxonomic rank whatever. The birds, being so well known and comparatively few, deserve to be considered by all Zoologists, and for this reason Mayr's book will be most instructive to entomologists and others. It must be said, however, that the insects present much greater variety, and in many cases much closer adaptations to the environment. Among the bees which I have studied, I will cite the genus of small prettily-colored bees called *Perdita*, confined to North America, and mainly to the west, with one species found by my wife as far south as Guatemala. New species of *Perdita* are continually being discovered, and it seems quite possible that five hundred exist in nature. They are nearly all oligotrophic, confined in their visits to one species of flower, or one group of closely allied flowers. In the dry regions of the southwest the sight of a plant new to the entomologist always arouses hopes of a new *Perdita*, and very often the expected bee is found. Now it would be absurd to group these species into "polytypic" groups, except in the sense of subgenus, or some would say closely related genera. They exist as distinct entities in nature, and although many species will be found in a single locality, they are not mixed, but are found on different plants, or in some cases at different times of the year. But occasionally exceptions occur. Many years ago, when on the way to visit the celebrated botanists, Mr. and Mrs. Brandegee, then living at San
Diego, I came across a sumach (Rhus) bush full of small bees, all females. They were described as *Perdita rhois*. Some years later, Timberlake collected at Whittier, on quite a different plant, some males, and these I described as new, without any doubt as to their distinctness. Now it turns out that this species, *Perdita rhois*, is common in southern California on many kinds of plants, and the Whittier bee is its male. Are there no subspecific groups in *Perdita*? Timberlake, in his unpublished manuscript, has recorded some. My wife and I collected a new *Perdita* visiting *Layia*, at San Miguel Island, California. Some years later we found at Santa Tomas, Lower California, a species, also on *Layia*, differing by the markings. This I am regarding as a subspecies. Thus it is evident that the intensive study of any insect group is likely to yield facts of great biological interest and illustrate in some measure the origin of species.

Mayr has at the end of his book a discussion of the "higher categories," particularly genera. He considers that generic subdivision has been overdone. He takes the fourth edition of the check list of the American Ornithologists’ Union, and enumerates forty-two "genera" which "could well be dispensed with and will probably disappear eventually from later editions." Among the insects a similar reduction is possible, although critical studies often bring out differences not at first noticed. In the case of the bees, I have been puzzled by the phenomena of "Emergent Evolution." It is apparent that even then the species, and perhaps genera, are of relatively recent origin, the gene-modifications from which they are built up may be much older. The various recombinations of these genes give rise to new types. It results from this that we have what has been called "Kaleidoscope Variation," and it is practically impossible to tell what was the exact cause of evolution. Thus the very numerous African bees of the genus *Megachile* could be arranged in subgenera, or even genera, on the basis of quite different characters. I do not at present see how to make the appropriate choices with any assurance that they represent natural groups. More intensive studies will probable result in a classification which can be accepted with confidence.

It will readily be seen that Mayr has written a most interest-
ing book. The practical moral is that good biological results come from intensive studies, and yet such studies, without a broad background of knowledge, may be largely sterile. There is indeed a wonderful opportunity for the younger generation, standing on the shoulders of the older folks, to do what they could never do.

Should the question be raised, what is the "practical value" of all this, several things may be said. In the first place, as we have indicated, the knowledge of variation and of sibling species may be of first class importance to the economic entomologist, whether in the agricultural or the medical field. The cultural side, the pleasure which may be derived from the study of nature, cannot be ignored. People pay immense sums, in the aggregate, for not too good entertainment; here is, available to all, the clean, beautiful, never ending drama of nature, to be had without price, or rather at the price of having learned to appreciate it. As a result of the present war, more and more wounded men will come back to us, the more numerous because the splendid medical discoveries of recent times have made it possible to save so many who would formerly have perished. In England they are stressing the crafts as a means of "occupational therapy," but probably, for those so inclined, some entomological hobby is no less valuable. A collector who makes little or no pretense to scientific knowledge may make valuable contributions to the subject with suitable guidance, as I could set forth at considerable length.

Finally, science is international, and so far as it goes, it will help to heal the wounds of war. Today we are horrified at the actions of the Nazis, and yet I have a picture in my mind of a meeting of the Entomological Society of Bremen, to which I was invited not long after the first world war. Exhibiting and discussing their specimens (I remember especially the exquisitely mounted microlepidoptera) these men appeared to have attained a high level of humanity, and I felt very much at home with them. It is difficult to believe—I do not believe—that they have the faults which people today ascribe to the Germans, and it is perhaps largely through the coming together of such people from all countries, all worshippers of the beauty, variety and incident of nature, that we may find a basis for the salvation of mankind.—T. D. A. Cockerell.
BOOK NOTICE


At a time when faunal lists and studies of geographical distribution appear to be somewhat out of favor with many entomologists, it is a pleasure to call attention to this work by Jones and Kimball outlining the results of their collecting and studies over many years.

According to the introduction by Jones, the lepidopterous fauna of these islands, which have a combined area of about 150 square miles, is rich and varied and there are recorded nearly 1,400 identified species, with more than 100 species awaiting identification. Although rich in species, much of the fauna is characterized by a scarcity of individuals. Many species have a wide distribution, but a considerable number have a southward rather than northward distribution.

The water-barrier between these islands and the mainland does not deter the flight of insects and the extra-zonal strays found on the islands indicate that the islands are subjected to the northward drift of southern species along the coast. Although some parts of the insect fauna may have had ancient occupancy, it is the belief of the authors that the fauna represents a continuous response to present and changing conditions.

In addition to the Introduction and the Annotated List, there is a Supplementary List, representing Nantucket and Marthas Vineyard specimens in the A. Bolter collection at the University of Illinois, which require further study, and also a list of "Unrecorded Species of Southern New England," by Charles P. Kimball.—H. B. W.
THE JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY 1893–1942*

BY HARRY B. WEISS

In an editorial in Entomological News for June, 1924, it is stated that "fifty years is a variable quantity. It is the major part of a man's life, an era for a nation, a passing moment in geology. For a magazine it is a ripe and venerable age." So the Journal of the New York Entomological Society has now reached a "ripe and venerable age."

Be that as it may, our Journal, for all its fifty years, is old only in comparison with such of its American contemporaries as the Annals of the Entomological Society of America, the Journal of Economic Entomology, each of which is 35 years old, both having started in 1908, and the Pan-Pacific Entomologist, which is 19 years old (first appearance in 1924).

In comparison with some existing American entomological periodicals, our Journal is much younger. The Proceedings-Transactions of the American Entomological Society, formerly the Entomological Society of Philadelphia, is in its 75th year, the Canadian Entomologist, in its 74th year, Psyche, in its 69th year, the Bulletin of the Brooklyn Entomological Society, in its 65th year, although for a period of 26 years (1886–1911) it was not published, Proceedings of the Entomological Society of Washington, in its 59th year, and Entomological News, in its 53rd year. Our closest contemporary from the standpoint of age is Entomological News, which is our senior by three years.

During the early days of the Society, the Journal was started by subscription, Mrs. Annie T. Slosson being the largest contributor. In part it was supported by the proceeds from auction sales of insects, and again Mrs. Slosson was the donor of the largest number of specimens.¹

Through the past fifty years the Journal has had six editors. Its first was William Beutenmüller who served eleven years (1893–

* Presented at the 50th Anniversary Meeting of the Society, Dec. 1, 1942.
1903). Mr. Beutenmüller was born in Hoboken, N. J., March 31, 1864, and educated in the public and private schools of New York City. From 1888 to 1912 he was curator of the department of entomology of the American Museum of Natural History. In 1900 he was president of the New York Entomological Society, and his continuing interest in entomology is indicated by his membership in 1927 in the Entomological Society of America, the American Association of Economic Entomologists, the Brooklyn Entomological Society and the Entomological Society of Washington. He was interested in the Orthoptera, Coleoptera and Lepidoptera, and published extensively on this latter order, particularly on the Lepidoptera found within 50 miles of New York City. His monographs on Sesiidae and gall insects are especially noteworthy. His collecting was done in the vicinity of New York City and at Black Mountain in North Carolina. Mr. Beutenmüller married Edna Hyatt, entomological artist, and lived the latter part of his life at Tenafly, N. J. He died February 23, 1934.2

The second editor of the Journal was Dr. Harrison Gray Dyar, who served four years (1904–1907). Dr. Dyar was born on February 14, 1866, at 331 Fifth Avenue, New York City. In 1889 he graduated from the Massachusetts Institute of Technology with the degree of B.S. in chemistry. From Columbia University in 1894 he received his A.M., and in 1895 his Ph.D. From 1896 to 1897 he was assistant in bacteriology at the College of Physicians and Surgeons in Columbia. From 1904 to 1916 he was entomological assistant in the Bureau of Entomology of the United States Department of Agriculture and from 1924 to 1929, Captain, Sanitary Department, Organized Reserves, United States Army. His earliest entomological interest was in the Lepidoptera and in 1894 he published on the classification of Lepidopterous larvae. Through his numerous later writings on this order he became one of the leading authorities in America. His paper on the Lepidoptera of the Harriman Alaska Expedition appeared in 1900 and in 1902 his large work, "A List of North American Lepidoptera and Key to the Literature of this

Order of Insects’ was published as Bulletin 52 of the United States National Museum.

He began the study of mosquito larvae in 1902 and contributed that part to ‘‘The Mosquitoes of North and Central America and the West Indies,’’ by Howard, Dyar and Knab, which was published in four volumes in 1912 by the Carnegie Institute of Washington. Hundreds of lepidopterous and dipterous (Culicidae) insects were described and named by Dr. Dyar, and some flies, with R. C. Shannon. In 1913 he began the publication of ‘‘Insector, Inscitiae Menstruus,’’ a periodical devoted to systematic entomology, which ended in 1926 and extended to 14 volumes. From 1897 until his death in the Garfield Hospital, Washington, D. C., January 21, 1929, he was Custodian of Lepidoptera at the United States National Museum. Many of Dr. Dyar’s important papers were published by the United States National Museum, Journal of the New York Entomological Society, Proceedings of the Entomological Society of Washington, Annals of the New York Academy of Sciences, Canadian Entomologist, etc.3

Professor William Morton Wheeler was the third editor of the Journal, and served from 1908 until the middle of 1912, except for a period in 1910 when Charles Schaeffer edited the December Journal for that year.

Professor Wheeler was born in Milwaukee, Wisconsin, on March 19, 1865. He was graduated from the German-American College in Milwaukee in 1884 and during the same year, entered the employ of Ward’s Natural Science Establishment at Rochester, N. Y., where he arranged zoological material and identified specimens. Leaving Ward’s in 1885 he returned to Milwaukee and taught German and physiology at the High School where Dr. G. W. Peekham was principal. After two years he was appointed custodian of the new Milwaukee Public Museum where he remained until 1890, when he was offered a fellowship at Clark University. Two years later he obtained a Ph.D. degree for his thesis entitled ‘‘Contribution to Insect Embryology.’’ The following year was spent in Europe.

Upon his return he went to the University of Chicago, first as instructor in embryology, and after 1896 as assistant professor,

staying in all five years and becoming, during this period, interested in various phases of entomology.

At the University of Texas in 1899, where he was professor of zoology, he became interested in ants and began a long series of investigations. In the summer of 1903 he was made curator of invertebrate zoology in the American Museum of Natural History and during his five years in this position he published many important papers. In 1908 he was at Harvard University as professor of economic entomology, and from 1915 to 1929 as dean of the Bussey Institution. His monumental work on ants was published in 1910.

In 1929 Professor Wheeler resigned his deanship and moved to Cambridge where he continued his teaching until his retirement in 1934. Three years later, or in 1937, he died at Cambridge, Mass., on April 19.

Many lasting contributions were made by Dr. Wheeler to biological science and to entomology in particular. He was a member of many entomological societies and the recipient of various honorary degrees and medals in recognition of his entomological research. An appreciation of his qualities as a scientist and as a man may be found in "Psyche" for September, 1937, in an account by Dr. Charles T. Brues, which occupies the entire issue, and which contains a long bibliography of Wheeler’s papers and books from 1885 to 1937, testifying to his varied interests and accomplishments.

From the middle of 1912 to the end of 1915 the Journal was edited by the "Publication Committee," but I am of the opinion that Mr. Charles Schaeffer really looked after the editing, for the committee, during this period. From 1916 to 1919, Mr. Schaeffer was definitely named as editor, making his entire term of service eight years.

Charles Frederick August Schaeffer was born of German parents in London, England, on July 12, 1860. In 1876 his education was completed in Germany. His entomological career began in 1898, as assistant to William Beutenmüller in the American Museum of Natural History where he remained four years. In 1902 he was employed on the staff of the Brooklyn Institute of
Arts and Sciences, as curator of Coleoptera, remaining here until his death, following a long period of illness, on August 29, 1934. Mr. Schaeffer’s entomological talents became apparent upon his acquaintance with Gustav Beyer, Charles Tuneson and Ottomar Dietz about 1889, and in 1892 when the New York Entomological Society was organized, he was one of its first members. For thirty-five years, he served the Society in various capacities, on different committees and as recording secretary. His published papers are all taxonomic and during his later years he specialized principally in the Chrycomelidae.⁴

Mr. Schaeffer was succeeded by Mr. Howard Notman, the fifth editor, who held office from 1920 until March, 1924 when he resigned. Mr. Notman, artist and entomologist, was first introduced to the New York Entomological Society by Mr. Robert Percy Dow, and his interest was in the Coleoptera. Mr. Notman at one time bought a large part of the Hugh Beyer collection but later gave up entomology for the study of music. According to “Who’s Who in New York (City and State),” 1929, Mr. Notman was born in Brooklyn, N. Y., April 20, 1881, and graduated from Harvard University in 1903. Later he spent a year in the Harvard Law School. When “Who’s Who in New York” was published, in 1929, he was a member of the Royal Society of Arts, Brooklyn Society of Artists, Brooklyn Society of Modern Artists, American Federation of Arts, New York Academy of Sciences, Entomological Society of America, Entomological Society of London, and the Brooklyn Entomological Society.

Mr. Notman’s revisions and descriptions of new species in the Coleoptera were published largely in the Journal of the New York Entomological Society, but his work also appeared in the Bulletin of the American Museum of Natural History, American Museum Novitates, Bulletin of the Brooklyn Entomological Society, Bulletin of the New York State College of Forestry and the Proceedings of the United States National Museum. At present Mr. Notman is living on Staten Island.

Upon his resignation in March, 1924, from the editorship of the Journal, Mr. Notman was succeeded by the writer, who, although he has been editor for nearly 19 years, which is a long

time, takes this occasion to deny that he was born in 1833 as given on page 285 of Herbert Osborn’s "Fragments of Entomological History" (Columbus, 1937).

The first Publication Committee in 1893, consisted of five members. In succeeding years the size of the committee was confined to four. This first committee was made up of William Beutenmüller, Ottomar Dietz, Charles Palm, Berthold Neumoegen and Harry Allehin.

Ottomar Dietz was born in Bremen, Germany, April 21, 1854, but he received his education in Konigsberg to which place his parents had moved. In 1880 he came to America, living first in Milwaukee, then Cincinnati, and finally settling in New York where he was engaged in newspaper advertising. He was well-known as a collector of Coleoptera and was one of the founders of the Society. He was an enthusiastic collector with a large circle of entomological friends. His last collecting trip was in June, 1901, to Brownsville, Texas. In previous years he had collected in Virginia and Florida. He died on December 25, 1901, at his home, 679 East 141st Street, after an illness of only 12 days.5

Charles Palm, another founder of the Society and member of the first publication committee, was born at Calbe, on the river Milde, Germany, in 1836. Coming to the United States in 1854, Mr. Palm built up a successful business, following the founding in 1856 of the firm Palm, Fechteler & Co., which was one of the first to introduce the decalcomania industry into this country. Starting from an importing business, it grew into one of the largest manufacturing firms in the United States. As late as 1934 this firm was the only large manufacturer in the East. At that time its office was at 15 East 26th Street, New York City, and its factory at 99 Maple Avenue, Weehawken, N. J.

Mr. Palm was active during the early days of the Society, when he was nearly sixty. For a long time he lived at 172 East 64th Street, New York, where his large collections of Lepidoptera and Coleoptera were housed and where he entertained his entomological friends like Dietz, Luetgens and Merkel. For more than 10 years he served on the executive and publication committees, and was vice-president of the Society for four years and presi-

dent in 1897. He resigned in February, 1916, at the age of 80 years when evening meetings became impossible for him. Seven species and genera of Lepidoptera were named in his honor, and his numerous friends included Charles Dury and W. H. Wenzel. Mr. Palm died on November 5, 1917, in his 82nd year. 6

The last member of the first "Publication Committee," about whom it was possible to find historical material is Berthold Neumoegen, who was born in Frankfort-on-the-Main, Germany, November 19, 1845. Mr. Neumoegen began to collect Lepidoptera about 1874 and his collection grew to be one of the finest in existence and contained many valuable types described by prominent Lepidopterists. Mr. Neumoegen himself described many new genera and species from this country and the West Indies and published a number of papers on the Bombycidae with H. G. Dyar, many of which appeared in our Journal.

He was a member of the New York Stock Exchange and in business as a banker and broker at 40 Exchange Place, New York City. At one time Mr. Jacob Doll assisted him in taking care of his collection. Mr. Neumoegen was friendly with Dr. Herman Strecker, and spoke five or six languages fluently. He died in New York on January 21, 1895, of consumption hastened by an attack of grip, and it is stated that he looked upon death as a relief. 7

It has been, thus far, difficult to locate information about Harry Allchin. Aside from the fact that he was a member of the first Publication Committee in 1893, we know that he was a member of the Society from that year until June, 1898, and that is all.

At various times between 1893 and 1942, thirty-four different members of our Society have served upon the Publication Committee, for periods of time ranging from one to many years. This is exclusive of the editors whose services have already been noted.

MEMBERS OF THE NEW YORK ENTOMOLOGICAL SOCIETY SERVING ON THE PUBLICATION COMMITTEE FROM 1893 TO 1942
(exclusive of editors)

Ottomar Dietz, 1893, 1 year
Harry Allchin, 1893, 1 year

B. Neumoegen, 1893, 1 year
Charles Palm, 1893–94; 01, 3 years
Charles Tunison, 1894, 1 year
L. H. Joutel, 1894–1902, 9 years
E. Daecke, 1894–1897, 4 years
F. Rabe, 1895, 1 year
Charles Schaeffer, 1896–1902; 1904–1915; 1920–1922, 22 years
C. F. Groth, 1898–1899, 2 years
E. G. Love, 1900; 1902; 1905; 1906–1910, 8 years
W. D. Kearfoot, 1903, 1 year
Herman Hug, 1903, 1 year
H. G. Dyar, 1903, 1 year
C. W. Leng, 1904–1906; 1931–1935, 8 years
C. T. Brues, 1904–1905, 2 years
Henry Bird, 1907, 1 year
E. P. Felt, 1908–1910, 3 years
R. C. Osburn, 1910–1912, 3 years
F. E. Lutz, 1910–1922; 1924–1930, 20 years
H. G. Barber, 1913, 1 year
J. D. Sherman, Jr., 1913; 1918–1919; 1923–1940, 21 years
W. P. Comstock, 1914–1920, 7 years
L. B. Woodruff, 1914–1915, 2 years
E. L. Dickerson, 1916–1917; 1921–1923, 5 years
C. E. Olsen, 1923–1935, 13 years
H. Notman, 1924, 1 year
H. T. Spieth, 1936–1937, 2 years
C. H. Curran, 1936; 1938, 2 years
E. L. Bell, 1937–1942, 6 years
William Moore, 1939–1940, 2 years
E. W. Teale, 1941–1942, 2 years
H. F. Schwarz, 1941–1942, 2 years

Mr. Schaeffer was on the Publication Committee for 22 years, Dr. Lutz for 20, Mr. Sherman for 21, and Mr. Olsen for 13 years. The terms of the other members range from one to nine years. Over the past 50 years the size of our Journal has slowly increased. During the first 10 years the average number of pages, per volume, was 228. During the second 10 years, it was 263, during the third, 280, the fourth, 422 and during the fifth
(9 years) period, the average will be in the neighborhood of 434 pages per volume. From 1893 to 1923 the subscription price was $2.00 per year. In 1924 it was increased to $3.00, where it has remained ever since.

During the fifty-year period, a total of over 1,400 papers was published, on various entomological subjects, taxonomic, morphological, biological, etc. Dividing this period into five of ten years each, we find that, over the years, there has been a change in the types of papers submitted to the Journal. A rough arrangement of the papers according to the subjects suggested by the titles was made for each ten-year period, with the following result:

**SUBJECT MATTER OF PAPERS PUBLISHED FROM 1893 TO 1941**

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* 9 years.

During the first thirty years of the Journal about 70 per cent of the papers were taxonomic, about 15 per cent biological, the remaining 15 per cent being made up of papers on morphology, behavior, faunal lists, and general subjects. During the past twenty years, these ratios have changed somewhat. The taxonomic papers over this latter period were about 50 per cent of the total, biological papers about 12 per cent, while the remaining
38 per cent consisted of faunal lists and titles on morphology, behavior, historical, bibliographical, biographical and economic entomology. In other words, the contents for the last twenty years have been more varied than previously. These conclusions are based upon a rough approximation of titles and not upon a close examination of the contents of each paper. In spite of this, it is believed that the conclusions are fairly accurate.

The first paper in Volume 1, Number 1 of the Journal is entitled “Common versus Proper,” by Annie Trumbell Slosson, who was elected at the first meeting of the Society on June 29, 1892, and who was one of its most distinguished and helpful members. Other contributors to the first number of the Journal were A. S. Packard, G. W. Angell, Mary Treat, Charles Palm, B. Neumöegen, Harrison G. Dyar, William Beutenmüller and William T. Davis. Later numbers of Volume I contained papers by Nathan Banks, William J. Fox, W. J. Holland, L. H. Joutel, C. W. Leng, R. Tootolengui, C. H. T. Townsend and F. M. Webster. Of these contributors, to the first volume of the Journal, whose names are well known in entomological circles, only 4 remain alive today—William T. Davis, C. H. T. Townsend, Nathan Banks, and W. J. Fox.

In succeeding volumes of the Journal numerous papers will be found by well-known professional and amateur entomologists. In fact the pages of the Journal have always been open to anyone with a contribution to the science of entomology and I do not believe that the prestige of the Journal has suffered by reason of this policy.

It is largely through scientific journals and other publications that science develops and the Journal of the New York Entomological Society has for fifty years been a part of the national circulatory system for entomological thought and ideas.
A few years ago I published a block of revisional notes on the Lepidopterous subfamily Danainæ (the milkweed butterflies). Since then there has been considerable activity in the group and some additions, comments and corrections are in order. First, attention should be called to the following important publications: d’Almeida, Revisión das especies americanas da superfamilia Danaoidea . . . Danainæ; in Memorias do Instituto Oswaldo Cruz, xxxiv, 1–113, pls. 1–30, 1939; an account of the migrations of the Monarch by Williams and others in Trans. Roy. Ent. Soc., xci, 147–148, 155–184, 1942; and papers by Talbot on Amauris in Trans. Roy. Ent. Soc., xc, 319–336 (with a key), Ideopsis in Proc. Roy. Ent. Soc. (B), ix, 197–202; Idea (i.e. Hestia) in Trans. Roy Ent. Soc., xci, 105–117, with key; and a few notes on species of Euplœa by Carpenter in Proc. Roy. Ent. Soc. (B), xi, 1942; also notes and three new names by Clark in Proc. U. S. Nat. Mus., xc, 531–542, 1941.

**GENITALIC CHARACTERS**

D’Almeida has made a substantial first start toward the presentation of the genitalic characters of the Danaids, with figures of all but one of the American true species, and representative old-world ones. We should first make three or four notes on nomenclature. Firstly as Hemming has noted, our current use of the name Anosia for the monarch, as based on Moore’s selection of plexippus as the type, is invalid, for Scudder had already chosen gilippus in 1875; and Tasitia with gilippus as type is a strict synonym. To clear the mess d’Almeida proposes Diogas for the Monarch, citing erippus as type. I have already noted my feeling that these are hardly even subgenera, and we duly find the genitalia of chrysippus (d’Almeida, Pl. 7, Figs. 1, 4, 5) almost identical with eresimus,
even to the two little flanges on the ãedeagus. *D. genutia* (*plexippus*) is more distinct, with the proper type of valve and ãedeagus, but the angular last sternite of *Diogas*. There are a couple of misdeterminations in d’Almeida. His *eresimus cleothera* is the new Central American race described below, while true *cleothera* is a *gilippus*-race from Haiti, near *hermippus* (his Pl. 18, Fig. 4). I have examined the genitalia (figure, left) and they confirm this. His *eresimus* also, is my recent race *dilucida*.

There are two striking differences between *eresimus* and *gilippus*: in *eresimus* the ãedeagus has two thin toothed flanges near the apex, and the last sternite is barely emarginate; in *gilippus* there are only two groups of 2 or 3 small teeth on the ãedeagus, and the last sternite is deeply divided. As is to be expected, *plexaure* shows no noticeable difference from *eresimus*.

*D. cleophile*, which d’Almeida lacked, turns out to be close to *crippus*, rather than *gilippus* (figure, right) in the single terminal spike on the valve, slender, simple ãedeagus and strongly toothed last sternite. Here pattern proves a better guide than venation! By the way, genitalia in this group are difficult to mount symmetrically. I found the nearest approach to success by removing only the juxta, and then flattening the residue a little laterally.
A further interesting point is that so far as studied all the genera of Danainæ with *paronychium* and *pulvillus* have also preserved the clasper, while *Danaus*, which has simple naked claws, has lost it.

*Idea* (*Hestia*)

Talbot still groups *hypermnestra* with the *idea* group in spite of the divergent pattern and unstable venation.

*Danaus megalippe portoricensis*

This was described by Clark on the basis of only two specimens. Cornell has a good block of 16, which gives a much better idea of the subspecies. As is so frequent with races, none of the characters prove quite stable: the length of fore wing averages 3 mm. less than in *megalippe*, but only two specimens are small enough to be abnormal for the other races (see graph). On the other hand North American *menippe* are substantially larger. The best character proves to be the lack of the white spots at end of cell, as only two specimens have them well developed above. The absence of white spots in the border of hind wing holds up fairly well, with no males and only half the females showing as many white spots as average *megalippe*, but the subapical spots fail entirely.

In striking contrast to this block from Porto Rico, the three females I saved from Vieques Id. are all of the *leucogyne* type, with dull coloring, and the white spotting as strong as in *megalippe*. Their expanse (46.7 mm. average) is normal for *megalippe*, but within the range of *portoricensis*.

*Danaus candidus* Clark

This is the form I mentioned (p. 135, ftn. 19) from Cuzco. We now have a second pair from Rio Piene, Apurimae, Peru, and it certainly deserves racial status, but I still believe it belongs to *gilippus*.

1 In making the graph I have grouped all specimens except *menippe*, *portoricensis* and *leucogyne*. They showed no sign of local variation in size, even the Mexico-Venezuela specimens with tawny subapical spots being no larger.

2 The gift of Mr. Frank Johnson.
THE NORTHERN RACES OF *D. ERESIMUS*

In my former paper I made no attempt to subdivide the northern population of *eresimus*, since I had only a few specimens at hand. It now seems best to define the leading races, especially as one of them has been generally reported and figured by mistake for *cleothera* and recently by both d’Almeida

![Graph](image)

_Danaus megalippe* (Monarch). Length of fore wing.

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<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
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<td><em>menippe</em> (U. S.)</td>
<td>60</td>
<td>51.6</td>
<td>2.6</td>
<td>.34</td>
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<tr>
<td><em>megalippe &amp; erippus</em> (S. Am.)</td>
<td>63</td>
<td>46.3</td>
<td>2.9</td>
<td>.36</td>
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<tr>
<td><em>portoricensis</em> (P. R.)</td>
<td>16</td>
<td>44.1</td>
<td>3.0</td>
<td>.78</td>
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(see above) and Clark (i.e., p. 539, Pl. 74, Figs. 3, 4). Taking Surinam, Mexico and Hispaniola for the type localities of three races, they are well contrasted, though the blend zone is embar-
rassingly large, covering Cuba and the whole area from Panama, except perhaps the extreme west, to the upper Amazon. The following key will define the races, but applies only to typical populations:

1. Border of hind wing below only slightly darker brown than ground and shading into it, or if black ill defined and not fully enclosing the inner row of white dots ......................................................... 2

2. Wings above heavily shaded with black between the two series of spots and along the border, at least; hind wing below warmly colored, tawny to red-brown ................................................................. 4

3. Hind wing with subterminal as well as terminal dots conspicuous, apex of fore wing more black, hind wing more tawny (West Peru and Ecuador) ........................................................................... erginus

4. Pm. paler patches on hind wing below even-colored, the ones at end of cell small; f. w. with pale or white pm. spots in cells M3, Cu3 and sometimes Cu2 (Antilles) ................................................................. tethys

- Pm. patches on hind wing below scaled conspicuously with white along the veins, sometimes reduced to their white edges, the spots at end of cell similar and often large; no pm. spots on fore wing below vein M3 (Central America) ................................................................. montezuma

Danais eresimus montezuma Talbot

Similar to D. e. eresimus, except as follows: Ground a little duller (the major part of hind wing and lower angle tawny,—Ridgway 13/i in nephele, ochraceous tawny or a shade brighter than that,—Ridgway 15/i in e. eresimus), postmedial white spots on the average smaller, the one in cell M1 generally less than 2 mm. wide, and those below M3 absent or the first one vestigial; black border wider, running about 5 mm. wide over M2–Cu2 of hind wing (3 mm. as a rule in e. eresimus), the two series of marginal white spots further apart. Under side of fore wing much as above, the pm. spot in cell M3 often visible as a white or buff point, never as a tawny patch; black shading commonly ending abruptly near vein M3 cell M3 being postmedially brown-black and M6 chestnut, shading into the tawny ground, as a rule; area before anal angle not noticeably brighter. Hind wing distinctive, with the pm. spots normally large, reaching from vein to vein and more or less dis-
tinctly edged along the veins with white scaling, sometimes fading out and only leaving the white scaling; also always with distinct similar spots around end of cell in cells R, M₁, and M₂, sometimes small and close to cell, more often nearly as large as the pm. spots and reaching out almost to them, or even partly fusing with them; veins around cell also edged with white. Ground darkened, as a rule contrastingly, between the two rows of patches, and cell Sc also with a corresponding dark bar, or more rarely patch, crossing it opposite end of cell. Border as above, but with both series of white marginal spots conspicuous.

Variation is moderate north of Panama, consisting mainly in the development of the spots around the cell, and the strength and extent of the brown shading on under side of hind wing. This is the form figured by d’Almeida and A. H. Clark as cleothera (Mem. Inst. Oswaldo Cruz, xxxiv, 34, Pl. 3, Figs. 1, 6, 15, Fig. 5, 16, Fig. 4; Proc. U. S. N. M., xx, Pl. 74, Figs. 3, 4). It differs from cleothera in genitalia and under side pattern, as well as locality, but resembles it in lacking the pm. spots below M₃ as mentioned by Hall in his description of the synonym D. kaempferi. Curiously d’Almeida has made the reverse step in his placing of kaempferi, which he lists as a race of crestitus.

Texas to Panama, in Panama mixed with specimens similar to the Antillean race. Male from La Encarnacion, Pital, Campeche, Mexico, 10/11/33, John T. Martin, in Cornell University Collection.


Mexico: Sinaloa, 1 ♂, 2 ♀ (Reading Mus.), Victoria, Tamaulipas, June, 1930, 1 ♀ with some white shading on hind wing (Academy of Natural Sciences, Philadelphia); Jalisco (American Museum of Natural History) 1 ♂ from Johnson; Colima, 1 ♂ (R.M.), Temixco, Guerrero, Oct.–Nov. 1928, 4 ♂ (Th. W. Bouchell) (A.N.S.P.); Acapulco (A. Agassiz) 1 ♀ (Museum of Comparative Zoology), Acapulco Bay, Nov. 25–29, 1937 (A.M.N.H.), Cuernavaca, 1 ♂ with heavy white shading about end of cell of hind wing above (A.M.N.H.); Cordoba, V. C., 1 ♂ with more limited white shading (A.M.N.H.); Jalapa, 3 ♂, 3 ♀ from Schaus coll. in U.S.N.M. and Edwards coll. at A.M.N.H.; Coatepec 1 ♂ (Schaus coll. at U.S.N.M.); Tacuapan, June 1908 (U.S.N.M.); La Encarnacion, Campeche, 4 ♂, 2 ♀ John T. Martin (received from Wards Nat. Sci. Establishment and mainly in Cornell).
GUATEMALA: Gualan, Jan. 20, 1906, 1 ♂, Los Amalis, Nov. 2, 1905, 1 ♂, Puerto Barrios, Feb. 25, 1905, 1 ♀, all Chas. C. Deam (U.S.N.M.); Cayuga, Schaus (U.S.N.M.), Florencia, Motagua River, July 1, 1930, 1 ♂ (A.N.S.P.), R. C. Williams Lot 82, 1 ♀ (A.N.S.P.), and a ♂ in the National Museum without specific locality.

SAN SALVADOR: Gotera, 1 ♀ (R.M.)

HONDURAS: San Pedro, 3 ♂, 2 ♀ (R.M.), La Ceiba, July 4, 1915 (U.S.N.M.), La Libertad, Comayagua, 2500 ft., June 28, 1933, J. B. Edwards 1 ♂ (M.C.Z.), Las Limas, May 15, do., ♀, Cantarranas, Rio Choluteca, 2200 ft. Aug. 2, 1930 (A.N.S.P.); without further data 3 ♂ in U.S.N.M., 1 ♂ in A.M.N.H. In one of the males from San Pedro and one without data the white along the veins below is very weak, though the patches still extend solidly from vein to vein, and the ground above is a little brighter.


COSTA RICA: San Mateo, Dec. 1906, Schaus, 1 ♂ (U.S.N.M.), Tuis, July, Schaus & Barnes, 1 ♂ with heavy white shading on disc of hind wing above (U.S.N.M.), Port Limon, 1 ♂ with white scaling on veins below weak (U.S.N.M. from Owen coll.) ; Banana River, May 1907, Schaus, 1 ♀ (U.S.N.M.).

PANAMA: Changuinola District, Bocas del Toro, April 25, 1924, J. C. Bradley, 1 ♂ (C.U.). This specimen nearly lacks the white scaling on the veins, but is very dark, with small sub-apical spots and none below M₃. Material from the Canal Zone area definitely belongs to the blend zone (see below).

_Danaus eresimus tethys_ new race

Intermediate in most particulars between _D. e. montezuma_ and _e. eresimus_. Upper side even brighter tawny than typical eresimus, much of the outer part of hind wing and lower half of fore wing being mars yellow of Ridgway (15i); under side of hind wing tawny olive (17"i). Border of wings intermediate, averaging 4 mm. wide, on hind wing below only just enclosing the inner white dots, and often emarginate between the two dots of each cell; which are closer to margin than in nephele; black shading postmedially on fore wing, in all but two specimens with cell M₂ pretty solidly brown-black,
but usually with $M_3$ of the ground color; pm. spots large, the one in cell $M_1$ normally over 2 mm. wide, and with large spots below $M_3$, most typically with a white one in cell $M_2$, a light tawny one in $Cu_3$, and a faint one on upper side only in $Cu_2$. Hind wing below with ground evenly colored, the pm. spots sharply defined, but without paler bordering, moderate-sized, being shorter than the distance between two veins; spots about end of cell similar but small and faint, or even absent. Veins with accompanying black scaling on membrane each side but narrowly and evenly, much less contrasting than in *e. montezuma*.

This race should perhaps not be separated from *e. eresimus*, the principal difference being the stronger black border on hind wing below, and even this appears in the blend-zone of N. W. South America, but it is locally quite constant on Hispaniola. Jamaica specimens are generally similar, but a higher percentage show the ground color postmediaclly on cells $M_1$ and $M_2$, and one out of ten has lost the lower pm. spots, so that it has the exact fore wing pattern of *montezuma*, (the ground color and under side of hind wing are still normal for *tethys*); a single specimen from the Bahamas shows the lightest apical area (mar's yellow, like the lower part of border) and the pm. area is somewhat lightened, but this may or may not mark a slight sub-race there.

Greater Antilles, except Porto Rico, in Cuba transitional to nephele. Holotype $\delta$ from Fond Parisien, Haiti, Feb. 11–18, 1922, F4634, alt. about 60 ft., in America Museum of Natural History. Paratypes:

**HISPANIOLA:** Haiti: same data as holotype, 10 $\delta$, 2 $\varphi$, (A.M.N.H. and partly distributed); Pont Beudet, Mar. 3–4, 1922, 1 $\delta$ (A.M.N.H.), Trouin, 4/3/35, 1 $\varphi$, Port de Paix, Mar. 28, 1917, W. W. Abbot, 1 $\delta$ (A.N.S.P.), Port au Prince, July, 1 $\varphi$ (M.C.Z.), Cul de Sac Plain, Dec. 14, 1927, G. N. Wolcott, 1 $\delta$ (A.M.N.H.), without further data, Uhler, 3 $\varphi$ (M.C.Z.); S. Domingo: Monte Cristi, Atwater, 2 $\varphi$, one dated July 1, 1932 (U.S.N.M.); Rio Yaque, 10 mi. south of Monte Cristi, Feb. 20, 21, 1930, A. L. Sullman, 2 $\varphi$ (A.M.N.H.), Barahona, July 6–11, 1932, W. M. Bush, 1 $\varphi$ (A.M.N.H.), Monserrat, July 12, 20–22, 1932, W. M. Bush, 1 $\varphi$, 2 $\varphi$ (A.M.N.H.), Passe à Roche, July 9, 1935, 1 $\delta$ (A.M.N.H.).

**JAMAICA:** near Duncans, June, L. Perkins, 3 $\delta$, 2 $\varphi$, three of them also marked "Stewart Castle" (M.C.Z.), without further data, 2 in U.S.N.M., 3 in A.N.S.P. Avinoff also took it, and I have seen the specimens at the Carnegie Museum.

**BAHAMAS:** Nassau, N.P., 11/10/1940 (A.N.S.P.).
BLEND-ZONES, CUBA

Cuba shows every possible combination of Central American and Haitian characters, in such form as to suggest a recent fusion of previously well-separated populations. Out of 17 specimens two males in the M.C.Z. (Soledad, Sta. Clara, Aug. 4, 1932, and Sierra Maestra, 1000 ft., July 4, 1930) show what the true endemic Cuban race should have been before it was swamped from both sides: ground above deep Indian red and even, exactly like D. g. berenice, pm. spots white, without tawny tint, black border broadish and black shading beyond cell not strong, nearly lost in the general dark ground; hind wing below dark with the spots strongly contrasting, but not much darkened between the rows of spots, spots at end of cell small but conspicuous, no dark bar across cell Sc; edging of veins as broad as in nephele, but not contrasting with the dark ground, the pm. row of spots distinctly edged with whitish. This is evidently a derivative of the mainland stock, as shown by the broad vein-lines and whitish edged spots, but strongly modified by mimicry of the very dark local berenice population. The rest run—ground like montezuma, tethys or intermediate; blackish beyond cell present, absent or intermediate; lower pm. spots present in 8, absent in 6, a single small white spot in 1; on hind wing below, cell Sc with bar across it in 2, suffused with brown in 5, ground evenly light in the residue; patches at end of cell large and scaled with white in the two that have a brown bar, small but strongly contrasting in the five with brown cell Sc, with little or no white in the residue, a few of which closely matched tethys. Black veins as in montezuma or tethys. There is no trace of typical eresimus.

PANAMA TO THE AMAZONS

As already noted, the Antillean race is almost exactly intermediate in characters between montezuma and eresimus, with the result that transitional specimens between the two latter are apt to match Antillean ones. It is not clear if this is the point of origin of the Antillean race, but as such specimens are not found in the part of Central America nearest the Antilles, and are rare in Cuba on the other side, I suspect the two populations are distinct.
Panama. Our only specimen from western Panama is typical montezuma, but in the Canal Zone region there is a blend population. Of our ten specimens four have the postmedial spots below M₃ as in eresisus and tethys, four lack them as in montezuma, and two have a single faint spot. On the under side pattern the four with eresisus pm. spots all show the eresisus under side pattern, the black border being always distinct but never sharply bounded, and there is always some tawny between the two rows of white spots, which are close together. On the other hand three of the remaining six show white scaling along the veins as in montezuma, but none have the brown bar across cell Sc.

Colombia. Three specimens from Rio Aguacatal, Western Cordillera, and Villavicenzio and two without further data are like eresisus, except for somewhat more black in the border below.

Venezuela. A block of males are almost typical eresisus, one specimen only having the black border beneath much too strong.

Upper Amazons. A pair from Teffé have the black border rather stronger than in typical eresisus. The apical half of fore wing is very rich deep brown, with the white spots large and contrasting, suggesting a possible first step toward erginus, but the border of hind wing above is normal. In the Colombia, Amazon and Guiana specimens as a whole, both the pm. spots are generally white, unlike the majority of Antillean, Panama and Venezuela specimens.
BOOK NOTICES


This volume of 560 pages is a comprehensive account of the types of house pests that frequently come to the attention of entomologists and that are just as frequently turned over to other specialists because many are either on the border line of entomology or are in non-entomological fields. For this reason Doctor Hartnack's present book, which supplements his former volume entitled "202 Common Household Pests" (1939) should be of unusual interest to entomologists who deal with urban populations and their pest troubles.

Part I is a discussion embracing the entire field of house pests, entomological and otherwise, interspersed with bits of history and folklore. Some of the accounts included therein deal with the relation of such pests to stored foodstuffs; to drinking water, to house climate, including ventilation, temperature and humidity; to city climate; and to "spoorology" or the traces left by pests on textiles, furniture, foods, walls, floors, man, animals, etc., whereby the trouble may be diagnosed. Doctor Hartnack writes at length on this latter subject and cites many interesting examples. Part I also includes a discourse on pest fighting from the primitive method of burning the house to the use of vermin-proof construction and modern fumigants. And in addition consideration is given to house pests and wastes, to common names of such pests, to the requirements of a good exterminator, to professional lingo, to Herman Landois who laid the scientific groundwork for our present knowledge of many house pests, and last but not least, to the author's interesting European background. This brief summary of Part I is not by any means exhaustive. Other related topics are included, along with Doctor...
Hartnack’s criticisms and opinions of official and unofficial agencies.

Part II deals with plants as house pests, such as bacteria, yeasts, molds, fungi, mosses, pollen, etc., to which our food, possessions and persons are subject. Many of these are just as destructive as insects but receive less consideration from the publicists. The work of various species is described and methods of control are recommended.

Part III covers the lower animals from one cell organisms through the flatworms, roundworms, earthworms, snails, slugs, millepedes, centipedes, insects, spiders, scorpions, to the mites and ticks all in their relation to the house and its inmates. As before, brief diagnostic characters are given plus descriptions of damage and methods of treatment.

Part V considers such animals as frogs, salamanders, reptiles, birds, mammals, all in their relation to man, either as friends, or foes, and their treatment, as such, follows the author’s plan in Parts II and III.

Although there are many textual references to American and European literature, there is no formal bibliography. This will be disappointing to some workers, but such a bibliography, embracing hundreds of titles, would have added materially to the cost of production.

Doctor Hartnack’s coverage and treatment of the entire subject of house pests is the most interesting and complete one that has ever appeared between two covers in this country.

Like his former book, the present one is highly individualistic. It does not follow the pattern to which entomological books in this country usually conform and Doctor Hartnack’s opinions of the shortcomings of certain institutions and agencies may be thought by some, not to belong in a book of this kind. Nevertheless, it is full of interest and information, even to those who are not particularly concerned with house pests. It is profusely and well illustrated from incunabula and modern works, and by enlivening sketches. In this book will be found an entire philosophy of house pests, embracing principles and their practical application.

In this country household insects are slowly receiving an in-
creasing and more detailed amount of attention by entomologists and I believe that it is only a question of time until there is built up about them, a great body of information comparable to what we now have about some agricultural pests.

In view of the fact that over 50 per cent of the country’s population is now urban, Doctor Hartnack’s book should serve not only as a valuable source of information, but as a stimulating foundation for more intensive studies of house pests and the conditions favoring their multiplication.—Harry B. Weiss.


This latest book by Mr. Teale, whose previous, notable books on natural history won for him the John Burroughs Medal, is about three persons, the author as a boy, and his grandfather and grandmother Way. The setting is his grandparents’ farm, Lone Oak, in Indiana close to the shore of Lake Michigan. Here he spent his summers and vacation days, from four to fifteen years of age, with the guidance and companionship of two understanding people, who unknowingly helped to shape his destiny. Here, over the years, he became saturated with Indiana sunshine, with the odors of the orchards and fields and with all the fascinating things about a farm and the surrounding countryside that appeal to a boy, with an exploring mind, and freed of restraint. Here, he played Indian, cured mouse pelts, raised pigs, hunted snakes, became an aviator and built a glider, whose flight ended in disaster. Here he established the Way-Teale Museum of natural history in the wagonshed with its collections of animals’ skulls, arrowheads, bark, wood, acorns, birds’ nests, wasp nests, roots, stones, and other objects. Here he worked on the farm, drove to market, read to his heart’s content, acquired a camera, then a second hand typewriter, and became an author, all before the age of sixteen and all with boyish failures and successes. During these exciting and adventuresome years the boy absorbed the folklore of the dune country and acquired unknowingly, lasting impressions of insects, birds and animals in their natural state,
and in their relation to each other. At the same time he was exposed to the kindly philosophy and humor of his grandparents who actually aided and encouraged him in his wild undertakings.

These three people lived very close to each other and their everyday life together, as eloquently told by Mr. Teale, becomes a fascinating account of the enjoyment and completeness that can be extracted from living naturally, in almost any surroundings, in an atmosphere of intelligence, understanding, sympathy and encouragement. The illustrations blend perfectly with the skill of the author.—Harry B. Weiss.
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