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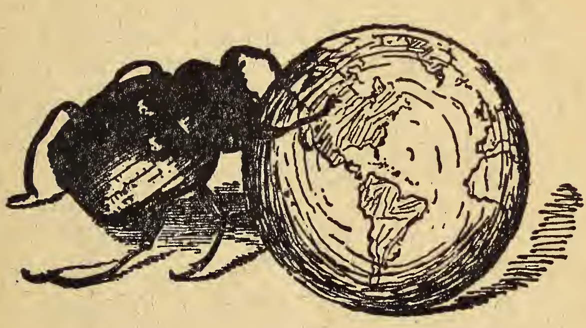

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AN ANNOTATED LIST OF THE BUTTERFLIES AND SKIPPERS OF CUBA (LEPIDOPTERA, RHOPALOCERA)

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PREFACE

In view of the fact that since the year 1935 when Mr. Marston Bates published his paper entitled "The Butterflies of Cuba"([1]), several species and subspecies of butterflies have been reported which had not previously been observed in Cuba, and bearing in mind that since the publication of Bates' catalog there has developed an intense activity in the field of taxonomy, we have considered it necessary to rectify the classification of many of the species included in the above mentioned catalog and to publish this paper giving the correct names of all the species and subspecies of butterflies found in Cuba up to the year 1953.

As we have consulted some publications not available to Bates, besides others edited after his work appeared, our bibliography will be found useful to those who desire to widen their knowledge of the Lepidoptera of Cuba.

While assembling our data and consulting our bibliography we have had the help of many scientists and librarians to whom we wish to express our gratitude, among them Dr. William T. M. Forbes, of

[1]See Bulletin of the Museum of Comparative Zoölogy at Harvard College, LXXVIII, No. 2, February, 1935, pp. 63-250.

the Department of Entomology of Cornell University; Dr. Charles D. Michener, Associate Curator of the American Museum of Natural History and now in the Department of Entomology of the University of Kansas; Ernest L. Bell, Dr. Alexander B. Klots and William P. Comstock, Research Associates of the American Museum of Natural History; the late José R. de la Torre-Bueno, who was editor of the Brooklyn Entomological Society; N. D. Riley, of the Department of Entomology of the British Museum; L. E. Commerford, Chief of Division of Publications of the Smithsonian Institution, Washington; Ralph L. Chermock, Assistant Professor of the Biology Department of the University of Alabama; Dr. Carlos G. Aguayo, Professor of Zoölogy of the University of Havana, Cuba; J. A. Ramos, Professor and Director of the Department of Biology of the University of Porto Rico; Dr. Oliveiro M. de Oliveira and Dr. Benedicto A. Monteiro Soares, Director and Sub-Director, respectively, of the Department of Zoölogy of the Ministry of Agricultura of Sâo Paulo, Brazil; F. Martin Brown, of Fountain Valley School, Colorado Springs; Romualdo Ferreira D'Almeida, of the Ministry of Education and Health of Rio de Janeiro, Brazil; Dr. Charles L. Remington, editor of the Lepidopterists' News; Miss Anita Hoffmann, daughter of the late Carlos Hoffmann, of Mexico; Rene Lichy, of Caracas, Venezuela; Dr. H. B. Hungerford, Head of the Department of Entomology of the University of Kansas; Abel Dufrane, Conservateur Musée d'Histoire Naturelle, of Ville de Mons, Belgium; Dr. Leonila Vázquez, of the Instituto of Biology Mexico; Harry K. Clench, of the Museum of Comparative Zoölogy at Harvard College; Dr. Richard M. Fox, of the Department of Entomology of the Carnegie Museum; S. G. Kiriakoff, of the University of Gent, Belgium; Zdenek Losenický, of Plzen, Czechoslovakia; William D. Field, Associate Curator of the United States National Museum, Washington; Cyril F. dos Passos, of Mendham, N. J.; John S. Garth, of the University of Southern California and Ricardo N. Orfila, Chief Section Ent. Inst. Nac. Inv. Ciencias Nat., Buenos Aires, Argentina.

Order LEPIDOPTERA

Suborder RHOPALOCERA

Superfamily PAPILIONOIDEA

Family PAPILIONIDÆ

Subfamily PAPILIONINÆ

Genus *Papilio* Linnæus

Papilio Linnæus, 1758: 458.
Genotype: *Papilio machaon* Linnæus, 1758.

1. PAPILIO (HECTORIDES) GUNDLACHIANUS Felder & Felder

Papilio gundlachianus Felder & Felder, 1864; Gundlach, 1881: 124; id., 1891: 450; Bates, 1935: 106; S. L. de la Torre, 1947b: 27; Jaume, 1947: 91; Brown, 1950: 40.
Papilio columbus: Rothschild & Jordan, 1906: 436.
Illustrations.—Bates, 1935: f. 3, (venation); S. L. de la Torre, 1946: pl. 10, f. 38-40, (scales); id., 1947b: pl. 1, f. 1.

2. PAPILIO (LÆRTIAS) DEVILLIERS Godart

Papilio devilliers Godart, 1823; Rothschild & Jordan, 1906: 514; Bates, 1935: 106; S. L. de la Torre, 1947b: 28; Jaume, 1947: 92; Brown, 1950: 41.
Papilio devilliersii: Gundlach, 1881: 123.
Papilio devilliersi: Holland, 1942: 313.
Illustrations.—Holland, 1942: pl. LXX, f. 1; S. L. de la Torre, 1947b: pl. 1, f. 2.

3. PAPILIO (LÆRTIAS) POLYDAMUS CUBENSIS Dufrane

Papilio (*Pharmacophagus*) *polydamas cubensis* Dufrane, 1946: 102.
Papilio polydamas: Gundlach, 1881: 121; id., 1891: 450; Dethier, 1940: 22.
Papilio polydamas polydamas: Rothschild & Jordan, 1906: 520; Bates, 1935: 108; Berger, 1939: 189; Comstock, 1944: 535; S. L. de la Torre, 1947b: 29; Jaume, 1947: 93.
Papilio polydamus polydamus: Bruner, Scaramuzza & Otero, 1945: 17; Beebe, 1949: 123; Brown, 1950: 41.
Papilio (*Lærtias*) *polydamas cubensis*: S. L. de la Torre, 1949c: 184.

This subspecies was described by Abel Dufrane in 1946 (see "Papilionidæ". Bull. & Ann. Soc. Ent. Belgium, vol. 82, pp. 101-122).
Illustrations.—S. L. de la Torre, 1947b: pl. 1, f. 3; Beebe, 1949: pl. I, f. 9.

4. PAPILIO (PAPILIO) POLYXENES POLYXENES Fabricius

Papilio polyxenes Fabricius, 1775; Gundlach, 1881: 136; Comstock, 1944: 539.
Papilio polyxenes polyxenes: Rothschild & Jordan, 1906: 547; Bates, 1935: 108; Bruner, Scaramuzza & Otero, 1945: 79, 128, 132; S. L. de la Torre, 1947b: 32; Jaume, 1947: 96.
Illustrations.—S. L. de la Torre, 1947b: pl. 4, f. 15, 16.

5. PAPILIO (HERACLIDES) THOAS OVIEDO Gundlach

Papilio oviedo Gundlach, 1866: 279; id., 1881: 133.
Papilio thoas oviedo: Rothschild & Jordan, 1906: 557; Bates, 1935: 109; Bruner, Scaramuzza & Otero, 1945: 145, 188; S. L. de la Torre, 1947b: 37; Jaume, 1947: 94.
Illustrations.—Gundlach, 1866: pl. 5, f. 1; S. L. de la Torre, 1946: pl. 10, f. 43, 44, (scales); id., 1947b: pl. 3, f. 14.

6.* PAPILIO (HERACLIDES) CRESPHONTES Cramer

Papilio cresphontes Cramer, 1777; Gundlach, 1866: 279; id., 1881: 131; Rothschild & Jordan, 1906: 562; Showalter, 1927: 109; Clark, 1932: 178; Hoffmann, 1933: 225; id., 1936: 262; id., 1940c: 659; Fazzini, 1934: 26; Bates, 1935: 110; Field, 1938b: 208; Holland, 1942: 317; Brown, 1943: 171; Jaume, 1947: 97.
Papilio cresphontes cresphontes: Hoffmann 1940b: 633; Chermock, 1946: 146.
Papilio thoas cresphontes: S. L. de la Torre, 1947b: 38.

The writer has not seen any Cuban specimens of this species, neither were they seen by Bates and the writer thinks the species was wrongly classified by Gundlach, having taken into consideration that only the *Papilio thoas* has been observed.

The marked (*) species have been collected in Cuba only a few times.

Illustrations.—Gundlach, 1866: pl. 5, fig. 2; Shouwalter, 1927: pl. V, f. 4; Clark, 1932: pl. 31, f. 1, pl. 32, f. 1; Holland, 1942, pl. XLII, f. 3, pl. II, f. 16, (larva), pl. VI, f. 8-10, (pupa); S. L. de la Torre, 1947b: pl. 3, f. 13, pl. 2, f. 8.

7. PAPILIO (HERACLIDES) CAIGUANABUS Poey

Papilio caiguanabus Poey, 1854; Gundlach, 1881: 127; Rothschild & Jordan, 1906: 567; Bates, 1935: 110; S. L. de la Torre, 1947b: 33; Jaume, 1947: 98; Brown, 1950: 64.

Illustration.—S. L. de la Torre, 1947b: pl. 2, f. 12.

8. PAPILIO (HERACLIDES) ARISTODEMUS TEMENES Latreille

Papilio temenes Latreille (not Godart), 1819. (See Brown, 1941: 131).

Papilio cresphontinus: Gundlach, 1881: 130.

Papilio aristodemus temenes: Rothschild & Jordan, 1906: 569; Bates, 1935: 111; Comstock, 1944: 536; Bruner, Scaramuzza & Otero, 1945: 12; S. L. de la Torre, 1947b: 38; Jaume, 1947: 99.

Illustrations.—S. L. de la Torre, 1947b: pl. 2, f. 10; id., 1946: pl. 10, f. 42, (scales).

9. PAPILIO (HERACLIDES) ANDRÆMON ANDRÆMON (Hübner)

Heraclides andræmon Hübner, 1823?.

Papilio andræmon: Gundlach, 1881: 128; Holland, 1916: 500; Brown, 1950: 64.

Papilio andræmon andræmon: Rothschild & Jordan, 1906: 571; Bates, 1935: 112; Bruner, Scaramuzza & Otero, 1945: 50, 156; S. L. de la Torre, 1947b: 36; Jaume, 1947: 100.

Illustrations.—S. L. de la Torre, 1947b: pl. 2, f. 7; Bruner, Scaramuzza & Otero, 1945: pl IX, f. 3; R. de la Torre, 1936: pl. 24, f. 1.

10. PAPILIO (HERACLIDES) ANDRÆMON HERNANDEZI Torre

Papilio (Heraclides) andræmon hernandezi R. de la Torre, 1936: 333; S. L. de la Torre, 1949: 65.

Papilio andræmon hernandezi: S. L. de la Torre, 1947b: 36.

This subspecies was described by Dr. Ricardo de la Torre Madrazo in 1936. (See Mem. Soc. Cub. Hist. Nat., vol. X, p. 333).

Illustration.—R. de la Torre, 1936: pl. 24, f. 2.

11.* PAPILIO (HERACLIDES) PALAMEDES Drury

Papilio palamedes: Clark, 1932: 252; Bates, 1935: 236; J. H. Comstock & A. B. Comstock, 1936: 55; Hoffmann, 1940c: 651; Holland, 1942: 321; S. L. de la Torre, 1947b: 26; Brown, 1950: 64.

This species was captured once in the province of Havana. (See Poey, 1846: 234; Gundlach, 1881: 138, and Bates, 1935: 236).

Illustrations.—Clark, 1932: pl. 47, f. 1, 2; J. H. Comstock & A. B. Comstock, 1936: pl. VII, f. 1; Holland, 1942: pl. XLII, f. 1.

12. PAPILIO (HERACLIDES) ANDROGEUS EPIDAURUS Godman & Salvin

Papilio epidaurus Godman & Salvin, 1890.

Papilio polycaon: Gundlach, 1881: 134; id., 1891: 454.

Papilio androgeus epidaurus: Rothschild & Jordan, 1906: 578; Hoffmann, 1933: 225; id., 1940c: 651; Bates, 1935: 112; id., 1939: 1; Comstock, 1944: 536; Bruner, Scaramuzza & Otero, 1945: 51; S. L. de la Torre, 1947b: 34; Jaume, 1947: 117.

Illustrations.—Comstock, 1944: pl. 11, f. 1; S. L. de la Torre, 1947b: pl. 2, f. 9, 11.

13.* PAPILIO (PTEROURUS) TROILUS ILIONEUS J. E. Smith

Papilio troilus ilioneus: Clark, 1932: 191; Field, 1938b: 212.

Papilio troilus: J. H. Comstock & A. B. Comstock, 1936: 59.

Papilio troilus form *ilioneus*: Holland, 1942: 321.

Papilio (Pterourus) troilus ilioneus: S. L. de la Torre, 1949: 65; S. L. de la Torre & J. T. Sierra, 1949: 195.

This species was reported by us in 1949. (See The Lepidopterists' News, vol. III, No. 6, p. 65, and Mem. Soc. Cub. Hist. Nat., vol. XIX, p. 195).

Illustrations.—J. H. Comstock & A. B. Comstock, 1936: pl. IX, f, 1-2; Holland, 1942: pl. XLI, f. 5, pl. II, f. 18, 19, 22, (larva), pl. IV, f. 5-7, (pupa).

14. PAPILIO (PTEROURUS) PELAUS ATKINSI Bates

Papilio pelaus pelaus: Rothschild & Jordan, 1906: 603.

Papilio pelaus atkinsi Bates, 1935: 113; Comstock, 1944: 538; S. L. de la Torre, 1947b: 29; Jaume, 1947: 90.

The marked (*) species have been collected in Cuba only a few times.

Papilio pelaus: Gunduach, 1881: 126.
Papililo pelaeus atkinsi: Bruner, Scaramuzza & Otero, 1945: 188.
Illustrations.—S. L. de la Torre, 1947b: pl. 1, f. 5; id., 1946: pl. 10, f. 41, (scales).

15. PAPILIO (PTEROURUS) OXYNIUS (Hübner)

Lærtias oxynius Hübner, 183—?.
Papilio oxynius: Gundlach, 1881: 127; id., 1891: 452; Rothschild & Jordan, 1906: 603; Bates, 1935: 114; id., 1939: 1; Bruner, Scaramuzza & Otero, 1945: 188; S. L. de la Torre, 1947b: 30; Jaume, 1947: 118; Brown, 1950: 64.
Illustrations.—S. L. de la Torre, 1947b: pl. 1, f. 6.

16. PAPILIO (IPHICLIDES) CELADON Lucas

Papilio celadon Lucas, 1852; Gundlach, 1881: 125; Rothschild & Jordan, 1906: 691; Holland, 1916: 500; id., 1942: 321; Bates, 1935: 114; Dethier, 1940: 22; S. L. de la Torre, 1947b: 31; Jaume, 1947: 119.
Illustrations.—Holland, 1942: pl. LXX, f. 11; S. L. de la Torre, 1947b: pl. 1, f. 4; id. 1946: pl. 10, f. 36, 37, (scales).

Family PIERIDÆ

Subfamily PIERINÆ

Genus *Ascia* Scopoli

Ascia Scopoli, 1777.
Genotype: *Papilio monuste* Linnæus, 1764.

17. ASCIA (ASCIA) MONUSTE MONUSTE (Linnæus)

Papilio monuste Linnæus, 1764.
Ascia (*Ascia*) *monuste crameri*: Field, 1938b: 198.
Ascia (*Ascia*) *monuste* form *crameri*: Hoffmann, 1940c: 662.
Ascia monuste var. *crameri*: Holland, 1942: 278.
Ascia monuste monuste: Comstock, 1943: 1; id., 1944: 529; S. L. de la Torre, 1949: 65; id., 1949d: 172.

This subspecies was reported by the writer in 1949. (See The Lepidopterists' News, vol. III, No. 6, p. 65, and Mem. Soc. Cub. Hist. Nat., vol. XIX, p. 172).

Illustrations.—Holland, 1942: pl. LXVII, f. 17; Comstock, 1944: pl. 8, f. 9; S. L. de la Torre, 1949d: pl. 5, f. 1, 2, 6.

18. ASCIA (ASCIA) MONUSTE EUBOTEA (Latreille)

Pieris eubotea Latreille, 1819.

Pieris monuste: Gundlach, 1881: 100; Holland, 1916: 496.

Pieris phileta phileta: Bates, 1935: 116; Bruner, Scaramuzza & Otero, 1945: 17, 22, 23, 51, 184, 193.

Pontia monuste: J. H. Comstock & A. B. Comstock, 1936: 72.

Ascia (Ascia) monuste: Field, 138b: 198; Hoffmann, 1940c: 662.

Ascia monuste: Holland, 1942: 278.

Ascia monuste eubotea: Comstock, 1943: 3; id., 1944: 529; Beatty, 1944: 157; J. A. Ramos, 1946: 54; S. L. de la Torre, 1949d: 173.

Pieris monuste eubotea: Avinoff & Shoumatoff, 1946: 268.

Illustrations.—Bruner, Scaramuzza & Otero, 1945: pl. VI, f. 4, (larva); J. H. Comstock, & A. B. Comstock, 1936: pl. XIII, f. 1; Holland, 1942: pl. XXXV, f. 1, 2; Comstock, 1944, pl. 10, f. 3, 4; S. L. de la Torre, 1949d: pl. 5, f 3, 4; id., 1946: pl. 10, f. 20-22, (scales).

19. ASCIA (ASCIA) MONUSTE PHILETA (Fabricius)

Papilio phileta Fabricius, 1775.

Ascia (Ascia) monuste form *phileta:* Field, 1938b: 198; Hoffmann, 1940c: 662.

Ascia monuste dimorphic ♀, *phileta:* Holland, 1942: 278.

Ascia monuste phileta: Comstock, 1943: 3; id., 1944: 530; Chermock, 1946: 144; S. L. de la Torre, 1949: 65; id., 1949d: 174.

This subspecies was reported by the writer in 1949. (See The Lepidopterists' News, vol. III, No. 6, p. 65, and Mem. Soc. Cub. Hist. Nat., vol. XIX, p. 174).

Illustrations.—Holland, 1942: pl. LXVII, f. 16; S. L. de la Torre, 1949d: pl. 5, f. 5.

20. ASCIA (GANYRA) MENCIÆ (Ramsden)

Pieris menciæ Ramsden, 1915: 15; Bates, 1935: 118; Jaume, 1947: 120.

Ascia (Ganyra) josephina menciæ?: Comstock, 1943: 6.

Ascia menciæ: S. L. de la Torre, 1949c: 178; id., 1949d: 171.

Genus *Pieris* Schrank

Pieris Schrank, 1801.

Andropodum Hübner, 1822.

Tachyptera Berge, 1842.
Genotype: *Papilio brassicæ* Linnaeus, 1758.

21.* PIERIS (SYNCHLOE) PROTODICE PROTODICE Boisduval & Leconte

Pieris protodice: Clark, 1932: 166; Anon. (Aguayo?), 1934: 110; M. Sánchez Roig & G. S. Villalba, 1934: 108; id., 1934b: 31; Bates, 1935: 236; Hoffmann, 1936: 261; id., 1940c: 661; Holland, 1942: 280; Brown, 1944: 116; Rawson, 1945: 49; Bruner, Scaramuzza & Otero, 1945: 22; Garth, 1950: 15.
Pieris rapæ: Anon. (Aguayo?), 1934: 34.
Pontia protodice protodice: J.H. Comstock & A. B. Comstock, 1936: 73.
Pieris (*Synchloe*) *protodice* f. *protodice:* Field, 1938b: 196.
Pieris protodice protodice: S. L. de la Torre, 1949: 65; id., 1949d: 171.

In 1933 several specimens of this species were captured by Dr. Mario Sànchez Riog and Gastón S. Villalba on the banks of the Almendares river, Havana province. (See Memorias Sociedad Cubana de Hist. Natural, vol. VIII, p. 108).

In 1934 Mr. José Cabrera collected three specimens more in Cotorro, Havana province. (Memorias Sociedad Cubana de Hist. Natural, vol. VIII, p. 34, and p. 110, (errata).

Illustrations.—Clark, 1932: pl. 29, f. 5-8; Holland, 1942: pl. XXXIV, f. 10,11; pl. II, f. 7, (larva); pl. V, f. 66, 67, (pupa), text fig. 26a, (larva), 26b, pupa); J. H. Comstock & A. B. Comstock, 1936: pl. XIII, f. 2, 3, 4; text fig. 27, (venation).

Genus *Appias* Hübner

Appias Hübner, 1819.
Genotype: *Papilio zelmira* Cramer, 1780.

22. APPIAS (GLUTOPHRISSA) DRUSILLA PŒYI Butler

Appias pœyi Butler, 1872.
Pieris ilaire: Poey, 1832.
Pieris pœyi: Gundlach, 1881: 103.
Tachyris ilaire: Holland, 1916: 496.
Appias ilaire pœyi: Bates 1935: 119; Jaume, 1947: 122.
Appias drusilla pœyi: Hall, 1936: 275.
Appias (*Glutophrissa*) *ilaire pœyi:* Field, 1938b: 194.

Appias (Glutophrissa) drusilla molpadia: D'Almeida, 1939c: 58; id., 1945; 233.

Appias peregrina: D'Almeida, 1945: 236.

Appias (Glutophrissa) drusilla pœyi: Comstock, 1943b: 2; id., 1944: 526; Dillon, 1947: 97; S. L. de la Torre, 1949c: 179, 180.

Illustrations.—Poey, 1832: 3 figs. not numbered; D'Almeida, 1939c: pl. 3, f. A, C, pl. 4, f. E.

23. APPIAS (GLUTOPHRISSA) DRUSILLA POEYI *f.* PEREGRINA Rober

Appias janeira f. *peregrina* Röber, 1909.

Appias peregrina: Bates, 1935: 237; Jaume, 1947: 121; D'Almeida, 1939c: 62.

Appias (Glutophrissa) drusilla pœyi var. *peregrina:* Comstock, 1943b: 3.

Appias (Glutophrissa) drusilla pœyi f. *peregrina*: S. L. de la Torre, 1949c: 180.

Genus *Melete* Swainson

Melete Swainson, 1831-32.

Daptonoura Butler, 1869.

Genotype: *Melete limnobia* Swainson, 1831-32 (=*Pieris limnoria* Latreille, 1819).

According to D'Almeida (1943: 80), the genotype of *Daptonoura* Butler is *Papilio flippantha* Fabricius, 1793 (=*Papilio lycimnia* Cramer, 1777), being *Pieris limnoria,* type of the genus *Melete,* a simple subspecies of *Papilio lycimnia* Cramer.

24. MELETE SALACIA CUBANA Fruhstorfer

Melete lycimnia cubana Fruhstorfer, 1908.

Daptonoura salacia: Gundlach, 1881: 105.

Melete salacia: Bates, 1935: 119, Bruner, Scaramuzza & Otero, 1945: 131, 138; Jaume, 1947: 123.

Melete salacia cubana: Bates, 1936: 225.

Illustrations.—Bates, 1935: f. 4, (venation), 5, (profile of head): S. L. de la Torre, 1946: pl. 10, f. 16, 17, (scales).

Genus *Eurema* Hübner

Eurema Hübner, 1819.

Terias Swainson, 1821.

Sphænogona Butler, 1870.

Genotype: *Pieris daira* Latreille, 1819 (=*Eurema demoditas* Hübner, 1819. =*Papilio delia* Cramer, 1780; homonym of *Papilio delia* Schiffermüller & Denis, 1775).

25. EUREMA (ABÆIS) NICIPPE (Cramer)

Papilio nicippe Cramer, 1779.

Eurema nicippe: Gundlach, 1881: 82; Klots, 1929: 103, 110, 120, 132, 147, 155; id., 1948: 51; 1935: 127; J. H. Comstock & A. B. Comstock 1936: 97; Holland, 1942: 301; Bruner, Scaramuzza & Otero, 1945: 32, 33; Avinoff and Shoumatoff, 1946: 269; S. L. de la Torre, 1946: 104; Garth, 1950: 13.

Terias nicippe: Holland, 1916: 498; D'Almeida, 1936: 13; id., 1944d: 74

Eurema nicippe nicippe: Clark, 1932: 149.

Eurema (Terias) nicippe: Hoffmann, 1933: 226.

Terias (Abaeis) nicippe: D'Almeida, 1936b: 189, 192, 327; id., 1938: 242.

Abæis nicippe: Brown, 1944: 114.

Eurema (Pyrisitia) nicippe: Comstock, 1944: 525.

Eurema (Abaeis) nicippe: Field, 1938b: 189; Hoffmann, 1940c: 659; Munroe, 1947: 3; S. L. de la Torre & Alayo, 1953: 10.

Illustrations.—Klots, 1929: pl. II, f. 36, 37; J. H. Comstock & A. B. Comstock, 1936: pl. XV, f. 3, 5; Holland, 1942: pl. XXXVII, f. 3, 4, 6, pl. II, f. 6, (larva), pl. V, f. 51, 52, (pupa); S. L. de la Torre, 1946: pl. 10, f. 4-7, (scales); d'Almeida, 1936: pl. 2, f. l, 6, pl. 8, f. 1, 2, (nerviation), pl. 9, f. 4, (genital), pl. 10, f. 2, (genital), f. 3, (palp), pl. 14, f. 4, (antenna), pl. 17, f. 2, 8, 12, (legs), Clark, 1932, pl. 28, f. 6; Comstock, 1944: pl. 8, f. 5; Klots, 1928: pl. II, f. 8, (genital), Pl. III, f. 15; S. L. de la Torre & Alayo, 1953: pl. VIII, f. 1, 2, 5, 6.

26. EUREMA (PYRISITIA) PROTERPIA PROTERPIA (Fabricius)

Papilio proterpia Fabricius, 1775.

Eurema proterpia: Gundlach, 1881: 84; Holland, 1942: 301; Avinoff & Shoumatoff, 1946: 269.

Eurema (Terias) proterpia: Hoffmann, 1933: 226.

Eurema proterpia: Klots, 1929: 104, 106, 107, 137, 147, 159; id., 1948: 51; Bates, 1935: 128; S. L. de la Torre, 1946: 105.

Terias proterpia proterpia: d'Almeida, 1936: 16; id., 1944: 74; Lichy, 1943: 175.

Terias (Pyisitia) proterpia proterpia: d'Almeida, 1936b: 192, 328; id., 1938: 242.

Eurema (Pyrisitia) proterpia: Hoffmann, 1940c: 659.

Pyrisitia proterpia: Brown, 1944: 112.

Eurema (Pyrisitia) proterpia proterpia: S. L. de la Torre & Alayo; 1953: 11.

Illustrations.—Holland, 1942: pl. XXXVII, f. 2; Klots, 1929 pl. III, f. 68, 69; id., 1928: pl. III, f. 14, (genital), f. 18, (venation); Bates, 1935: f. 6, (venation); S. L. de la Torre, 1946: pl. 10, f. 9, (scales); d'Almeida, 1936: pl. 2, f. 4, 5, pl. 7, f. 1, 2, (venation); pl. 9, f. 5, (genital), pl. II, f. 1, (genital); S. L. de la Torre & Alayo, 1953: pl. I, figs. 1, 2, 5, 6.

27. EUREMA (PYRISITIA) PROTERPIA PROTERPIA *f.* GUNDLACHIA (Poey)

Terias gundlachia Poey, 1853.

Eurema gundlachia: Gundlach, 1881: 85; Klots, 1929, 104, 106, 137, 145, 159, 160; id., 1948: 51; Bates, 1935: 129; Holland, 1942: 300; S. L. de la Torre, 1946: 105.

Terias gundlachia gundlachia: d'Almeida, 1936: 21; id., 1944d: 75.

Terias (Pyrisitia) gundlachia gundlachia: d'Almeida, 1936b: 192, 329.

Eurema (Pyrisitia) gundlachia: Hoffmann, 1940c: 659.

Eurema longicauda: Holland, 1942: 300.

Terias proterpia gundlachia: Lichy, 1943: 175.

Pyrisitia gundlachia: Brown, 1944: 111.

Eurema (Pyrisitia) proterpia proterpia f. *gundlachia:* S. L. de la Torre & Alayo, 1953: 12.

Illustrations.—Klots, 1929: pl. III, f. 72, 73; Holland, 1942: pl. LXXIII, f. 25, pl. XXXVII, f. 1, (=*E. longicauda*); d'Almeida, 1936: pl. 2, f. 3, 9, pl. 9, f. 7, (genital), pl. 10, f. 6, (palp), pl. 11, f. 2. (genital), pl. 17, f. 3, (legs); S. L. de la Torre & Alayo, 1953: pl. I, f. 3, 4, 7, 8.

28. EUREMA (PYRISITIA) DINA DINA (Poey)

Terias dina Poey, 1832; Holland, 1916: 498.

Eurema dina: Gundlach, 1881: 86.

Eurema dina dina: Klots, 1929: 105, 119, 139, 144, 160; id., 1948: 51; Bates, 1935: 130, (part); Bruner, Scaramuzza & Otero, 1945: 139.

Terias (Pyrisitia) dina dina: d'Almeida, 1936b: 194, 216; id., 1944d: 79.

Eurema (Pyrisitia) dina dina: Comstock, 1944: 525; S. L. de la Torre & Alayo, 1953: 13.

Illustrations.—Poey, 1832: 2 figs. not numbered; Klots, 1929: pl. III, f. 79; d'Almeida, 1936b: pl. 5, f. 3, (genital), pl. 9, f. 7, (genital), pl. 13, f. 20, pl. 15, f. 7, pl. 16, f. 7; S. L. de la Torre & Alayo, 1953: pl. II, f. 1, 2, 6, 7.

29. EUREMA (PYRISITIA) DINA DINA *f.* CITRINA (Poey)

Terias citrina Poey, 1853; Holland, 1916: 498.

Eurema citrina: Gundlach, 1881: 87.

Eurema dina f. ♀ *citrina:* Klots, 1929: 105, 118, 119, 139, 144, 160.

Eurema dina dina: Bates, 1935: 130. (Part.)

Terias (Pyrisitia) dina citrina: d'Almeida, 1936b: 194.

Terias (Pyrisitia) dina dina, var. i: d'Almeida, 1936b: 218; id., 1938: 232.

Terias dina var. *citrina:* d'Almeida, 1944d: 79.

Eurema (Pyrisitia) dina citrina: S. L. de la Torre, 1949: 65.

Eurema (Pyrisitia) dina dina f. *citrina:* S. L. de la Torre & Alayo, 1953: 13.

This is the winter form of *E. dina dina.*

Illustrations.— Klots, 1929: pl. III, f. 80; d'Almeida, 1936b: pl. 12, f. 5; S. L. de la Torre & Alayo, 1953: pl. II, f. 3, 4, 8, 9.

30. EUREMA (PYRISITIA) LARÆ (Herrich-Schäffer)

Terias laræ Herrich-Schäffer, 1862: 120

Eurema laræ: Gundlach, 1881: 88; Bates, 1936: 226; Bruner, Scaramuzza & Otero, 1945: 175; Munroe, 1947: 4; id., 1950: 175.

Eurema (Pyrisitia) laræ: S. L. de la Torre & Alayo, 1953: 14.

Illustrations.—S. L. de la Torre & Alayo, 1953: pl. III, f. 1, 2, 7, 8.

31. EUREMA (PYRISITIA) LARÆ f. RICARDI S. L. Torre & Alayo

Eurema (Pyrisitia) laræ f. *ricardi* S. L. de la Torre & Alayo, 1953: 15.

Illustrations.—S. L. de la Torre & Alayo, pl. III, f. 3, 4, 9, 10.

This is the summer form of *E. laræ,* which was described by Dr. S. L. de la Torre and P. Alayo in 1953. (See Bull. Orte. Dpto. Ext. y Rel. Cult., No. 27)

32. EUREMA (PYRISITIA) NEDA (Latreille)

Pieris neda Latreille, 1819.
Eurema nise perimede: Klots, 1929: 105, 119, 140, 147, 162; id.. 1948: 51.
Eurema nise: Bates, 1935: 129; Bruner, 1947: 25.
Terias (Pyrisitia) neda: d'Almeida, 1936b: 196, 239; id., 1938: 234; id., 1944d: 82.
Eurema (Pyrisitia) neda: S. L. de la Torre & Alayo, 1953: 16.
Illustrations.—Klots, 1929: pl. IV, f. 93, 94; d'Almeida, 1936b: pl. 2, f. 1, (genital), pl. 4, f. 2, (genital) pl. 9, f. 4, (genital), pl. 13, f. 15, 16, pl. 16, f. 8; S. L. de la Torre & Alayo, 1953: pl III, f. 5, 6, 11, 12.

33.* EUREMA (PYRISITIA) NISE (Cramer)

Papilio nise Cramer, 1775: 31.
Eurema venusta: Klots, 1929: 141.
Terias nise: d'Almeida, 1936: 244; id., 1938: 234; id., 1944d: 82.
Eurema venusta venusta: Dillon, 1947: 100.
Eurema nise: Munroe, 1950: 180.
Eurema (Pyrisitia) nise: S. L. de la Torre & Alayo, 1953: 16.
Illustrations.—S. L. de la Torre & Alayo, 1953: pl. II, f. 5, 10,

Mr. J. Cabrera collected two specimens of this species in Pinar del Rio province (1910), which are in Chas. T. Ramsden's Museum of the University of Oriente, in Santiago de Cuba. This new record was reported by Dr. Salvador L. de la Torre and Pastor Alayo in 1953.

34. EUREMA (PYRISITIA) LISA EUTERPE (Ménétriés)

Colias euterpe Ménétriés, 1832.
Eurema lisa: Gundlach, 1881: 89; Bates, 1935: 130; Dethier, 1940: 21.
Terias euterpe: Holland, 1916: 499.
Eurema lisa euterpe: Klots, 1929: 105, 116, 138, 145, 160; Avinoff & Shoumatoff, 1946: 271.
Terias (Pyrisitia) euterpe: d'Almeida, 1936b: 193, 251; id., 1938: 234; id., 1944d: 83.
Eurema (Pyrisitia) lisa euterpe: Comstock, 1944: 523; Beatty, 1944:

157; J. A. Ramos, 1946: 53; S. L. de la Torre & Alayo, 1953: 17.

D'Almeida does not divide this species into subspecies, considering the species of Cuba and Haiti similar to those of the mainland. Comstock, however, finds sufficient differences between the two to justify its separation into subspecies.

D'Almeida (1936b: 256, 257) called *pauperata* to a variety of his *Terias euterpe,* characterized by being smaller and lighter; which inhabits Cuba, (See pl. 12, f. 3).

Illustrations.— Bates, 1935: f. 7, (profile of head); S. L. de la Torre, 1946: pl. 10, f. 1-3, (scales); Klots, 1929: pl. III, f. 78; d'Almeida, 1936b: pl. 6, f. 4. (genital), pl. 12, f. 3, (var. *pauperata*), f. 10, pl. 14, f. 10, pl. 16, f. 10; Comstock, 1944: pl. 9, f. 24; Klots, 1928: pl. 12, (genital), f. 17, (venation); S. L. de la Torre & Alayo, 1953: pl. IV, f. 1, 2, 3, 7, 8, 9.

35. EUREMA (PYRISITIA) MESSALINA MESSALINA (Fabricius)

Papilio messalina Fabricius, 1787.

Eurema messalina: Gundlach, 1881: 98; Klots, 1929: 103, 114, 115, 116, 131, 147, 155, 156; id., 1948: 51; Avinoff & Shoumatoff, 1946: 269.

Eurema messalina messalina: Bates, 1935: 126; Bruner, Scaramuzza & Otero, 1945: 66.

Terias (Pyrisitia) messalina messalina: d' Almeida, 1936b: 198, 262; id., 1938: 235; id., 1944d: 85.

Eurema (Pyrisitia) messalina messalina: S. L. de la Torre & Alayo, 1953: 18.

Illustrations.—Klots, 1929: pl. II, f. 41, 42; S. L. de la Torre, 1946: pl. 10, f. 11, 12, (scales); d'Almeida, 1936b: pl. 8, f. 11, (genital), pl. 12, f. 2, pl. 13, f. 7, pl. 18, f. 4; S. L. de la Torre & Alayo, 1953, pl. IV, f. 6, 12, (winter form).

36. EUREMA (PYRISITIA) MESSALINA MESSALINA *f.* GNATHENE (Boisduval)

Terias gnathene Boisduval, 1836.

Eurema messalina: Gundlach, 1881: 98 (in part).

Eurema messalina messalina: Bates, 1935: 126 (in part).

Terias (Pyrisitia) messalina messalina var. f: d'Almeida, 1936b: 264.

Eurema (Pyrisitia) messalina messalina f. *gnathene:* S. L. de la

Torre & Alayo, 1953: 19.

Illustrations.— S. L. de la Torre & Alayo, 1953: pl. IV, f. 4, 5, 10, 11.

This is the summer form of *E. messalina messalina.*

37. eurema (eurema) lucina lucina (Poey)

Terias lucina Poey, 1853; Holland, 1916: 499.

Eurema lucina: Gundlach, 1881: 95; Bates, 1935: 124; Bruner, Scaramuzza & Otero, 1945: 177.

Eurema lucina f. *lucina:* Klots, 1929: 102, 113, 123, 146, 150.

Terias (Eurema) lucina lucina: d'Almeida, 1936b: 205, 226; id., 1944d: 85.

Eurema (Eurema) *lucina lucina*: S. L. de la Torre & Alayo, 1953: 19.

Illustrations.—S. L. de la Torre, 1946: pl. 10, f. 8, (scales); Klots, 1929: pl. I, f. 1; id.; 1928: pl. II, f. 4, (genital); d'Almeida, 1936b: pl. 12, f. 1; pl. 16, f. 14; S. L. de la Torre & Alayo, 1953: pl. IV, f. 1, 2, 6, 7.

38. eurema (eurema) lucina lucina *f.* fornsi (Poey)

Terias fornsi Poey, 1854.

Eurema fornsi: Gundlach, 1881: 96.

Eurema lucina form *fornsi:* Klots, 1929: 102, 113, 123, 145, 150.

Eurema priddyi forbesi: Klots, 1929: 102, 115, 123, 124, 145, 150.

Terias (*Eurema*) *lucina fornsi:* d'Almeida, 1936b: 205, 267; id., 1944d: 85.

Eurema (*Eurema*) *lucina lucina* f. *fornsi:* S. L. de la Torre & Alayo, 1953: 20.

Illustrations.—Klots, 1929: pl. I, f. 2, (form *fornsi*), f. 4, 5, (form *priddyi forbesi);* d'Almeida, 1936b: pl. 8, f. 14, (genital); pl. 12, f. 4; pl. 18, f. 6; S. L. de la Torre & Alayo, 1953: pl. IV, f. 3, 4, 8, 9: This is the winter form of *E. lucina lucina.*

39. eurema (eurema) conjungens (Herrich-Schäffer)

Terias conjungens Herrich-Schäffer, 1864.

Eurema conjungens: Gundlach, 1881: 97.

Eurema (*Eurema*) *conjungens*: S. L. de la Torre & Alayo, 1953: 20.

Illustrations.—S. L. de la Torre & Alayo, 1953: pl. V, f. 5.

Mr. P. Alayo has one specimen of this species collected in Oriente province.

40. EUREMA (EUREMA) DAIRA PALMIRA (Poey)

Terias palmira Poey, 1851.
Terias albina Poey, 1851.
Eurema palmira: Gundlach, 1881: 92; Klots, 1948: 52 and 112, (errata).
Eurema albina: Gundlach 1881: 94.
Eurema palmyra palmyra: Klots, 1929: 102, 113, 126, 147, 151.
Eurema palymra: Avinoff & Shoumatoff, 1946: 270.
Eurema daira palmira: Bates, (in part), 1935: 125; id., 1939: 2; d'Almeida, 1944d: 86; Bruner, Scaramuzza & Otero, 1945: 9, 66.
Terias daira palmyra: Hall, 1936: 275.
Terias (Eurema) jucunda palmira: d'Almeida, 1936b: 208, 273; id., 1938: 235; id., 1944d; 85.
Eurema (Eurema) palmira palmira: Comstock, 1944: 519: J. A. Ramos, 1946: 53.
Eurema (Eurema) daira palmira: S. L. de la Torre & Alayo, 1953: 21.
Illustrations.—Klots, 1929: pl. I, f. 11; d'Almeida, 1936b: pl. 15, f. 10, 11; Comstock, 1944: pl. 9, f. 26; S. L. de la Torre & Alayo, 1953: pl. VI, f. 1, 2, 5, 6.

41. EUREMA (EUREMA) DAIRA PALMIRA *f.* EBRIOLA (Poey)

Terias ebriola Poey, 1851.
Eurema jucunda: Gundlach, 1881: 94, (not Boisduval & Leconte).
Eurema daira ebriola: Klots, 1929: 103, 113, 126, 144, 152.
Eurema daira palmira: Bates, 1935: 125, (in part).
Terias (Eurema) daira ebriola: d'Almeida, 1936b: 211, 214, 280; id., 1944d: 86.
Eurema (Eurema) daira ebriola: Comstock, 1944: 520; Beatty, 1944: 157; S. L. de la Torre, 1949: 65.
Eurema ebriola: Avinoff & Shoumatoff, 1946: 271; Klots, 1948: 52
Eurema (Eurema) daira palmira f. *ebriola:* S. L. de la Torre & Alayo, 1953: 21.
Illustrations.—Klots, 1929: pl. I, f. 19, 20; d' Almeida, 1936b: pl. 7, f. 2, (genital), pl. 8, f. 7, 13, (genital), pl. 14, f. 7, pl. 15, f. 3; Comstock, 1944: pl. 9, f. 25: Klots, 1928: pl. II, f. 5, (genital); S. L. de la Torre & Alayo, 1953: pl. VI, f., 3, 4, 7, 8. This is the winter form of *E. daira palmira.*

42. EUREMA (EUREMA) ELATHEA ELATHEA (Cramer)

Papilio elathea Cramer, 1777.

Eurema elathea: Gundlach, 1881: 91; Bates, 1935: 126; Avinoff & Shoumatoff, 1946: 271; Klots, 1948: 52; Munroe, 1951: 55.

Terias elathea: Holland, 1916: 499; Hall, 1936: 275.

Eurema elathea f. elathea: Klots, 1929: 103, 111, 128, 152.

Eurema (Terias) elathea: Hoffmann, 1933: 226.

Terias (Eurema) elathea elathea: d'Almeida, 1936b: 211, 213, 285, 299; id., 1938: 235; id., 1944d: 87; Berger, 1939: 190.

Terias (Eurema) lye d'Almeida, 1936b: 212, 284; id., 1944d: 86.

Eurema (Eurema) elathea: Comstock, 1944: 521; Beatty, 1944: 157.

Eurema (Eurema) elathea elathea: S. L. de la Torre & Alayo, 1953: 22.

D'Almeida in his "Segunda nota suplementar a "Revisao das *Terias* Americanas", (1944d: 86), admits that his *Terias lye* does not seem to be a good species, placing it as a synonym of *Eurema elathea* and not of *E. daira palmira* as done by Bates (1939: 2).

Illustrations.—Klots, 1929: pl. 1, f. 21, 22; d'Almeida, 1936b: pl. 11, f. 1, pl. 13, f. 6, pl. 15, f. 1, *(T. lye);* Comstock, 1944: pl. 9, f. 23; text fig. 22, (venation); S. L. de la Torre & Alayo, 1953: pl. VII, f. 1, 2, 3, 6, 7, 8.

43. EUREMA (EUREMA) ELATHEA ELATHEA *f.* CUBANÀ (Herrich-Schäffer)

Terias cubana Herrich-Schäffer, 1864.

Eurema cubana: Gundlach, 1881: 90.

Eurema palmyra palmyra: Klots (in part), 1929: 102, 126.

Eurema daira palmira: Bates, 1935: 125, (in part).

Terias elathea var. c-male and var. n-female; d'Almeida, 1936b: 288, 289.

Eurema (Eurema) palmira palmira: Comstock (in part), 1944: 519.

Eurema (Eurema) elathea cubana: S. L. de la Torre, 1949: 65.

Eurema (Eurema) elathea elathea f. *cubana:* S. L. de la Torre & Alayo, 1953: 23.

William P. Comstock places to *Terias cubana* in the synonym of his *E. (Eurema) palmira palmira;* d'Almeida places it in the synonym of *Terias elathea.* We think that *Terias cubana* is a seasonal form of this species.

Illustrations.—S. L. de la Torre & Alayo, 1953: pl. VII, f. 4, 5, 9, 10.

44. EUREMA (EUREMA) AMELIA (Poey)

Terias amelia Poey, 1853; Holland, 1916: 499.
Eurema amelia: Gundlach, 1881: 98; Klots, 1929: 104, 110, 136, 143, 154; Bates, 1935: 128.
Terias (Eurema) amelia: d'Almeida, 1936b: 204, 307; id., 1944d: 88.
Eurema (Eurema) amelia: S. L. de la Torre & Alayo, 1953: 24.
Illustrations.—Klots, 1929: pl. II, f. 33; d'Almeida, 1936b: pl. 8, f. 16, (genital), pl. 14, f. 22; Klots, 1928: pl. II, f. 2, (genital); S. L. de la Torre & Alayo, 1953: pl V, f. 10.

45. EUREMA (EUREMA) BOISDUVALIANA (Felder & Felder)

Terias boisduvaliana Felder & Felder, 1865; d'Almeida, 1936: 41; id., 1944d: 77.
Eurema boisduvaliana: Klots, 1929: 104, 107, 108, 133, 143, 157; id., 1948: 51; Bates, 1935: 127; Brown 1944: 109; Bruner, 1947: 25.
Terias (Eurema) boisduvaliana: d'Almeida, 1936b: 201, 202, 307, 332.
Eurema (Eurema) boisduvaliana: Hoffmann, 1940c: 658; S. L. de la Torre & Alayo, 1953: 25.
Illustrations.—Klots, 1929: pl. II, f. 51, 52; S. L. de la Torre & Alayo, 1953: pl. VIII, f. 3, 4, 7, 8.

Genus *Phoebis* Hübner

Phœbis Hübner, 1819.
Callidryas Boisduval & Leconte, 1829.
Metura Butler, 1873; preoccupied in the family *Psychidæ.*
Aphrissa Butler, 1873.
Rhabdodryas Godman & Salvin, 1889.
Parura Kirby, 1896, (for Metura).
Prestonia Schaus, 1920. . . .
Genotype: *Papilio argante* Fabricius, 1775 *(=Papilio cipris* Cramer, 1777).

46. PHŒBIS (PHŒBIS) SENNÆ SENNÆ (Linnæus)

Papilio sennæ Linnæus, 1758.
Catopsilia eubule: Gundlach, 1881: 115; Holland, 1916: 496; Hall, 1936: 275.

Phœbis eubule sennæ: Brown, 1929: 8; Avinoff & Shoumatoff, 1946; 272.

Phœbis eubule sennæ f. ♀ *sennalba* Brown, 1929: 8.

Phœbis sennæ sennæ: Bates, 1935: 133; Field, 1938b: 185; d'Almeida, 1940; 70; id., 1944b: 2; Bruner, Scaramuzza & Otero, 1945: 31-33; S. L. de la Torre, 1946b: 109, 111, 120; Munroe, 1951: 56.

Phœbis eubule sennæ?: Schweizer, 1941: 9.

Phœbis (Phœbis) sennæ sennæ: Comstock, 1944: 505; Beatty, 1944: 157; J. A. Ramos, 1946: 53.

Illustrations.—Brown 1929: f. 8-10, (genital); Comstock, 1944: pl. 8, f. 6; d'Almeida, 1940: pl. 1, f. 3, (genital), pl. 3, f. 3, 5, pl. 4, f. 5-7, pl. 6, f. 2, 10, 12, pl. 9, f. 1, pl. 11, f. 6, (larva), 8, 10, (pupa).

47. PHŒBIS (PHŒBIS) PHILEA THALESTRIS (Illiger)

Papilio Danaus thalestris Illiger, 1801.

Catopsilia thalestris: Gundlach, 1881: 107; id., 1891: 449.

Phœbis philea thalestris: Brown, 1929: 11; Bates, 1935: 134; d'Almeida, 1940: 117; id., 1944b: 10; Bruner, Scaramuzza & Otero, 1945: 32.

William P. Comstock (1944: 510) considers *Phœbis philea* as a distinct species of *Phœbis thalestris,* and says that both species "occur together in Cuba".

Illustrations.—Brown, 1929: f. 14-16, (genital); d'Almeida, 1940: pl. 3, f. 8, pl. 5, f. 6, pl. 8, f. 4, pl. 9, f. 5, Comstock, 1944: pl. 10, f. 14, *(Phœbis philea* (Johansson)).

48. PHŒBIS (PHŒBIS) AVELLANEDA (Herrich-Schäffer)

Callidryas avellaneda Herrich-Schäffer, 1864.

Catopsilia avellaneda: Gundlach, 1881: 109.

Phœbis avellaneda: Brown, 1929: 11; Bates, 1935: 134; d'Almeida, 1940: 120; id., 1944b: 10.

Illustrations.—Brown, 1929: f. 17-19, (genital); d'Almeida, 1940: pl. 1, f. 9, (genital), pl. 2, f. 7, (genital), pl. 5, f. 1, pl. 7, f. 2, pl. 8, f. 1, pl. 10, f. 1; S. L. de la Torre, 1946: pl. 10, f. 25, (scales).

49. PHŒBIS (PHŒBIS) ARGANTE MINUSCULA (Butler)

Callidryas minuscula Butler, 1869.

Catopsilia argante: Gundlach, 1881: 110.

Phœbis argante rorata: Brown, 1929: 13; Bates, 1935: 135.

Phœbis (Phœbis) argante f. ♀ *clarki:* Hoffmann, 1940c: 657
Phœbis argante argante: d'Almeida, 1940: 89, 103; id., 1944b: 6.
Phœbis (Phœbis) argante minuscula: Comstock, 1944: 508; S. L. de la Torre, 1952: 61.

The subspecies *rorata* is of the Hispaniola and possibly it can be found in Cuba, according to Comstock.

Illustrations.—Brown, 1929: f. 23-25, (genital); d'Almeida, 1940: pl. 1, f. 4, (genital), pl. 2, f. 1, (venation), f. 8-10, (legs), f. 13, (genital), f. 14, (antenna), f. 15, (palp), pl. 3, f. 2, (f. *albante);* f. 6, 7, pl. 4, f. 1, 4, pl. 5, f. 3, pl. 6, f. 3, 4, 6, 8, 11, pl. 7, f. 3, pl. 11, f. 5, (larva), f. 7, 9, (pupa); S. L. de la Torre, 1946: pl. 10, f. 31-35, (scales).

50. PHŒBIS (PHŒBIS) AGARITHE ANTILLIA Brown

Phœbis agarithe antillia Brown, 1929: 15; Avinoff & Shoumatoff, 1946: 273; Dillon, 1947: 98; L. Vázquez, 1948b: 472.
Catopsilia agarithe: Gundlach, 1881: 111.
Catopsilia agarithe fornax: Holland, 1916: 497.
Phœbis agarithe agarithe: Bates, 1935: 135.
Phœbis agarithe antillea: d'Almeida, 1940: 107.
Phœbis (Phœbis) agarithe antillia: Comstock, 1944: 509; S. L. de la Torre, 1952: 65.

Illustrations.—Brown, 1929: f. 20-22, (genital); Comstock, 1944: pl. 10, f. 9; S. L. de la Torre, 1946: pl. 10, f. 26-28, (scales).

51. PHŒBIS (APHRISSA) STATIRA CUBANA d'Almeida

Aphrissa statira cubana d'Almeida, 1939b: 432.
Catopsilia statira: Gundlach, 1881: 118; id., 1891: 449.
Catopsilia neleis: Holland, 1916: 497.
Phœbis statira jada: Bates, 1935: 136.
Phœbis statira cubana: Avinoff & Shoumatoff, 1946: 273.
Phœbis (Aphrissa) statira cubana: Comstock, 1944: 513; Munroe, 1947: 2; S. L. de la Torre, 1949c: 183.

According to d'Almeida, *jada* is merely a simple form of *statira statira,* which inhabits the mainland.

Illustrations.—Brown, 1929: f. 5-7, (genital); d'Almeida, 1939b: pl. 6, f. 6; Comstock, 1944: pl. 10, f. 11; S. L. de la Torre, 1946: pl. 10, f. 29, 30, (scales)

52. PHŒBIS (APHRISSA) NELEIS (Boisduval)

Callidryas neleis Boisduval, 1836
Catopsilia neleis: Gundlach, 1881: 117.
Catopsilia editha?: Holland, 1916: 498.
Phœbis neleis: Bates, 1935: 137; Munroe, 1947: 2.
Aphrissa neleis neleis: d'Almeida, 1939b: 433.
Phœbis (Aphrissa) neleis: Comstock, 1944: 513; S. L. de la Torre, 1949c: 183.

We separate *statira* from *neleis* because the genitals of those species offer great differences.

Illustrations.—d'Almeida, 1939b: pl. 5, f. 19, 20, (genital), pl. 6, f. 3-5.

53. PHŒBIS (APHRISSA) ORBIS ORBIS (Poey)

Callidryas orbis Poey, 1832.
Catopsilia orbis: Gundlach, 1881: 113.
Catopsillia drya: Holland, 1916: 497.
Phœbis orbis: Bates, 1935: 138.
Aphrissa orbis: d'Almeida, 1939b: 438.
Phœbis (Aphrissa) orbis orbis: Munroe, 1947: 1; S. L. de la Torre, 1949c: 183, 184.

Illustrations.—d'Almeida, 1939b: pl. 5, f. 12, 15, 17, (genital), pl.7, f. 1, 2, pl. 8, f. 4, 8; Poey, 1832: 5 figs. not numbered.

Genus *Anteos* Hübner

Anteos Hübner, 1819.
Amynthia Swainson, 1831.
Genotype: *Papilio mærula* Fabricius, 1775.

The genotype of *Gonepteryx* ([1]) is *Papilio rhamni* Linnæus, 1758; the only species cited of that genus.

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[1] *Gonepteryx* Leach, 1815.
Gonoptera Billberg, 1820.
Rhodocera Boisduval & Leconte, 1833.
Goniapteryx Westwood, 1840.
Gonioptera Wallengren, 1853.

54. ANTEOS MÆRULA MÆRULA (Fabricius)

Papilio mærula Fabricius, 1775.
Gonepteryx mærula: Gundlach, 1881: 119.
Anteos mærula mærula: Bates, 1935: 139; Comstock, 1944: 502; Bruner, Scaramuzza & Otero, 1945: 32.
Anteos mærula: Field, 1938b: 183; d'Almeida, 1938b: 575; id., 1945: 230; Hoffmann, 1940c: 656; Brown, 1944: 103; Avinoff & Shoumatoff, 1946: 274.
Illustrations.—d'Almeida, 1938b: pl. 1, f. 1, (venation), f. 9, (genital), pl. 3, f. 1, 2; Comstock, 1944: pl. 8, f. 7.

55. ANTEOS CLORINDE (Godart)

Colias clorinde Godart, 1823.
Anteos clorinde nivifera: Bates, 1935: 139; Dethier, 1940: 17; Comstock, 1944: 503.
Anteos clorinde: Field, 1938b: 183; d'Almeida, 1938b: 572; id., 1945: 229; Hoffmann 1940c: 656; Brown, 1944: 102; S. L. de la Torre, 1952: 63.
Gonepteryx clorinde: Holland, 1942: 290
Anteos clorinde clorinde: Schweizer, 1941: 10; Comstock, 1944: 503.
Illustrations.—d'Almeida, 1938b: pl. 1, f. 2-4, (legs), f. 7, 8, (genital), f. 10, (palp), f. 11, (antenna), f. 12, (genital), pl. 2, f. 1; Holland, 1942: pl. LXXI, f. 11; S. L. de la Torre, 1946: pl. 10, f. 23, 24, (scales).

Genus *Kricogonia* Reakirt

Kricogonia Reakirt, 1863.
Genotype: *Colias lyside* Latreille, 1819.

56. KRICOGONIA LYSIDE (Latreille)

Colias lyside Latreille (not Godart), 1819. (See Brown, 1941: 132).
Kricogonia lyside: Gundlach, 1881: 120; Bates, 1935: 141; Field, 1938b: 187; Hoffmann, 1940c: 658; Brown, 1944: 106; Comstock, 1944: 517; Avinoff & Shoumatoff, 1946: 272.
Kricogonia lyside form ♂ terissa: Field, 1938b: 187.
Kricogonia lyside ab. *unicolor:* Avinoff & Shoumatoff, 1946: 272.

Illustrations.—Holland, 1942: pl. XXXIV, f. 20, 21; Comstock, 1944: text figs. 20, 21, (venations), pl. 10, f. 8.

57. KRICOGONIA CABRERAI Ramsden

Kricogonia cabrerai Ramsden, 1920: 259; id., 1922: 211; Bates, 1935: 141.

William P. Comstock supposes that *Kricogonia cabrerai* Ramsden can be a subspecies of *Kricogonia castalia* (Fabricius). See Insects of Porto Rico and the Virgin Islands, 1944: 515).

Subfamily *Coliadinæ*

Genus *Zerene* Hübner

Zerene Hübner, 1819.
Megonostoma Reakirt, 1863.
Meganostoma Kirby, 1871.
Genotype: *Papilio cesonia* Stoll, 1790.

58. ZERENE CESONIA CESONIA (Stoll)

Papilio cesonia Stoll. 1790.
Meganostoma cesonia: Gundlach, 1881: 105; Hoffmann, 1936: 261.
Zerene cæsonia: Showalter, 1927: 109; Fazzini, 1934: 42; J. H. Comstock & A. B. Comstock, 1936: 90; Hoffmann, 1940c: 656; Holland, 1942: 292; Brown, 1944: 102; Garth, 1950: 13; Vázquez, 1953: 257.
Zerene cæsonia cæsonia: Clark, 1932: 251.
Zerene cesonia cesonia: Bates, 1935: 141.
Colias (Zerene) cæsonia: Field, 1938b: 182.
Illustrations.—Showalter, 1927: pl. IV, f. 9; Clark, 1932: pl. 28, f. 5; Fazzini, 1934: p. 42, fig. not numbered; J. H. Comstock & A. B. Comstock, 1936: pl. XVII, f. 5, 6; Holland, 1942: pl. XXXVI, f. 3, 4.

Genus *Nathalis* Boisduval

Nathalis Boisduval, 1836.
Genotype:*Nathalis iole* Boisduval, 1836.

59. NATHALIS IOLE Boisduval

Nathalis iole Boisduval, 1836; Hoffman, 1933: 227; id., 1940c: 659; Bates 1935: 142; J. H. Comstock & A. B. Comstock, 1936: 86;

Dethier, 1940: 19; Avinoff & Shoumatoff, 1941: 309; id., 1946: 271; Holland, 1942: 283; Brown, 1944: 114; Garth, 1950: 14; S. L. de la Torre, 1951b: 89.

Nathalis jole: Gundlach, 1881: 99; Hoffmann, 1936: 261.

Nathalis iole f. *iole:* Field, 1938b: 193.

Illustrations.—J. H. Comstock & A. B. Comstock, 1936: pl. XV, f. 4, 6; Holland, 1942: pl. XXXII, f. 21, 22; S. L. de la Torre, 1946: pl. 10, f. 13-15, (scales); id., 1951b: pl. XLIV, f. 1.

60. NATHALIS IOLE *f.* ALAYOI S. L. de la Torre

Nathalis iole f. *alayoi* S. L. de la Torre, 1951b: 89.

This form was described by the writer in 1951 (See Memorias de la Sociedad Cubana de Hist. Nat., vol. XX, pp. 89-92).

Illustrations.—S. L. de la Torre, 1951b: pl. XLIV, f. 2.

Subfamily *Dismorphiinæ*

Genus *Dismorphia* Hübner

Dismorphia Hübner, 1816.

Leptalis Dalman, 1823.

Hemerocharis Boisduval, 1836.

Genotype: *Papilio laia* Cramer, 1779.

61. DISMORPHIA CUBANA (Herrich-Schäffer)

Leptalis cubana Herrich-Schäffer), 1862

Dismorphia cubana: Gundlach, 1881: 81; Bates, 1935: 143.

Illustrations.—Bates, 1935: f. 8, (venation); S. L. de la Torre, 1946: pl. 10, f. 18, 19, (scales).

(TO BE CONTINUED)

GIBBIUM PSYLLOIDES CZEMPINSKI IN KENTUCKY

A note published in this Journal (Vol. 61(2):92,1953) by Harry B. Weiss reported the collection of this species in Trenton, N.J. on carpets. Weiss calls attention to the small number of references to this beetle in the literature of American economic entomology and thinks it desirable to have additional locality records in the literature. His comments prompted the writer to publish this note.

In the insect collections of the Kentucky Agricultural Experiment Station are specimens of this species with definite Kentucky locality records as follows: *Lexington,* December 23, 1940, from feed sample, 1 specimen, James Rose- collector. *Middlesborough,* May, 1942, numerous specimens, Anderson Wood- collector. Mr. Wood collected a number of his specimens crawling in a bath tub and on a tile wall near the tub. They were suspected of breeding in the tub drain but this was not definitely established. Specimens were also found crawling on woolen materials in a nearby clothes closet. There was no proof of their feeding. Live specimens sent to the Experiment Station readily ate timothy seed and particles of dried insect specimens. *Tompkinsville,* July 29, 1946, 7 specimens, taken in a dwelling. *Maysville,* November 20, 1953, 3 specimens, taken in the attic of a dwelling. In these instances the beetles attracted attention by their presence and not because of damage done. — LEE H. TOWNSEND, College of Agriculture and Home Economics, University of Kentucky, Lexington.

CHANGES IN THE FAT CONTENT OF THE JAPANESE BEETLE (POPILLIA JAPONICA NEWMAN) DURING METAMORPHOSIS.

By Guido W. Battista
Department of Biology, Fordham University[1]

Lipid metabolism has been the subject of much investigation for many years. In the past, studies have been confined chiefly to the vertebrates, although some work has been done on various forms of the invertebrates. Wilber and Bayors (1947) made a study of several marine annelids and reported a wide variation in total lipids and postulated an apparent ratio of these lipids to each other. They indicated a direct relationship between the concentration of cholesterol and that of phospholipids. They stated that cholesterol may be a tissue constituent in the annelids, as reported for the vertebrates by Bloor (1943).

Some work has been done on the fractionation of lipids in insects. Bergmann (1934) reported on the chrysalis oil of the silkworm, *Bombyx mori.* His figures show that 33 per cent of the unsaponifiable fraction is made up of sterols, of which 85 per cent is cholesterol. However, the unsaponifiable fraction is only 1.5 per cent of the total lipids. In the grasshopper, *Melanoplus atlanis,* according to Giral (1946), the free fatty acids make up 74.4 per cent of the total lipids, and the unsaturated predominate over the saturated fatty acids. Finkel, (1948) observed that the fat content for the five day old larvæ of the mealworm, *Tenebrio molitor,* was 7.79 per cent of the wet weight, whereas in 200 day old larvæ, this value increased to 17.4 per cent. The phospholipids for this same period were found to decline from 2.06 to 0.81 per cent of the wet weight. The explanation for this relationship may be, as pointed out by Levenbook (1951), that energy is better stored in the fatty acids of the relatively stable triglyceride than the more soluble phospholipids. Levenbook (1951)

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The author wishes to express sincerest gratitude for the stimulation, interest and critical guidance of Dr. Daniel Ludwig.

observed in the tracheal cells of the horse bot fly *Gastrophilus intestinalis* larva, a great amount of phospholipid at the beginning of the third instar. During the metamorphosis of the blowfly, *Calliphora erythrocephala,* Levenbook (1953) reported no major changes in lipid phosphorus.

The role of lipids in intermediary metabolism during insect metamorphosis has been sadly neglected. Frew (1929) found no change in the fat content during the first part of the pupal stage of the blowfly (species not given) although a decrease was observed in the latter stages. During the life cycle of the tent caterpillar, *Malacosoma americana,* Rudolfs (1926) found that the percentage of ether-soluble materials increased during development, and at an accelerated rate, during the first part of metamorphosis. This increase was followed by a gradual decrease during the latter part of this period. Evans (1932) observed that at 17°C a rapid decrease occurred in the fatty acids of the blowfly, *Lucilia sericata,* up to the eighth day after the larva has stopped feeding, when it decreased more slowly until about the tenth day. At this point he found a definite increase in the fatty acids and later another peak in this synthesis at the fourteenth day. He believed that this latter peak was associated with the onset of histogenesis. Becker (1934) showed a gradual decrease in the fat content during metamorphosis of the mealworm, *Tenebrio molitor,* although the fats of specific organs, which persist into the imago, remained constant. Using the same species, Evans (1934) observed that very little fat is consumed during metamorphosis, but the beginning and end of this period are marked by its utilization. In 1943 Pepper and Hastings, working on the sugar beet webworm, *Loxostege sticticolis,* found no definite changes in the ether-extractable materials although a 40 per cent increase was noted in the saturation of the unsaturated fatty acids. Ludwig and Rothstein (1949), working on the Japanese beetle, *Popillia japonica,* reported a sharp drop in the ether-soluble neutral fat on the fifth and sixth days of pupal life. They also reported that from this point to the emergence of the adult, this fraction of the lipid content gradually decreased in amount.

This review has shown that the information concerning the lipid content of the insects during metamorphosis is very meager. Most of the work has been confined to the four major stages of the life cycle regardless of age or extent of development in the particular stage. Further investigation seems necessary to better understand the role and fate of the lipids during the intermediary metabolism in the insect. In the present investigation, the author has attempted to demonstrate daily changes of some of these lipids during metamorphosis of the Japanese beetle.

MATERIALS AND METHODS

Japanese beetle larvæ were collected in the field from November, 1952, through April, 1953. Second- and third-instar larvæ were brought into the laboratory, each larva being placed in a one-ounce metal salve box containing moistened soil taken from the site of collection. The larvæ were fed wheat, a few grains being added to each box as needed. They were kept in incubators, at a constant temperature of 25°C., until they reached the desired stage of development. In the early months of collection the larvæ were in diapause, a resting stage which usually lasts about 50 days at 25°C. During this period of the life cycle the larvæ feed very little and the boxes were examined weekly. When the diapause was ended, a more frequent check on the larvæ was made due to an increase in activity and feeding.

Observations were made twice each day on the insects in the late pre-pupal stage to obtain the proper age of pupæ. Hence the age of a pupa may be in twelve hour error. When the desired stage of development had been reached, the insects were weighed and killed by placing them individually in small vials containing a mixture of three parts of absolute alcohol and one part absolute ether (Bloor 1943). Aluminum foil was used to cap the vials to assure that no alcohol or ether soluble materials could be removed from the plastic caps used to close the vials. The vials containing the insects were then carefully marked and stored under refrigeration until the time of analysis. The stages in the life cycle chosen for this report included the following: diapause larvæ, postdiapause larvæ, early prepupæ, late prepupæ, newly molted pupæ, pupæ for each day of the ten day pupal period, and newly emerged adults. Separate records were kept on the analysis for male and female adults. In this present investigation, all the determinations made were obtained with the use of the Beckman DU spectrophotometer. Calibration curves were constructed, and from them daily checks could be made both on the instrument used and the technique employed. The fatty acid determinations were made using the method of Bloor (1916a) as modified by Snell and Snell (1937). Measurements of cholesterol were based on the method of Bloor (1916b). The lipid phosphorus determinations were made according to Young-

TABLE 1.

VARIATIONS IN THE LIPIDS OF THE JAPANESE BEETLE DURING METAMORPHOSIS

Values Expressed in Per Cent Wet Weight

Stage of Development	Fatty Acid	Cholesterol	Lipid Phosphorus	Lecithin
Third-instar larva* ..	1.54	......	......	......
Third-instar larva	2.82	0.0372	0.0175	0.4375
Early prepupa	3.29	0.0451	0.0213	0.5325
Late prepupa	3.39	0.0347	0.0250	0.6250
Pupa:				
Just molted	2.67	0.0445	0.0251	0.6275
1-day	2.81	0.0375	0.0269	0.6725
2-day	3.68	0.0552	0.0296	0.7400
3-day	2.18	0.0444	0.0288	0.7200
4-day	3.72	0.0460	0.0288	0.7200
5-day	2.11	0.0408	0.0309	0.7725
6-day	2.67	0.0532	0.0316	0.7900
7-day	3.12	0.0536	0.0293	0.7325
8-day	2.70	0.0424	0.0293	0.7325
9-day	2.77	0.0614	0.0341	0.8525
Adult, just molted:				
Female	2.49	0.0584	0.0481	1.2025
Male	2.01	0.0710	0.0479	1.1975

* Diapause larvæ

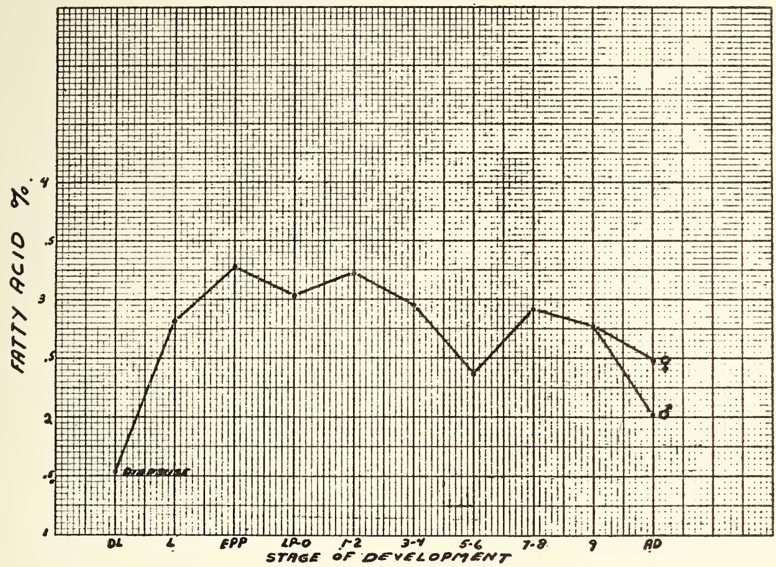

Figure 1. Changes in the fatty acid content during metamorphosis. (Values expressed as per cent of the original wet weight.)

burg and Youngburg (1930). In most cases the above procedures had to be changed slightly to obtain color reactions which would fall in the safe margin of the spectrophotometer scale.

To minimize possible random variations, it was decided to group the averages for successive stages. The groupings used were, diapause larvæ, postdiapause larvæ, early prepupæ, late prepupæ-newly molted pupæ, 1-2 day pupæ, 3-4 day pupæ, 5-6 day pupæ, 7-8 day pupæ, 9 day pupæ, and adults which were recorded separately according to their sex. Since Ludwig and Rothstein (1949) showed a decrease in the free fats during the fifth and sixth days of the pupal stage at 25°C., results of these days were grouped together to determine whether a comparable decrease in the fatty acids occurs at this stage.

RESULTS

The results of the analysis on the fatty acids are given in Figure 1 and Table I. They show that in diapause larvæ the fatty acid content is low, 1.54 per cent of the wet weight. Fatty acids increase to 2.82 per cent during the postdiapause of the larval stage. During the early prepupal stage, there is a sharp increase to 3.29 per cent of the wet weight. Relatively little change is seen in the fatty acid content during the prepupal and early pupal stages, however, a sharp drop occurs during the fifth and sixth days. The value then rises but not to its former level showing a utilization of fatty acids during metamorphosis. The male adult shows a lower fatty acid content than does the female. This difference is probably associated with the storage of lipids in the developing eggs.

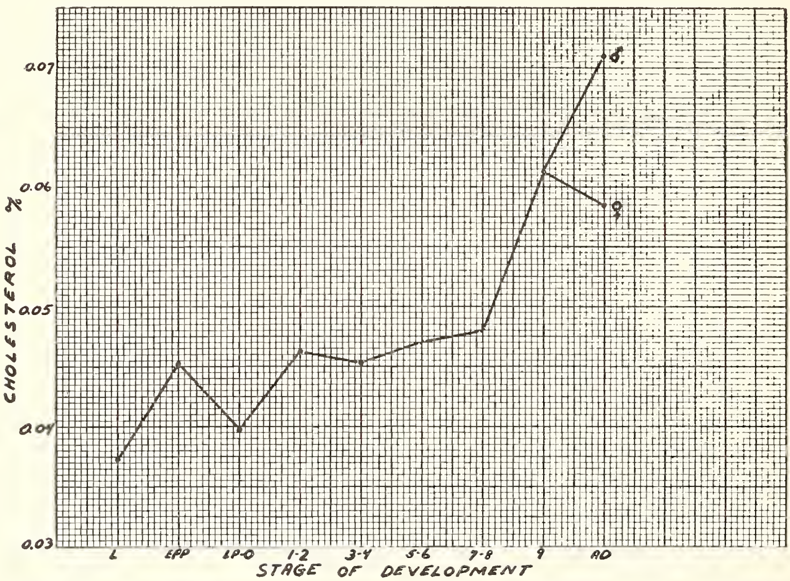

Figure 2. Changes in the cholesterol content during metamorphosis. (Values expressed in per cent of the original wet weight.)

The cholesterol content during metamorphosis is shown in Figure 2 and Table I. In the transition from the larva to the pupa, there is an irregular increase which continues until the eighth day of the pupal period when a very sharp increase is noted during the last day of pupal life. In this fraction the adult male shows a higher concentration than does the female.

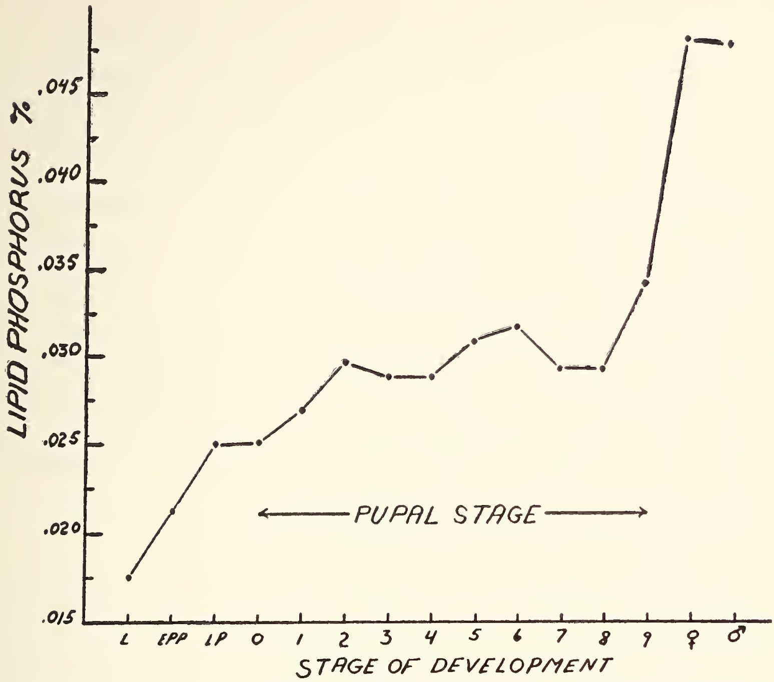

Figure 3. Changes in the lipid phosphorus content during metamorphosis. (Values expressed in per cent of the original wet weight.)

Figure 3 and Table I contain the values obtained for the lipid phosphorus concentrations, which were determined to increase very rapidly during the metamorphosis of the larva to the late prepupa. An irregular but progressive increase is observed during the pupal period. The emergence of the adult is accompanied by a sharp rise in the content of this fraction. The values for the adult male and female are approximately the same.

DISCUSSION

The marked decrease in the fatty acid content observed on the fifth and sixth days of the pupal stage agrees with the work of Ludwig and Rothstein (1949). They, too, found a utilization of fat between the fifth and sixth days. Ludwig and Rothstein (1949) also showed an irregular but rapid decrease in the glycogen content during the first four days of pupal life in the Japanese beetle, an increase on the fifth day, and a gradual decrease throughout the remainder of the pupal period. This decrease during the first four days and increase on the fifth day of pupal life coincides with the reciprocal findings for the fatty acid content in this present investigation. It then becomes evident, from this utilization of glycogen and simultaneous mobilization of the fatty acids during the early days of pupal life, that the main source of energy during this period comes from glycogen and not from fat stores. The increase in glycogen at the fifth day appears to be at the expense of the fatty acids which are observed to drop sharply at this stage, thus indicating a replenishment of the sacrificed glycogen by the fat mobilized. This suggestion agrees with that of Ludwig and Rothstein who believed that the glycogen is formed from lipids. Couvreur (1895) also suggested that, since the increase in glycogen coincides with a decrease in fat, the glycogen may be formed from the fat.

Although there is no apparent synthesis of fatty acid during the last day of the pupal stage, it is possible that the fatty acid formation is still being continued but only in amounts necessary for the vital repair of the adult tissues. That this observation is not limited to the Japanese beetle may be observed in the work of Evans (1932) who worked with the sheep blow fly, *Lucilia sericata.* This investigator found that the total fatty acid content decreased during the early stages of pupation then increased at the time when he believed histogenesis begins. The total fatty acid content then decreased progressively as the organism approached adult life.

The decrease in cholesterol associated with the change from early prepupa to early pupa may be correlated with histolysis which is known to occur at this time (Anderson, 1948). This decrease is followed by a synthesis of cholesterol throughout the pupal period. Since cholesterol is known to be a tissue constituent and not an immediate energy source, it is not inconceivable that this synthesis represents the progressive formation of imaginal tissues. That cholesterol synthesis can occur during periods of mild starvation was shown by Terroine (1914) who worked with canine tissue. Many other investigators obtained similar results working with a variety of other laboratory animals (Bloor, 1943). During the pupal stage of the Japanese beetle, no food is taken in and no waste material is voided except CO_2 and possibly water, hence this stage in the life cycle can be considered a period of starvation. Although fluctuations in the cholesterol content were observed, the general trend is upward during metamorphosis.

The results obtained in the lipid phosphorus studies show a progressive rise in this fraction during metamorphosis. It can be noted that during the larval stage, which is a period of feeding, the lipid phosphorus content shows a marked increase indicating that the fat stores are being built up. This fact is further strengthened by the observation that the fatty acids and free fats are also being stored at this time. During the relatively inactive pupal period, there is an increase in the lipid phosphorus content but at a less rapid rate. This slower increase may be due to the fact that food intake has ceased thereby decreasing the amount of fat being transported to the depots. It is of interest to note that the lipid phosphorus content is increased moderately at about the fifth and sixth days of pupal life. This increase may be correlated with a simultaneous decrease in the fatty acid content, indicating that part of the available fatty acids are being incorporated in the formation of phospholipids which act as carriers of fats to and from the depots. In this particular instance the increase in the phospholipids may be indicative of fat utilization, supplying energy directly for the histogenesis of imaginal tissues, or indirectly, through the synthesis of glycogen, which is known to increase at this time. This consideration is further substantiated by the fact that toward the end of the pupal stage, an additional increase in the lipid phosphorus content occurs, thus indicating that fat stores are being utilized to provide energy needed for the development and differentiation of new adult tissues.

SUMMARY

Determinations were made on the fatty acid, cholesterol, and lipid phosphorus content of the Japanese beetles at various stages of the life cycle.

The fatty acid content was seen to increase during the first stages of metamorphosis, decrease sharply on the fifth and sixth days of pupal life and then gradually build up on the seventh day of pupal life and to diminish slightly toward the emergence of the adult.

The cholesterol content was seen to increase gradually during the entire life cycle. The synthesis was distinct and progressive during the pupal period.

An increase in the lipid phosphorus content was evident during metamorphosis. It is known that phospholipids act as carriers to and from the depots and hence an increase in the phospholipids is indicative of fat mobilization or utilization during metamorphosis.

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JOSEPH COOPER'S PAPERS ON INSECTS

During the early days many observations upon injurious insects were made by farmers. One of these observers in New Jersey was Joseph Cooper who had a farm at Cooper's Point, Gloucester County, N. J. A keen observer, an experimenter with various farm crops, a practitioner of plant selection, a member of the Philadelphia Society for the Promotion of Agriculture, Mr. Cooper's agricultural papers appeared in the publications of the "Philadelphia Society for the Promotion of Agriculture", the "Burlington Society for the Promotion of Agriculture and Domestic Manufactures" (N.J.), "The Burlington Advertiser" (N.J.), "The Rural Visitor" (Burlington, N.J.), "Bickerstaff's Boston Almanack, or the Federal Calendar for 1876", etc. One of his entomological papers was upon the peach borer. This was entitled "On the nature of the worm so prejudicial to the peach tree for some years past and a method for preventing the damage in future, in a letter . . . to Mr. Clifford." This was read July 19, and is referred to in the Proceedings of the American Philosophical Society, vol. 22, Appendix, p. 65, 1771 as ordered to be published in the "Pennsylvania Gazette" and "Pennsylvania Journal", both weekly newspapers.

Another insect paper by Mr. Cooper appeared, more than two years after being written, in the "Papers of the Massachusetts Society for Promoting Agriculture" (1799, pp. 26-28). This was a "Letter from Mr. Joseph Cooper to William Russell, Esq., on the Hessian Fly and the Early White Wheat", written from Cooper's Point, New Jersey, December 30, 1796. Mr. Cooper mentions his observations on the injury to wheat in his neighborhood by the Hessian fly and recommended late sowing and the planting of "white wheat."

—H. B. WEISS.

CONCERNING THE STATUS OF ISCHYRUS GRAPHICUS LACORDAIRE, WITH DESCRIPTIONS OF FOUR NEW EROTYLID SPECIES FROM WESTERN NORTH AMERICA (COLEOPTERA: EROTYLIDÆ)

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Ischyrus quadripunctatus quadripunctatus (Olivier) new combination

Erotylus quadripunctatus Olivier, 1791, Encyc. Meth. Hist. Nat. Ins. 6: 437.

Ischyrus quadripunctatus (Olivier) Lacordaire, 1842, Monographie des Erotyliens, p. 127.

Ischyrus quadripunctatus var. *A.* Lacordaire, loc. cit.

Ischyrus quadripunctatus var. *alabamæ* Schaeffer, 1931, Bull. Brooklyn Ent. Soc. 26: 175.

Ischyrus quadripunctatus a. *antedivisa* Mader, 1938, Ent. Blätter 34: 19.

The variability in color pattern of this eastern Nearctic subspecies is reflected in the synonymy above. The nominate form of Olivier has the black basal elytral fascia entire, the prosternum and pterothorax black, and the abdomen broadly black medially with the lateral fifths red. A variant form has the basal elytral fascia interrupted in the humeral areas by the reddish yellow ground color, leaving a short, elongate black spot lying laterad of each humeral callus but not attaining the lateral margin, and a large, quadrate black spot medially.

The color of the body below is sporadically variable. Occasional specimens from widely separated localities and belonging to either of the above forms or to their intermediates show a more or less extensive reduction of black underneath.

Lacordaire placed the nominate form in his genus *Ischyrus* as an originally included species. At the same time, he described the variant form with the basal elytral fascia interrupted as variety *A.*

Schaeffer described as variety *alabamæ* aberrant specimens of the nominate form with the body below largely red.

Mader rightly synonymized variety *alabamæ* Schaeffer with *quadripunctatus* Olivier and gave the name *antedivisa* to Lacordaire's variety *A*.

Examination of some 300 specimens from over the entire range of this complex (roughly North America east of the 100th meridian) reveals the following pattern of variation: Specimens taken from the Northeast north of approximately the 37th parallel approach 90 percent constancy in having the basal elytral fascia interrupted and are thus referable to variety *antedivisa* Mader. From localities south of the 37th parallel in the Atlantic States, however, specimens are about equally divided between those having the fascia interrupted and those having the fascia entire and with all degrees of intergradation generously represented. Of the 43 specimens I have examined from peninsular Florida approximately 80 percent have the basal elytral fascia entire, and so belong to *quadripunctatus* Olivier, sensu stricto.

In view of the immensity of the intergradation zone the north-south variation pattern appears to be essentially clinal in nature. Moreover, the clinal pattern disappears west of about the 85th meridian in the huge Mississippi drainage basin; specimens from this region are like those from the Atlantic intergrade zone in showing scant geographical correlation with color variation. This entire eastern North American population, therefore, is apparently at most in the stage of incipient (or vestigial) subspeciation, with foci of homogeneity in Florida and in the region embracing New York, Pennsylvania, and adjacent southern Quebec and Ontario.

Crotch (1873, Cistula Ent. 1: 144.) subsequently designated *Erotylus quadripunctatus* Olivier type of the genus *Ischyrus* Lacordaire.

RANGE: Eastern North America from Florida to southern Quebec and Ontario, New England excluded, west to approximately the 100th meridian, west of which it is not known to occur. The northern boundaries of the Texas Counties of Webb, Duval, Jim Wells, and Nueces and the Rio Grande River to the northwest form a tentative line delimiting this subspecies from the one following.

Ischyrus quadripunctatus graphicus Lacordaire new combination

Ischyrus graphicus Lacordaire, 1842, Monographie des Erotyliens, p. 125.

The nominate populations of *Erotylus* (=*Ischyrus*) *quadripunctatus* Olivier from eastern North America and *Ischyrus graphicus* Lacordaire from Mexico are strikingly similar in both structure and color pattern. They differ, however, in the following respects: *quadripunctatus* has the head completely black, the pronotal apex immaculate, the prosternum entirely black and weakly compresso-carinate medio-apically, the pterothorax below completely black, and the abdomen broadly black medially and red only on the lateral fifths; *graphicus* has the disc of the head red, the pronotum with two small triangular black spots near the middle of the apical border, the prosternum apically red and strongly compresso-carinate medio-apically (produced into a small pitcher-like lip), and the abdominal black confined to the posterior borders of the four basal sternites but extending forward medially on each segment. Both forms exhibit variation in the black basal elytral fascia, this being sometimes entire and sometimes interrupted laterally so that a black spot is left in each humeral region but not touching the lateral elytral margin.

The similarities of the two forms have been noted by others. G. R. Crotch, who worked very capably on the world Erotylidæ during the latter half of the nineteenth century, repeatedly referred to *graphicus* as a possible race of *quadripunctatus*; yet he never synonymized the names. In his "Descriptions of Erotylidæ from Santo Domingo" (1873, Cistula Ent. 1: 144.) Crotch says of *graphicus*: "These, as well as the Mexican exponents of this species, appear to be a southern form of *I. quadripunctatus* with the head more or less rufous." Three years later (t. c., p. 427.) he again says of *graphicus*: "Closely allied to *I. 4-punctatus,* and may perhaps prove to be a red-headed southern form of it."

Material now at hand corroborates Crotch's observation. Specimens from Kingsville, Kleberg County, Texas, and from Weslaco, Hidalgo County, Texas, exhibit intergradation between the two forms. These have the disc of the head red, the pronotal apex immaculate, the prosternum apically rufescent, and the abdomen with somewhat less black than that of *quadripunctatus.* A specimen from Rancho Presa Nueva, Nuevo León, Mexico, has the disc of the head red but is like *quadripunctatus,* otherwise. In addition to these, I have thirteen typical *graphicus* specimens—one from British Honduras and twelve from Costa Rica.

The two subspecies display an interesting size relationship. Taking the two forms together as a cline, specimens show a gradual increase in size from Central America northward to Quebec and Ontario (ostensibly in accordance with Bergmann's Rule). Bearing an inverse correlation to size is the strength of the prosternal carination; the smaller specimens from any given locality always have the prosternal apex more strongly carinate than the larger specimens.

The size range in terms of body length for the sixteen specimens of *graphicus* is 5.52-7.25 mm. (mean: 6.36). For sixteen specimens of *quadripunctatus* selected at random the range of length is 5.93-8.14 mm. (mean: 7.30). Paradoxically, two *graphicus* specimens from San José, Costa Rica, are the largest of the sixteen, while the other ten Costa Rican specimens (labelled simply "Costa Rica") are much smaller. If not attributable to nutritional differences, this anomaly may perhaps be explained by Bergmann's Rule, in accordance with which one would expect to find larger specimens of a given group at higher elevations or latitudes where temperatures are lower. If the two large specimens were taken in or near the city of San José, they were collected at an elevation of nearly 4000 feet; if taken not in the city but elsewhere in the province of San José, they may have come from a higher elevation. The three specimens from Texas and Nuevo León (which I assign to *graphicus*) are only slightly smaller than the two San José specimens. The data, however, are too few and the specimens too poorly distributed geographically to warrant strong conclusions regarding a size gradient in *graphicus.*

Lacordaire (1842, Monographie des Erotyliens, pp. 125-128.) also recognized the similarity of the two forms, as is evidenced by his numbering *graphicus* 45 and *quadripunctatus* 48 in his serial arrangement designed to indicate similarities as much as possible. It is unfortunate, however, that he selected the carination of the prosternum as the basis for dividing the genus into subsections or species groups, for by this artificial division *graphicus* and *quadripunctatus* were placed in different subsections and considered different species.

The color of the disc of the head appears to be the most stable and geographically constant of the diagnostic characters separating the two populations. Thus *graphicus* may be recognized by the red spot on the head. Gorham (1887, Biol. Centr.-Amer. Insecta. Coleoptera. Vol. VII, pl. 2, fig. 17.) presents a rather good colored figure of *graphicus*. The two black denticles near the middle of the pronotal apex are too small to show clearly, however.

Measurements, in millimeters, of the 16 specimens available are as follows (the range is followed by the arithmetic mean in parentheses): length, 5.52-7.25 (6.36); width, 2.35-3.24 (2.89); width of pronotal base, 2.07-2.90 (2.51); median pronotal length, 1.17-1.61 (1.46); width at extremities of pronotal apical angles, 1.24-1.68 (1.50); width of head at eyes, 1.10-1.54 (1.37); interocular width of vertex, 0.58-0.85 (0.72); vertical diameter of eye, 0.49-0.62 (0.55).

RANGE: Extreme southern Texas south through eastern Mexico into Central America and possibly into northern South America. The northern boundary of this subspecies is not sharply determinable, but the intergrade zone does not appear to be wide. According to the available evidence, the northern borders of the Texas Counties of Webb, Duval, Jim Wells, and Nueces, along with the Rio Grande River northwestward form an approximately accurate demarcation.

Ischyrus chiasticus, n. sp.

This form appears to be a possible subspecies of *Ischyrus quadripunctatus* (Olivier), yet both in color pattern and in geographical range, so far as is known, it constitutes a distinct population. It is known from the mountains of southern Arizona and from the

Mexican State of Sinaloa (one specimen); thus it apparently ranges from southern Arizona into Mexico along the Sierra Madre Occidental for an unknown distance. Its closest relative, *I. quadripunctatus graphicus* Lacordaire, is found from extreme southern Texas south into Mexico (presumably along the Sierra Madre Oriental) and on into Central America. If intergrading populations of these two forms are eventually found, they will almost certainly occur in southern Mexico where the two cordilleras become confluent. The prairies and deserts of northern Mexico, western Texas, and southern New Mexico support few trees upon which grows the fungous food of these beetles.

Diagnosis: Closely related to *I. quadripunctatus graphicus* Lacordaire but distinguishable from it and all other North American forms by a large, black, X-shaped spot occupying the basal third of the elytra (including the scutellum and basal margin of pronotum).

It seems best to describe this species in terms of a comparison of the type with the specimens of *I. q. graphicus* at my disposal and with *I. q. quadripunctatus,* the most common North American form.

description of type: Resembles *graphicus* in gross color pattern of reddish yellow and black, and more specifically as follows: The disc of the head is red; the pronotum bears two small, black triangular spots medio-apically, four circular black spots in a transverse row across the disc, and a narrow black basal border; the elytra have black submedian and basal fasciæ; and the abdominal sternites are largely reddish yellow.

The differences, however, are numerous and striking. In size, *chiasticus* is considerably larger, the length and width of the type being 7.45 and 3.45 mm. respectively as compared with maximal measurements of 7.25 and 3.24 mm. of the sixteen *graphicus* specimens. (Note, however, that some overlap exists in the ranges of all measurements of the two groups of specimens.)

In color pattern *chiasticus* differs from both *q. graphicus* and *q. quadripunctatus* thus: The pronotal apex is narrowly bordered with black throughout its interocular extent; the basal elytral fascia is ruptured into three black spots—a large median one which is concave laterally and posteriorly, and a small comma-shaped spot filling the humeral angle of each elytron; thus, taken together, the three spots appear like the Greek letter *chi* or a fat 'X' enclosed in single quotation marks (whence the trivial name); the submedian elytral fascia is wider and more weakly undulate and extends more broadly along the suture to the apex; the narrow, black peripheral border of the elytra behind the submedian fascia suddenly increases to twice its width at a point halfway or more to the apex; the black medio-apical vitta on each elytron is absent; the elytral epipleura are nigrescent before the submedian fascia; and the prosternum, mesosternum, and lateral thirds of metasternum are red, not black.

MEASUREMENTS OF TYPE (in mm.): length, 7.45; width, 3.45; width of pronotal base, 2.97; width at extremities of pronotal apical angles, 1.77; pronotal median length, 1.73; width of head at eyes, 1.61; interocular width of vertex, 0.87; vertical diameter of eye, 0.62.

TYPE: male, collected by E. S. Ross, July 1936 [California Academy of Sciences].

TYPE LOCALITY: Patagonia, Santa Cruz County, Arizona.

PARATYPES, 26, as follows: 5, Patagonia, Ariz., July 1936 (E. S. Ross); 1, Patagonia, Ariz., Aug. 2, 1924 (E. P. Van Duzee); 3, Nogales, Ariz., Sept. 8, 1906; 1, Pepper Sauce Canyon, Santa Catalina Mts., Ariz., Aug. 17, 1924 (J. O. Martin); 1, Paradise, Chiricahua Mts., Ariz., 5000-6000 ft., Aug. 22, 1927 (J. A. Kusche); 2, Washington Mts. [Mt. Washington?], near Nogales, Ariz., Sept. 7, 1927 (J. A. Kusche); 1, Elkhorn Ranch, east side, north end Baboquivari Mts., Ariz., July 28, 1952 (H. B. Leech and J. W. Green); 1, Brown's Canyon, Baboquivari Mts., Ariz., July 29, 1952 (H. B. Leech and J. W. Green); 4, the same, July 30, 1952; 1, Venedio [El Venadillo?], Sinaloa, Mexico [all in the Calif. Acad. Sci. Collection]; 5, Baboquivari Mts., Ariz., 1927 (O. C. Poling) [Cornell Univ.]; 1, Carr Canyon, Huachuca Mts., Ariz., June 6, 1930 [Univ. of Calif.].

In addition to the paratypes there are two specimens in the Fall Collection at the Museum of Comparative Zoology, Harvard College, from the Baboquivari Mts., Ariz., one dated June 15-30, 1923, the other Sept. 15-30, 1923.

VARIATION: The 27 specimens before me are quite uniform in color pattern and display no notable variations except perhaps in size. Measurement, in mm., of all specimens reveals the following variation (range followed by arithmetic mean in parentheses): length, 6.69-8.56 (7.56); width, 2.90-3.80 (3.37); width of pronotal base, 2.62-3.24 (2.96); median pronotal length, 1.54-1.89 (1.72);

width at extremities of pronotal apical angles, 1.56-1.84 (1.75); width of head at eyes, 1.40-1.68 (1.56); interocular width of vertex, 0.76-0.92 (0.86); vertical diameter of eye, 0.58-0.67 (0.61). No secondary sexual characters are evident. This appears true even of measurements; consequently both sexes are measured in one lot.

Ischyrus aleator, n. sp.

This unusual form becomes the fourth species of *Ischyrus* known to occur in America north of Mexico since Casey rightly restricted the genus by removing *Pseudischyrus* in 1916. A single male specimen is included in material kindly sent me by Mr. Hugh B. Leech from the collection of the late Dr. E. C. Van Dyke of the California Academy of Sciences.

DIAGNOSIS: Bearing scant similarity to any described form, it may be recognized by the following characteristics: Each elytron bears at the base between the scutellum and humeral callus an oval, flat, declivent area which lies in the plane of the pronotum and is skirted laterally by the base of a dark median elytral vitta. The strange coloration consists of a tawny ground color ornamented by three fusco-piceous elytral vittae and a similar dark framework on the median half of the pronotum surrounding a large tawny spot shaped like the emblem of the club suit in a deck of playing cards. The trivial name (L., gambler) alludes to the latter characteristic.

DESCRIPTION OF TYPE: COLOR: tawny or light brownish yellow, the legs and thorax below a bit darker, the following fusco-piceous: antennal club, epistoma, the periphery of a large trefoil-shaped spot of the ground color occupying median third of pronotum, a common elytral vitta along the suture including the scutellum and narrowing to the apex, a wider lateral vitta along middle of each elytron largely limited to fifth and sixth intervals and not attaining elytral apex, the lateral elytral borders, and the elytral epipleura.

SHAPE: relatively depressed for an *Ischyrus,* length 2.3 times the width, elytral sides remarkably parallel, the body semicircularly rounded anteriorly, parabolically rounded in apical elytral three-eighths, surface of entire body and appendages with a minutely reticulate microsculpture.

HEAD: inserted in pronotum to middle of eyes; vertex moderately punctate, the punctures approximately equal to coarse ocular facets in diameter but smaller medio-basally; epistoma faintly margined along the strongly anteriorly convergent sides, apex slightly concave, disc twice as densely punctate as vertex with punctures half as large; antennæ as long as width of pronotum at apical angles, the club dark, three-segmented, lax, its length 2.25 times width, segment nine equilateral-triangular, ten sublunate and wider than nine or eleven, eleven circular and one-third as wide as vertical diameter of eye, the stem tawny, more sparsely pubescent, segment three as long as four and five together; palpi a bit lighter in color than surrounding sclerites, terminal segment of maxillary palpus truncate-oval, its width equal to length of third antennal segment; mentum triangular, its basal width half again as great as median length which is equal to that of terminal segment of maxillary palpus, its disc with a small raised triangle basally which bears four or five setigerous punctures along each side.

PRONOTUM: weakly convex, strongly transverse, widest sub-basally, basal width almost twice median length; sides sharply margined, subparallel basally and strongly, arcuately convergent to the obtuse, slightly produced apical angles; apex shallowly concave and finely margined behind eyes, immarginate and transverse between eyes; base truncate, immarginate, with a moderately produced, evenly rounded lobe limited to median two-fifths; basal impressions moderately strong, bearing a few basal punctures larger and shallower than those on disc; discal punctures weak on median third, suddenly stronger and similar to those of vertex on lateral thirds, densest along lateral margins.

SCUTELLUM: subcordate, twice as wide as long, the base faintly, evenly concave.

ELYTRA: length about 1.75 times width; base immarginate, flattened on each side between scutellum and humeral callus; sides widest and perfectly parallel for one-half their length shortly behind base, parabolically rounded in apical three-eighths; each elytron bearing seven unimpressed striæ, the punctures of which are small, separated by two to three times their diameter, obsolescent apically; intervals moderately punctulate; setæ, as on head and pronotum, scarcely detectable.

THORAX BELOW: prothoracic venter scarcely punctulate, smooth save for a few short longitudinal furrows on prosternal process; prosternum faintly compressed, apically truncate, the process subquadrate, basally truncate, bounded laterally by weak ridges bent abruptly mesad beside anterior coxal edges; mesosternum subquadrate, smooth, weakly obtuse-angular behind; mesopleural sclerites lighter in color like abdomen, the mesepisternum only half as large as mesepimeron; metasternum with small, sparse punctures antero-laterally which become much weaker and denser medially and posteriorly, the setæ extremely tenuous but long; metepisternum vaguely lighter in color; metasternal coxal lines short, obsolescent.

ABDOMEN: punctulate like middle of metasternum, the punctules denser medially and apically, setae of similar length but distinctly stronger than those of metasternum; four basal sternites with posterior borders narrowly darker in color; abdominal coxal lines raised, V-shaped, obsolescent.

MEASUREMENTS OF TYPE (in mm.): length, 5.80; width, 2.55; width of pronotal base, 2.30; median pronotal length, 1.20; width at extremities of pronotal apical angles, 1.43; width of head at eyes, 1.29; interocular width of vertex, 0.71; vertical diameter of eye, 0.51; width of terminal segment of maxillary palpus, 0.23.

TYPE: male, taken by J. A. Kusche on June 24, 1927 [Van Dyke Collection, California Academy of Sciences].

TYPE LOCALITY: Cave Creek (7000 ft.), Chiricahua Mts., Cochise County, Arizona.

PARATYPES: none.

VARIATION: This type of color pattern normally lends itself to some variation; thus the median, trefoil-shaped pronotal spot may be larger or smaller or assume a different shape. Secondary sexual characters are probably not present.

Mycotretus nigromanicatus, n. sp.

A large New World genus, *Mycotretus* is rich in species throughout tropical America but has not previously been reported north of Mexico (excluding certain species erroneously assigned to it). The mountains of southern Arizona are apparently the northern extremity of the range of a number of Neotropical erotylids, e.g. *Hæmatochiton elateroides* Gorham, *Scæother carbonarius* Gorham, probably the present form, and perhaps others.

DIAGNOSIS: The closest relative of this species cannot be determined at the present time. The unusual five-jointed antennal club and unique color pattern—a bright reddish yellow body with black scutellum and appendages—clearly distinguish it from all published descriptions. It differs structurally from all erotylids north of Mexico except *Cypherotylus californicus* (Lacordaire) by having the pronotum entirely, finely margined. [The latter is a much larger black form with dirty-yellowish elytra (in life light purplish) bearing numerous black spots.] The trivial name (L., having long black sleeves) is suggested by the black appendages.

DESCRIPTION OF TYPE: COLOR: bright reddish yellow, the following black or piceous: eyes, antennæ, scutellum, and legs exclusive of coxæ and tarsi, the palpi and tarsi fusco-testaceous; the body nitidous, essentially glabrous.

SHAPE: elliptical, somewhat depressed; length 2.1 times width; widest point of body about one-third the elytral length behind base; sides evenly arcuate, slightly indented at elytral-pronotal base; ends of body equally, moderately parabolically rounded in anterior and posterior fifths.

HEAD: ocular striæ scarcely arched upward above eyes, extending over antennal bases; vertex moderately densely punctate, the punctures small and very shallowly impressed, suddenly deeper and sparser in a staggered row across the base; epistoma transversely hexagonal, immarginate, with the oblique latero-basal sutures piceous and unimpressed, the apex faintly angularly concave, the discal punctures denser but scarcely smaller than on vertex; eyes finely facetted, one-fifth wider than long; antennæ about one-sixth longer than pronotal width at apical angles, moderately robust; the club totally carbonarius, five-segmented, its length 2.5 times width, its segments more strongly punctate-asperate and densely pubescent than those of stem; segment seven triangular, one-third wider than the longitudinally obovate sixth; ten widest; eleven transversely elliptical, one-third wider than long, its width equal to that of nine and to length of eye; stem segments piceous, minutely alutaceous; segment three one-ninth shorter than four and five together; terminal segment of maxillary palpus transversely arcuate, its apex truncate and brushless, its width twice its length and one-fifth greater than length of eye; mentum transversely subrectangular, moderately large, with a dark amber margin except basally, one-third wider than long, its width one-tenth greater than length of terminal segment of maxillary palpus; genæ moderately punctate-pubescent behind, each bearing a deep, transversely arcuate indentation mesad of the hind inner angle of eye; postmandibular lobes (flanges of head capsule between eye and oral cavity) short, stout, sub-erect, scarcely half as long as eye, their anterior and lateral edges continuous in arcs which strongly converge anteriorly.

PRONOTUM: weakly convex, transversely sub-trapezoidal, entirely finely margined, faintly widest one-eighth before base, the basal width 1.67 times median length; sides evenly arcuate, moderately convergent to the obtuse, somewhat rounded, weakly produced apical angles, apex transverse between apical angles and with a darker, semi-translucent border; base equal in width to elytral base, the basal lobe moderately produced; basal impressions extremely weak but detectable, each bearing an uneven basal row of six or seven large punctures much larger than those of disc; punctuation similar to that of vertex, the punctures slightly stronger just beyond the middle of each side, becoming smaller and denser along extreme sides and a bit smaller and sparser medially; angle pores (large punctures at pronotal angles) small, simple, lying in vertical planes.

SCUTELLUM: black, one-half wider than long, base transverse; sides short, subparallel; postero-lateral edges straight, forming a sharp, slightly obtuse angle apically.

ELYTRA: approximately one-half longer than wide; bases margined, the submarginal striole interrupted by several irregularly spaced punctures; widest point one-third from base; sides rather evenly, weakly arcuate, the common apex parabolically rounded in the ultimate two-fifths; each elytron bearing seven unimpressed striæ plus a weak and basally incomplete eighth; strial punctures moderate, much stronger than those of pronotal disc, mostly separated by a little more than their diameters; intervals rather densely punctulate, the punctules closer together than strial punctures; setae hardly detectable.

THORAX BELOW: prothoracic venter smooth, scarcely punctulate; prosternum apically truncate, weakly compressed, the process with four or five small punctures, limited laterally by straight ridges which extend along inner edges of coxæ and diverge a bit posteriorly to the shallowly concave base; mesosternum with median disc subquadrate, scarcely wider than long, smooth; mesopleural sclerites exhibiting strong, minutely reticulate microsculpture; metathorax smooth, with very sparse, minute punctules and setæ; metasternal coxal lines long, extending two-thirds the distance to metasternal lateral margins.

LEGS: piceous-black excepting coxæ and tarsi (of the forelegs only the coxæ and left trochanter are present); the coxæ narrowly separated, the middle ones separated by a distance equal to width of middle femora, the front and hind pairs by two-thirds as much.

ABDOMEN: almost glabrous and smooth but sparsely, minutely punctulate-pubescent; basal sternite with a small median patch of denser punctules and setæ; the punctules becoming a little stronger and denser apically, especially on apical half of ultimate sternite; abdominal coxal lines weak but distinct, forming straight-line continuations of inner edges of hind coxae and extending obliquely backward more than halfway across basal sternite.

MEASUREMENTS OF TYPE (in mm.): length, 4.83; width, 2.30; width of pronotal base, 2.00; median pronotal length 1.20; width at extremities of pronotal apical angles, 1.27; width of head at eyes, 1.20; interocular width of vertex, 0.85; horizontal diameter of eye, 0.30; width of terminal segment of maxillary palpus, 0.36.

TYPE: male, collected by Witmer Stone, July 19, 1919 [Academy of Natural Sciences of Philadelphia Type no. 10701].

TYPE LOCALITY: Pinery Canyon (6000 ft.), Chiricahua Mts., Cochise County, Arizona.

PARATYPES: none.

VARIATION: The small patch of denser punctures and setæ on the middle of the basal abdominal sternite may be a secondary sexual character of the male—such a phenomenon occurs in *Cypherotylus californicus* (Lacordaire).

Dacne cyclochilus, n. sp.

The late Dr. E. A. Schwarz of the U. S. National Museum recognized this form as an undescribed species; several specimens in different collections have been found bearing his manuscript name. It is, indeed, the most distinctive of the four unchallenged New World species, all of which occur in the United States.

DIAGNOSIS: closely related to *picea* Leconte from which it differs in several respects—in the elytral punctuation tending toward linear arrangement, in the more attenuate bodily form, and especially in the nature of the epistoma. The transversely elliptical epistoma, with its sides deflected, and the transverse, entire suture separating it from the frontal region between the antennal insertions serve to distinguish this species at once from the other American members of the genus.

DESCRIPTION OF TYPE: COLOR: dark reddish brown, somewhat piceous along the suture and elytral sides and on pterothorax below; moderately nitidous.

SHAPE: elongate-elliptical, narrow, rather depressed for a *Dacne;* length 2.33 times width, with widest point of body one-third the elytral length behind base; sides gently, evenly arcuate; the body semicircularly rounded in anterior twelfth, more tapering or parabolically rounded in posterior fourth.

HEAD: ocular striæ extending over antennal insertions; entire upper surface with a minutely reticulate microsculpture (the same present and equally strong on body below, less distinct on pronotum and elytra); vertex sparsely punctate, the punctures small, somewhat denser laterally; epistoma transversely elliptical (whence the trivial name: Gk., round lip), twice as wide as long, separated from frontal region by an entire, very fine but distinct suture, the sides strongly declivent, immarginate, somewhat rounded; epistomal punctures denser, not smaller than those of vertex, the setæ more distinct; antennæ about one-tenth longer than width of pronotum at apical angles, moderately robust, the club four-segmented, not very compact, its length twice the width; segment eight obconical or triangular and one-fifth wider than seven, hence belonging to club even though only half as wide as nine; segment eleven transversely elliptical, its width 0.85 the length of eye; stem with a few short yellow setæ; segment three one-fifth shorter than four and five together, five to seven moniliform, subequal in size; mentum strongly transverse, its width four times median length and equal to width of terminal antennal segment, its apex suddenly acuminate medially.

PRONOTUM: weakly convex, relatively depressed as in *picea,* transversely subrectangular, widest basally; basal width 1.58 times median length; sides straight and weakly convergent anteriorly in basal four-fifths, arcuately more strongly convergent in apical fifth; lateral marginal beads in lateral view scarcely increasing in thickness anteriorly (not strongly so as in *picea);* apical angles acute, not strongly produced, not quite equalled by the weakly convex and bilobed, immarginate apex when the four pronotal angles are in equal focus (resembling *picea* in this respect and differing from *californica* (Horn) and *quadrimaculata* (Say) in both of which the apex considerably surpasses the apical angles); base slightly narrower than elytral base, entirely, finely margined; basal lobe narrower and somewhat more strongly produced than apex; basal impressions absent; punctuation moderate, the punctures shallow, flat-bottomed but sharply incised, their diameters equal to about half the basal width of third antennal segment, mostly separated by once to twice their diameters, becoming slightly larger and considerably denser laterally; pubescence weak, the setæ only slightly exceeding the punctures.

SCUTELLUM: one-fourth wider than long, the sides moderately convergent anteriorly, apex arcuately rounded, disc rather densely punctulate.

ELYTRA: three-fourths longer than wide, widest one-third from base; sides equally, somewhat arcuately convergent anteriorly and posteriorly for one-third elytral length from widest point, the common apex sharply, parabolically rounded in the remaining third; elytral bases distinctly margined, the submarginal striole interrupted by several irregularly spaced punctures; elytral punctures small, their diameters about one-half those of pronotal punctures, likewise flat-bottomed and sharply incised, definitely tending to form straight rows, becoming obsolescent apically; strial and interval punctures forming alternating rows, the former a bit larger and partly underlain by piceous spots, setæ small, silvery, and decumbent but exceeding the punctures by perhaps half the diameter thereof; reflected light shows the first and second striæ to be faintly impressed and the disc to be rugulose with fine transverse cracks between punctures.

THORAX BELOW: pronotal epipleura coarsely punctate, the epimeral area longitudinally rugose; prosternum likewise coarsely punctate with the punctures partially confluent in the episternal areas, evenly convex, the apex truncate, the process sparsely punctulate, limited laterally by low, arcuate ridges which do not extend cephalad of the coxae to form prosternal lines, strongly widening basally, the base weakly arcuately concave; setæ short, not exceeding punctures; mesosternum with median disc narrowest posteriorly, the width here about half again the median length, anteriorly weakly convex, moderately punctulate, the lateral wings more coarsely punctate-asperate; mesopleural sclerites scarcely punctate, strongly corrugated in microsculpture; metasternum coarsely punctate laterally, the punctures becoming smaller medially and obsolescent posteriorly, densest antero-medially;

the setæ distinct, exceeding punctures by as much as two to three times their diameters; metasternal coxal lines entirely absent; metepisterna coarsely punctate, the punctures partially confluent, the setæ shorter than on metasternum.

LEGS: of typical conformation for the genus but, like those of *picea,* less robust than in *californica* and *quadrimaculata,* the ratio of length to width of hind femora being nearer 3:1 than 2:1 as in the latter two species.

ABDOMEN: rather densely punctate, the punctures stronger latero-basally, becoming smaller medially and apically and much denser apically; setæ correspondingly dense, their size uniform and similar to that of metasternal setæ; abdominal coxal lines extremely short, raised, acuminate.

MEASUREMENTS OF TYPE (in mm.): length, 2.90; width, 1.24; width of pronotal base, 1.01; median pronotal length, 0.64; width at extremities of pronotal apical angles, 0.74; width of head at eyes, 0.67; interocular width of vertex, 0.48; horizontal diameter of eye, 0.18.

TYPE: female, taken by Hubbard and Schwarz on June 28 [U. S. National Museum Type no. 61978]. The female genital tube in this genus appears to show diagnostic specific characters, hence the selection of a female type.

TYPE LOCALITY: Alta, Salt Lake County, Utah.

PARATYPES, 174, as follows: 74, Alta, Utah, June 28 (Hubbard and Schwartz) [U. S. Nat. Mus.]; the following 16 also from Alta, Utah: 6 [Brooklyn Museum Collection, U. S. Nat. Mus.]; 4 [U. S. Nat. Mus.]; 4 [Hamilton Collection, Carnegie Mus.]; 1 [A. Fenyes Collection, Calif. Acad. Sci.]; 1 [R. Hopping Collection, Calif. Acad. Sci.]; 6, Brightons, Utah, July 18 (Hubbard and Schwarz) [U. S. Nat. Mus.]; 1, Logan Canyon, Utah, June 30, 1948 (S. L. Wood) [Utah State Agric. College]; 6, Salt Lake City, Utah, July 21 [H. Klages Collection, Carnegie Mus.]; 61, Utah, July 19 [U. S. Nat. Mus.]; 4, Mt. Shasta, Calif., 8000 ft., July 1914 [Blaisdell Collection, Calif. Acad. Sci.]; 6, Mt. Shasta, Calif., July 15, 1941 (W. B. Cook) [Calif. Acad. Sci.].

VARIATION: The entire transverse suture at the epistomal base is difficult to see in some specimens; careful orientation of the specimen to the light, however, always admits of its detection. The length ranges from 2.48 to 3.31 mm., and the color varies from yellow in the tenerals to piceous in the older specimens. No secondary sexual characters have been found.

"TULANE STUDIES IN ZOOLOGY", A NEW PERIODICAL

The above is the title of a new journal, devoted primarily to the zoology of the Gulf of Mexico and bordering region, and published by Tulane University of Louisiana, New Orleans, under the editorship of George Henry Penn. According to the announcement it was started to encourage the publication of papers on the zoology of the Gulf Coastal area. Each number will contain an individual paper and will be issued separately. Contributors need not be members of the Tulane University faculty. Volume 1, Number 1, dated June 1, 1953, (8 pages), contains a paper entitled "On a New Genus and Species of Mysid from Southern Louisiana, (Crustacea)." Other papers accepted for future publication in Volume 1, range from 8 to 24 pages each and deal with lizards, salamanders and crawfishes. As nothing is said to the contrary it is assumed that entomological papers will be accepted if they deal with species of the Gulf Coastal area and are accepted by the editor and his editorial committe. Although separate numbers of this publication may be purchased by individuals, subscriptions are not accepted and it will be distributed almost entirely in exchange for other biological publications.—H.B.W.

THE NEOTROPICAL SPECIES OF THE ANT GENUS STRUMIGENYS FR. SMITH: GROUP OF SALIENS MAYR

BY WILLIAM L. BROWN, JR.

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This is part of a continuing revision of the New World species of the dacetine ant genus *Strumigenys* Fr. Smith. Previous parts may be found in this Journal (Vol. 61, pp. 53-59 and 101-110. 1953); these contain explanations of the abbreviations for measurements and indices used in all sections. Other sections are under press or being prepared; the final section will include a key to the workers of all species of the genus of the Western Hemisphere.

The present section deals with two species surely belonging to the *mandibularis* series: *S. saliens* Mayr and *S. borgmeieri* n. sp., and a third, *S. trinidadensis* Wheeler, that may be regarded as a connecting form between the *mandibularis* series and the group of species related to *S. hindenburgi* Forel. For the present, the three species *saliens, borgmeieri,* and *trinidadensis* may be considered to make up the *saliens* group. *S. saliens* itself appears to be intermediate in many respects between two *mandibularis* series groups: the group of *smithii* Forel and the group of *cordovensis* Mayr.

Strumigenys saliens Mayr

Strumigenys saliens Mayr, 1887, Verh. zool.-bot. Ges. Wien 37: 574, worker, female (original description). ?Emery, 1890, Bull. Soc. Ent. Ital. 22: pl. 7, fig. 1, worker. (*Nec* Wheeler, 1916, Bull. Mus. Comp. Zool. 60: 326; 1922, Amer. Mus. Novit. 45: 12; Trinidad records based on a damaged example of *S. trinidadensis* in MCZ).

Strumigenys saliens var. *procera* Emery, 1894, Bull. Soc. Ent. Ital. 26: 215, pl. 1, fig. 9, female. NEW SYNONYMY.

Strumigenys saliens var. *angusticeps* Forel, 1912, Mém. Soc. Ent. Belg.

19: 198, worker. NEW SYNONYMY.

WORKER: TL 3.5-4.1, HL 0.81-0.95, ML 0.50-0.60, WL 0.82-0.97 mm.; CI 69-77, MI 60-65. Measurements made on 4 cotype workers of *S. saliens,* 3 cotype workers of var. *angusticeps,* and 31 other workers. At least 12 nest series from southeastern Brazil and northeastern Argentina are represented.

In most general characters, this species is intermediate between the *smithii* and *cordovensis* groups of the *mandibularis* series. Emery's figure of 1890 illustrates satisfactorily the head shape and mandibular dentition as seen in the *saliens* types, but this figure exaggerates the relative length of the mandibles to a marked degree. Normal variation in this species is moderate, chiefly involving the size and spacing of the two slender preapical teeth; the distal of these two teeth usually near the apical fifth of ML, its length ¾ or less that of the dorsal tooth of apical fork; proximal preapical tooth as long as or shorter than the distal. The preapical teeth are separated by a distance equalling their lengths or slightly more. The normal dentitional variation includes forms like that of the female described as var. *procera* by Emery, and there seems to be no good reason to retain a separate name for Emery's variant at this time. (The types of Forel's var. *angusticeps* match the *saliens* types very closely in all characters, and it seems that Forel drew non-existent distinctions.)

The apical fork of the mandible has the dorsal tooth slender, 0.10 to 0.13 mm. long, slightly longer than its ventral mate. An intercalary tooth present, large and spiniform, ca. ⅔ the length of the dorsal tooth.

General plan of alitrunk as in *cordovensis* and *smithii,* but the propodeal declivity steeper and more sharply angled against the gently but distinctly convex propodeal dorsum. Upper and lower propodeal teeth on a single side remote, slender, acute, somewhat elevated, joined at their extreme bases only by a very low, concave, cariniform lamella; upper pair of teeth longer than lowers and usually about half as long as the distance between the centers of their bases, seen from above.

Petiolar peduncle slender, about as long as its node. Seen from above, free portion of node (including anterior slope) more or less approximately as long as broad. Midventral spongiform band rather uniform in depth, fairly well developed. Node distinct, with a sloping but convex anterior face, evenly rounded above and with only the posterodorsal and posterolateral surfaces covered by the spongiform band. Postpetiolar node transversely ovate, ca. 1.4 times as broad as long (average); disc decidedly convex, densely punctulate, opaque, with a few feeble rugulæ, its spongiform appendages well developed, but less so than in *smithii.*

Gastric costulæ few, weak, widely spaced and never extending more than 1/5 the length of the first tergite; usually much shorter, and in some series reduced to indistinct vestiges. Body largely densely reticulo-punctulate, opaque; gaster and lower mesopleura smooth and shining. Pilosity much as in *smithii*. Color rather uniform medium ferrugineous, appendages lighter; internidal variation slight.

FEMALE: a specimen from the type series, now in the British Museum, was kindly measured by Mr. G E. J. Nixon; I have also measured 4 additional specimens from Brazilian localities. Examples from Nova Petropolis most resemble Emery's figure of var. *procera*.

TL 4.2-4.5, HL 0.88-0.93, ML 0.50-0.53, WL 0.99-1.02 mm.; CI 73-82, MI 57-61; forewing L 3 mm. or slightly more. Eyes very large and convex. Mesonotum evenly and densely punctulate, with a feeble median sulcus and a few long, posteriorly-inclined hairs. Nearly all of mesopleura smooth and shining. Petiolar node broader than long and flattened obliquely from in front and above, as in the *smithii* worker, but a little less extreme. Color much as in worker. Forewing venation: Rs+M and M distal to this lacking, as are also cu-a and m-cu. Rs weak; rest of venation fairly well preserved. Posterior wing with four hamuli. Male unknown to me.

Material studied: BRAZIL: Santa Caterina : Blumenau (Hetschko), *saliens* cotypes [syntypes] [Naturhistorisches Museum, Wien; British Museum (Natural History); D. Zoologia, São Paulo; MCZ; USNM]. Blumenau (F. Müller). Nova Teutonia (F. Plaumann). Hamonia (Leuderwaldt). Paraná: Rio Negro (Reichensperger), two series. Rio Grande do Sul: Nova Petropolis (P. Buck). Rio de Janeiro (State and District): Rio (Göldi), cotypes of var. *angusticeps* [syntypes] [Museum d'Histoire Naturelle, Geneva; MCZ]. Pico Tijuca; Corcovado (H.S. Lopes). The type of var. *procera* [not studied; in Museo Civico di Storia Naturale, Genova] came from Novo Friburgo (collector unknown). ARGENTINA: Misiones: Loreto (A. Ogloblin).

So far, *S. saliens* has been collected only in southeastern Brazil and the Paraná Basin. It nests in (and beneath the bark of) rotten logs, according to the scanty collecting data available. *S. saliens* is readily distinguished from allied species by means of its fairly large size, proportions of head and mandibles, its distinctive propodeal armament with reduced infradental lamellae, and the shape and sculpture of its postpetiolar disc.

Strumigenys borgmeieri, n. sp.

WORKER: With the general characters of the *smithii, saliens* and *cordovensis* groups of the *mandibularis* series, but differing from all in its much narrower head, tapered mandibles with apically crowded preapical dentition, different form of petiolar and postpetiolar nodes and spongiform appendages, different pilosity pattern and in its generally very slender body build.

TL 3.3, HL 0.74, ML 0.52, WL 0.77 mm.; CI 65, MI 67. Head evenly convex above, narrow, occipital lobes narrowly rounded behind and only gently convex laterally; posterior excision semicircular, deep. Eyes moderately large, convex, laterally oriented. Clypeus triangular, with gently arcuate anterior border; tumulus low and round, placed just anterior to the center of the clypeal disc. Antennal scape 0.51 mm. long, very slightly curved, very gently incrassate away from the base, the thickest point between the midlength and apex. Funiculus 0.81 mm. long, apical segment (V) 0.37 mm. long, segment IV 0.20 mm. long, segment II longer than III, II + III about equal to the length of I (0.12 mm.).

Mandibles straight and slender, inner borders parallel when closed; external borders drawn in slightly at their insertions, thickest just distad of the insertions, and from this point the shafts are evenly tapered to their apices. Elements of dentition of the same number and general relationships as in *saliens* and the other *mandibularis* series species, all teeth slender and spiniform. Dorsal and ventral teeth of apical fork approximately equal (ca. 0.06 mm.), intercalary tooth closest to the ventral tooth and about 2/3 its length. Distal preapical tooth about 4/5 the length of the dorsal apical and separated from it by a distance very slightly greater than the length of the latter (0.06-0.07 mm.). The entire apical and preapical armament is crowded into scarely more than the apical fifth of the exposed mandibular length. The proximal preapical tooth slightly shorter than the distal preapical and separated from the latter by about its own length (0.04-0.05 mm.). Oblique setæ of inner mandibular borders, found in the other *mandibularis* series species, are also well developed in *borgmeieri*. Labral lobes very small, tuberculiform.

Alitrunk much as in *smithii*, but much more slender and with a less pronounced metanotal groove and constriction; dorsum of propodeum only very feebly convex. Seen from above, anterior pronotal margin distinct and carinate, entire, evenly and rather narrowly rounded; humeral angles undeveloped, their piligerous tubercles inconspicuous. Median dorsal pronotal carina and promesonotal suture obsolete. Propodeal lamellæ small, translucent, forming upper and lower short, apically rounded teeth, the lowers slightly the larger; lamella connecting upper tooth with lower tooth moderately excised.

Petiole with a distinct, dorsally rounded node and a tapered peduncle subequal to it in length. The node is long-oval seen from above; maximum width about 0.15 mm. A thin, even longitudinal band and two tiny transparent rounded lobes one on each side of the band posteriorly complete the ventral petiolar spongiform vestiture; the node is free above and laterally, with only a very narrow, raised, collar-like flange of thin, stiff translucent material around the posterodorsal border which widens slightly on each side behind to form thin posterolateral lobes. Postpetiole muffin-shaped, basically much as in *saliens;* the disc strongly convex, subcircular in outline seen from above, slightly broader than long, continuously marginate along the sides and behind. A thin, transparent lamelliform band running around below the posterior border of the disc, confluent ventrolaterally on each side with a large, dependent, subacute, vesicular leaflike lobe of thin, transparent lamellar material. First gastric sternite anteriorly with a low half-ring of spongiform tissue. A very narrow, thin, arching lamelliform band along the anterior discal border.

Body finely and densely reticulo-punctulate, opaque; funiculi, much of legs, mandibles, and postpetiolar disc with feebler sculpture, subopaque. Gaster smooth and shining, basally with about 15 distinct and well spaced costulæ extending about 1/6 the length of the basal gastric tergite.

Body proper clothed abundantly with fairly short but conspicuous, strongly spatulate hairs, disposed as follows: dorsum of head including clypeus covered, the hairs subreclinately curved anteriorly. 7-8 slender ones directed apically along the anterior border of each scape. Promesonotum with hairs like those of the head, but not so conspicuous, and curved medially. A row, curved posteriorly, along each side of the propodeal dorsum. Posterior surfaces of both nodes each with a conspicuous patch, suberect and posteriorly curved. Dorsum of gaster, except for an anterior partially nude area, with a conpicuous, spaced clothing of slender, appressed spatulate hairs, their apices directed posteriad. In addition to the ground pilosity, there are three pairs of longer, erect clavate hairs, flattened apically, one pair on the vertex and one pair each on the humeri and at the anterior fifth of the center of gastric segment I. Most surfaces of mandibles, legs, antennæ, and underside of head with a dense vestiture of short, narrowly spatulate or simple hairs, mostly subappressed or appressed. Apex and venter of gaster with a few long, erect subflagellate hairs.

Color medium ferrugineous, slightly on the yellowish side, the head very slightly darker than alitrunk; gaster medium red-brown, slightly darker than rest of body.

Holotype a unique worker in the collection of Father Thomáz Borgmeier, Jacarepaguá, Rio de Janeiro, Brazil, collected at Tapera, Pernambuco, Brazil (Pickel). Nothing is known concerning the biology of this very distinct species.

Strumigenys trinidadensis Wheeler

Strumigenys trinidadensis Wheeler, 1922, Amer. Mus. Novit. 45: 12, worker (original description).

Strumigenys saliens, Wheeler, 1916 and 1922, *nec* Mayr; see under *S. saliens* synonymy above.

WORKER: TL 3.4-3.8, HL 0.78-0.83, ML 0.52-0.56, WL 0.80-0.88 mm.; CI 78-82, MI 66-69. Measurements are from 12 specimens representing six localities and at least that many nests. Quantitative internidal variation virtually absent. A check inspection of a larger series from the same nests showed no variation in absolute measurements beyond the cited extremes. The holotype, though damaged, is a representative specimen toward the upper end of the size range.

This species is intermediate in general charactistics between the *mandibularis* series and the *hindenburgi-emeryi* series. The head is somewhat depressed, with prominent occipital lobes and a large occipital excision. The eyes are large and convex and directed predominantly laterad. Mandibles nearly straight, but with convex outer borders, narrowed just at insertions, thickest just apicad of insertions, and tapered from there to apex. A single reduced intercalary tooth present as a reclinate spur on the inner side of the ventral tooth of the apical fork. Preapical teeth two, small and widely spaced; distal preapical tooth near the apical quarter of the ML, proximal a bit apicad of mid-ML. Distal preapical tooth uually about 1/3 or less the length of the dorsal apical tooth, proximal even shorter, but both teeth fully distinct even at low magnifications, and both acute. Scapes long, slender, very nearly straight, slightly incrassate near base and gently tapering toward apex.

Humeri angulate and tuberculate; promesonotal suture marked by a distinct semicircular carina; median promesonotal carina strong. Region centering on metanotal groove deeply impressed. Propodeal teeth long, slender, acute, inclined, the upper pair as long as or slightly longer than the distance between the centers of their bases and only slightly longer than the lower pair. Lamella between upper and lower teeth of a single side reduced to a low, concave carina, much as in *saliens.* Petiolar peduncle long, slender, as long as or slightly longer than node; node long, low, rounded above, its free part longer than broad. Of petiolar appendages, the ventral band is reduced to a narrow sliver; posterodorsal collar fairly well developed, its lateral portions with heavily sclerotized central pads. Postpetiole slightly broader than long; disc convex; spongiform appendages fairly well developed, the lateral pads with sclerotized darker portions in the centers.

Head, alitrunk and both nodes densely reticulo-punctulate and opaque, the dorsal surfaces mostly with weak overlying rugulation. Basal segment of gaster entirely and very densely and finely longitudinally striolate, silky-opaque. Apical segments and venter of gaster smooth and shining, with minute, spaced piligerous punctulae.

Ground pilosity of head, including border pilosity of clypeus and scapes, consisting of small and inconspicuous, more or less reclinate, narrow-spatulate hairs. A pair of longer erect spatulate hairs in front of occipital excision. Paired long flagellate hairs found: one pair on lateral occipital borders, one pair on humeri, one pair bilaterally on mesonotum. Numerous long flagellate hairs erect on both nodes, becoming very abundant and crowded on the gaster, venter as well as dorsum. Color uniform ferrugineous yellow.

MALE (a specimen taken with workers at Tumupasa, Bolivia): TL 3.0, HL 0.55, WL 0.94, forewing L 2.6, greatest eye diameter 0.29 mm.; CI 112 (HW including eyes is 0.62 mm.). Straightline exposed length of a single mandible about 0.11 mm. Eyes very large, bulging, distant from mandibular insertions by about the mandibular length. Mesothorax bulky, dorsum flat, notaulices distinct anteriorly only; parapsidal furrows distinct. Scutum with longitudinal rugulation superimposed on reticulate ground sculpture. Upper propodeal teeth represented by subrectanglar projections subtended by gently concave lamelliform carinæ.

Petiole claviform, node low and poorly differentiated from its peduncle, the dorsal surface of which slopes evenly and gradually up to the nodal summit. Postpetiole broader than long, disc convex. Both nodes with small but dense paired subspongiform pads in the posterolateral and posteroventral positions.

Gaster feebly and indefinitely striate at extreme base; otherwise, like the nodes and most of the thoracic pleura, smooth and shining. Pilosity general and fairly abundant, of moderate- and medium-length fine, curved simple hairs, reclinate to inclined erect, not conspicuous. Wings densely covered with brownish microtrichia.

Veins of forewing with Rs+M obsolete, Mf3.4 obsolescent, Rs very weak and indefinite. Hamuli of hindwing 5.

Yellowish ferrugineous except for head and median section of scutum, which are blackish-brown.

The mandibles, as in other species, are much reduced; nevertheless, the acute apices are barely capable of being opposed at their extreme tips. The inner borders are nearly straight, outer borders convex, blades tapered to very acute apices. Genitalia of a second specimen from the same (Tumupasa) series have been dissected, and a figure of the volsella will be presented in another part of this revision. The genitalia are in the usual strumigenite pattern, and were fully retracted in the present cabinet specimens.

The holotype of *S. trinidadensis* [MCZ] is a damaged specimen from Port of Spain, Trinidad (R. Thaxter). Another damaged specimen with the same data as the holotype is also in the MCZ; this is the specimen Wheeler thought to be *S. saliens.*

Other material studied: Trinidad: Mt. Tucuche (P.J. Darlington). Brazil: Recife (Lima-Castro). Tapera, Pernambuco (Pickel). Bolivia: Cachuela Esperanza, Rio Beni (W. M. Mann). Tumupasa (Mann).

The range of this species, formerly thought to be confined to Trinidad, is now shown to be very extensive on the South American mainland. Probably collecting in central Brazil will show it to be a common species in many localities. We have no information regarding its nesting habits or ecological preferences within its known range.

With its densely striolate gastric dorsum and dense, long, fine, erect, flagellate gastric pilosity, this species resembles a few other New World forms: *hindenburgi* Forel, *marginiventris* Santschi and *lanuginosa* Wheeler, but it differs from all of these in details of mandibular form and dentition, propodeal armament and other features. *S. hindenburgi* has the same dental formula in general, but in this species the mandibles are inserted much closer together and the proximal preapical tooth is reduced to a very small denticle; furthermore, *hindenburgi* has a broad lamellate margin along each dorsal scrobe border, lacking in *trinidadensis*. The mandibles of *trinidadensis* are basically those of the *mandibularis* series, although the relatively reduced status of the proximal preapical tooth may cause some confusion when the species has to be contrasted with forms having this tooth really drastically reduced and denticuliform.

INTERNATIONAL UNION FOR THE STUDY OF SOCIAL INSECTS

The number of scientists interested in the investigation of problems concerning the social insects, and the variety of interests among these individuals, have increased sufficiently to create a demand for an international organization to coordinate their efforts and facilitate the study of such problems.

After a preliminary meeting at the 1951 International Congress of Entomology in Amsterdam, the organization of national branches proceeded in France, Germany, Italy, the United States, and other countries. The International Union through which these branches are now associated has its office in Paris, 105 Boulevard Raspail, at the laboratory of Dr. Pierre-P. Grassé, who is President of the international organization.

The principal objective of the International Union is to encourage the scientific study of problems concerning the social insects including all phases of their biology, ecology, taxonomy, and behavior, and to facilitate the exchange of evidence and ideas in this general field through conferences and appropriate publications. The organization will thus foster communication within a large and heterogeneous international body of scientists interested in the social insects and related forms. Previously, articles published on subjects cognate to the social insects have been scattered through a considerable number of highly diversified journals, and integration has been correspondingly limited among the interested investigators and students themselves.

An introductory *BULLETIN* of three numbers was published in France during 1953 and issued to members through the Paris office. Beginning in 1954 an illustrated journal of 320 pages entitled "Insectes Sociaux" will be published by Masson and issued in an annual volume of quarterly numbers. Subscriptions to this journal may be arranged through Stechert-Hafner, 31 East 10 Street, New York.

Two international symposia on the social insects have been sponsored by this organization and a third one is to be held in conjunction with the next International Congress of Entomology. The North

American branch sponsored symposia at the meetings of the Entomological Society of America in Philadelphia in 1952 and in Los Angeles in 1953, and further ones will be held. Comparable conferences are organized periodically by the other national branches.

Those who are seriously interested in the scientific study of problems pertaining to the social insects may apply to the Secretary of the North American branch, Dr. Robert E. Gregg, Department of Zoology, University of Colorado, Boulder, Colorado, for membership application blanks. Members of the organization, in consideration of a modest annual dues payment, receive the "Notes and News" section of the journal.

The North American branch invites the interest of prospective members in Canada, Central America, Mexico and the United States.—T. C. SCHNEIRLA, Chairman, North American branch, I. U. S. S. I.

The

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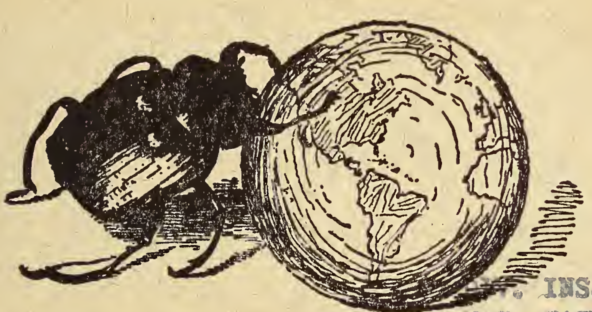

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THE SPIDER GENERA EPISINUS AND SPINTHARUS FROM NORTH AMERICA, CENTRAL AMERICA AND THE WEST INDIES (ARANEÆ: THERIDIIDÆ)

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The cooperation and help of a number of individuals have made possible the revision of these two genera of combfooted spiders. Dr. W. J. Gertsch, Curator of Spiders of the American Museum of Natural History, generously loaned the large collection of *Episinus* and *Spintharus* under his care, and offered many greatly appreciated suggestions and other aids. Additional specimens were loaned by the late Miss E. B. Bryant and Dr. P. J. Darlington of the Museum of Comparative Zoology, Dr. R. V. Chamberlin of the University of Utah, Dr. H. Dietrich of Cornell University, and Dr. B. J. Kaston of the Connecticut Teachers College in New Britain. For the gift of specimens from Dr. H. Wiehle of Dessau, Germany, I am deeply grateful. I also owe many thanks to Mrs. C. Crocker who helped in providing library material and to my wife who helped in all parts of the work.

All measurements given are the maximum (excluding spines) for the respective parts. The drawings are of the left palpi. All types are deposited in the American Museum of Natural History.

Episinus Latreille

Episinus Latreille, 1809, Genera Crustaceorum et Insectorum 4: 371.
Genotype: *Episinus truncatus* Latreille.

Janulus Thorell, 1881, Ann. Mus. Genova 17: 163. Genotype: *Janulus bicornis* Thorell, 1881. New synonymy.

? *Episinopsis* Simon, 1894, Hist. Nat. Araignées 1: 522. Genotype: *Episinopsis rhomboidalis* Simon, 1894. (Probably should be united with *Episinus;* however, the type could not be consulted.)

Janula Strand, 1932, Folia zool. hydrobiol. 4: 139. (To replace *Janulus* which has been used by Lowe, 1852, for a mollusk.) New synonymy.

Medium sized to small theridiid spiders. Carapace longer than wide. Height of carapace about one-third to one-half its width. Thoracic region usually slightly higher than eye region, or of equal height. Species of larger size have a deep, wide, median longitudinal depression in thoracic region. Frequently in species of smaller size there is a characteristic pair of tubercles between anterior and posterior median eyes (figs. 40, 42, 43). Anterior eye row straight, slightly recurved or procurved as seen from in front, posterior row straight or slightly recurved as seen from above. Median eyes closer to laterals than to each other. Lateral eyes touching or slightly separated from each other. Anterior medians subequal or slightly larger than others. Lenses of eyes in several species modified into tubercles with only the apex transparent (fig. 42). Cheliceræ small. Sternum slightly longer than wide, truncate between posterior coxæ. First legs longest, third shortest. Retrolateral tubercles on patellæ usually present. A tarsal comb present on fourth legs. Abdomen longer than wide or sometimes wider than long to subtriangular, wider near spinnerets and sometimes with a pair of large lateral extensions near the posterior end (figs. 32-38). Colulus very small, sometimes not visible. Some specimens of *E. cognatus* have decorative spindle shaped setæ (fig. 41) on abdomen and *E. gratiosus* has these on both the abdomen and legs. Some specimens of other species have a small median dorsal nipple-like tubercle on the abdomen (figs. 35, 38), or a small thorn-like process on each lateral extension (fig. 38).

Epigynum with more or less distinct openings in a depression. One pair of seminal receptacles present. Palpus (figs. 1-14) with a median apophysis (M in figs.), which is a separate sclerite dorsal in position, sausage shaped, and holding the bulb in the cymbium (Y). Radix (R) of various shapes and conductor (C) a characteristic, very large, and very complex group of sclerites apparently held together by haematodocha. The conductor may hold the tip of the embolus (E). The embolic division resembles that of other theridiids related to *Theridion.* The male genitalia of *Episinus* appear similar to those of *Thwaitesia.* The genera can readily be distinguished, however, by the shapes of their abdomens. *Thwaitesia* has a high median dorsal extension but no lateral ones.

Wiehle, (1937), describes the two European species as hanging with outstretched legs, *Tetragnatha*-like, underneath horizontal threads in low shrubs. *Episinus amoenus* according to Archer, (1946), preys on ants, and lives on evergreen shrubs or in leaf litter next to logs in rich forests.

In a study of the web of *Episinus angulatus* (Blackwall), Holm, (1938), found that immature spiders in captivity construct a simple web to catch insects. The spiders sit between two threads (figs. 44, 45). The lower portions of the two threads below the spider are of viscid silk and break easily. Any insect caught by the strands breaks the thread and is pulled up and eaten by the spider. When disturbed, the spiders stretched their legs parallel to the body, and on further disturbance would fall to the ground. The egg sac, which is usually found under loose stones and moss is white, spherical to pear shaped, 6-7 mm. in diameter, and has a stalk of coarse threads. The 27-47 light red eggs are contained by a covering of tight threads and the outside is made of many coarse threads. The female leaves the egg sac after it is made.

Members of the genus *Episinus* have been described from most parts of the world, however, none is known from Canada and only two species occur in the United States. *Episinus amoenus,* which resembles the European species of *Episinus,* is found in the south-eastern states, and *E. cognatus,* which is closer to several rare species found in Mexico, Central America and the West Indies, is found in Texas, Mexico and Central America.

Species described as *Episinus* which do not belong to it are: *Episinus minusculus,* Gertsch, 1936, Amer. Mus. Novitates 842: 9 (fig.9 ♂), which belongs to a new genus described elsewhere.

Episinopsis simplicifrons Simon, 1897, Proc. Zool. Soc. London p. 860, from St. Vincent Island is not known to me. It probably belongs to *Episinus.*

Episinus truncatus Latreille
Figures 1-3, 15, 16

Episinus truncatus Latreille, 1809, Genera Crustaceorum et Insectorum 4: 371. -Wiehle, 1937, Theridiidæ in Die Tierwelt Deutschlands 33: 128 (figs. 4-9 ♂ ♀).

Distribution: Europe, Russia and North Africa (Wiehle, 1937). The American records referring to this species are probably all *E. amoenus* Banks.

Episinus amoenus Banks

Figures 4, 17, 18, 32, 39.

Episinus amoenus Banks, 1911, Proc. Acad. Nat. Sci. Philadelphia 63: 445 (figs, 13, 15 ♂ ♀). -Roewer, 1942, Katalog der Araneæ 1: 450. -Comstock, 1940, The Spider Book, rev. edit. p. 357 (figs. 335-336 ♀). -Muma, 1944 Amer. Mus. Novitates 1257: 7. -Muma, 1945, Bull. Univ. Maryland Agric. Exp. Sta. A38: 26. -Archer, 1946, Pap. Alabama Mus. Nat. Hist. 22: 32.

Episinus truncatus, Keyserling, 1884, Die Spinnen Amerikas 2(1): 209. -Marx, 1889, Proc. U. S. Nat. Mus. 12: 524. -Marx, 1891, Proc. Ent. Soc. Wash. 2: 156. -Banks, 1910, Bull. U. S. Nat. Mus. 72: 24. -Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist. 29: 176. -Comstock, 1912, The Spider Book, p. 342, (figs. 335-336 ♀). -Bishop and Crosby, 1926, Jour. Elisha Mitchell Scient. Soc. 41: 177. -Chamberlin and Ivie, 1944, Bull. Univ. Utah, Biol. Ser. 8: 80. (not *E. truncatus* Latreille).

MALE: Carapace brown with radiating dusky marks, and a dusky border. Eye region black. Cheliceræ and clypeus dusky. Sternum dusky brown, lighter in the center. Legs yellow brown with dusky and brown marks. Abdomen white with dusky grey to black markings.

Carapace highest between third and fourth coxæ. The high area has a Y shaped depression, anterior to which is a longitudinal thoracic line. Clypeus concave, deeply undercutting eye region (fig. 39). Anterior eye row straight, posterior row recurved. Tubercles between eyes absent, but area slightly raised. Anterior median eyes separated by two-thirds their diameter, almost touching laterals. Posterior median eyes separated by one diameter, one diameter from laterals. Lateral eyes separated by less than one-fifth their diameter. Anterior median eyes slightly larger than others which are about subequal. Height of clypeus equals diameter of anterior median eyes. Sternum longer than wide, (1.3: 1), posterior coxæ separated by less than one-quarter their diameter. Abdomen two and one-half times longer than wide. Palpus illustrated by figure 4.

Total length of a male from Maryland 3.0 mm. Carapace 1.24 long, 1.04 wide, 0.39 high. First femur, 3.30; patella and tibia, 3.60; metatarsus, 3.45; tarsus, 1.10. Second patella and tibia, 1.73. Third patella and tibia, 1.15. Fourth patella and tibia, 2.45.

FEMALE: The color and structure is similar to that of the male except for the abdomen which is quite variable in shape. The tubercles may be long and pointed in immature individuals or short and round in mature females (figs. 32, 39). The epigynum is a depression with the posterior rim and openings of the ducts sclerotized, (fig. 17). The internal genitalia are lightly sclerotized, the lumen of the coiled connecting ducts is difficult to see (fig. 18).

Total length 3.0-4.5 mm. A female from Florida, total length 4.3; carapace, 1.60 long, 1.30 wide, 0.65 high. First femur, 3.20; patella and tibia, 3.20; metatarsus, 3.18; tarsus, 0.98. Second patella and tibia, 2.01. Third patella and tibia, 1.30. Fourth patella and tibia, 2.89.

Episinus amoenus, found in the southeastern states, appears to be closely related to *E. angulatus* (Blackwall), and other European species. Details of the genitalia differentiate it from them.

Type locality: Male and female cotypes from north fork, Swannanoa River, Black Mountain, North Carolina, collected in May from rhododendron bushes: probably in the Museum of Comparative Zoology.

Records: MARYLAND: Dorchester Co.: Sharptown, June 15, 1942, sweeping low bushes, ♂ (M. H. Muma). Prince Georges Co.: College Park, ♀ (Muma 1944). DISTRICT OF COLUMBIA: Oct., 2 juv. (W. H. Fox); Aug., ♀ (W. H. Fox); Washington, juv. (N. Banks); Rock Creek, Potomac Hills (Marx 1891). VIRGINIA: Highland Co.: Monterey, July 30, 1943 in mixed forest, ♀ (R. Craft). NORTH CAROLINA: Durham Co.: Durham, June 11, 1953, ♀ (L. and H. Levi). Grant Co.: Raleigh, Aug. 1912, ♀, juv. (C. S. Brimley). Buncombe Co.: Black Mountain, ♀ (N. Banks); Montreat, Oct. 16, 1923, juv. TENNESSEE: "Montvale Springs", March 18, 1929, 2 juv. (W. M. Barrows). GEORGIA: Neel Gap (P. W. Fattig), Dougherty Co.: Albany, July 18, 1938, ♀ (H. K. Wallace). Hall Co.: five miles north of Gainesville, April 26, 1943, juv. (Chamberlin and Ivie 1944). Rabun Co.: Clayton to Tallulah Falls, April 28, 1943, juv. (Chamberlin and Ivie 1944). ALABAMA: Cherokee Co.: May's Gulf, Oct. 13, 1949, juv. (J. H. Robinson). Baldwin Co.: Hog Creek, 1940, juv. (Archer

1946); Black Warrior National Forest, June 1939, ♀ (Archer 1946). Clarke Co.: Three miles north of Grove Hill, juv., (Archer 1946). Coosa Co.: Hatchet Creek, June 1940, ♀ (Archer 1946). Tuscaloosa Co.: Alberta City, June 5, 1941, ♀ (Archer 1946). FLORIDA: Alachua Co.: west of Gainesville, April 18, 1938, ♀ (W. J. Gertsch). Dade Co.: Royal Palm State Park, Feb. 26, 1936, ♀.

Episinus bruneoviridis (Mello-Leitão) new combination

Figures 13, 19, 20, 34.

Faiditus bruneoviridis Mello-Leitão, 1948, An. Acad. Brasileira Cienc. 20:156 (figs. 4, 5 ♀).

MALE: Carapace yellowish with cephalic area dusky, a median dusky line and dusky border. Eyes with black rings and some red pigment. Sternum yellow. Legs yellow with dusky spots.

Carapace typical with slight tubercles between anterior and posterior median eyes. A deep wide longitudinal depression in thoracic region. Anterior eye row slightly procurved, posterior row recurved. Anterior median eyes separated by two-thirds their diameter, almost touching laterals. Posterior median eyes separated by one diameter, by two-thirds from laterals. Laterals almost touching. Anterior lateral and posterior eyes 0.6 diameter of anterior medians, which are the largest. Height of clypeus equals almost two diameters of anterior median eyes. Sternum longer than wide (1.3:1). Small tubercule on retrolateral face of patella. Palpal femora fairly long. The palpus is illustrated by figure 13.

Carapace 0.81 mm. long, 0.71 wide. First femur, 1.55; patella and tibia, 1.82; metatarsus, 1.70; tarsus, 0.38. Second patella and tibia, 1.04. Third patella and tibia, 0.65. Fourth patella and tibia, 1.50.

FEMALE: Coloration similar to that of male. Legs with irregular light dusky patches, more distinct on venter of segments. Abdomen with a dorsal white folium, sides black to dusky-grey, venter light grey (fig. 34).

Tubercles of eye region apparently of variable height. Eyes slightly farther apart than those of male. Height of clypeus one and one-half diameters of anterior median eyes. First and fourth legs subequal in length. Abdomen egg shaped, widest near spinnerets, and sometimes coming to a point above carapace. One specimen had a small nipple-shaped protuberance on dorsum at highest point of abdomen. Epigynum quite variable in regard to proportions. It is illustrated by figure 19. The openings are apparently slitlike, on the anterior margin of a sclerotized area. They lead into lightly sclerotized connecting canals of large diameter (fig. 20).

Total length of females from 2.4-2.9 mm. Total length of a female from Panama 2.5, carapace 1.04 long, 0.85 wide. First femur, 1.70; patella and tibia, 1.71; metatarsus, 1.70; tarsus, 0.65. Second patella and tibia, 1.03. Third patella and tibia, 0.78. Fourth patella and tibia, 1.70.

Type locality: Cane Grove, British Guiana.

Records: CANAL ZONE: Barro Colorado Isl., several records. TRINIDAD: Navy base, south west, April 1945, ♀ (R. Ingle).

Episinus gratiosus Bryant
Figure 23

Episinus gratiosus Bryant, 1940. Bull. Mus. Comp. Zool. 86: 313 (fig. 65 ♀). -Bryant, 1948, Bull. Mus. Comp. Zool. 100: 382.

This species is not known to me. Both the abdomen and legs, according to the author, have spindle shaped spines. The epigynum "with a transverse oval opening at the anterior end, followed by a convex area, showing a pair of dark oval sacs beneath the skin". (fig. 23).

The female holotype is from Oriente, Pico Turquino, (1500 feet) in Cuba, in the Museum of Comparative Zoology, and an additional specimen was found in the hills near Port-au-Prince, (2000 feet) in Haiti (Bryant 1948).

Episinus cognatus O. P.-Cambridge
Figures 8-10, 21, 22, 33, 41.

Episinus cognatus O. P.-Cambridge, 1893, Biologia Centrali-Americana, Araneidea 1: 109 (pl. 15, fig. 2 ♂).-F. O. P.-Cambridge, 1902, Biologia Centrali-Americana, Araneidea 2: 398 (pl. 37, fig. 26, 27 ♀ ♂).-Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist. 29: 175.-Banks, 1929, Bull. Mus. Comp. Zool. 69: 87 (figs. 23, 45, 49, 53, 76 ♂ ♀).-Roewer, 1942, Katalog der Araneae 1: 449.

Episinus putus O. P.-Cambridge, 1894, Biologia Centrali-Americana, Araneidea 1: 132 (pl. 18, fig. 7 ♂).-F. O. P.-Cambridge, 1902, Biologia Centrali-Americana, Araneidea 2: 397 (pl. 37, fig. 25 ♂).-Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist. 29: 176.-Roewer, 1942, Katalog der Araneae 1: 450. New synonymy.

Episinus bigibbosus O. P.-Cambridge, 1896, Biologia Centrali-Americana, Araneidea 1: 167, 208 (pl. 20, fig. 8 ♀; pl. 26, fig. 6 ♂).

MALE: Carapace yellowish, with an indistinct median dusky line and an indistinct dusky border. Region around eyes reddish. Sternum yellow, dusky on sides. Legs yellow with indistinct dusky patches. Abdomen white with grey and black spots, venter grey with a white line on each side (fig. 33).

Carapace with many fine hairs. A deep longitudinal thoracic depression present. No noticeable tubercles in eye region. Both eye rows recurved. Bases of anterior median eyes separated by one diameter, one-fourth of their diameter from bases of laterals. Bases of posterior median eyes separated by their diameter, two-thirds their diameter from bases of laterals. Bases of lateral eyes almost touching. It appears that only the apical portions of the lenses are clear, the bases having pigmentation. Anterior median eyes larger than others. Clypeus convex, height a little more than diameter of anterior median eye. Sternum one and one-half times longer than wide. All palpal segments very long. Abdomen two and one-half to three times as long as wide. Palpus illustrated by figures 8-10.

Total length of male 3.9-4.3 mm. Total length of a male from Hidalgo, 4.3; carapace 1.41 long, 1.22 wide. Palpal femur, 1.95. First femur, 3.74; patella and tibia, 3.95; metatarsus, 4.67; tarsus, 1.18. Second patella and tibia, 2.22. Third patella and tibia, 1.44. Fourth patella and tibia, 3.01.

FEMALE: Coloration similar to that of male. Structure of carapace and eyes like that of male except for posterior median eyes which are separated by two diameters and two diameters from laterals. Anterior median eyes larger than others. The palpal segments are of normal length. The shape of the abdomen is illustrated by figure 33. Several specimens have half a dozen large spindle-shaped setæ (fig. 41) on the sides of the abdominal tubercles. The openings of the epigynum (fig. 21) are at the posterior end of the depression. The internal genitalia are much less sclerotized than in the preceding species, (fig. 22).

Total length of female 4.5-6.0 mm. A female from Hidalgo measured 5.3 total length, carapace 1.60 long, 1.36 wide. First femur, 3.54; patella and tibia, 3.74; metatarsus, 4.30; tarsus, 0.94. Second patella and tibia, 2.16. Third patella and tibia, 1.44. Fourth patella and tibia, 3.10.

F. O. P.-Cambridge mentions as the only difference between *E. putus* and *E. cognatus*, that the sclerites of the tip of the bulb are curved in one species and not in the other. However, only a slight twisting of the palp will produce in its sclerites the differences upon which Cambridge based his two species. For that reason, the species are here synonymized. *Episinus cognatus* is known from Texas to Panama.

Type localities: The male holotypes of both *E. cognatus* and *E. putus* are from Teapa in Tabasco, collected by H. H. Smith. The female holotype of *E. bigibbosus* came from Bugaba in Panama and was collected by Champion. All types, according to F. O. P.-Cambridge, are in the collection of Godman and Salvin.

Records: TEXAS: Hidalgo Co.: Edinburg, Aug. 25, 1935, ♀ (S. Mulaik); s. of Pharr, April 5, 1936, ♂ (S. Mulaik). TAMAULIPAS: 3 miles s. of Villa Juarez, April 17, 1938, ♀ (A. M. and L. I. Davis); SAN LUIS POTOSI: 5 miles n. of Tamazunchale, July 2, juv. (A. M. and L. I. Davis); Tamazunchale, May 20, 1952, ♂ (W. J. Gertsch); 4 miles n. of Ciudad de Valles, Nov. 26, 1938, ♀ (A. M. and L. I. Davis). HIDALGO: Chapulhuacan, May 20, 1952, ♂ ♀ (W. J. Gertsch). VERACRUZ: Cordoba, May 15, 1946, juv. (J. C. and D. L. Pallister); Tlacotalpan, July 19, 1946, ♀ (H. Wagner). OAXACA: Palomares, July 1909, ♂ (A. Petrunkevitch); Soyaltepec, Aug. 2, 1946, ♀ (H. Wagner). CHIAPAS: Finca Santa Marta nr. Huehuetan, Aug. 1, 1950, ♂ (C. and M. Goodnight); Ocosingo Valley, Finco El Real, July 1-7, 1950, juv. (C. and M. Goodnight and L. Stannard). GUATEMALA: Moca, June 1947, ♀ (C. and P. Vaurie); San Jeronimo, July 27, 1947, ♀ (C. and P. Vaurie). CANAL ZONE: Barro Colorado Isl., Feb. 10, 1936, ♀ (W. J. Gertsch).

Episinus panamensis, new species
Figures 14, 35.

MALE: Carapace yellowish with a black border and four pairs of dusky patches on sides. Eye region dusky red. Sternum yellowish. Legs yellowish with dusky rings on distal ends of femora and tibiæ; patellæ and proximal ends of metatarsi dusky. There are several additional dusky patches on the femora. Dorsum of abdomen whitish with dusky patches (fig. 35), venter whitish.

Structure of carapace typical with a pair of tubercles in eye region. Anterior eye row straight, posterior row recurved. Anterior medians separated by one-fourth their diameter, almost touching bases of laterals. Posterior median eyes separated from each other by two diameters of transparent lenses and by one diameter from laterals. Laterals separated by two-thirds their diameter. Transparent portions of anterior median eyes twice the size of those of other eyes. Clypeus concave, one and one-half diameters of anterior median eyes. Basal portions of anterior lateral and all posterior eye lenses opaque. Sternum as wide as long, posterior coxae separated by more than their diameter. Retrolateral surface of each patella with a tubercle. Abdomen with a central dorsal nipple-like protuberance (fig. 35). Palpal segments long, palpus illustrated by figure 14.

Total length of male holotype 1.7 mm.; carapace 0.65 long, 0.66 wide. First femur, 1.69; patella and tibia, 1.75; metatarsus, 1.74; tarsus, 0.59. Second patella and tibia, 0.88. Third patella and tibia, 0.62. Fourth patella and tibia, 1.30.

Type locality: Male holotype from Barro Colorado Island, Canal Zone, May 8, 1946 (T. C. Schneirla).

Episinus erythrophthalmus (Simon), new combination
Figures 24, 25, 36.

Janulus erythrophthalmus Simon, 1894, Proc. Zool. Soc., London, 1894, p. 525.-Simon, 1894, Histoire Naturelle des Araignées 1: 514 (fig. 524, 525).-Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist. 29: 180.

Janula erythrophthalma, Roewer, 1942, Katalog der Araneæ 1: 456.

FEMALE: Carapace yellowish-white, darker on sides and in eye region. Eyes all light colored except anterior medians which are dark. Sternum slightly dusky, legs yellow white. Abdomen, dorsum yellowish-white, sides and posterior portions pink, venter yellowish-pink; white pigment spots on sides of spinnerets, on outsides of these a dusky patch.

A pair of tubercles present between anterior and posterior median eyes. Eyes on slight tubercles. Both eye rows recurved. Anterior median eyes separated by two-thirds their diameter, by one-fourth from laterals. Base of posterior median eyes separated by one diameter and touching laterals. Anterior median eyes slightly larger than others. Height of clypeus equals about one diameter of anterior median eyes. Abdomen slightly longer than wide (fig. 36). Ducts of seminal receptacles opening on sides of a depression; outside and anterior to openings on each side is a sclerite (fig. 24).

Measurements of a female from Trinidad, total length 2.2 mm.; carapace, 0.76 long, 0.65 wide. First femur, 1.55; patella and tibia, 1.62; metatarsus, 1.50. Second patella and tibia, 0.91. Third patella and tibia, 0.65.

Type locality: St. Vincent Island in the Lesser Antilles.

Records: TRINIDAD: Navy Base, Oct. 1944, ♀ (R. Ingle). VENEZUELA: (Simon 1894).

Episinus juarezi, new species
Figures 5, 6, 30, 31, 42, 43.

MALE: Carapace yellow white with a dark border and dark maculations on the sides. Eyes reddish, except anterior medians which are dark. Legs white with distal portions of femora, patellæ, distal portions of tibiæ and proximal portions of metatarsi dusky to black. Abdomen, dorsum with irregular black and small white, pink and yellow spots. Venter dark yellow except for a white area surrounded by black under each lateral extension.

A pair of tubercles present in eye region. Eyes on distinct tubercles (fig. 42, 43), tubercles sometimes transparent and may originally have been part of the lens. If tubercle transparent, the iridescent floor visible. Both eye rows recurved. Anterior median eyes separated by one diameter, by one-third diameter from laterals. Transparent lenses of posterior median eyes separated by one and three-quarters from each other and by one diameter from laterals. Lateral eyes separated by two-thirds their diameter. Posterior median eyes and lateral eyes half the diameter of anterior medians. Height of clypeus equals one and one-half diameters of the anterior median eyes. Abdomen wider than long with a small median dorsal tubercle. The palpus is illustrated by figures 5 and 6.

Total length of male holotype 1.6 mm.; carapace 0.69 long, 0.62 wide. First femur, 1.14; patella and tibia, 1.24; metatarsus, 1.05; tarsus, 0.47. Second patella and tibia, 0.72. Third patella and tibia, 0.49. Fourth patella and tibia, 0.85.

FEMALE: The coloration is like that of the male except that none of the females examined had dusky patches on legs. Coloration of abdomen highly variable, sometimes all red to various patterns of black, red, and yellowish,

Eyes slightly closer together than those of male, but on similar tubercles. Size of eyes like those of male. Height of clypeus equal to diameter of anterior median eyes, height of chelicerae equals about two and one-third diameters of anterior median eyes. Abdomen wider than long, a median tubercle sometimes present. Epigynum with an anterior and a very small posterior lip. Ducts open on sides (fig. 30, 31).

Total length of females 1.9-2.2 mm. Female allotype total length 2.2; carapace, 0.78 long, 0.72 wide. First femur, 1.33; patella and tibia, 1.43; metatarsus, 1.30; tarsus, 0.57. Second patella and tibia, 0.81. Third patella and tibia, 0.63. Fourth patella and tibia, 1.04.

Type locality: Male holotype and one male paratype from thirteen miles south of Villa Juarez, Tamaulipas, April 17, 1938 (A. M. and L. I. Davis).

Records: SAN LUIS POTOSI: 5 mi. n. of Tamazunchale, July 2, ♀ (A. M. and L. I. Davis); Tamazunchale, July 18-20, 1946, ♀ allotype (J. C. and D. L. Pallister). OAXACA: Palomares, July 1909, ♀ paratype (A. Petrunkevitch).

Episinus chiapensis, new species
Figure 7.

MALE: Carapace yellow-white with a narrow black border that widens caudad. Eyes reddish. Sternum, legs yellow-white. Anterior of dorsum of abdomen with white pigment spots to a line between lateral abdominal extension, posterior portion black, sides dusky and venter yellowish-white.

Eye tubercles smaller than in preceding species. Anterior eye row straight. Anterior median eyes separated by one-half their diameter, by one-eighth from laterals. Posterior median eyes separated by two-thirds their diameter, by one-half from laterals. Laterals separated by one-fourth their diameter. Posterior median eyes and lateral eyes two-thirds the diameter of anterior medians. Height of clypeus equals one diameter of anterior median eyes. Abdomen similar to that of *E. juarezi*. This species differs from *E. juarezi* in that it has longer legs, no eye tubercles, smaller tubercles between the eyes, and in that the conductor of the palpus is of a slightly different shape (fig. 7).

Total length 1.4 mm.; carapace, 0.65 long, 0.57 wide. First femur, 1.27; patella and tibia, 1.39; metatarsus, 1.20; tarsus, 0.57. Second patella and tibia, 0.78. Third patella and tibia, 0.57. Fourth patella and tibia, 1.04.

Type locality: Male holotype from Las Ruinas de Palenque, Chiapas, July 1948 (C. and M. Goodnight).

Records: CHIAPAS: Las Ruinas de Palenque, July 12, 1949, one juvenile collected while sweeping (C. Goodnight).

Episinus colima, new species
Figures 11, 40.

MALE: Carapace yellowish-white with a fine dusky margin; sternum and legs yellow-white, patellæ dusky. (Abdomen missing).

The two tubercles of the carapace very pronounced (fig. 40). Anterior eye row straight. Anterior median eyes separated by one diameter, almost touching laterals. Posterior median eyes separated by two-thirds diameter and touching laterals. Lateral eyes almost touching. Diameter of posterior median eyes 0.9 diameter of anterior medians; laterals 0.7 diameter of anterior medians. Height of clypeus equals a little less than a diameter of anterior median eye. Second legs longer than fourth. The abdomen of the type has been lost. This species differs from *E. nadleri* in details in the shape of the conductor of the palpus (fig. 11).

Carapace 0.52 mm. long, 0.47 wide. First femur, 0.76; patella and tibia, 0.91; metatarsus, 0.55; tarsus, 0.43. Second patella and tibia, 0.58. Third patella and tibia, 0.44. Fourth patella and tibia, 0.53.

Type locality: Male holotype from Las Humedades, Armeria, in Colima, January 19, 1943 (F. Bonet).

Episinus dominicus, new species
Figures 26, 27, 38.

FEMALE: Carapace light yellowish with irregular dusky maculations. Eyes, excepting dark anterior medians, are light. Sternum and legs, light yellow-white. Abdomen, all yellow-white with irregular dusky markings covering the whole dorsum. Thorns on lateral extension of abdomen brown. A small brown spot on each side of pedicel and two indistinct brown spots above spinnerets.

Tubercles between anterior and posterior median eyes large. Anterior eye row straight. Anterior median eyes separated by one diameter, less than one-eighth diameter from laterals. Posterior median eyes separated by one diameter, touching laterals. Lateral eyes touching each other. Diameter of posterior median eyes 0.8 diameter of anterior medians, lateral eyes 0.7 diameter of anterior medians. Height of clypeus equals diameter of anterior median eyes. Cheliceræ two and one-half diameters of anterior median eyes. Abdomen hairy, with a median nipple-like tubercle, a similar tubercle on each lateral extension and another between each lateral tubercle and the median one, (fig. 38). Epigynum differs from that of *E. nadleri* in that it lacks an anterior lip (fig. 26).

Total length 1.8 mm.; carapace 0.69 long, 0.65 wide. First femur, 1.14; patella and tibia, 1.25; metatarsus, 0.99; tarsus, 0.51. Second patella and tibia, 0.79. Third patella and tibia, 0.62. Fourth patella and tibia, 0.96.

Type locality: Female holotype from Valle de Polo, (2000-3000 feet), Dominican Republic, Aug. 1935 (H. B. Hassler).

Episinus nadleri, new species
Figures 12, 28, 29, 37.

MALE: Carapace yellow white, eye region reddish. A pair of lateral reddish-brown bands, fused in front, run posterior and are pointed behind (fig. 37). Legs yellow white with a dark mark near distal end of femora. Dorsum of abdomen white with some dusky markings anterior and on sides. Venter yellowish white, white on venter of lateral extensions.

Carapace fairly high. Tubercles between eyes large. Anterior eye row slightly procurved. Anterior median eyes separated by two-thirds diameter, almost touching laterals. Bases of posterior medians separated by one diameter, by one-third diameter from laterals. Diameter of bases of posterior median eyes 0.8 diameter of anterior medians, laterals 0.6 of anterior medians. Height of clypeus equals about diameter of anterior median eyes, cheliceræ two diameters of anterior median eyes. Second and fourth legs subequal in length. A small median protuberance on abdomen and a small dorsal thorn on each lateral extension of abdomen. This species differs from others in the shape of the palpal sclerites (fig. 12).

Total length 1.4 mm.; carapace 0.63 long, 0.55 wide, 0.33 high. First femur, 0.80; patella and tibia, 0.91; metatarsus, 0.75; tarsus, 0.41. Second patella and tibia, 0.62. Third patella and tibia, 0.43. Fourth patella and tibia, 0.65.

FEMALE: Coloration much like that of male, but quite variable. Carapace sometimes all dark red. Dorsum of abdomen with a grey pattern (fig. 37) with some reddish around the edges. Venter with two black bands, as wide as their intermediate area which is yellow white with some reddish pigment, sides white.

Structure much like that of male except for anterior eyes which are slightly farther apart but about the same size as those of male. Abdomen lacking thorns on lateral extensions. Epigynum a slight circular depression, in the center of which is a lip (fig. 28). The ducts open into the posterior margin of the depression.

Total length of the females 1.6-2.4 mm. Holotype, total length 2.4; carapace 0.75 long, 0.65 wide, 0.22 high. First femur, 1.04; patella and tibia, 1.04; metatarsus, 0.90; tarsus, 0.49. Second patella and tibia, 0.65. Third patella and tibia, 0.52. Fourth patella and tibia, 0.81.

Type locality: Female holotype from South Bimini, Bahama Islands, Dec. 12-18, 1952 (A. M. Nadler).

Records: BAHAMA ISLANDS: South Bimini, Aug. 2-9, 1951, ♀ paratype (C. and P. Vaurie); Dec. 5-9 ♂ allotype (A. M. Nadler); March 22-28, 1953, ♀ paratype (A. M. Nadler). North Bimini, Dec. 4, 1952, juv. (A. M. Nadler).

Spintharus Hentz

Spintharus Hentz, 1850, Jour. Boston Soc. Nat. Hist. 6: 284. Genotype: *Spintharus flavidus* Hentz.

Medium sized theridiid spiders. Carapace low and almost circular in outline, highest between posterior median eyes. Thoracic region hardly raised with a slight median circular depression. Clypeus concave. Eyes small and subequal or anterior medians slightly smaller. Anterior eye row straight to slightly recurved as seen from in front, posterior row procurved as seen from above. Lateral eyes touching. Anterior eyes closer to laterals than to each other. Posterior eyes much closer to laterals than to each other. Chelicerae small. Posterior coxae separated by their width. Legs long. First or fourth legs longest, third shortest. Comb present on fourth tarsi. Spinnerets on posterior tip of abdomen. Colulus very small, usually with the two setae on its tip barely visible. Epigynum an oval pit, one pair of seminal receptacles present. Embolic division (E in fig. 48) of palpus has shape typical of that of theridiids close to *Theridion*. The length of the embolus is supported by the conductor (C) which is attached to the tegulum (T) by haematodocha. Only a seam in *Spintharus flavidus* appears to separate the median apophysis (M) from the tegulum. The median apophysis fastens the bulb in the alveolus of the cymbium (Y). A radix (R) is present.

Spintharus flavidus is common under the lower surface of leaves of bushes. It builds a delicate, nearly invisible web, and each foot is supported by a thread. (Comstock, 1940). The only known species of *Spintharus* are from America. (*S. argenteus* Dyal, 1935, Bull. Dept. Zool., Panjab Univ. 1: 159 (figs. 80-85 ♂ ♀) is probably not a *Spintharus*.)

Species described as *Spintharus* which do not belong to this genus: *Spintharus minutus* Petrunkevitch, 1926, Trans. Connecticut, Acad. Sci. 28: 51 (fig. 11 ♀) from the Virgin Islands. Bryant, (1942, Bull. Mus. Comp. Zool. 89: 343) synonymized *Theridion dexteri* Petrunkevitch, 1930, Trans. Connecticut Acad. Sci. 30: 200 (fig. 45-50 ♂ ♀) from Puerto Rico with this species.

Spintharus flavidus Hentz
Figures 46, 48-50, 52, 53.

Spintharus flavidus Hentz, 1850, Jour. Boston Soc. Nat. Hist. 6: 284 (pl. 10, fig. 8 ♀).-Hentz, 1875, Spiders of the United States, p. 156, (pl. 17, fig. 8 ♀).-Emerton, 1882, Trans. Connecticut Acad. Sci. 6: 28 (pl. 5, fig. 7 ♀).-Keyserling, 1884, Die Spinnen Amerikas 2(1): 176 (pl. 8, fig. 107 ♂ ♀).-Marx, 1889, Proc. U. S. Nat. Mus. 12: 523.-Marx, 1892, Proc. Ent. Soc. Washington 2: 156.-Simon, 1894, Proc. Zool. Soc. London 1894, p. 521.-Simon, 1894, Histoire Naturelle des Araignées 1: 513 (fig. 519).-Banks, 1896, Jour. New York Ent. Soc. 4: 228.-Banks, 1898, Proc. California Acad. Sci., 3rd ser. 1: 279.-Emerton, 1902, The Common Spiders of the United States, p. 127 (fig. 302 ♀).-F. O. P.-Cambridge, 1902, Biologia Centralia-Americana, Araneidea 2: 398 (pl. 37, fig. 28, 29 ♂ ♀).-Banks, 1904, Proc. Acad. Nat. Sci. Philadelphia 56: 126.-Bryant, 1908, Occas. Pap. Boston Soc. Nat. Hist. 7: 11.-Banks, 1910, Bull. U. S. Nat. Mus. 72: 24.-Banks, 1911, Proc. Acad. Nat.

Sci. Philadelphia 63: 446.-Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist. 29: 187.-Comstock, 1912, The Spider Book, p. 341 (fig. 332-334 ♂ ♀).-Barrows, 1918, Ohio Jour. Sci. 18: 304.-Petrunkevitch, 1925, Trans. Connecticut Acad. Sci. 27: 67.-Bishop and Crosby, 1926, Jour. Elisha Mitchell Sci. Soc. 41: 180.-Crosby and Bishop, 1928, Mem. Cornell Univ. Agric. Exp. Sta. 101: 1040.-Banks, 1929, Bull. Mus. Comp. Zool. 69: 86.-Petrunkevitch, 1930, Trans. Connecticut Acad. Sci. 30: 178.-Banks, Newport and Bird, 1932, Univ. Oklahoma Biol. Surv. 4: 22.-Kaston, 1938, Bull. Connecticut Geol. Nat. Hist. Surv. 60: 186.-Comstock, 1940, The Spider Book, rev. edit., p. 356, (fig. 332-334 ♂ ♀).-Bryant, 1940, Bull. Mus. Comp. Zool. 86: 309.- Roewer, 1942, Katalog der Araneæ 1: 444.-Muma, 1943, Common Spiders of Maryland, p. 63 (pl. 12, fig. 18, 19 ♂ ♀).-Muma, 1945, Bull. Univ. Maryland, Agric. Exp. Sta. A38: 27.-Archer, 1946, Pap. Alabama Mus. Nat. Hist. 22: 29.-Bryant, 1948, Bull. Mus. Comp. Zool. 100: 380.-Kaston, 1948, Bull. Connecticut Geol. Nat. Hist. Surv., 70: 90 (fig. 87 ♀).-Archer, 1950, Pap. Alabama Mus. Nat. Hist. 30: 25 (pl. 3, fig. 1,2 ♂).-Kaston, 1953, How to Know the Spiders, p. 158 (fig. 398 ♀).

Spintharus elongatus Keyserling, 1884, Die Spinnen Amerikas, 2(1): 178 (pl. 8, fig. 108 ♀).

Spintharus lineatus O. P.-Cambridge, 1896, Biologia Centrali-Americana, Araneidea 1: 190 (pl. 23, fig 11 ♂).

Spintharus affinis O. P.-Cambridge, 1896, Biologia Centrali-Americana, Araneidea 1: 190 (pl. 24, fig. 2 ♂).

MALE: Coloration of carapace yellowish white, sometimes with a dusky border Sternum, legs, yellowish white. Distal ends of femora, tibiae and metatarsi frequently yellow, dusky, black or red. Abdomen with fine dusky or black longitudinal lines on each side and indications of two dusky or red crossbands.

Anterior median eyes separated by 0.8 their diameter, one-third their diameter from laterals. Posterior median eyes separated by two and one-half diameters, by one-half diameter from laterals. Eyes subequal in size. Height of clypeus three diameters of anterior median eyes, chelicerae slightly longer. First legs usually longer than fourth. Two fine spines present on dorsal surface of patella, and one in center of tibia. Sides of abdomen almost parallel, or slightly wider anterior, three times as long as wide. The palpus (fig. 48, 49) differs from that of *S. gracilis* Keyserling (Die Spinnen Amerikas 2(2): 244, pl. 20, fig. 298 ♂ ♀) in the shape of the conductor and also in that the embolus of specimens of *S. gracilis* from Brazil examined describes a very much wider loop than that of *S. flavidus*. The shape of the palp of *S. gracilis* is rounder.

Total length of males 2.2-3.1 mm. A specimen from Alabama measured 2.7 total length; carapace 0.93 long, 0.87 wide, 0.36 high. First femur, 2.60; patella and tibia, 2.54; metatarsus, 2.88; tarsus, 0.56. Second patella and tibia, 1.30. Third patella and tibia, 0.81. Fourth patella and tibia, 2.08.

FEMALE: Coloration like that of male except for abdomen (fig. 46, 50) which is white or yellow with black or red marks, but quite variable in color judging by the preserved specimens.

Anterior median eyes slightly smaller than others in a ratio (1: 1.2) and separated from each other by one and one-quarter diameters and by one-half diameter from laterals. Posterior median eyes separated by two to three diameters, two-thirds diameter from laterals. Height of clypeus three and one-half diameters of anterior median eyes, cheliceræ four diameters. Fourth or first legs the longest. Abdomen widest near anterior end. Tracheal spiracle some distance (about the length of an anterior spinneret) from spinnerets. The internal female genitalia are very difficult to study. The canal enters the seminal receptacles laterad. Whether the coils posterior to the seminal receptacles are supports or part of the duct is not certain, although they are believed to be part of the duct. There is considerable variation as to the position of these coils in different specimens. Epigynum is illustrated by figure 52.

Total length of females 3.0-5.4 mm. A specimen from Alabama measured 3.60 total length; carapace 1.10 long, 1.07 wide, 0.44 high. First femur, 2.20; patella and tibia, 2.14; metatarsus, 2.31; tarsus, 0.56. Second patella and tibia, 1.17. Third patella and tibia, 0.75. Fourth femur, 2.45; patella and tibia, 2.20; metatarsus, 2.70; tarsus, 0.69.

This is an extremely variable species. In some specimens from Central America the eye region is elevated and the eyes are closer together. The coloration and shape of the abdomen is quite variable. One specimen from Veracruz has tubercles on the anterior end of the abdomen. The embolic division of the palpus varies in shape in different males particularly as to curvature and length of embolus. The connecting ducts of the female genitalia likewise are quite variable. It is assumed, however, that a specimen on hand from Trinidad is a distinct species.

Type localities: *Spintharus flavidus* was described by Hentz as coming from Alabama. Keyserling described *S. elongatus* from Tambillo, Peru. *S. lineatus* O. P.-Cambridge was found in Chichochoc, Guatemala and *S. affinis* in Coban, Guatemala.

Distribution: Eastern United States, Mexico, Central America and probably South America.

Records: MASSACHUSETTS: Middlesex Co.: Malden (Bryant 1908). Suffolk Co.: Boston (Bryant 1908). CONNECTICUT: New Haven Co.: Meriden (Bryant 1908): New Haven (Kaston 1948). NEW YORK: Tompkins Co.: Ithaca (Crosby and Bishop 1928). Long Island (Banks 1896). NEW JERSEY: Bergen Co.: Alpine. MARYLAND: Anne Arundel Co.: Annapolis (Muma 1943). Charles Co.: (Muma 1945). Garrett Co.: Salt Rock Creek (Muma 1943). Howard Co.: Scaggsville (Muma 1943). Prince Georges Co.: Fort Washington (Muma 1943); Suitland (B. Malkin). Somerset Co.: Princess Anne, (Muma 1943). Washington Co.: Town Hill (Muma 1943). DISTRICT OF COLUMBIA: (Marx 1892; Muma 1945). VIRGINIA: Rockbridge Co.: Greenlee. Brunswick Co.: Alberta (Bishop and Crosby 1926). WEST VIRGINIA: Ohio Co.: Wheeling (K. W. Haller). Hancock Co.: Tomlinson Run State Park (K. W. Haller). OHIO: Knox Co.: Brinkhaven (Barrows 1918). KENTUCKY: Carter Co.: Olive Hill. NORTH CAROLINA: Wake Co.: Raleigh (Bishop and Crosby 1926). Madison Co.: Paint Rock (Banks 1911). GEORGIA: Clarke Co.: Athens. Hall Co.: Gainesville (B. J. Kaston). FLORIDA: Duval Co.: Jacksonville. Pinellas Co.: Clearwater (B. Malkin). Sarasota Co.: Sarasota (A. M. Nadler). Highlands Co.: Highlands Hammock (W. J. Gertsch and A. M. Nadler); Lake Ishtopoka (A. M. Nadler). Collier Co.: Everglades (A. M. Nadler). Monroe Co.: Tavernier (A. M. Nadler). Dade Co.: Miami (A. M. Nadler); Kendall (A. M. Nadler). ALABAMA: Madison Co.: Monte Sano (Archer 1946). Cherokee Co.: May's Gulf (Archer 1946). De Kalb Co.: De Soto State Park (Archer 1946). Jefferson Co.: Shade's Mountain (Archer 1946). Hale Co.: Moundville (Archer 1946). Escambia Co.: Brewton (Archer 1946). Houston Co.: Dothan (Archer 1946). Mobile Co.: Mon Luis Island (Archer 1946). Baldwin Co.: Hog Creek

(Archer 1946); Cheaha State Park (Archer 1946); Lagoon (A. F. Archer). OKLAHOMA: Delaware Co.: (Banks, Newport and Bird 1932). BAJA CALIFORNIA: (Banks 1898). DURANGO: El Salto (W. J. Gertsch). COLIMA: Manzanillo (F. Bonet). PUEBLA: Huauchinango (H. M. Wagner). VERACRUZ: Cordoba (J. C. and D. L. Pallister). CHIAPAS: Las Casas (C. and M. Goodnight, L. Stannard); Tenejapa (C. Goodnight). GUATEMALA: Moca (C. and P. Vaurie). PANAMA: El Volcan, Chiriqui (W. J. Gertsch). CANAL ZONE: Barro Colorado Isl. (Banks 1929). CUBA: Soledad (Bryant 1940); Trinidad Mountains (Bryant 1940); Pico Turquino (Bryant 1940). HAITI: La Visite (6000-7000 ft.) (Bryant 1948); foot hills, n.e. of LaHotte (4000 ft.) (Bryant 1948). DOMINICAN REPUBLIC: Cordillera Central, n. of Loma Rucilla Mountains, (5000-8000 ft.) (Bryant 1948); foot hills of Cordillera Central, n. of Santiago, (2000-5000 ft.) (Bryant 1948); Cordillera Central, rain forest n. of Valle Nuevo, (6000 ft.) (Bryant 1948). PUERTO RICO: Adjuntas (Petrunkevitch 1930). LESSER ANTILLES: St. Vincent Island (Simon 1894). PERU: Utcuyacu, Junin, (1600-2200 m.) (F. Woytkowski).

Spintharus hentzi, new species
Figures 47, 51, 54, 55.

FEMALE: Carapace yellowish white, a reddish brown patch on each side on posterior lateral corner. Sternum yellowish white. Legs yellow white with patellæ and tibiæ darker, especially on the fourth legs which have these two segments reddish brown. Abdomen yellowish white except dorsum which is yellowish between inner pair of dark red longitudinal stripes. Tubercles and area between them covered by a dark red patch. Four pairs of white spots on dorsum. The pair of spots on ectal sides of tubercles are not visible in figure 47.

Eyes on diagnostic turret (fig. 51). Anterior median eyes separated by one diameter, almost touching laterals. Posterior median eyes a little less than one and one-half diameter apart, less than a fourth their diameter from laterals. Laterals touching each other. Anterior median eyes smaller than others in a ratio (1: 1.8). Height of clypeus about 6 diameters of anterior median eyes. Fourth legs much longer than first. Abdomen with a diagnostic pair of anterior tubercles (fig. 47, 51). The internal genitalia, because they are sclerotized, are difficult to study. Connecting ducts appear to be without loops (fig. 55). Epigynum (fig. 54) similar to that of *S. flavidus*.

Total length of female holotype 4.5 mm; carapace 1.10 long, 1.14 wide, 0.59 high. First patella and tibia, 2.01. Second patella and tibia, 1.34.

Third patella and tibia, 0.94. Fourth femur, 2.82; patella and tibia, 2.30; metatarsus, 2.90; tarsus, 0.72.

This species differs from *S. flavidus* in that the eyes are on a turret and closer together, in having a pair of abdominal tubercles and in that the internal female genitalia are more sclerotized, and the connecting canals are devoid of a loop. Only the study of a male will make certain that this species is distinct from *S. flavidus* and *S. gracilis.*

Type locality: Female holotype from Arima, Trinidad, collected in May, 1953 by N. L. H. Krauss.

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Wiehle, H. 1937. Theridiidæ oder Haubennetzspinnen (Kugelspinnen) in F. Dahl. Die Tierwelt Deutschlands 33: 119-222.

Plate I

Fig. 1-3. *Episinus truncatus* Latreille, left palpus. 1. Ventral view. 2. Ventral view, expanded (cymbium removed). 3. Dorsal view, expanded (cymbium removed).

Fig. 4. *E. amœnus* Banks, palpus, ventral view.

Fig. 5-6. *E. juarezi* n. sp., palpus. 5. Ventral view. 6. Ventral view, expanded.

Fig. 7. *E. chiapensis* n. sp., palpus, ventral view.

Fig. 8-10. *E. cognatus* O. P.-Cambridge, palpus. 8. Ventral view. 9. Ventral view, expanded. 10. Dorsal view, expanded (cymbium removed).

Fig. 11. *E. colima* n. sp., palpus, ventral view.

Fig. 12. *E. nadleri* n. sp., palpus, ventral view.

Fig. 13. *E. bruneoviridis* (Mello-Leitão), palpus, ventral view.

Fig. 14. *E. panamensis* n. sp., palpus, ventral view.

(C, conductor; E. embolus; M, median apophysis; R, radix; T, tegulum; Y, cymbium.)

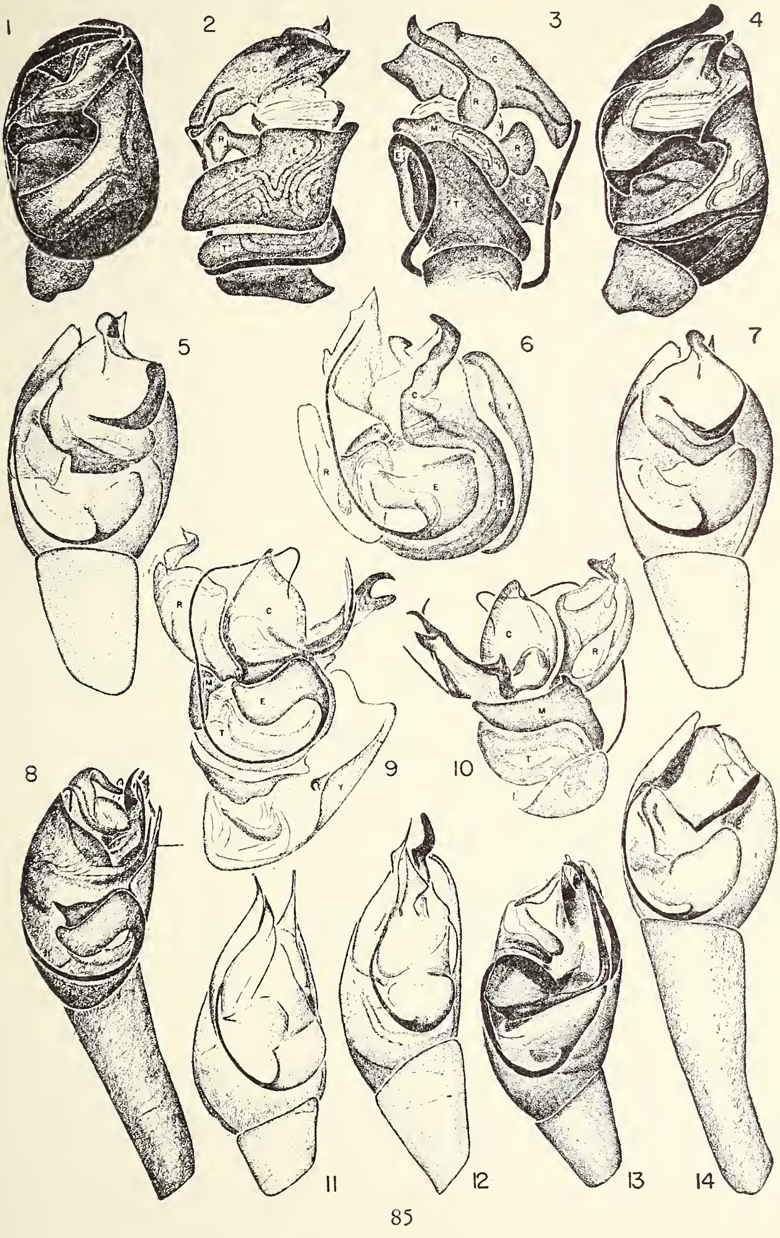
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Plate II

Fig. 15-16. *Episinus truncatus* Latreille. 15. Epigynum. 16. Female genitalia, dorsal view.

Fig. 17-18. *E. amœnus* Banks. 17. Epigynum. 18. Female genitalia, dorsal view.

Fig. 19-20. *E. bruneoviridis* (Mello-Leitão) 19. Epigynum. 20. Female genitalia, dorsal view.

Fig. 21-22. *E. cognatus* O. P.-Cambridge. 21. Epigynum. 23. Female genitalia, dorsal view.

Fig. 23. *E. gratiosus* Bryant, epigynum (after Bryant).

Fig. 24-25. *E. erythrophthalmus* (Simon). 24. Epigynum. 25. Epigynum, cleared.

Fig. 26-27. *E. dominicus* n. sp. 26. Epigynum. 27. Epigynum, cleared.

Fig. 28-29. *E. nadleri* n. sp. 28. Epigynum. 29. Female genitalia, dorsal view.

Fig. 30-31. *E. juarezi* n. sp. 30. Epigynum. 31. Female genitalia, dorsal view.

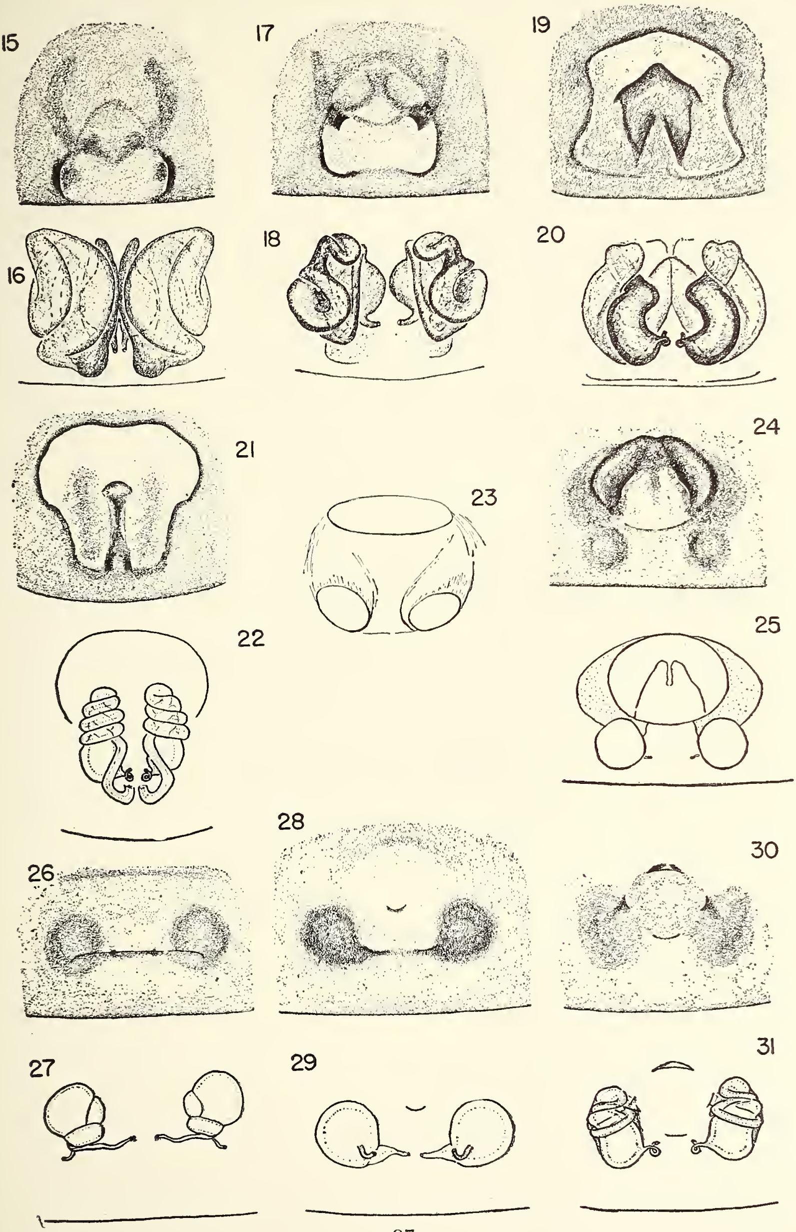
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Plate III

Fig. 32. *Episinus amœnus* Banks, dorsal view, female (legs removed).

Fig. 33. *E. cognatus* O. P.-Cambridge, dorsal view, female.

Fig. 34. *E. bruneoviridis* (Mello-Leitão), dorsal view, female.

Fig. 35. *E. panamensis* n. sp., dorsal view, male.

Fig. 36. *E. erythrophthalmus* (Simon), dorsal view female.

Fig. 37. *E. nadleri* n. sp., dorsal view, female.

Fig. 38. *E. dominicus* n. sp., dorsal view, female.

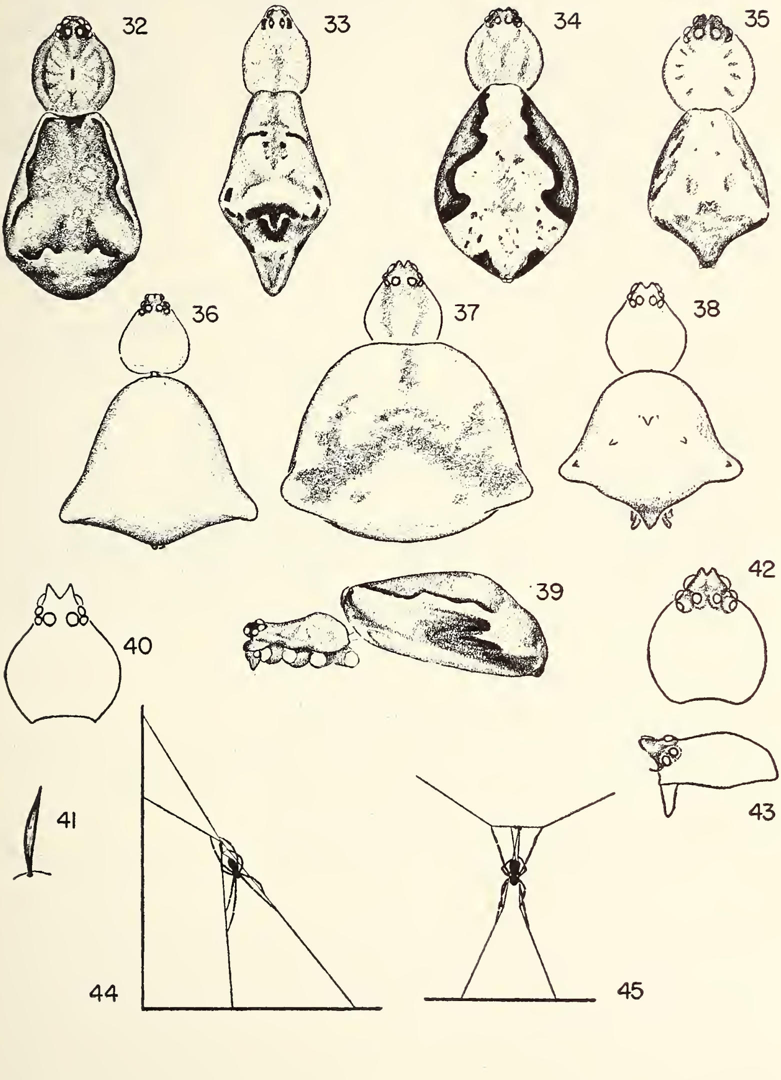
Fig. 39. *E. amoenus* Banks, lateral view, female.

Fig. 40. *E. colimus* n. sp., dorsal view of carapace, male.

Fig. 41. *E. cognatus* O. P.-Cambridge, spindle shaped seta.

Fig. 42-43. *E. juarezi* n. sp., carapace, male. 42. Dorsal view. 43. Lateral view.

Fig. 44-45. *E. angulatus* (Blackwall), web (after Holm).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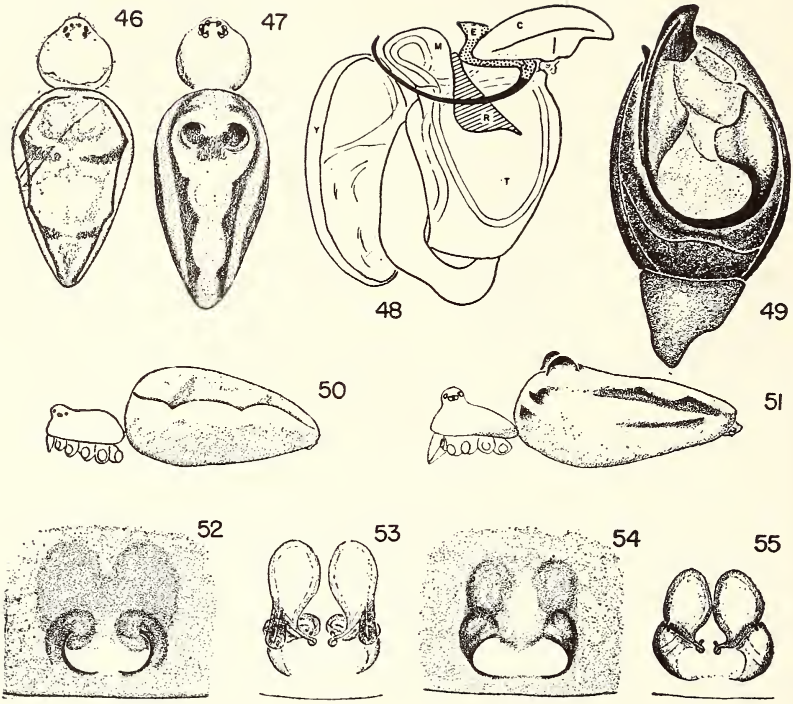

Fig. 46. *Spintharus flavidus* Hentz, dorsal view, female.

Fig. 47. *S. hentzi* n. sp., dorsal view, female.

Fig. 48-50. *S. flavidus* Hentz. 48. Palpus, subventral view, expanded. 49. Palpus, ventral view. 50. Lateral view, female.

Fig. 51. *S. hentzi* n. sp., lateral view, female.

Fig. 52-53. *S. flavidus* Hentz. 52. Epigynum. 53. Female genitalia, dorsal view.

Fig. 54-55. *S. hentzi* n. sp. 54. Epigynum. 55. Female genitalia, dorsal view.

(C, conductor; E, embolus; M, median apophysis; R, radix; T, tegulum; Y, cymbium.)

NOTES ON THE BUMBLE-BEE (BOMBUS FERVIDUS FABRICIUS) AND ITS CHROMOSOMES

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One of the more common of the bumble-bees in northern New England is *B. fervidus.* Yet its nests are not always easily found and collected. So when, in the present case, a nest was located in the open space beneath the frames of an abandoned beehive, collection seemed imperative, especially as it was necessary to move the hive.

The nest was a loose mass of soft, lightly entangled, slender grass blades, amongst which there were a few bits of goose-down. The position of the beehive made it almost certain that all this material was carried in and arranged by the bees. In the center of this mass, there was the single irregular comb, about 12cm. across, resting on a thin layer of grass blades. Collection was made late in the afternoon of August 19, 1947, and included all foraging bees as they returned (from foraging). Presumably the entire colony was taken: no additional bees were observed later.

Fixation was in a modification of Bouin's solution, the adults being plunged directly into this fluid without dissection. The contents of the cells were removed carefully and also put into the fixing fluid. Finally several pieces of the comb itself were dropped into the fixative. Five separate cells in the comb were partially full of a very thick dark brown honey which was extremely fragrant and of a very fine taste.

The nest contained four eggs, fifteen larvæ, forty-two pupæ (plus one male prepupa) and seventeen adults. Later on, each of these was sectioned and stained in Heidenhain's hæmatoxylin, as were a few of the emptied cells. The adult bees comprised one conspicuously large specimen, 21.5 mm. long, and an extremely small one (scarcely 7.8 mm. long; all the others were very uniformly 13 — 16 mm.

long). Of this group, ten were very definitely worker adults, containing very small undeveloped ovaries with no eggs; the remaining five were male bees, with mature sperm.

Of the pupæ, 37 were found to be males, five were apparently to become workers, and one only was a queen.

The larvæ fall into three very distinct size groups; seven are large ones, nearly fully grown. Of these, six are males, the other probably a worker. Two of the males are about half the length of the preceding group. Six larvæ are very small; two of these are definitely males, the other four are as yet indeterminate.

One of the eggs was newly laid and uninucleate. The others all had embryo developed to cover the greater part of the yolk surface. In one, development of the stomo- and proctodæum was well advanced, but differentiation was not great. Two of the eggs showed a great many cells with nuclei in various stages of division. Each nucleus contained a single rather prominent nucleolus, and an indeterminate number of very small uniformly dispersed chromatin granules. The surrounding cytoplasm was noticeably more dense than that of the nucleus and quite uniform. The earliest evidence of impending division was found in a gradual increase in the amount of dark staining material, which tended gradually to aggregate to form what at first appeared to be a continuous but irregular filament, and then with increasing diameter broke into discrete elongate particles. There were twelve of these; usually it was difficult to determine the exact number at this stage, since they were not all in one plane. (Fig. 1.) Typical division stages showed the various phases passed through, (Fig. 2 & 3 for anaphase and Fig. 6 for metaphase and telophase). There was one conspicuous exception to this series, and it was shown quite clearly in a great many cells in these eggs. Mostly these cells were in the epidermis, and were usually rather conspicuous because they protruded above the general level of the egg surface, often for about one half their diameter. In these cells, the number of chromosomes was just double that of those above described, being clearly twenty-four. Two of these cells are shown in metaphase in Figs. 4 & 5. It is to be noted that these cells seem to be rather uniformly distributed in the epidermal tissues.

Dividing nuclei occurred rather sparingly in the cells of the fifteen larvæ, and showed little that was not seen earlier in the eggs. Here, however, there was greater difference in the sizes of the cells, with corresponding but smaller differences in the nuclear sizes. In Figure 7 is shown a typical epidermal cell, with the twelve chromosomes forming a compact group in a faintly staining enveloping substance. Surrounding this there is a conspicuously clear zone, in turn surrounded by the darker mass of uniformly fine granular cytoplasm. Figure 8 presents a chromosome picture that is frequently seen in this bee, that of two chromosomes noticeably smaller than the other ten. This apparently is not so in all the cells, as is clear from a comparison of these two figures.

In the larvæ were to be seen frequently cells in which there were more than the usual number of chromosomes, usually 24 instead of 12. (Fig. 10.) As in the eggs, these cells occurred singly, almost always in the epidermis. Occasionally a cell was noted which seemed to have even more than 24 chromosomes. Figure 9 is an example, in which there appear to be at least thirty chromosomes. No differences were to be found between corresponding cells in worker and male larvæ. No good dividing nuclei were found in the testes in larvæ.

Among the pupæ, only in the males were there cells showing good nuclear divisions. In them these were often abundant, especially in the testes. Some of the individuals showed no indication of reduction divisions, the testes still being formed of uniformly regular crowded cells (Fig. 11); other specimens showed testes in which sperm maturation was nearly completed. In individuals between these two groups, there were often large numbers of dividing cells in all stages, from regular divisions of undifferentiated cells showing the usual twelve quite uniform chromosomes (Figs. 12-15), to those showing various stages in reduction division (Figs. 18-23). The latter occurred in scattered groups in the several testes lobes, each group seeming to be very uniform in the stage and rate of division of its cells; but among the different groups, there was the greatest of irregularity.

One fact was very frequently noticeable — when the chromosomes began moving from the metaphase plate to the poles, often very great irregularity seemed to be the rule. Another noticeable feature was the presence of one or two small granules among the chromosomes. Perhaps there were always two of these granules, but in many cases, there seemed to be only one. Not infrequently none was observed, especially in the earlier stages of division. It is easy to suppose that even if present one or both of these granules could be obscured by a much larger chromosome. With separation of the chromosome halves and migration to the spindle poles, these granules seemed to be much more frequently observed, when they were quite often seen lagging behind on the spindle, even after the chromosomes had begun to lose their identity when merging into a forming nucleus. (Figs. 15, 17, 21 & 22). In no case could any connection of the granules to any chromosome be detected.

At the completion of the reduction divisions, there were often formed rather large spherical cells not unlike the cells forming the early testes except that these following reductions had very small spherical nuclei about 2μ in diameter. (Fig. 26.) In other and apparently more usual cases, reduction division led into sperm maturation at once. Well before the end of pupation, sperm formation had been completed in the entire testes.

In the pupa, many cells were observed to have a larger chromosome number than twelve. Most conspicuous of these polyploid cells were some in the forepart of the intestine, where the cells occurred singly, were of noticeably larger size and when properly oriented showed conspicuous spindles. (Fig. 28.) In these cells the chromosome number was frequently 24, but occasionally appeared to be at least 30 or higher. (Fig. 27.) In the forepart of the gut, in the region of the proventriculus, similar large cells with increased chromosome numbers were often observed. (Fig. 25.)

In the head, where they were apparently always limited to certain of the appendages and to the epidermis, there were some exceptionally large cells. No satisfactory divisions were observed in any of these cells, but a few gave indication that the chromosome numbers were large, perhaps as high as 36.

As is usual in Hymenoptera, the cells of the brain cortex showed a very great range in size, some being truly gigantic. In no case could an accurate chromosome count be made in any of these large cells, but it was definitely in the order of 24 and 36.

Little need be said of the adults here. The only dividing nuclei found in any of them were in the queens, and there only in the cells of the follicular epithelium. Even here nuclear divisions were rarely found. In these, there were invariably twelve chromosomes, very small here as would be expected, considering the small size of the cells.

Presumably such reduction divisions as were to occur in the females had been completed before fixation. But all stages in egg formation were found. In the smallest eggs, scarcely distinct from the surrounding cells, the nucleus was relatively very large, with conspicuously sparse chromatin substance. As egg enlargement progressed, the egg nucleus gradually changed its position and its shape, moving to a position near the lower end of the egg, until it seemed pressed against the egg membrane and had a thick discoid shape. Later in development, it moved away from this position and once again became spherical.

Sectioning of the cells of the comb showed that in nearly all cases the inner wall of the cell was covered with an irregular layer of pollen grains, sometimes sparse and sometimes two to four grains thick. These grains were from four different plants, in about equal numbers. Very rarely a grain of some other plant was seen. These were of the same species as those which were observed in the midguts of the several larvæ.

EXPLANATION OF FIGURES

1. Epidermal cell of embryo in egg, the chromatin now aggregated into twelve chromosomes.

2. From the same egg, an epidermal cell in early anaphase, the twelve pairs of chromosomes being quite clear. The darker ones are above the shaded ones.

3. Two epidermal cells, one showing a later stage of anaphase. The nucleus of the cell at the right is sectioned, only ½ being figured in this section. The chorion is indicated above the cells.

4. Two complete epidermal cells plus a portion of a third from the epidermal layer of the same egg. One cell protrudes very prominently above the surface of the egg; in this there are 24 chromosomes.

5. Another of these protruding cells, also with 24 chromosomes, from another egg.

6. Two cells from stomodaeum, that at the left with twelve chromosomes at metaphase, that at the right in (late) telophase, the nuclear division nearing completion. These cells border the lumen of the stomodaeum.

7. Surface cell from a small worker larva, showing the twelve small chromosomes.

8. Cell from a medium sized worker larva, showing twelve chromosomes, two of which are conspicuously smaller.

9. Epidermal cell of same medium sized larva, with over 30 chromosomes.

10. Surface cell of medium sized larva, showing one of the many cells having a greater number of chromosomes. In this nucleus there are 24, in metaphase.

11. Spermatogonia, in early prophase.

12. & 13. Spermatogonia, showing metaphase plate, with twelve chromosomes, plus small granule.

14. Spermatogonium, showing 12 chromosomes, plus very small granule, very irregularly distributed on the spindle.

15. Spermatogonium, in mid- anaphase, with twelve chromosomes to each half, plus a minute granule.

16. Spermatogonium, showing bent spindle.

17. Early telophase, with minute granule remaining remote from two chromosome masses.

18. Stage of second spermatocyte division.

19. Early pairing of chromosomes in spermatocyte division.

20. Spermatocyte division, showing six chromosomes, plus two minute particles.

21. Late anaphase, showing six pairs of chromosomes, plus two small granules, in spindle fibres.

22. Group of three cells in early to mid- telophase, showing lagging particles; and at right, six chromosomes at each pole.

23. A cell similar to one at right above, but cut transversely, showing the six small chromosomes rather clearly.

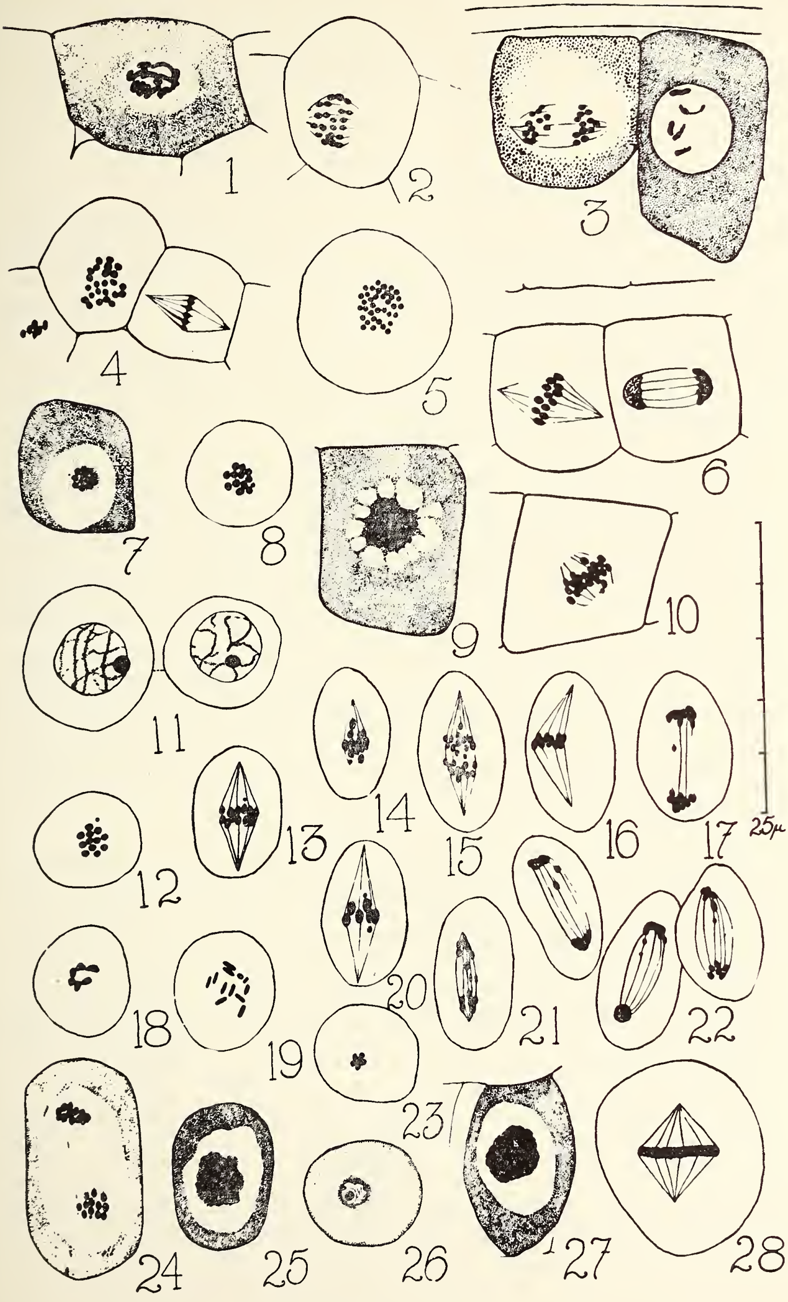
24. In wall of oesophagus, in thorax of male pupa, showing late anaphase with twelve chromosomes, plus small granule.

25. In same region as fig. 24, but in metaphase, and with 24 chromosomes.

26. Cell before beginning of sperm formation.

27. Large cell in fore part of intestine, showing at least thirty chromosomes.

28. Cell in same region, at right angles to that in fig. 27.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NEW ARRANGEMENTS FOR JOURNAL

Beginning with Volume 62, of which this Journal is the second issue, the publication of the Journal of the New York Entomological Society has been transferred to New Haven, Connecticut. The present editor and the editor emeritus, had been hopeful that it would be possible to continue publication with the former publishers, Business Press, Inc., of Lancaster, Pennsylvania, but the matter of costs forced the Society to make the final decision.

We have nothing but praise for the careful, workmanlike product of the former publishers, who served us well for the 28 year period, 1925 - 1953. The Science Press Printing Company, Lancaster, Pennsylvania, operated by the Cattell family, printed the Journal during the years 1925 - 1947 and when that company sold out to Business Press, Inc., this publication went over to the new company which continued to serve us through 1953. We would not ordinarily differentiate between Business Press and Science Press, because of the fact that most of the persons with whom the Journal dealt transferred their employment from the former firm to the latter, when the business was sold.

So we have moved. Obviously, there have been many difficulties in bringing forth the first issue of Volume 62, due in March, 1954, and appearing, finally, in December, 1954. Publication of the current issue has also lagged badly. It is expected that, during the 1955 calendar year, the Journal will be able to make a partial recovery toward appearing on schedule and that the four issues of the 1956 volume will appear by the end of that year. — F. A. Soraci.

A NEW ARACHISOTHRIPS FROM ARGENTINA

By J. Douglas Hood
Cornell University, Ithaca, N. Y.

The species bescribed below was taken by Dr. Petr Wygodzinsky at Tucumán Argentina, and is particularly interesting because the known distribution of the genus is thereby extended from Mexico and Jamaica to the far southern portion of South America.[1]

Arachisothrips seticornis, sp. nov. (Pls. V and VI).

Female (macropterous).— Length 0.82 mm. Color brownish yellow; pterothorax darkened laterally, abdomen paler apically, legs concolorous with body; fore wings with a gray-brown band across middle of inflated part, this band broadened along posterior margin of wing and connected along this margin with a second cross-band which occupies basal half of narrowed apical part of wing; antennal segment I yellow and paler than head, II yellowish brown and darker than head, III and IV yellow and shaded with gray in about basal half except for the yellow, narrow pedicel of III; V-VIII gray brown, the first of these paler than the others, especially in basal half.

Head (Fig. 2) typical in form, with strongly constricted, neck-like base, protruding eyes, distinct postocular notch, and broad frontal costa; cheeks greatly swollen, somewhat diverging posteriorly, then so abruptly constricted that the posterior margin of the resulting bulge is transverse; dorsal surface polygonally reticulate. Eyes small, rounded, 53μ long dorsally, 40μ wide, 91 apart. Ocelli small, borne on a slight prominence, the median one facing forward above a longitudinal groove, the posterior pair directed somewhat posteriorly and laterally, 13μ in diametter and 13μ apart. Mouth-cone short (66μ), broadly rounded. Antennae (Fig. 3) eight-segmented, typical in structure, terminal segment extremely long and slender, about twenty-two times as long as greatest width; antennae almost devoid of setae and with all sense-cones simple and arising from outer surface of segments, III-V each with one near apex, VI with one at apical third, VII with one at basal third, this the largest; segment II reticulate with asperate lines, III-V each with several distinct, raised cross-lines.

Prothorax (Fig. 2) transverse, sides diverging posteriorly (rather than merely rounded), dorsum finely cross-striate throughout, except in the two sublateral foveae and for a few polygonal reticles laterally (rather than

[1]The cost of the cuts for the two accompanying plates was borne by Cornell University, through its committee on Faculty Research Grants.

striate merely anteriorly and posteriorly); posterior third abruptly elevated and with its anterior margin vertical (rather than undifferentiated from rest of notum); all setae minute. Fore wings (Figs. 1, 4, 5) typical, greatly inflated in basal two-thirds to form a sac, but not appreciably constricted at middle of this inflation, entire surface of wing except extreme tip and an area along costal margin near base of wing polygonally (usually hexagonally) reticulate; ambient vein complete, broad, and strong, its costal portion set with stout, nearly black, backwardly-curved, asperate (not pinnate) setae (Fig. 6) which are supported by pale stalks, the setae disposed in two series in the saccate part of wing, one series arising from anterior margin of vein and directed outward, the other arising from inner surface and directed inward, both series inclined upward (morphologically) and together presenting the appearance of ribs arising from a breastbone, several of them projecting beyond base of wing as seen from above; median vein broad and distinct, with one stalked seta where it ends on distal margin of inflation; one long (160μ), slender, pale seta extending into wing-sac; hind wings typical. Legs typical, tibiae claviform (Figs. 7-9).

Abdomen normal, lightly reticulate at sides, lightly cross-striate elsewhere in most of dorsal surface.

Measurements of female (holotype): Length 0.82; head, total length 0.110, median length 0.106, width across eyes 0.171, just behind eyes 0.155, greatest width across cheeks 0.167, least width near base 0.107; prothorax, median length of pronotum 0.070, greatest width of pronotum 0.190; mesothorax, greatest width across anterior angles 0.203; metathorax, greatest width posteriorly 0.231; fore wings, length 0.853, greatest width 0.276; abdomen, greatest width 0.337.

Antennal segments:	I	II	III	IV	V	VI	VII	VIII
Length (μ):	30	47	110	63	62	43	32	132
Width (μ):	34	35	18	17	19	14	9	6

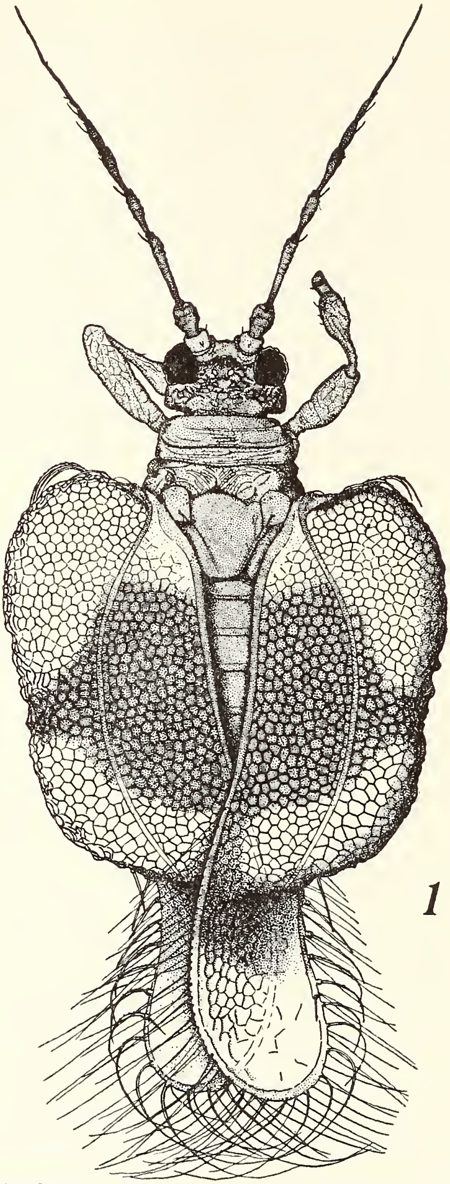
Total length of antenna 0.519 mm.

ARGENTINA: Tucumán, February 14, 1953, Dr. Petr Wygodzinsky, 1 ♀ (holotype), from "Parque Aconquija, in a dark and rather moist place in the forest, near a small creek, among fallen leaves."

It is impossible to compare this species satisfactorily with the two previously-named ones because the descriptions of the latter are too brief and do not include the measurements which present-day workers on the group consider essential. The eight-segmented antennae should presumably distinguish it from the Jamaican *millsi,* whose antennae are said to be seven-segmented, though the reference in the original description of that species is to a figure which shows an eight-segmented antenna. From the Mexican *boneti,* described in somewhat less than seven full lines of text, which is said to have eight-segmented antennae but where again the reference is apparently to the wrong figure, the present species would appear to differ markedly in (1) the subangulate, rather than rounded, cheeks; (2) the shallower constriction near the middle of the saccate part of the fore wings; and (3) the form of the sides of the pronotum. Perhaps, too, the eighth antennal segment is slenderer. The conspicuously elevated posterior third of the pronotum and the almost complete cross-striation of its surface, referred to in the description above, are presumably characters possessed in common by all three species, even though not shown in the figure of *boneti.*

Seen for the first time, the members of this genus present a most un-thysanopterous appearance, because their greatly inflated fore wings, marked with a dark cross-band and reticulated, produce a striking resemblance to the homopterous Tingidae, such as *Corythuca* —in fact, one wonders whether their apparent scarcity might not be partly due to the failure of collectors to penetrate their disguise. With their wings removed, however, or if short-winged, they would be looked upon by any student of the thrips as a thoroughly conventional type of Heliothripinae, and, indeed, the characters exhibited by the wings are merely of degree, rather than of kind: Reticulated fore wings and stalked setae, for example, occur in *Parthenothrips* and saccate fore wings in *Retithrips.* The legs and antennae, as well as other body parts and the sculpture, are closely duplicated in other members of the same group.

This close relationship certainly must be reflected in their food habits, and the three known species, rather than being "inhabitants of ground cover" are much more likely feeders upon green leaves like their relatives. The fact that only five specimens are known to date bears out a belief that we know little about where to look for them.



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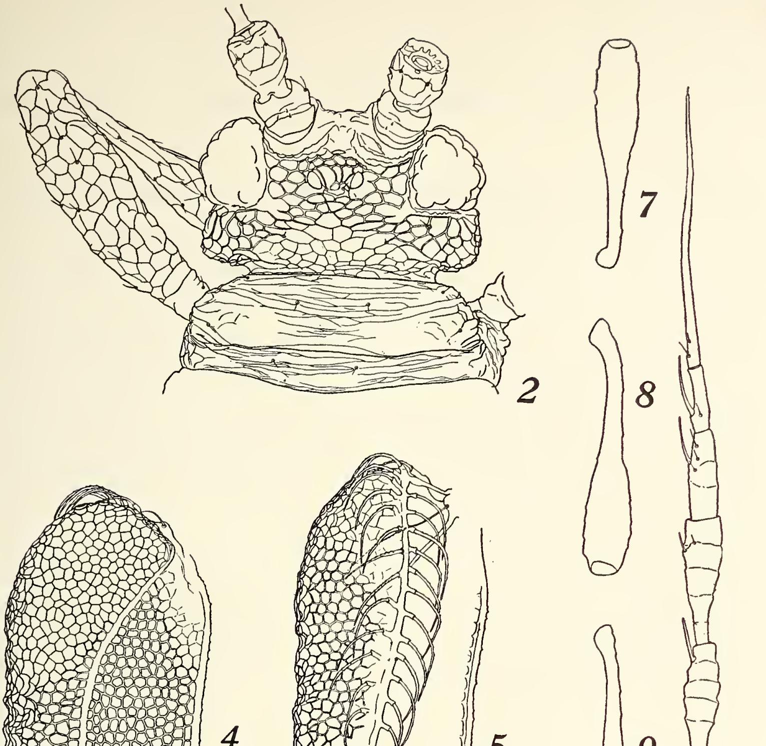
Arachisothrips seticornis, sp. nov.; ♀, holotype, x 46.
[J.D.H., camera lucida]



Arachisothrips seticornis, sp. nov.; ♀, holotype. — 2, head and prothorax, x 157. — 3, left antenna and front of head, x 196. — 4, left fore wing, x 73. — 5, anterior portion of right fore wing, ventral aspect, x 73 (sculpture of the morphologically ventral surface shown only at bend of wing). — 6, basal portion of costal vein of left fore wing, x 196. — 7, left fore tibia, ventral aspect, x 118. — 8, left middle tibia, ventral aspect, x 118. — 9, left hind tibia, ventral aspect, x 118.

[J.D.H., camera lucida]

INSECTS FOR SALE IN NEW YORK CITY BEFORE 1800

The "New-York Daily Advertiser" of December 26, 1796 carried the following: "A Naturalist, lately arrived from Europe, takes this method to inform his friends and the public in general, that he has brought with him, a large collection of birds, insects, butterflies, and several quadrupeds, from different parts of the world, which he will dispose of, either by large or small quantities. He further informs, that he possesses entirely the art of stuffing animals, &c. so as to give them their natural appearance, as well as to preserve them from decay. Apply at No. 355 Broadway."

Another insect that was offered for sale by some one at No. 7 Beekman street, New York, along with wax figures, "and an alarm against House Breaking and Fire", consisted of a "brilliant Diamond Beetle." This advertisement was printed in the "New-York Daily Advertiser" of March 21, 1791. — H. B. Weiss.

EXHIBITS OF INSECTS IN NEW YORK CITY BEFORE 1800

In the "Weekly Museum" of July 26, 1794, the Museum and Wax Works in the Exchange advertised its "largest collection of Birds, Butterflies, Insects and Beetles in America; from Europe, Asia, Africa and America. The collection contains near 600 Birds, upwards of 2000 Insects." A later advertisement in the "Columbian Gazetteer" of October 16, 1794 is somewhat more detailed and refers to the number of insects as being between two and three thousand "such as butterflies, Stinging bees, Biting flies and Beetles—One box 26 by 18 inches, contains one thousand and forty-two different species of Beetles arranged in families."

William Winstanley in the "Weekly Museum" of February 4, 1797 stated that a New Panorama would be opened "in Greenwich street near the bottom of Barley street" on the sixth of the month and that a print shop at the Panorama was well furnished among other things with "a large collection of American Butterflies and other insects in frames." — H. B. Weiss.

REDESCRIPTION OF DISCOTHYREA TESTACEA ROGER, A LITTLE-KNOWN NORTH AMERICAN ANT, WITH NOTES ON THE GENUS (HYMENOPTERA: FORMICIDÆ)

BY MARION R. SMITH[1] AND MERLE W. WING[2]

The primary purpose of this paper is to redescribe and figure *Discothyrea testacea* Roger, an almost unknown North American ant, and to furnish such historical and biological facts concerning it as may be of interest. The genus *Discothyrea* is also discussed and all the known species listed.

In 1863 (Berlin. Ent. Ztschr. 7: 176-177) Roger described a new genus and species of ponerine ant, *Discothyrea testacea,* on the basis of a worker and dealated female. His generic description was unusually thorough, his specific description extremely brief. Through some unfortunate oversight he failed to designate a specific type locality; however, this was remedied later in 1863 in his "Verzeichniss der Formiciden — Gattungen und Arten," where he gave "Nord Amerika" as the general type locality without further remark.

From 1863 until 1948 no one in this country succeeded in finding additional individuals, and the presence of *testacea* in North America was becoming a matter of considerable doubt. Such well-known works as Wheeler's, 1910 and 1926 editions of "Ants"; Smith's, 1947, "A Generic and Subgeneric Synopsis of the United States Ants, Based on the Workers"; and Creighton's, 1950, "Ants of North America", made no mention of the genus or species. So far as we are aware, no one in North America has ever seen Roger's types. A number of workers, especially beginners, did not know that *Discothyrea* had ever been recorded for North America, although the species *testacea* is listed for North America by Emery (1911, in Wytsman's Genera Insectorum, fascicule 118, p. 52). Emery

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[2]Raleigh, N. C.

apparently recorded the form from North America entirely on the basis of Roger's original statement. Not only had our workers failed to find *testacea,* but even another North American species, *Ponera gilva* (now *Euponera gilva)* described by Roger in 1863, was not collected again until 1919. The authors do not believe that either species is so rare that it should not have been collected on numerous occasions during this time. Credit for collecting the first *Discothyrea* since Roger's time, though, should go to the junior author, who found a single worker on August 29, 1948, while collecting from soil humus by means of a Berlese funnel about three miles from Holly Springs (Wake County), North Carolina. Less than a year later (April 29, 1949) H. T. Vanderford found three workers of *Discothyrea* adhering to the roots of a swamp fern growing on the edge of an old salt marsh lake at Savannah, Georgia. Approximately two months later he collected two additional workers and a dealated female from almost the same spot, an area of approximately six square feet. Vanderford kindly permitted us to study all his specimens except one worker, and we came to the conclusion that they represent the same species as that of the individual collected in North Carolina which we believed to be Roger's *testacea.*

Realizing that Roger's types should be in the Zoological Museum of the University of Berlin, we sent H. Bischoff one worker each of the North Carolina and Georgia individuals to be compared with the type. At the same time we requested Dr. Bischoff to furnish us with as detailed information as possible concerning specific locality, date, and collector of the types. After comparing our individuals with the type Dr. Bischoff pronounced them to be the same species. He also stated that there were no original labels of Roger's attached to the type, but only labels by Gerstäcker as follows: "*Discothyrea testacea* Rog.*, Amer. Sept." The asterisk following Roger's name is interpreted as indicating type designation. No further information was available, but it is Dr. Bischoff's opinion that the type specimens may have been sent to Roger by Christian Zimmerman from one of the Carolinas. Upon reading the biography of Dr. Zimmerman we learned that he was a German who migrated to and lived in the United States from 1832 to 1867, mostly in Georgetown and Columbia, South Carolina. He had been a teacher of music and drawing and a collector and student of insects, mostly Coleoptera. It appears that we shall never know for certain the locality or collector of *testacea,* and that we can only surmise that the species was collected in the Carolinas, probably by Zimmerman. This is especially unfortunate, since *testacea* is the genotype of *Discothyrea.*

So far as we know, only 21 forms of *Discothyrea* have been described, these having been recorded from all the faunal realms except the Palearctic. The ants are believed to be well adapted to the Temperate and Torrid Zones of the earth. The forms and the faunal realms from which they have been recorded are as follows:

Nearctic

testacea Roger (the genotype), 1863, worker, dealate female, (probably North or South Carolina).

Neotropical

denticulata Weber, 1939, worker, Forest Settlement, Mazaruni River, British Guiana.

horni Menozzi, 1927, alate female, fig. 1, San Jose, Costa Rica. Menozzi, 1937, worker, San Jose, Costa Rica.

humilis Weber, 1939, dealate female, Barro Colorado Island, Panama Canal Zone.

icta Weber, 1939, dealate female, grounds of Imperial College of Tropical Agriculture, St. Augustine, Trinidad, British West Indies.

isthmica Weber, 1940, dealate female, Barro Colorado Island, Panama Canal Zone.

neotropica Bruch, 1919-1920, dealate female, 3 figs., Alta Gracia, Province of Cordoba, Argentina.

Ethiopian

hewitti Arnold, 1916, worker, Grahamstown, Cape Province, South Africa.

oculata Emery, 1901, worker, alate female, male, Cameroons, Africa.

oculata var. *sculptior* Santschi, 1913, worker, French Congo, Africa.

patrizzi Weber, 1949, worker, dealate female, fig. 1, Kenya, Africa.

traegaordhi Santschi, 1914, worker, Pietermaritzburg, Natal, Africa.

Oriental

globus Forel, 1905, worker, Tjompea, Java.

globus var. *sauteri* Forel, 1912, worker, dealate female, Pilam, Formosa.

Australian

antarctica Emery, 1895, worker, North Island, New Zealand. Emery, 1897, worker, pl. 2, fig. 8, Hunua Mountains, New Zealand. Moore, 1938, biology and distribution.

bidens Clark, 1927-1928, worker, pl. 1, figs. 30, 31, Victoria, Australia.

clavicornis Emery, 1897, worker, pl. 15, figs. 39, 40, German, New Guinea.

Mann, 1919, alate female, fig. 6, Fulakora, Ysabel, British Solomon Islands.

crassicornis Clark, 1926-1927, worker, pl. 6, figs. 4, 4a, worker, Manjimup, Western Australia.

leæ Clark, 1934, dealate female, pl. 2, fig. 11, Mt. Lofty, Southern Australia.

remingtoni Brown, 1948, worker, figs. 1A, 1B, 7 Mi S. E. La Foa, New Caledonia.

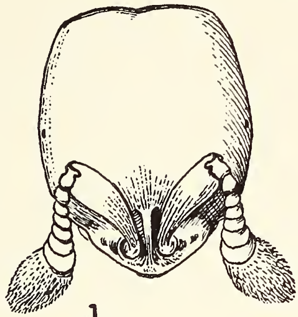
turtoni Clark, 1934, worker, dealate female, pl. 4, figs. 5, 6, Otway Range, Australia.

The worker of our North American *Discothyrea* is readily distinguishable from that of other North American ponerine genera in the possession of a 9-segmented antenna[3], the funiculus of which is strongly thickened (clavate) toward the apex and the last funicular segment remarkably enlarged, oval and approximately as long as the combined lengths of the preceding funicular segments; the semicircular, disk-like clypeus extended above the mandibles; extremely minute or almost obsolescent eye; dorsum of thorax without sutures; gaster strongly curved anteroventrally with the apical segments protruding from the venter rather than the apex of the large, second gastric segment; erect hairs lacking from most of the body except usually

[3]Some species of *Discothyrea* are known to have only a 7-segmented antenna, the reduction in segments probably being due to fusion. One should be cautious, therefore, in accepting a given number of segments as being invariable for a species. It is not impossible that individuals in a colony may have a variable number of segments composing the antenna.

the apex of the gaster; body unusually small (less than 2 mm.) and with a dull opaque or subopaque cast.

The North American female is very similar to the worker except for her larger size, possession of wings (when a virgin), and modifications of the head and thorax such as ocelli, compound eyes, and the



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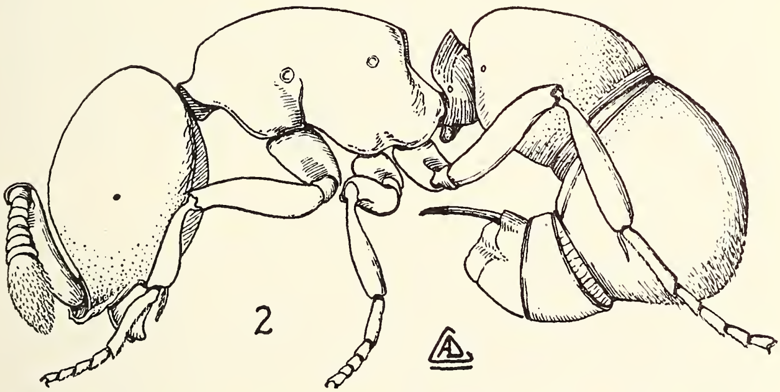

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Worker of *Discothyrea testacea* Roger. Fig. 1, anterior view of head. Fig. 2, lateral view of body (illustrations by Arthur D. Cushman).

extra sclerites of the thorax. We have not seen a *Discothyrea* male, but a male of *oculata,* an African species, is known to have a 13-segmented antenna with a short scape, which is approximately as long as the combined lengths of the first three funicular segments, the frontal carinæ fused to form a single vertical plate as in the worker and female, the thorax with Mayrian furrows, the anterior wing lacking a disocidal cell but having at least one closed cubital cell, the petiole and gaster almost as those of the other castes.

Although *Discothyrea* is an ancient and relict genus, we are not aware of any fossil forms. These highly specialized ants are well adapted to their cryptotobiotic life. Little is known concerning their feeding habits, but it is almost a certainty that they are carnivorous, probably on some of the small organisms near the surface of the soil, humus, or well rotted cavities of logs and stumps. Their unusually small colonies must not comprise more than a dozen or so adult individuals and should be found in the habitats mentioned above. It is quite likely that females establish colonies alone without the assistance of workers.

Discothyrea testacea Roger, 1863, Berlin. Ent. Ztschr. 7:177, worker, female (without locality). — Roger, 1863, Verzeichniss der Formiciden, Gattungen und Arten, p. 21 (designated "Nord Amerika" as type locality). — Mayr, 1886, Zool. — Bot. Gesell. Wien 36: 438. — Emery, 1895, Zool. Jahrb. Abt. f. System. 8: 226. — W. M. Wheeler, 1911, Ann. N. Y. Acad. Sci. 21: 162. — Emery, 1911, *in* Wytsman's Genera Insectorum, fascicule 118, p. 52. — Weber, 1939, Ann. Ent. Soc. Amer. 32: 99, 101-102, worker, female (in key). — Weber, 1940, Psyche 47: 79. — Donisthorpe, 1943, Ann. and Mag. Nat. Hist. 10: 640. — Borgmeier, 1949, Rev. Brasil Biol. 9: 205, worker, female (in key). — M. R. Smith, 1951, *in* U. S. Dept. Agr. Monogr., No. 2, p. 785.

WORKER. Length 1.55 mm.

Head ovoid, approximately one and one-third times as long as broad (maximum length from the extreme anterior border of the clypeus to the posterior border of the head, 0.46 mm., maximum breadth, eye to eye, 0.34 mm.), with weakly convex sides, rounded posterior corners and almost imperceptibly emarginate posterior border. Compound eye extremely minute, scarcely perceptible, placed on side of head nearer to the base of the mandible than to the posterior border of the head, composed of only a few ommatidia. Antenna 9-segmented, placed near the extreme anterior border of the head; scape short (excluding the pedicel, 0.25 mm. in length), strongly curved and also strongly thickened (clavate) toward the apex; funiculus short and stout, the first segment as long as, or longer than broad, the second through the seventh segments successively widening, each of these being clearly broader than long, the last funicular segment (eighth) extraordinarily large, oval, and approximately as long as the combined lengths of the preceding funicular segments. Clypeus extended over the mandibles as a plate or disk-like process, the anterior edge of which is subangularly arched (from side to side). Frontal carinæ fused with the clypeus into an extremely thin, vertical plate, which extends from the anterior border of the clypeus between and also past the antennal insertions, the plate bearing a very small but visible hole (viewed in profile). Mandible subtriangular, the masticatory border bearing several rather indistinct denticuli at the base and a fairly distinct and acute tooth at the apex. In profile, dorsum of the thorax rather evenly and moderately arched (anteroposteriorly), meeting the slightly inclined declivity of the epinotum to form a distinct angle. Thorax, from above, 0.46 mm. in length (from the extreme anterior border of the pronotal collar to the point where the dorsum of the thorax meets the epinotal declivity, widest at the pronotal humeri, narrowest at the epinotal tubercles; the promesonotal and mesoepinotal sutures lacking; pronotal humeri rounded or subangular; dorsum of the thorax meeting the epinotal declivity to form a distinct subangular emargination between the epinotal tubercles. Legs moderately long, the femora and tibiæ not especially thickened, the anterior and posterior tibia each with a well developed and distinct spur, the spur apparently lacking on the middle tibia. Petiole, in profile, erect, somewhat wedge-shaped, with the apex of the wedge directed dorsally, ventral border of the petiole with a spine-like lamella; viewed anteriorly, the petiole also appears wedge-shaped, with the highest point of the wedge at about the middle of the dorsal border of the petiole. Gaster from above, 0.63 mm. in length (from the extreme base of the first gastric segment to the extreme apex of the second gastric segment), the first two segments combined form an ellipsoid, the base of which is subtruncate and the apex of which is subangularly rounded; in profile, the much rounded apical segments of the gaster are borne from the venter rather than the apex of the second gastric segment. Extreme apex of gaster with a sting as in other ponerines.

Body and appendages devoid of any erect or suberect hairs. Pubescence scarcely perceptible, grayish, extremely fine and very closely appressed on body and appendages.

Body light brown or yellowish brown to slightly reddish brown, the color depending largely on the intensity of the light, subopaque or opaque, this also depending upon the light intensity. Eyes blackish.

The two Georgia workers are similar to the North Carolina worker except for some minor differences that seem scarcely worth mentioning. Differences in the length of the head, for instance, are very close, 0.03 — 0.04 mm., so these might well be within the range of error in measuring. The epinotal declivity of each of these workers also appears more vertical, and the general body color more infuscated or sordid.

DEALATE FEMALE. Length 2.01 mm.

Larger than the worker. Total body length obtained in the same manner as with the worker and comprising the following parts, head 0.50 mm., thorax 0.66 mm., gaster 0.85 mm. Differing from the worker largely in the usual female characters such as the possession of ocelli, compound eyes, and thoracic modifications. Other differences are mandible edentate except for the single apical tooth; eye rather large, oval, approximately 0.13 mm. at its greatest width and bearing in this width 10-12 ommatidia, placed approximately 0.05 mm. from the base of the mandible; anterior ocellus borne less than 0.10 mm. behind a transverse line connecting the posterior border of each eye; compound eyes and borders around the ocelli black; pronotal humeri more angular; epinotal declivity apparently more concave. Color similar to that of the two Georgia workers but more sordid than that of the worker from North Carolina.

The redescription of the worker is based largely on the individual from North Carolina which has been carefully compared with the type. The redescription of the female is from the single, dealated Georgia individual.

Type locality — North America (very probably collected in one of the Carolinas by Dr. Christian Zimmerman).

Other localities — 3 miles from Holly Springs (Wake County), North Carolina, Merle W. Wing and Savannah, Georgia, H. T. Vanderford.

AN ANNOTATED LIST OF THE BUTTERFLIES AND SKIPPERS OF CUBA (LEPIDOPTERA, RHOPALOCERA)

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(Continued from Vol. LXII, No. I

Family Danaidæ

Subfamily Danainæ

Tribe Danaini

Genus *Danaus* Kluk

Danaus Linnæus, 1758.
Danaus Kluk, 1780.
Danaida Latreille, 1804.
Anosia Hübner, 1816.
Danais Latreille, 1819.
Danaomorpha Kremky, 1925.
Panlymnas Bryk, 1937.
Diogas d'Almeida, 1938.
Genotype: *Papilio plexippus* Linnæus, 1758.

According to Opinion Number 124 of The International Commission on Zoological Nomenclature, Linnæus did not use the word *Danaus* as a generic term. (See Smithsonian Misc. Coll. vol. 73, No. 8, p. 1, Oct. 28, 1936).

62. danaus (diogas) plexippus menippe (Hübner)
(The Monarch)

Anosia menippe Hübner, 1816.
Danais erippus: Gundlach, 1881: 23.
Anosia (*Danaida*) *plexippus*: Abbot, 1914: 205.
Danaida (*Anosia*) *archippus*: Kremky, 1925: 166.
Anosia plexippus: Showalter, 1927: 113; Fazzini, 1934: 18; J. H. Comstock & A. B. Comstock, 1936: 204.

Danaus plexippus plexippus: Clark, 1932: 115; id., 1941: 533; Bates, 1935: 145; Field, 1938b: 127; Comstock, 1944: 430; Bruner, Scaramuzza & Otero, 1945: 17; J. A. Ramos, 1946: 52; S. L. de la Torre, 1946: 106; id., 1946b: 109, 117; id., 1947: 19.

Danais plexippus: Hoffmann, 1933: 227; id., 1936: 262; Holland, 1942: 68; Avinoff & Shoumatoff, 1946: 274.

Diogas curassavicae: d'Almeida, 1939: 44; Hoffmann, 1940c: 663.

Danaus (Anosia) curassavicæ curassavicæ: Berger, 1939: 191.

Danaus erippus menippe: Forbes, 1939: 133.

Danaus plexippus: Brown, 1944b: 238; Evans, Kloet, Hincks. . , 1946: 4; Weiss & Boyd, 1950: 164; Judd, 1950: 169; Garth, 1950: 15.

Danaus menippe menippe: Chermock, 1947: 2.

Danaus (Danaida) plexippus plexippus: Dufrane, 1948: 192.

Danaus plexippus menippe: Field, 1950: 236.

Danaus (Diogas) plexippus menippe: S. L. de la Torre, 1951: 95.

Illustrations.—Kremky, 1925: pl. XX, f. 3, (genital), text figs. 6-8, (legs), 9, (genital); Showalter, 1927: pl. 9, f. 12, p. 124, fig. not numbered; Clark, 1932: pl. 6, f. 4, pl. 58, f. 1, 2, pl. 63, f. 2, 3, pl. 64, f. 1, 2; id., 1941: pl. 71, f. 1; Fazzini, 1934: p. 19, f. not numbered; J. H. Comstock & A. B. Comstock, 1936: pl. I, f. 1, 2, (larva), f. 3, (chrysalis), f. 4, pl. XXVIII, f. 1, pl. XXXII, f. 3; d'Almeida, 1939: pl. 4, f. 5, 6, 8, (genital), pl. 5, f. 5, 7, pl. 16, f. 1, 3; id., 1944: pl. 2, f. 1, 2; Holland, 1942: text figs. 4, 5, (eggs), 14, 15, (head of caterpillar), 16, 18, (larva), 23, 24, (larva and chrysalis), 29, 30, (head), 40, (venation), 41, 42, (section of larva), 80, (swarm of *D. plexippus* resting on a tree), pl. IV, f. 1-3, (chrysalis), pl. VII, f. 1; Comstock, 1944: pl. 5, f. 9; S. L. de la Torre, 1946b: pl. 13, f. 31-34; id., 1947: pl. I, f. 2; Weiss & Boyd, 1950: pl. XVI, f. 50a, 50b.

63. DANAUS (DIOGAS) PLEXIPPUS PLEXIPPUS (Linnæus)

Papilio plexippus Linnæus, 1758.

Danaida (Anosia) archippus nigrippus: Kremky, 1925: 167.

Danaus plexippus nigrippus: Field, 1938b: 128.

Danaus erippus megalippe: Forbes, 1939: 133.

Diogas curassavicæ nigrippus: d'Almeida, 1939: 54.

Danaus plexippus megalippe: Clark, 1941: 536; Beatty, 1944: 156; S. L. de la Torre, 1947: 19.
Diogas erippus?: Schweizer, 1941: 11.
Diogas curassavicæ megalippe: d'Almeida, 1944: 53.
Danaus (*Diogas*) *plexippus megalippe*: S. L. de la Torre, 1949: 65.
Danaus plexippus plexippus: Field, 1950: 236.
Danaus (*Diogas*) *plexippus plexippus*: S. L. de la Torre, 1951: 96.

This subspecies was reported by the writer in 1947. (See Memorias de la Sociedad Cubana de His. Nat., vol. XIX, p. 19).

Illustrations.—Kremky, 1925: text fig. 10, (genital); d'Almeida, 1939: pl. 18, f. 3; Clark, 1941: pl. 71, f. 2; S. L. de la Torre, 1947: pl. I, f. 1; Garth, 1950: f. 7.

64. DANAUS (DIOGAS) PLEXIPPUS PORTORICENSIS Clark

Danaus plexippus portoricensis Clark, 1941: 539; Comstock, 1944: 431; d'Almeida, 1944: 54; S. L. de la Torre, 1947: 20; Munroe, 1951: 56.
Danaus megalippe portoricensis: Forbes, 1943: 297.
Diogas curassavicae portoricensis: d'Almeida, 1944: 70.
Danaus (*Diogas*) *plexippus portoricensis*: S. L. de la Torre, 1949: 65; id., 1951: 96.

This subspecies was reported by the writer in 1949 (See The Lepidopterists' News, vol. III, No. 6, p. 65).

Illustrations.—Clark, 1941: pl. 72, f. 3, 4; d'Almeida, 1944: pl. 2, f. 1, 2; Comstock, 1944: text fig. 1, (venation); pl. 5, f. 10.

65. DANAUS (DANAUS) GILIPPUS BERENICE (Cramer)

Papilio berenice Cramer, 1779.
Danais berenice: Gundlach, 1881: 24; Holland, 1942: 69.
Anosia berenice: Holland, 1916: 488; Showalter, 1927: 113; J. H. Comstock & A. B. Comstock, 1936: 207; Hoffmann, 1940c: 662.
Danaus gilippus berenice: Bates, 1935: 146; Forbes, 1939: 135; Bruner, Scaramuzza & Otero, 1945: 17; S. L. de la Torre, 1946: 106; Chermock, 1947: 2.
Danaus berenice berenice: Field, 1938b: 129; Clark, 1941: 541; S. L. de la Torre, 1947: 20.
Anosia gilippus berenice: d'Almeida, 1939: 23; id., 1944: 39.

Anosia eresimus kaempfferi: d'Almeida, 1939: 36; id., 1944: 41, 46.
Danaus (*Danaus*) *gilippus berenice*: S. L. de la Torre, 1951: 97.
Illustrations.—Showalter, 1927: pl. IX, f. 11; d'Almeida, 1939: pl. 6, f. 1, (genital), pl. 15, f. 4; Clark, 1941: pl. 73, f. 3; Holland, 1942: pl. VII, f. 2; S. L. de la Torre, 1946: pl. 10, f. 45-47, 50, (scales); id., 1947: pl. 2, f. 7, 8.

66. DANAUS (DANAUS) GILIPPUS STRIGOSA (H. W. Bates)

Danais strigosa H. W. Bates, 1864.
Danais berenice strigosa: Hoffmann, 1924: 1; id., 1933: 228.
Anosia berenice strigosa: J. H. Comstock & A. B. Comstock, 1936: 208.
Danais berenice: Hoffmann, 1936: 262.
Danaus berenice strigosa: Field, 1938b: 129; Clark, 1941: 541; S. L. de la Torre, 1947: 20; Garth, 1950: 16.
Danaus gilippus strigosa: Forbes, 1939: 135; Chermock, 1947: 2.
Anosia gilippus berenice var. *strigosa*: d'Almeida, 1939: 25; id., 1944: 43.
Anosia berenice form *strigosa*: Hoffmann, 1940c: 662.
Danais berenice var. *strigosa*: Holland, 1942: 69.
Anosia berenice race *strigosa*: Brown, 1944b: 237.
Danaus (*Danaus*) *gilippus strigosa*: S. L. de la Torre, 1949: 65; id., 1951: 98.

This subspecies was reported by the writer in 1947 (See Mem. Soc. Cub. Hist. Nat., vol. XIX, p. 20).

Illustrations.—Hoffmann, 1924: f. 2; J. H. Comstock & A. B. Comstock, 1936: pl. XXXII, f. 2; d'Almeida, 1939: pl. 6, f. 2, (genital), pl. 7, f. 2, (genital), pl. 18, f. 1; Clark, 1941: pl. 73, f. 4; Holland, 1942: pl. VII, f. 3; S. L. de la Torre, 1947: pl. 2, f. 9.

67. DANAUS (DANAUS) GILIPPUS GILIPPINA (Hoffmann)

Anosia berenice form *gilippina* Hoffmann, 1940: 277; id., 1940c: 662; d'Almeida, 1944: 41.
Danaus (*Danaus*) *gilippus gilippina*: S. L. de la Torre, 1949: 65; id., 1951: 98.

This subspecies was reported by the writer in 1949 (See The Lepidopterists' News, vol. III, No. 6, p. 65).

Illustrations.—Hoffmann, 1940: f. 3, 4; d'Almeida, 1944: pl. 1, f. 3, pl. 2, f. 3.

68. danaus (danaus) eresimus tethys Forbes

Danaus eresimus tethys Forbes, 1943: 301.

Danaus eresimus: *Bates,* 1935: 146; Clark, 1941: 541; S. L. de la Torre, 1946: 106; id., 1947: 21.

Danais eresimus: Avinoff & Shoumatoff, 1946: 275.

Danaus (*Danaus*) *eresimus tethys*: S. L. de la Torre, 1951: 99.

This subspecies was described by William T. M. Forbes in 1943 (See Journal N. Y. Ent. Soc., vol. LI, p. 301).

Illustrations.—Clark, 1941: pl. 74, f. 1, 2; S. L. de la Torre, 1946: pl. 10, f. 48, 49, (scales); id., 1947: pl. 2, f. 6.

69. danaus (danaus) eresimus montezuma Talbot

Danaus eresimus montezuma Talbot, 1943; Forbes, 1943: 299; Chermock, 1947: 2.

Danais cleothera: M. Sánchez Roig & G. S. Villalba, 1934: 109; id., 1934b: 32.

Anosia eresimus cleothera: d'Almeida, 1939: 34.

Anosia cleothera: Hoffmann, 1940c: 663; Brown, 1944b: 238.

Danaus cleothera: Clark, 1941: 539; S. L. de la Torre, 1947: 21.

Anosia eresimus ares d'Almeida, 1944: 46.

Danaus (*Danaus*) *eresimus montezuma*: S. L. de la Torre, 1949: 65; id., 1951: 100.

This subspecies was reported by Dr. Mario Sánchez Roig and Gastón S. Villalba in 1934 (See Mem. Soc. Cub. Hist. Nat., vol. VIII, No. 2, p. 109, and Revista de Agricultura, vol. 15, No. 55, p. 32).

Illustrations.—M. Sánchez Roig & G. S. Villalba, 1934b: f. 2 ?; d'Almeida, 1939: pl. 3, f. 1, 6, (genital), pl. 15, f. 5, pl. 16, f. 4; Clark, 1941: pl. 74, f. 3, 4; S. L. de la Torre, 1947: pl. 2, f. 4, 5.

Subfamily Lycoreinæ

Tribe Lycoreini

Genus *Lycorea* Doubleday

Lycorea Doubleday, 1847 (See Brown, 1941: 136).

Lycorella Hemming, 1933.

Genotype: *Lycorea atergatis* Doubleday & Hewitson, 1847 (See Brown, 1941: 136).

70. lycorea ceres demeter C. & R. Felder

Lycorea demeter C. Felder & R. Felder, 1867; Gundlach, 1881: 19.
Lycorea ceres demeter: Bates, 1935: 147; d'Almeida, 1939: 88; id., 1944: 62; Comstock, 1944: 437; Bruner, Scaramuzza & Otero, 1945: 78; S. L. de la Torre, 1946: 106.
Illustrations.—d'Almeida, 1939: pl. 23, f. 1; S. L. de la Torre, 1946: pl. 10, f. 51, 52, (scales).

Tribe Anetiini

Genus *Anetia* Hübner

Anetia Hübner, 1823, f. 1, 2.
Anelia Hübner, 1823, f. 3, 4.
Clothilda Blanchard, 1840.
Genotype: *Anetia numidia* Hübner, 1823?.

71. anetia (clothilda) numidia briarea (Latreille)

Argynnis briarea Latreille, 1820.
Clothilda pantherata: Gundlach, 1881: 27.
Anelia numidia numidia: Bates, 1935: 148.
Anetia numidia: d'Almeida, 1939: 60; id., 1944: 56.
Clothilda (Clothilda) numidia briarea: Forbes, 1939: 108.
Anetia (Clothilda) numidia briarea: S. L. de la Torre, 1952: 69.
Illustrations.—Bates, 1935: f. 9, (venation); d'Almeida, 1939: pl. 11, f. 8, 10, (genital), f. 15, (venation), pl. 12, f. 4, 10, (legs), f. 5, (palp), f. 17, (tarsus), pl. 13, f. 7, (genital), pl. 20, f. 1, 2.

72. anetia (clothilda) pantherata clarescens (Hall)

Clothilda pantherata clarescens Hall, 1925.
Clothilda numida: Gundlach, 1881: 27.
Anelia pantherata clarescens: Bates, 1935: 150; S. L. de la Torre, 1946: 106.
Anetia pantherata clarescens: d'Almeida, 1939: 62; id., 1944: 57.
Clothilda (Clothilda) pantherata clarescens: Forbes, 1939: 108.

Anetia (*Clothilda*) *pantherata clarescens*: S. L. de la Torre, 1952: 69.
Illustrations.—d'Almeida, 1939: pl. 28, f. 2, 4; S. L. de la Torre, 1946: pl. 10, f. 53, 54, (scales).

73. ANETIA (SYNALPE) CUBANA (Salvin)

Clothilda cubana Salvin, 1869; Gundlach, 1881: 28.
Anelia cubana: Bates, 1935: 150; S. L. de la Torre, 1946: 106.
Anetia cubana: d'Almeida, 1939: 63; id., 1944: 57.
Clothilda (*Synalpe*) *cubana*: Forbes, 1939: 107.
Anetia (*Synalpe*) *cubana*: S. L. de la Torre, 1952: 69.
Illustrations.—d'Almeida, 1939: pl. 29, f. 1, 2.

Subfamily ITHOMIINÆ

Genus *Hymenitis* Hübner

Hymenitis Anon. (Illiger?), 1807.
Hymenitis Hübner, 1816.
Greta Hemming, 1934.
Genotype: *Papilio diaphanus* Drury, 1773 (=*Hymenitis diaphane* Hbn., 1816).

We do not know whether a generic name of an anonymous author is accepted in Nomenclature. d'Almeida asked that question of the International Commission on Zoological Nomenclature (See his paper entitled "Alguns tipos de géneros da ordem Lepidoptera. la. Nota: Rhop., Fam. *Mechanitididae*. Papéis Avulsos do Dep. Zool. Secret. da Agric. Sâo Paulo, vol. II, No. 14, p. 185). We await their opinion; meanwhile, agreeing with d'Almeida, we consider this name null and adopt the name *Hymenitis* Hübner, 1816, placing the name *Greta* Hemming, in the synonymy of the same.

74. HYMENITIS CUBANA Herrich-Schäffer

Hymenitis cubana Herrich-Schäffer, 1862; Gundlach, 1881: 19; Bates, 1935: 151; id., 1939: 2; Bruner, Scaramuzza & Otero, 1945: 38; S. L. de la Torre, 1946: 106.
Illustrations.—Bates, 1935: f. 10, (venation); S. L. de la Torre, 1946: pl. 10, f. 55, 56, (scales).

Family SATYRIDÆ

Subfamily SATYRINÆ

Genus *Calisto* Hübner

Calisto Hübner, 1823.
Genotype: *Papilio zangis* Fabricius, 1775.

75. CALISTO HEROPHILE HEROPHILE Hübner

Calisto herophile Hübner, 1823; Gundlach, 1881: 26; Lathy, 1899: 226; Holland, 1916: 494; Bates, 1935: 152; id., 1939: 3; Dethier, 1940: 14; Comstock, 1944: 480; S. L. de la Torre, 1946: 106.
Calisto herophile herophile: Bates, 1935b: 242; Michener, 1943: 6, id., 1949: 1; Munroe, 1950b: 225; S. L. de la Torre, 1952: 62.
Illustrations.—Lathy, 1899: pl. IV, f. 8, 9; Bates, 1935: f. 11, (venation); id., 1935b: f. 6, (genital); Dethier, 1940: pl. III, f. 1, (2o. instar head capsule), f. 3, (first instar head capsule), f. 5, 6, (eggs), f. 9, 11, (color pattern on an abdominal segment); S. L. de la Torre, 1946: pl. 10, f. 57-62, (scales).

76. CALISTO HEROPHILE PARSONSI Clench

Calisto herophile parsonsi Clench, 1943: 26; Michener, 1949: 1; S. L. de la Torre, 1950: 72; id., 1952: 62.
Calisto sp.: Munroe, 1950b: 229.

This subspecies was captured by Dr. Carl T. Parsons in the Trinidad Mts., Las Villas province, and described as a new subspecies by Mr. Harry K. Clench in 1943 (See Psyche, vol. L, Nos. 1-2, p. 26).

77. CALISTO BRUNERI Michener

Calisto bruneri Michener, 1949: 2; S. L. de la Torre, 1952: 62.

This species was described by Dr. Charles D. Michener in 1949 (See American Museum Novitates, No. 1391, p. 2).

78. CALISTO SMINTHEUS SMINTHEUS Bates

Calisto smintheus Bates, 1935b: 242.
Calisto delos Bates, 1935b: 243; id., 1939: 4; Michener, 1943: 6; id., 1949: 2; S. L. de la Torre, 1949: 65.

Calisto sznintheus smintheus: Bates, 1939: 3; Michener, 1943: 6; id., 1949: 1; S. L. de la Torre, 1949: 65; id., 1952: 62; Munroe, 1950b: 226.

This species was reported by Mr. Marston Bates in 1939 (See Mem. Soc. Cub. Hist. Nat., vol. XIII, p. 3).

Illustration.—Bates, 1935b: f. 9, (genital).

79. CALISTO SMINTHEUS MURIPETENS Bates

Calisto smintheus muripetens Bates, 1939: 3; Michener, 1943: 6; id., 1949: 1; S. L. de la Torre, 1949: 65; id., 1952: 63; Munroe, 1950b: 226.

This subspecies was described by Mr. Marston Bates in 1939 (See Mem. Soc. Cub. Hist. Nat., vol. XIII, p. 3).

80. CALISTO SMINTHEUS BRADLEYI Munroe

Calisto smintheus bradleyi Munroe, 1950b: 227; S. L. de la Torre, 1952: 63.

This subspecies was described by Eugene G. Munroe in 1950 (See Jour. N. Y. Ent. Soc., vol. LVIII, No. 4, p. 227).

Family NYMPHALIDÆ

Subfamily HELICONIINÆ

Tribe HELICONIINI

Genus *Heliconius* Kluk

Heliconius Kluk, 1802; Latreille, 1804 (part).
Eueides Hübner, 1816: 11.
Sunias Hübner, 1816: 12.
Migonitis Hübner, 1816: 12 (preoccupied in Mollusca).
Ajantis Hübner, 1816: 13.
Apostraphia Hübner, 1816: 13.
Sicyonia Hübner, 1816: 13.
Heliconia Godart, 1819 (part).
Laparus Billberg, 1820.
Phlogris Hübner, 1825.
Semelia Doubleday, 1844.
Blanchardia Buchecker (1880?); preoccupied in fishes.

Heliconias Boenninghausen, 1896.
Genotype: *Papilio charithonia* Linnaeus, 1767.

81. HELICONIUS (HELICONIUS) CHARITHONIUS RAMSDENI Comstock & Brown

Heliconius charithonius ramsdeni Comstock & Brown, 1950: 14.
Heliconius charithonia: Gundlach, 1881: 20.
Heliconius charithonius: Holland, 1916: 488.
Heliconius charithonia charithonia: Bates, 1935: 157; Bruner, Scaramuzza & Otero, 1945: 128.
Heliconius charithonius charithonius: Comstock, 1944: 438; Beatty, 1944: 156; J. A. Ramos, 1946: 52.
Heliconius (Heliconius) charithonius charithonius: S. L. de la Torre, 1949b: 192.
Heliconius (Heliconius) charithonius ramsdeni: S. L. de la Torre, 1952: 70.
Illustrations.—Michener, 1942: f. 1, (venation), f. 13, (harpe); Comstock & Brown, 1950: f. 3D.

82. HELICONIUS (HELICONIUS) CHARITHONIUS PUNCTATUS Hall

Heliconius charithonia punctata Hall, 1936: 276.
Heliconius charithonius punctatus: Comstock, 1944: 439; Beatty, 1944: 156; Comstock & Brown, 1950: 11.
Heliconius (Heliconius) charithonius punctatus: S. L. de la Torre, 1949: 65; id., 1949b: 192; id., 1952: 70.

This subspecies was annotated for Cuba by the writer in 1949 (See The Lepidopterists' News, vol. III, No. 6, p. 65, and Memorias Sociedad Cubana de Hist. Nat., vol. XIX, p. 192).

Illustrations.—Comstock, 1944: pl. 7, f. 12; Comstock & Brown, 1950: f. 3A.

83. HELICONIUS (EUEIDES) CLEOBÆA CLEOBÆA (Geyer)

Eueides cleobæa Geyer, 1832, Gundlach, 1881: 22; id., 1891: 445.
Eueides cleobæa cleobæa: Bates, 1935: 158; Comstock, 1944: 440; Bruner, Scaramuzza & Otero, 1945: 128.
Heliconius (Eueides) cleobæa: Michener, 1942: 3.
Heliconius (Eueides) cleobæa cleobæa: S. L. de la Torre, 1949b: 192.

Genus *Philæthria* "Dalman" Billberg

Philæthria "Dalman" Billberg, 1820.
Metamandana Stichel, 1907.
Genotype: *Papilio dido* Clerch, 1764.

84. * PHILÆTHRIA DIDO (Clerch)

Papilio dido Clerch, 1764.
Metamandana dido: Bates, 1935: 237; Hoffmann, 1940c: 674.
Philæthria dido: Michener, 1942: 3; S. L. de la Torre, 1949: 65; id., 1949b: 193.

This species is cited by Bates as doubtful; but we know that it has been observed on several occasions in Cuba.

Illustrations.—Michener, 1942: f. 8, (venation), f. 9, (harpé).

Tribe DIONINI

Genus *Dryas* Hübner

Dryas Hübner, 1807.
Colænis Hübner, 1819.
Genotype: *Papilio iulia* Fabricius, 1775.

85. DRYAS IULIA CILLENE (Cramer)

Papilio cillene Cramer, 1782.
Colaenis delila: Gundlach, 1881: 55.
Colaenis julia cillene: Holland, 1916: 489; Riley, 1926: 240.
Colaenis julia nudeola: Bates, 1935: 159; Bruner, Scaramuzza & Otero, 1945: 127.
Colaenis cillene: Holland, 1942: 78.
Dryas iulia cillene: S. L. de la Torre, 1949b: 193 (See W. P. Comstock, 1944: 443, and C. Michener, 1942: 4).
Illustrations.—Michener, 1942: f. 3, (venation), f. 12, (harpé); Holland, 1942: pl. LXXI, f. 1, 2.

Genus *Agraulis* Boisduval & Leconte

Agraulis Boisduval & Leconte, 1836?.
Genotype: *Papilio vanillæ* Linnaeus, 1758.

Dr. Charles D. Michener considers different the genus *Agraulis* Bsd. & Lec., 1836?, to the genus *Dione* Hübner, 1819 (See American Museum Novitates, No. 1215, p. 5).

86. AGRAULIS VANILLÆ INSULARIS Maynard

Agraulis insularis Maynard, 1889.

Dione vanillæ: Gundlach, 1881: 57; Hall, 1936: 276.

Dione vanillæ var. *insularis*: Holland, 1916: 490.

Dione vanillæ insularis: Riley, 1926: 243; Bates, 1935: 160; Comstock, 1944: 443; Beatty, 1944: 156; Bruner, Scaramuzza & Otero, 1945: 127; J. A. Ramos, 1946: 52; Avinoff & Shoumatoff, 1946: 275; Munroe, 1951: 56.

Agraulis vanillæ insularis: Michener, 1942b: 2; S. L. de la Torre, 1949b: 194.

Illustrations.—Michener, 1942: f. 6, (venation), f. 17, (harpé); Comstock, 1944: pl. 6, f. 4.

87. AGRAULIS VANILLÆ NIGRIOR Michener

Agraulis vanillæ nigrior Michener, 1942b: 7; S. L. de la Torre, 1949: 65; id., 1949b: 194.

This subspecies was reported by the writer in 1949 (See The Lepidopterists' News, vol. III, No. 6, p. 65, and Memorias Sociedad Cubana de Hist. Nat., vol. XIX, p. 194).

Subfamily NYMPHALINÆ

Genus *Euptoieta* Doubleday

Euptoieta Doubleday (not Hübner), 1848.

Genotype: *Papilio claudia* Cramer, 1775.

88. EUPTOIETA HEGESIA HEGESIA (Cramer)

Papilio hegesia Cramer, 1779.

Euptoieta hegesia: Gundlach, 1881: 44; id., 1891: 447; Holland, 1916: 491; Bates, 1935: 161; d'Almeida, 1941: 308; S. L. de la Torre, 1943: 140; Bruner, Scaramuzza & Otero, 1945: 184; Avinoff & Shoumatoff, 1946: 276.

Euptoieta hegesia karibica Stichel, 1938.

Euptoieta hegesia hegesia: Berger, 1939: 196; Comstock, 1944: 444; S. L. de la Torre, 1952: 65.

Illustrations.—Holland, 1942: pl. VIII, f. 8; S. L. de la Torre, 1943: pl. 16, f. 2; Comstock, 1944: text fig. 5, (the markings in the forewing discal cell).

89. EUPTOIETA CLAUDIA (Cramer)

Papilio claudia Cramer, 1775.

Euptoieta claudia: Clark, 1932: 114; J. H. Comstock & A. B. Comstock, 1936: 109; Hoffmann, 1936: 262; id., 1940c: 674; Field, 1938b: 122; Holland, 1942: 80; S. L. de la Torre, 1943: 139; id., 1949: 65; Brown, 1944c: 346; Avinoff & Shoumatoff, 1946: 276; Bruner, 1947: 26; Garth, 1950: 20.

Euptoieta claudia claudia: Schweizer & W. Kay, 1941: 15.

This species was reported by the writer in 1943 (See Mem. Soc. Cub. Hist. Nat., vol. XVII, p. 139).

Illustrations.—Clark, 1932: pl. 21, f. 1, 2; J. H. Comstock & A. B. Comstock, 1936: pl. XVIII, f. 4; Holland, 1942: pl. V, f. 8, 9, (chrysalis), pl. VIII, f. 9; S. L. de la Torre, 1943: pl. 16, f. 1.

Genus *Melitæa* Fabricius

Melitæa Fabricius, 1807.

Genotype: *Papilio cinxia* Linnæus, 1758.

90. MELITÆA (MICROTIA) PELOPS PELOPS (Drury)

Papilio pelops Drury, 1770.

Phyciodes pelops: Gundlach, 1881: 53; Hall, 1936: 276.

Phyciodes pelops aegon: Bates, 1935: 162; Avinoff & Shoumatoff, 1946: 277.

Phyciodes pelops pelops: Comstock, 1944: 446.

Melitæa (*Microtia*) *pelops pelops*: S. L. de la Torre, 1952: 66.

We place this species in the subgenus *Microtia* of the genus *Melitæa* according to Wm. T. M. Forbes (See "The genus *Phyciodes*", 1945. Ent. Amer., vol. XXIV, No. 4, p. 152 and 188).

Illustrations.—Comstock, 1944: text fig. 7, (venation), pl. 9, f. 1.

Genus *Phyciodes* Hübner

Phyciodes Hübner, 1819.

Genotype: *Papilio cocyta* Cramer, 1777 (=*Papilio tharos* Drury, 1773).

91. PHYCIODES (PHYCIODES) PHAON PHAON (Edwards)

Melitæa phaon Edwards, 1864.

Phyciodes phaon: M. Sánchez Roig & Gastón S. Villalba, 1934: 109; id., 1934b: 32; Field, 1938b: 115; Hoffmann, 1940c: 676; Holland, 1942: 137.

Phyciodes phaon phaon: Bates, 1935: 162; Brown, 1944c: 350; Bruner, 1947: 26.

Phyciodes (Phyciodes) phaon: Forbes, 1945: 154.

Phyciodes (Phyciodes) phaon phaon: S. L. de la Torre, 1952: 66.

Illustrations.—M. Sánchez Roig & G. S. Villalba, 1934b: f. 3; Holland, 1942: pl. XVII, f. 22, 23.

92. PHYCIODES (PHYCIODES) PHAON PHAON f. HIEMALIS Edwards

This is the winter form of that species, which was reported by the writer in 1952 (See Mem. Soc. Cub. Hist. Nat., vol. XXI, p. 66).

Phyciodes (Phyciodes) phaon phaon f. *æstiva* Edwards (1878: 179) is the summer form of that species.

93. PHYCIODES (ERESIA) FRISIA FRISIA (Poey)

Melitea frisia Poey, 1832.

Phyciodes frisia: Gundlach, 1881: 53; Avinoff & Shoumatoff, 1946: 277.

Eresia frisia: Holland, 1916: 491.

Phyciodes frisia frisia: Bates, 1935: 163; Comstock, 1944: 448.

Anthanassa frisia: Holland, 1942: 140.

Phyciodes (Eresia) frisia frisia: Forbes, 1945: 156; S. L. de la Torre, 1952: 66.

Illustrations.—Poey, 1832: 3 figs. not numbered; Bates, 1935: f. 12, (venation); Holland, 1942: text fig. 94, (neuration), pl. XVII, f. 42; Comstock, 1944: pl. 6, f. 6; Forbes, 1945: pl. X, f. 29, (genital).

Genus *Chlosyne* Butler

Chlosyne Butler, 1870.

Genotype: *Papilio janais* Drury, 1782.

94. CHLOSYNE PEREZI PEREZI (Herrich-Schäffer)

Synchloe perezi Herrich-Schäffer, 1862.
Chlosyne perezi: Gundlach, 1881: 54.
Chlosyne perezi perezi: Bates, 1935: 164; Comstock, 1944: 449.

Genus *Polygonia* Hübner

Polygonia Hübner, 1819.
Grapta Kirby, 1837.
Genotype: *Papilio c-aureum* Linnæus, 1758.

95. * POLYGONIA INTERROGATIONIS *f.* FABRICII (Edwards)

Polygonia interrogationis form *fabricii*: Clark, 1932: 94; J. H. Comstock & A. B. Comstock, 1936: 134; Field, 1938b: 75; Hoffmann, 1940c: 680.
Grapta interrogationis var. *fabricii*: Fazzini, 1934: 30.
Polygonia interrogationis: Holland, 1942: 149.
Polygonia interrogationis var. *fabricii*: S. L. de la Torre, 1943: 140.
Polygonia interrogationis fabricii: S. L. de la Torre, 1949: 65.

This species was reported by the writer in 1943 (See Mem. Soc. Cub. Hist. Nat., vol. XVII, p. 140).

Illustrations.— Clark, 1932: pl. 10, f. 3; J. H. Comstock & A. B. Comstock, 1936: pl. XXIII, f. 1; Holland, 1942: pl. I, f. 3, pl. III, f. 23, 27, (larva), pl. IV, f. 21, 22, 24-26, 40, (chrysalis); pl. XIX, f. 1; S. L. de la Torre, 1943: pl. 16, f. 3.

Genus *Vanessa* Fabricius

Cynthia Fabricius, 1807: 88.
Vanessa Fabricius, 1807: 110.
Pyrameis Hübner, 1819.
Genotype: *Papilio atalanta* Linnaeus, 1758.

We use the name *Vanessa* according to Opinion number 156 of the International Commission on Zoological Nomenclature (See "Opinions and Declarations Rendered by the International Commission on Zoological Nomenclature". Vol. 2, Part 26, pp. 239-250, London, 1944).

96. * VANESSA ATALANTA ITALICA Stichel

Vanessa atalanta italica Stichel, 1907; Field, 1938b: 82; S. L. de la Torre, 1952: 68.

Pyrameis atalanta: Gundlach, 1881: 39.

Vanessa atalanta var. *edwardsi?*: Grinnell, 1918: 113.

Vanessa atalanta: Showalter, 1927: 107; Fazzini, 1934: 16; Bates, 1935: 165; J. H. Comstock & A. B. Comstock, 1936: 154; Hoffmann, 1940c: 680; Holland, 1942: 153; Comstock, 1944: 451; Brown, 1945: 31; Avinoff & Shoumatoff, 1946: 278; Bruner, 1947: 26; Garth, 1950: 27.

Pyrameis atalanta atalanta: Clark, 1932: 84.

Illustrations.—Showalter, 1927: pl. 3, f. 3; Clark, 1932: pl. 7, f. 5, 6; Fazzini, 1934: p. 17, fig. not numbered; J. H. Comstock & A. B. Comstock, 1936: pl. XXVI, f. 1, 2; Holland, 1942: pl. III, f. 35, pl. IV, f. 52, 53, 55, (chrysalis), pl. XLIII, f. 4.

97. VANESSA VIRGINIENSIS IOLE (Cramer)

Papilio iole Cramer, 1775.

Pyrameis huntera: Gundlach, 1881: 41.

Vanessa virginiensis virginiensis: Bates, 1935: 165.

Vanessa virginiensis: Comstock, 1944: 449; Avinoff & Shoumatoff, 1946: 278.

Vanessa virginiensis iole: d'Almeida, 1941: 308; S. L. de la Torre, 1952: 68.

98. VANESSA CARDUI CARDUELIS (Seba)

Papilio carduelis Seba, 1765; Cramer, 1779.

Pyrameis cardui: Gundlach, 1881: 40; Clark, 1932: 88; Fazzini, 1934: 14.

Vanessa cardui: Grinnell, 1918: 113; Bates, 1935: 166; J. H. Comstock & A. B. Comstock, 1936: 158; Hoffmann, 1940c: 681; Holland, 1942: 154; Comstock, 1944: 450; Brown, 1945: 31; Avinoff & Shoumatoff, 1946: 278; Bruner, 1947: 26; Garth, 1950: 27.

Vanessa cardui carduelis: Field, 1938b: 85; S. L. de la Torre, 1952: 68.

(TO BE CONTINUED)

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NEW AMERICAN TEREBRANTIAN THYSANOPTERA

By J. Douglas Hood

With the exception of one from Texas, the eight new species described below are from the American tropics — Argentina, Costa Rica, Panamá, British West Indies, French West Indies, Puerto Rico, and Surinam.

Heterothrips clusiæ, sp. nov.

Like *condei* in having fore wings much paler basally, abdominal sterna with setæ anterior to those on posterior margin, and middle and hind tibiæ yellow but clouded at middle; but with fringe of microtrichia on abdominal tergum VI broadly interrupted on either side of median line and pronotum with about 35 transverse striæ.

FEMALE (macropterous). — Color blackish brown, not paler in basal abdominal segments; legs pale yellow, with fore and hind femora shaded at middle of dorsal surface, the hind femora more darkly; fore wings brown, recognizably paler for a short distance beyond their dark base; antennæ about concolorous with body in segments I and II, slightly paler in VI-IX, II pale yellow apically, III wholly pale yellow, IV yellow but lightly shaded with gray, V darker but yellowish basally. Length about 1 mm. (fully distended, 1.2). Head 104, across eyes 134, just behind eyes 130, across cheeks 137, at base 125, distinctly cross-striate, about 8 striæ in occipital area; a pair of setæ directly in front of median ocellus; eyes 67, width 41, interval 53; mouth-cone with tip about 50 beyond dorsal margin of head; antennæ normal; segment III composed of three parts; I 20(27), II 34(23-24), III 53(23), IV 35(23), V 24(18), VI 27(17), VII 14(11), VIII 14(9), IX 14(5). Pronotum 110, width 176; surface cross-striate with about 35 heavy dark lines about 3μ apart, and with a relatively large number of dark setæ (those at middle of disc occasionally as close together as their length); mesonotum strongly and closely cross-striate, the striæ less than 2μ apart; metanotum sculptured concentrically, the striæ with closely set microtrichia; fore wings

672, setæ dark brown in dark areas, costa with about 27, anterior vein with about 28, posterior vein with about 22. Abdomen 277 at segment IV, closely pubescent laterally in I-VII, almost completely in VIII, in posterior two-thirds of IX, and with a patch at middle of X; comb complete on terga VII and VIII, on VI interrupted broadly at sides of a median group of 8-13, II-V with a few microtrichia at median line; sterna II-VII with posterior comb and with a number of dark setae in advance of those along posterior margin.

MALE (macropterous). — Length about 0.8 mm. (fully distended, 0.9). Color as in female, but with somewhat paler antennæ; abdominal terga with a few microtrichia on posterior margin at middle, VII and VIII with comb complete, IX not modified; sterna without glandular areas.

SURINAM: Landerij (air-field near Paramaribo), July 4, 1951, Dr. D. C. Geijskes and J. D. H., 6 ♀♀ (including holotype) and 4 ♂♂ (including allotype), from flowers of *Clusia nemorosa* G. F. W. Meyer.

Heterothrips cacti, sp. nov.

Allied most closely to the following species (*trinidadensis*) and apparently also to *flavitibia,* agreeing with both in having (1) posterior margins of abdominal terga fringed with microtrichia which arise directly from the terga themselves (rather than from margining plates or scales), (2) pronotum not closely striate with dark lines, (3) fore wings with white subbasal cross-band, (4) mid and hind tibiæ dark across middle and yellow at either end, (5) head with a pair of setæ directly in front of median ocellus, and (6) antennal segment III composed of three parts; but differing from both in having numerous short dark setae on pronotum only about their length apart, mesonotum not closely striate (the striæ at middle about 6μ apart), ventral surface of pterothorax and abdomen with numerous conspicuous dark setæ like those on pronotum (in addition to the setæ on posterior margins of abdominal sterna), and antennæ nearly white in the broad sensory band which occupies the apical two-fifths.

FEMALE (macropterous). — Color blackish brown, not paler in basal abdominal segments; legs paler than body, the fore pair yellow with femora heavily shaded along upper surface except at tip, their tibiæ lightly clouded at middle, mid and hind femora and mid tibiæ brown at middle and yellow at either end, the hind tibiæ yellow but shaded at middle of upper surface, all tarsi yellow; fore wings brown at extreme base, remainder pale yellowish in its basal fifth and yellowish brown beyond, darker at tip of wing; antennæ about concolorous with body in segments I, II, and V-IX, but with II yellow across tip and V and VI somewhat yellowish in most of basal half, III clear whitish yellow, IV abruptly brown in basal three-fifths (pedicel darkest) and abruptly nearly white in apical two-fifths. Length about 1.2 mm. Head 127, width across eyes 164, just behind eyes 159, across cheeks 161, across base 148, delicately cross-striate, about 9 stronger striæ in occipital area; a pair of setæ directly in front of median ocellus; eyes 87, width 54, interval 56; mouth-cone with tip about 67 beyond dorsal margin of head; antennæ normal; segment III composed of three parts; I 24(33), II 37(28), III 60(27), IV 44(23), V 31(18), VI 33(16), VII 24(13), VIII 20(10), IX 23(7). Pronotum 150, width 231; surface cross-striate with delicate lines which frequently anastomose and are about 6μ apart (three or four along anterior margin dark), and with numerous dark setæ (those at middle of disc about as far apart as their length); mesonotum similarly sculptured; metanotum sculptured concentrically as in *sericatus* group, the striæ with closely set microtrichia; fore wings 714, setæ dark gray-brown in dark areas, costa with about 32, anterior vein with about 25, posterior vein with about 24. Abdomen 300 at segment IV, pubescent laterally in I-VII and in about posterior half of VIII and IX, VII with a small median patch, VI and X nearly bare medially; comb complete on terga VI-VIII, usually with a few median teeth on II-V; sterna II-VI similarly but somewhat irregularly fringed, and with numerous dark setæ in advance of those along posterior margin.

MALE (macropterous). — Length about 1 mm. Color about as in female, but with much paler antennæ, segment II paler and much more yellowish than I, III pale yellow, IV golden yellow in basal three-fifths and pale beyond, V-VII brownish yellow and successively shaded a little more darkly with gray, VIII and IX yellowish gray; abdominal terga II-VI with a few microtrichia on posterior margin at middle, VII and VIII with comb complete, IX not modified; sterna VI-VIII each with a transverse glandular area.

ARGENTINA: Ingeniero Juarez, Formosa, November 29, 1949, F. Monrós, 3 ♀♀ (including holotype) and 5 ♂♂ (including allotype), from cactus flowers; received from Dr. Abraham Willink.

Heterothrips trinidadensis, sp. nov.

Allied most closely to the preceding species (*cacti*) and apparently also to *flavitibia,* agreeing with both in having (1) posterior margins of abdominal terga fringed with microtrichia which arise directly from the terga themselves (rather than from margining plates or scales), (2) pronotum not closely striate with dark lines, (3) fore wings with white subbasal cross-band, (4) mid and hind tibiæ dark across middle and yellow at either end, (5) head with a pair of setæ directly in front of median ocellus, and (6) antennal segment III composed of three parts; but differing from the former species in that the pronotum and the ventral surface of pterothorax are sparsely set with pale setæ, abdominal sterna without setæ in front of posterior marginal ones, and in the coloration of the fourth antennal segment; and differing from the latter species (*flavitibia*) also in the color of the fourth antennal segment.

FEMALE (macropterous). — Color dark blackish brown, not paler in basal abdominal segments, with bright red internal pigmentation; femora concolorous with body save for yellow tips of fore pair; fore tibiæ largely yellow but shaded heavily along dorsal surface except at ends; mid and hind tibiæ pale whitish yellow, the former with middle half blackish brown, the latter similarly but not so heavily darkened in a band whose middle is beyond middle of tibiæ and which is largely confined to dorsal surface; all tarsi whitish yellow; fore wings dark brown at extreme base and in apical four-fifths, remainder white; antennæ about concolorous with body in segments I, II, and IV-IX, I and II more brownish, IV-IX more blackish and darker, IV with the sensoria themselves pale, III pale yellow to deep incision at basal two-fifths, brownish yellow beyond, shading to a dark gray apical band which begins at first whorl of setæ. Length about 1.3 mm. (distended, 1.55). Head 122, across eyes 145, across cheeks 147, across base 140, delicately cross-striate, about 11 stronger striæ in occipital area; a pair of setæ in front of median ocellus; eyes 74, width 45, interval 55; mouth-cone with tip about 47 beyond dorsal margin of head; antennæ normal; segment III composed of three parts; I 24(29), II 38(26), III 63(25), IV 43(25), V 27(19), VI 27(16), VII 16-17(11), VIII 14(10), IX 19(6). Pronotum 137, width 216; surface with three or four distinct cross-striæ along anterior margin and along posterior margin, remainder almost smooth; mesonotum with heavy close dark striæ; metanotum sculptured concentrically as in *sericatus* group, the striæ granulate; fore wings 763, setæ dark brown in dark areas, costa with about 31, anterior vein with about 26, posterior vein with 19. Abdomen 398 at segment IV, pubescent, but with the microtrichia minute or wanting at extreme sides of III-X, IX and X with the usual median patch, IX bare across base; comb complete on terga VI-VIII, usually a few teeth medially on II-V; sterna II-VI similarly fringed, but without setæ in advance of the dark ones along posterior margin.

MALE (macropterous). — Length about 1 mm. Color and structure almost as in female; comb broadly interrupted on either side of median line of tergum VI, IX not modified; sterna III-VIII each with a transverse glandular area.

TRINIDAD: El Tucuche, June 22, 1951, J. D. H., 6 ♀♀ (including holotype) and 1 ♂ (allotype), in flight at extreme summit of the mountain. — St. Augustine, June 25, 1951, J. D. H., 1 ♀ from a dead branch.

Sericothrips vicenarius, sp. nov.

Like typical *sambuci* in having the body pale yellow, without dark antecostal lines on abdominal terga, no comb on tergum VI, non-banded fore wings, and fore wings without accessory setæ; but with three pairs of minute gray dots in area of pronotal blotch and a similar pair of dots at sides of metanotum, at posterior angles of metathorax, and on abdominal terga II-VI, the pronotum much more closely striate in area of blotch than anterior to it, segment IV of antennæ about 2.0 times, VI about 2.6 times, as long as wide, and the setæ on fore wings and that on posterior angles of pronotum brown or gray, those at middle of anterior margin of fore wings about 30μ and shorter than width of wing.

FEMALE (macropterous). — Color nearly uniform pale yellow (due to internal pigmentation in body, legs, antennal segments I-V, and wing veins), somewhat whitish in abdomen, with small gray dots (visible by reflected light) as described above; legs concolorous with body; fore wings colorless except for an extremely faint cloud opposite anal area and the conspicuous yellow-pigmented ambient, anal, and medial veins; antennæ yellow, sometimes slightly darkened in apical portion of segment I, III narrowly shaded with gray just beyond pedicel and again at tip, IV more heavily darkened beyond setæ, apical third of V and all of VI-VIII gray.

Length about 1.1 mm. (distended, 1.2 mm.). Head 97μ long, 153 across eyes, 146 across cheeks, 130 across base, 20 across frontal costa, faintly cross-striate with pale lines, chætotaxy normal; occipital apodeme colorless, far posterior to eyes and to ocellar area, arched forward only slightly, with about three striæ behind it medially; eyes 68 long, 41 wide, 71 apart; mouth-cone short, broadly rounded at tip, extending about 85 beyond posterior margin of head; antennæ normal, setæ on II-V mostly gray, segment I 19(29), II 36(27), III 50(20), IV 43(20), V 39(20), VI 43(16), VII 10(7), VIII 13-14(5). Pronotum 123 long, 171 wide, cross-striate throughout, more finely in blotch, about 16 striæ crossing midline in front of median setæ of blotch, without inter-strial lines or wrinkles; seta at posterior angles 32μ, gray, other setæ paler; meso- and metanota similarly finely striate; hind tibiæ not especially slender, about 171μ long; fore wings about 728μ long, setæ dark yellowish gray, costa with 25-29, median vein with 3 or 4 + 18-22, those on vein at middle of wing about 34μ. Abdomen normal in structure and chætotaxy, 280μ wide at segment IV, without medial fringe on posterior margin of terga I-VI.

TEXAS: Bay City, March 31, 1939, J. D. H., 7 ♀♀ (including holotype), from leaves of *Baccharis halimifolia* L. (det. by C. V. Morton); Francitas, Feb. 26, 1939, J. D. H., 10 ♀♀, from miscellaneous living vegetation.

Sericothrips mimosæ, sp. nov.

Like *burungæ* in having the fore wings light gray, with an obscure dark area opposite the slightly darkened anal lobe and a minute colorless spot beyond the area, without indications of cross-bands, veins orange-pigmented in fresh specimens, one accessory seta on fore wings, abdominal terga II-VII with complete dark antecostal line, VII and VIII (only) with complete comb, and pronotal blotch distinct, though broken; but with the head dark yellowish brown in ocellar area and along occipital line, with abdominal terga II-VIII rather heavily shaded at sides behind basal dark line, this shading occupying about one-half the length of the segments and extended on VII and VIII to posterior margin in about median fourth, with about 16 striae medially in front of pronotal blotch, and the wing setæ longer, those on costal margin at middle of wing about 43μ long.

Female (macropterous). — Color orange-yellow, head nearly colorless between antennæ and darkened with brown in ocellar area and broadly so along occipital line; pronotal blotch distinct, dark gray-brown and complete along anterior margin, about three pairs of paler, coalescing gray spots occupying the foveæ behind; mesonotum darkened anteriorly and at sides, metascutellum irregularly darkened; abdominal terga II-VII with complete dark brown antecostal line, VIII with this line dark in median third, all of these segments shaded (especially at sides) behind the line for about one-half their length, the shading extended on VII and VIII to posterior margin in about median fourth; IX and X not darkened; legs about concolorous with body, femora and front and middle tibiæ obscurely darkened or spotted at middle, hind tibiæ yellow; fore wings pale gray, with orange pigment (especially in veins), somewhat darker in anal lobe and opposite it, with a minute colorless spot at basal fifth, the setae all dark gray; antennæ nearly colorless in segment I, brown beyond, II as dark as VI, III nearly colorless in basal two-thirds of pedicel and in a narrow line just beyond, yellowish in basal half or more of swollen apical portion, narrowly nearly black at tip, IV and V nearly black in pedicel and at tip, paler beyond pedicel, VI-VIII dark brown.

Length about 1.1 mm. (distended, 1.3 mm.). Head 107 long, 150 across eyes, 136 across cheeks, 120 across base, 15 across frontal costa; sculpture normal, consisting of fine cross-lines, these dark in the dark parts of occiput, absent from the pale transverse area between occipital line and the ocellar area and eyes. Pronotum 122 long, 175 across, with dark cross-lines of sculpture, these closer together in blotch, about 16 medially in front of blotch; seta at posterior angles 55 long, nearly black, outstanding, other setæ paler, normal in number and distribution. Mesonotum and metascutellum finely and closely striate, without inter-strial roughenings; fore wings 770 long, slender but normal, with about 3 + 24 setæ on vein and one accessory seta near tip; hind tibæ 218 long, not especially slender. Abdomen 276 wide (at segment IV), structure and chætotaxy normal, all setæ brown. Antennal segments: I 21(26-27), II 40(26), III 57(20), IV 54(18), V 44(16-17), VI 53(16), VII 11(7), VIII 13(5).

MALE (macropterous). — Nearly identical in color and structure with female; length about 1 mm.

COSTA RICA: Turrialba, Jan. 16, 1951, Dr. T. Roy Hansberry, 18 ♀ ♀ and 5 ♂ ♂ (including holotype and allotype), from *Mimosa* flowers and foliage.

Echinothrips caribeanus, sp. nov.

Like *americanus* in having dark brown body with red internal pigmentation and abdominal terga II-VII with microtrichia arising from the lines of sculpture at sides in posterior half; but with the fore wings nearly uniform brown, setæ on wings shorter (those at middle of costa about 65μ, at middle of vein about 50μ), occipital and pronotal reticles not wrinkled, and setæ on dorsum of antennal segment II near apex blunt and tapering only slightly.

FEMALE (macropterous). — Color dark brown, with red internal pigmentation; fore legs yellow, lightly shaded at middle of femora and near base of tibiæ; mid and hind tarsi and distal halves of their tibiæ yellow, remainder of legs dark brown except for yellow bases of femora; fore wings light gray, with orange pigment in ambient vein; antennæ dark brown in segments I and II, somewhat paler in V beyond setæ and in VI-VIII, remainder pale yellow with III shaded in constricted portion just beyond pedicel.

Head 143μ long, across eyes 151, across cheeks 145, at base 139, across frontal costa 18, cheeks slightly concave, serrate in basal half, sculpture and chætotaxy normal, reticles not roughened; mouth-cone extending 74μ beyond posterior dorsal margin of head, broadly rounded at tip, maxillary palpi 2-segmented; antennæ normal, segment I 24(31), II 40(29), III 56(16), IV 45(17), V 50(16-17), VI 66(16-17), VII 17(8), VIII 25(6). Pronotum 113μ long, 202 across, sculpture as illustrated for *subflavus;* setæ at posterior angles grayish yellow, slightly dilated and blunt at tip, inner 51μ, outer 56;

fore wings 896μ long, costa with about 16 setæ, vein with about 14, these dilated at tip and yellow. Abdomen normal, with dark raised lines of sculpture along sides curved posteriorly, those in about posterior half with microtrichia.

MALE ♂ (macropterous). — Virtually identical with female in color and structure, but with numerous glandular areas on sterna III-VIII; length about 1.22 mm. (distended, 1.35 mm.).

GUADELOUPE: March 12, 1915, Dr. C. B. Williams, 16 ♀♀ (including holotype) and 3 ♂♂ (including allotype), from lower side of leaves of *Erythrina* sp.; same, 2 ♀♀, from grass and low herbage; same, 1 ♀ from jaws of ant.

MARTINIQUE: March 14, 1915, C. B. W., 2 ♀♀, swept from grass.

ST. VINCENT: Kingston, Dec. 10, 1917, C. B. W., 1 ♀, underside leaf of small weed.

TRINIDAD: St. Annes, Jan. 7, 1917, C. B. W., 1 ♀, swept from low herbage.

PANAMA: Barro Colorado Island, C. Z., July 29, 1933, J. D. H. and James Zetek, 1 ♂, from flower of *Euphorbia brasiliensis*.

PUERTO RICO: El Yunque (Caribbean National Forest), June 16, 1951, J. D. H., 1 ♀, from grass.

Enneothrips (Enneothripiella) subtilis, sp. nov.

Distinctive in having head and body yellowish brown, with all femora partly or largely brown, antennal segments I-IX almost wholly brown, abdomen very closely striate with dark lines at sides, the lines without microtrichia, interocellar setæ short and inconspicuous, and seta at posterior angles of prothorax about as long as width of fourth antennal segment.

FEMALE (macropterous). — Color nearly uniform yellowish brown, abdomen paler medially in segments III-V, head narrowly darkened across base; fore femora brown along outer surface, yellow along inner surface and at tip, the mid femora largely brown, hind femora dark brown, all of them yellow at base; tibiæ and tarsi yellow, the former lightly clouded with brown along outer surface; fore wings dark brown, pale in about second seventh except along costal margin; antennæ nearly uniform brown throughout, segment I only slightly paler than II, III pale in pedicel and (like IV and V) narrowly pale just beyond pedicel. Length about 0.9 mm. Head 89 μ, width across eyes 130, across cheeks 128, cheeks nearly straight and parallel; dorsal surface with fine raised cross-lines which project distinctly beyond outline of cheeks, no wrinkles between the lines, ocellar area similarly but more faintly sculptured; chætotaxy normal, all setæ slender, pale, and inconspicuous, interocellar setæ about 17 μ; occipital apodeme darkened, marginal; eyes 57 μ, width 39, interval 52; ocelli about 14 μ in diameter, the posterior pair about 20 apart and about 11 from median ocellus; mouth-cone with tip slender (not broadly rounded) and extending about 110 μ beyond posterior dorsal margin of head, maxillary palpi 3-segmented; antennæ normal, almost as illustrated for type species, segment I 19(24) μ, II 33(22, exclusive of the strongly-projecting lines of sculpture), III 39(17), IV 43(16), V 39(15), VI 37(14-15), VII 13(8), VIII 8(6-7), IX 12(4). Pronotum 106 μ, width 157, seta at posterior angles 30; striæ very fine and close (1.5-2 μ apart), without interlineations; mesonotum as closely but more strongly striate, anterior sclerite of metanotum similarly striate across base, longitudinally striate elsewhere, reticulated medially only at extreme posterior margin; fore wings 546 μ, typical, with 24-26 setæ on costal margin, fore vein with 4+7-8 in basal half and 1+1 in apical sixth, hind vein with 13-15 evenly-spaced ones. Abdomen 238 μ wide at segment IV, lateral thirds of most terga with striæ dark, strong, inclined backward, and closely spaced (about 1.5 μ apart), microtrichia only along posterior margins of terga at sides; comb on VIII complete; setæ dark gray, segment IX with seta I 50 μ, II and III 57, X with seta I 70, II 67.

TRINIDAD: April 1, 1915, Dr. C. B. Williams (No. 635), 1 ♀ (holotype), swept from grass.

Enneothrips (Enneothripiella) flaviceps, sp. nov.

Distinctive in having head and legs pale lemon-yellow, antennæ with segment I yellow and remainder almost wholly brown, abdomen without microtrichia arising from lines of sculpture (the latter weak, transverse, and rather widely spaced), interocellar setæ fully twice as long as diameter of ocelli, and seta at posterior angles of prothorax longer than fourth antennal segment.

FEMALE (macropterous). — Color of head and abdomen pale lemon-yellow, thorax orange-yellow, the head narrowly darkened across base, abdominal terga II-VIII gray medially, more narrowly so on VI-VIII, these clouds darkest anterior to antecostal line; thoracic nota with very obscure clouds either side of middle; legs nearly clear yellow; fore wings almost uniform yellowish brown; antennæ with segment I pale like head, II-IX brown, II darker than III and somewhat orange, III pale yellow in pedicel and basal part of widened portion, IV pale basally, V with pedicel dark, both of last nearly colorless just beyond pedicel, VI-IX uniform brown. Length about 0.9 mm. Head

107 μ, width across eyes 140, across cheeks 134, across base 122, cheeks slightly arched; dorsal surface with fine raised cross-lines which project only slightly beyond outline of cheeks, but without wrinkles between the lines, the striæ longitudinal medially between bases of antennæ, ocellar area smooth; chætotaxy normal, but interocellar setæ long (35 μ) and gray, other setæ shorter and paler; occipital apodeme darkened, marginal; eyes 67 μ, width 49, interval 62; ocelli 13-14 μ in diameter, the posterior pair about 23 apart and 10-11 from median ocellus; mouth-cone with tip slender (not broadly rounded) and extending about 81 μ beyond posterior dorsal margin of head, maxillary palpi 3-segmented; antennæ normal, almost as illustrated for type species, segment I 19(24) μ, II 32(23-24), III 37(19), IV 47(19), V 38(16), VI 34(17), VII 13(10), VIII 10(7), IX 13(4). Pronotum 111 μ, width 142, seta at posterior angles 56; striæ fine and close, without interlineations; mesonotum finely striate, anterior sclerite of metanotum reticulate medially in about posterior half, striate elsewhere; fore wings 546 μ, typical, with about 26 setæ on costal margin, fore vein with 4+6 in basal half and 1+1 in apical sixth, hind vein with about 13 evenly-spaced ones. Abdomen 251 μ wide at segment IV, lateral thirds of most terga transversely weakly striate, microtrichia only along posterior margins at sides; comb on VIII complete; setæ dark gray, I-III on IX 45-47 μ, I and II on X 62.

PANAMA: Barro Colorado Island, C. Z., August 8 (1 ♀, holotype, from unidentified plant), Aug. 10 (2 ♀ ♀ from leaves of *Machaerium purpurascens*), and Aug. 14 (1 ♀ from miscellaneous vegetation), 1933, J. D. H.

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), XXVIII

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The preceding part under this general title was published in the Journal of the New York Entomological Society, 61: 147-157; 1953. At this time I am considering a series of Tipulidæ that were taken at El Limbo, in the Yungas del Palmar, Province of Chapare, Department of Cochabamba, Bolivia, at a general altitude of 2,000 meters, in March 1953. This important series of crane-flies was received from Mr. Alberto F. Prosen, to whom I express my sincere appreciation. The types of the novelties are preserved in my personal collection.

Besides the Tipulidæ herein described as new, a considerable number of additional species were included, with the same data as given above. Most of these were known previously only from Ecuador and Peru and provided marked extensions of range.

Tipula (*Eumicrotipula*) *conspicillata* Alex.
Limonia (*Limonia*) *bimucronata* Alex.
L. (*L.*) *brachyacantha* Alex.
L. (*Dicranomyia*) *labecula* Alex.
L. (*D.*) *subandicola* Alex.
L. (*Geranomyia*) *aequalis* Alex.
L. (*G.*) *carunculata manabiana* Alex.
L. (*G.*) *stoica* Alex.
Shannonomyia sopora Alex.
Atarba (*Ischnothrix*) *obtusiloba* Alex.
A. (*Atarba*) *macracantha* Alex.
A. (*A.*) *scabrosa* Alex.
Elephantomyia (*Elephantomyia*) *boliviensis* Alex.
Teucholabis (*Teucholabis*) *ducalis* Alex.
Gonomyia (*Paralipophleps*) *heteromera* Alex.
G. (*Lipophleps*) *projecta* Alex.
G. (*L.*) *senaria* Alex.
Erioptera (*Empeda*) *austronymphica* Alex.

E. *E.* *boliviana* Alex.
E. *E.* *percupida* Alex.
E. (*Erioptera*) *andina* Alex.
E. *E.* *multiannulata* Alex.
E. *E.* *urania* Alex.
Molophilus (*Molophilus*) *piger* Alex.
M. (*M.*) *tucumanus* Alex.

Genus *Tipula* Linnæus

Tipula (Eumicrotipula) longurioides new species

Belongs to the *glaphyroptera* group; general coloration of præscutum yellow, subnitidous, with three reddish brown stripes; a conspicuous brown spot on the pretergite beneath the humeri; antennæ very short; femora obscure yellow, darker outwardly, with a vague darker nearly terminal ring; wings weakly tinged with brown, almost unpatterned; cells *C* and *Sc*, with the stigma, darker brown; vein R_{1+2} entirely atrophied; abdomen black, the basal segments and the hypopygium yellowed; male hypopygium with the posterior border of tergite produced into a short median point; gonapophysis very large and conspicuous; eighth sternite unarmed.

Male. Length about 12 mm.; wing 14 mm.; antenna about 2.4 mm.

Female. Length about 11.5 mm.; wing 14 mm.; antenna about 2 mm.

Frontal prolongation of head yellow; nasus very short; basal three segments of palpi yellow, the terminal one abruptly black. Antennæ unusually short in both sexes; basal three segments yellow, the remainder black; flagellar segments subcylindrical, with poorly developed basal enlargements; verticils much shorter than the segments; terminal segment very reduced. Head buffy; vertical tubercle low.

Pronotum obscure yellow, restrictedly patterned with darker medially and on sides. Mesonotal præscutum yellow with three reddish brown to brown stripes, the surface subnitidous; a very conspicuous black spot on the pretergites opposite the humeral region of the præscutum; posterior sclerites of notum yellow, patterned with more reddish brown, including the scutal lobes, scutellum and central line of the mediotergite. Pleura and pleurotergite more opaque yellow; a very small black dot on dorsal anepisternum before the wing-root. Halteres with stem pale brown, knob obscure brownish yellow. Legs with the coxæ and trochanters obscure yellow; femora obscure yellow, more infuscated outwardly, with a vague darker nearly terminal ring; tibiæ and tarsi more reddish brown, the outer tarsal segments darker; claws (male) simple. Wings with a weak brownish tinge, cells *C* and *Sc*, with the stigma, darker brown; small and vague darkenings at origin of *Rs*, cord and outer end of vein *Cu*; obliterative areas before stigma and across cell *1st* M_2 restricted and inconspicuous; veins brown. Venation: R_{1+2} entirely atrophied; petiole of cell M_1 about one-half longer than *m*; basal section of vein M_4 perpendicular.

Basal abdominal segments broadly yellow laterally, the tergites with a conspicuous blackened central stripe, the fourth and succeeding segments black; hypopygium light yellow. Male hypopygium with the tergite transverse, its posterior border broadly emarginate, the median area produced into a small carinate blade; lateral angles narrowly produced into longer points. Basistyle small, unproduced, its lobes reduced and inconspicuous. Outer dististyle a weak club with relatively few long setæ. Inner dististyle with the beak and lower beak conspicuous, the latter smaller and more blackened; setæ of dorsal region long but scattered and relatively few in number. Gonapophysis very conspicuous, appearing as a broadly flattened obtuse blade, with a smaller inner one that narrows outwardly, bidentate at extreme tip. Eighth sternite unarmed, the posterior border pale and very shallowly emarginate.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953.

Allotopotype, ♀.

The present fly is quite distinct in the coloration, venation and structure of the male hypopygium. It is most similar to species such as *Tipula* (*Eumicrotipula*) *flavidula* Alexander but quite distinct in the coloration, wing pattern, and details of structure of the male hypopygium.

Genus *Limonia* Meigen

Limonia (Rhipidia) proseni new species

General coloration of mesonotum light brown, pleura with a broad darker brown longitudinal stripe; antenna (male) unipectinate, black throughout except for the pale apical pedicels of the segments; femora obscure yellow, pale brown outwardly, most extensively so on the fore legs; wings faintly infuscated, with a restricted darker brown pattern; Sc_1 ending just before midlength of *Rs*; cell *1st* M_2 long-rectangular; *m-cu* shortly before fork of *M*; male hypopygium with two short rostral spines.

Male. Length about 6.5 mm.; wing 7 mm.

Rostrum black, relatively long, about one-half the remainder of head; palpi black. Antennæ black, the glabrous apical pedicels of the flagellar segments obscure yellow; flagellar segments unipectinate, the longest branches nearly as long as the segments; penultimate segment vaguely produced, darkened except for the apical stem, shorter than the terminal segment. Head light brown; anterior vertex reduced to a capillary line.

Pronotum dark brown. Mesonotal præscutum almost uniformly light brown, without clearly defined stripes, the sides paler; scutal lobes light brown; remainder of notum more testaceous yellow. Pleura with a broad diffuse darker brown longitudinal stripe, the ventral pleurites yellow. Halteres with stem pale yellow, knob weakly darkened. Legs with coxæ and trochanters testaceous yellow, the fore coxæ darker; femora obscure yellow, the tips passing into pale brown, most extensive on the fore legs, very narrow on the hind pair; tibiæ and tarsi pale brown, the outer tarsal segments darker. Wings faintly infuscated, with a restricted darker brown pattern, arranged much as in *domestica* and allies; small spots at near midlength of cell *Sc*, origin of *Rs* and fork of *Sc*; cord and outer end of cell *1st* M_2; stigma ringed with pale brown, the center pale; a dusky streak in cell R_2 beyond stigma, with scarcely indicated similar darkenings in cells R_3 and R_5; broad but diffuse dusky clouds in cell *R* adjoining vein *M* and in base of cell *1st A*; veins pale brown, darker in the patterned areas. Venation: *Sc* relatively long, Sc_1 ending shortly before midlength of *Rs*, Sc_2 close to its tip; cell *1st* M_2 long-rectangular, nearly equal to the distal section of vein M_3; *m-cu* about one-fifth its length before the fork of *M*.

Abdomen dark brown, including the hypopygium, the basal sternites a trifle paler. Male hypopygium with the tergite semicircular in outline, the posterior border broadly rounded; setæ relatively few, marginal. Basistyle with the ventromesal lobe relatively large, with a small accessory lobule near base. Dorsal dististyle a stout rod, strongly curved on outer half, suddenly narrowed into a terminal spine. Ventral dististyle fleshy, its area approximately three times that of the basistyle; rostral prolongation stout, with two short spines that are not quite as long as the prolongation beyond their insertion. Gonapophysis with mesal-apical lobe black, nearly straight, the narrowed tip a little curved.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953.

Limonia (*Rhipidia*) *proseni* is dedicated to Señor Alberto F. Prosen. It is most similar to species such as *L.* (*R.*) *sycophanta* Alexander and *L.* (*R.*) *thysbe* Alexander, differing in the coloration, venation, and slight details of the male hypopygium.

Limonia (Geranomyia) neanthina new species

Generally similar to *anthina* and *glauca;* size relatively small (wing under 8 mm.); general coloration greenish yellow, the præscutum with a broad reddish brown central stripe; femora with two blackened rings, the narrower one subterminal; wings pale yellow, with a conspicuous brown pattern; male hypopygium with the notch of the tergite very deep and narrow, the lobes conspicuous; rostral spines straight, from a small common basal tubercle.

Male. Length, excluding rostrum, about 6 mm.; wing 7.5 mm.; rostrum about 4 mm.

Female. Length, excluding rostrum, about 6.5 mm.; wing 7.6 — 7.8 mm.; rostrum about 4 mm.

Rostrum black throughout, long in both sexes, exceeding one-half the wing. Antennæ black; flagellar segments oval with short verticils. Head above black, with a narrow buffy gray central line over the entire vertex.

Pronotum reddish brown, paling to greenish yellow on sides. Mesonotal præscutum with a broad median reddish brown stripe, the lateral borders less evidently darkened, leaving broad pale green intermediate areas between the stripes; posterior sclerites of notum strongly greenish, the centers of the scutal lobes darkened. Pleura and pleurotergite greenish, presumably fading to yellow in long dead specimens. Halteres with stem pale green, knobs infuscated. Legs with the coxæ and trochanters pale green; femora on proximal half chiefly blackened, the bases yellowed, least extensive on fore legs, more broadly so on the middle and posterior pairs; outer half or less yellow, enclosing a second blackened ring that is subequal to the yellow annuli before and beyond it; tibiæ dark brown or blackened, the bases yellowed; tarsi light brown, the outer segments black. Wings tinged with yellow, the prearcular and costal fields more saturated; a relatively heavy brown pattern, as follows: Bases of cells *R* and *M;* supernumerary crossvein in cell *Sc;* origin of *Rs;* fork of *Sc;* stigma, confluent with a complete band at cord; outer end of cell *1st* M_2; marginal clouds at ends of longitudinal veins, largest over the Anals; a restricted heavy darkening at midlength of cell *2nd A;* veins light yellow, infuscated in the patterned areas. Venation: *Sc* long, Sc_1 ending about opposite midlength of *Rs*, Sc_2 near its tip; *r-m* reduced by approximation of adjacent veins; cell *1st* M_2 subequal in length to distal section of vein M_{1+2}.

Abdomen pale brown, strongly suffused with green, including the hypopygium. Male hypopygium with the tergite narrowed posteriorly, the caudal border with a deep and narrow notch, the lobes obtuse, conspicuous. Ninth sternite broadly semioval, with numerous rather short setæ that are well-distributed over the surface. Dorsal dististyle a gently curved rod that narrows to the long straight terminal spine. Ventral dististyle large and fleshy, its area exceeding four times that of the basistyle; rostral prolongation moderately long, with two straight spines that exceed the prolongation, placed close together at summit of a low common tubercle. Gonapophysis pale, the mesal-apical lobe relatively slender, without a lateral flange, gently curved to the acute tip. Aedeagus relatively broad, glabrous, terminating in two very large apical flaps, their apices obtuse.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953. Allotopotype, ♀. Paratopotypes, 2 ♀♀.

The most similar described species is *Limonia (Geranomyia) anthina* Alexander, of Peru, which differs in the larger size, details of coloration, and in the structure of the male hypopygium.

Genus *Orimarga* Osten Sacken

Orimarga (Orimarga) subcostata new species

Size relatively small (wing, female, about 5.5 mm.); general coloration gray, the præscutum with three vaguely darker stripes; intermediate flagellar segments nearly globular; legs obscure yellow, the outer tarsal segments darkened; wings with a weak brownish tinge; *Sc* very long, Sc_1 ending beyond three-fourths the length of *Rs; R_2* longer than R_{1+2}; basal section of R_{4+5} short, suberect at origin; *m-cu* nearly three times its length before fork of *M*.

Female. Length about 6 mm.; wing 5.6 mm.

Rostrum and palpi brownish black, the former about one-third the remainder of head. Antennæ very pale brown, the pedicel brighter; intermediate flagellar segments nearly globular, with inconspicuous vestiture; outer segments passing into oval. Head light gray; anterior vertex about three times the diameter of scape.

Thoracic dorsum gray, the præscutum with three scarcely indicated brownish gray stripes; scutal lobes faintly brownish gray. Pleura infuscated dorsally, more brownish yellow below. Halteres obscure yellow. Legs with the coxæ and trochanters testaceous yellow; remainder of legs brownish yellow to obscure yellow, the outer tarsal segments darkened. Wings with a weak brownish tinge, the prearcular and costal fields more whitened; veins very pale brown, more yellowed at the wing base. Anterior branch of *Rs* without macrotrichia; veins R_{4+5}, M_{1+2}, M_3 and M_4 with trichia. Venation: *Sc* very long, Sc_1 ending beyond three-fourths the length of *Rs*, Sc_2 some distance from its tip, with no indication of the free tip of Sc_2; *Rs* angulated at origin, long, about equal to the distal section of vein R_{4+5}; R_{1+2} shorter than R_2; *m-cu* nearly three times its length before fork of M, about opposite Sc_2; basal section of vein R_{4+5} short, suberect at origin, about in alignment with fork of *M;* cell M_3 longer than its petiole. In one wing of type, vein R_2 entirely atrophied.

Abdomen dark brown, including the genital shield; cerci short, slightly upcurved, horn-yellow, the tips ending almost on a level with those of the hypovalvae.

Holotype, ♀, El Limbo, Cochabamba, 2000 meters, March 1953.

Orimarga (Orimarga) subcostata is quite distinct from all other described regional species in the venation, particularly the combination of very long *Sc* and short R_{1+2}. In general, it is closest to species such as *O.* (*O.*) *dampfi* Alexander, yet quite distinct in the features listed.

Genus *Atarba* Osten Sacken

Atarba (Ischnothrix) rectangularis new species

General coloration of thorax buffy; antennæ (male) elongate, approximately equal to the body, the flagellar segments with a long outspreading pubescence; wings tinged with brown, the long-oval stigma darker brown; vein R_3 short, oblique, *m-cu* beyond midlength of cell *1st* M_2; abdominal segments bicolored, especially the sternites; male hypopygium with the median area of the posterior border of the eighth sternite produced into a long parallel-sided lobe, the ninth sternite into two strong horns; ædeagus small and weak.

Male. Length about 6 — 6.2 mm.; wing 6.6 — 7 mm.; antenna about 6.3 — 6.4 mm.

Rostrum obscure yellow; palpi dark brown. Antennæ (male) very long, approximately equal to the body; scape and pedicel light yellow, flagellum dark brown; flagellar segments very long-cylindrical, with abundant erect white pubescence, this three or four times as long as the diameter of the segment. Head light brown.

Thoracic dorsum buffy, without a distinct pattern; scutellum and postnotum darker, pruinose. Halteres with stem pale, knob weakly darkened. Legs with the coxæ pale, the fore pair darker in front; trochanters pale yellow; remainder of legs light brown, the outer tarsal segments blackened. Wings tinged with brown, the long-oval stigma darker brown; veins dark brown. Venation: *Sc* relatively long, Sc_1 ending beyond midlength of *Rs*, Sc_2 a short distance from its tip; vein R_3 short, oblique, subequal to the distance on margin between it and the tip of R_{1+2}; *m-cu* beyond midlength of cell *1st* M_2

Abdominal tergites brown, the posterior borders more yellowed; sternites bicolored, yellow, with a darkened ring at near midlength of each; subterminal segments dark brown, forming a conspicuous ring; basistyles of hypopygium light yellow. Male hypopygium with the posterior border of the eighth sternite produced into a long parallel-sided lobe, its apex truncate, the length about two and one-half times its width. Ninth sternite produced into two stout yellow horns that are only slightly divergent, narrowed to the acute tips. Basistyle elongate, without mesal lobes. Outer dististyle slender, gently curved toward apex, with a series of about a score of appressed spines, the outer ones longer; inner style a little longer, dark colored. Aedeagus slender, unusually small and weak.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953.

Paratopotype, ♂.

This fly is most similar to species such as *Atarba* (*Ischnothrix*) *capitella* Alexander and *A.* (*I.*) *digitifera* Alexander, differing from all in the structure of the male hypopygium, especially the nature of the lobe of the eighth sternite. The paratype is much darker, with slightly different venation, yet seems to be conspecific.

Genus *Teucholabis* Osten Sacken

Teucholabis (Teucholabis) analis new species

General coloration of entire body polished black, the pronotal scutellum, an area at center of the suture and the mesonotal scutellum yellow; antennæ and legs entirely black; halteres black, the knobs orange; posterior tibiæ and basitarsi weakly dilated; wings whitish, restrictedly patterned with brown, including the cord and wing tip; basad of cord with no dark areas except at end of vein *2nd A; Sc* relatively long, Sc_1 ending about opposite two-fifths *Rs*, the branches of the latter parallel to one another; sternal pocket of fifth segment conspicuous.

Male. Length about 8 mm.; wing 7 mm.

Female. Length about 6.5 mm.; wing 6 mm.

Rostrum, palpi and antennæ black, the flagellar segments subglobular. Head black.

Thorax almost uniformly polished black, the pronotal scutellum and pretergites, a restricted median area at the suture, and the mesonotal scutellum light yellow. Pleura polished black, the dorsopleural membrane pale yellow. Halteres with stem black, the apex of knob orange. Legs entirely black, in male the posterior tibia before midlength and posterior basitarsus on proximal third slightly dilated. Wings whitish, rather restrictedly patterned with dark brown, including the stigma and a confluent band over the cord, outer end of cell *1st* M_2, and a weak cloud at end of *Sc;* wing tip rather broadly dark brown, leaving nearly the basal halves of cells *2nd* M_2 and M_3 pale, the dark pattern continued basad as a very narrow marginal seam to vein *Cu;* cell *Sc* dark; no darkening basad of cord except a single spot at end of vein *2nd A;* veins dark brown, more yellowed in the prearcular field. Venation: *Sc* relatively long, Sc_1 ending about opposite two-fifths *Rs;* R_2 only a little distad of level of cord, R_{2+3+4} thus very short to virtually lacking; branches of *Rs* extending parallel to one another for virtually their whole lengths.

Abdomen black throughout. Sternal pocket of fifth segment conspicuous, including a dense concentration on either side of a narrow longitudinal cleft, with coarser, inwardly-directed bristles on either side; on sternite six with a group of about twenty very long setæ on either side of a broad central area. Hypopygium lost.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953.

Allotopotype, ♀, pinned with type.

Teucholabis (*Teucholabis*) *analis* is most similar to species such as *T.* (*T.*) *cybele* new species and *T.* (*T.*) *decora* Alexander, differing in the coloration of the body and appendages, and in the distribution of the wing pattern.

Teucholabis (Teucholabis) cybele new species

Head and abdomen black; thorax variegated black, yellow and fulvous, præscutum black with a transverse fulvous band at midlength; a major black area on the mesepisternum; halteres black; legs black, the fore and middle femora broadly yellow basally; wings with the restricted ground pale yellow, heavily patterned with dark brown; pocket of fifth abdominal sternite in male an oval area of dense microscopic points; male hypopygium with the spine of basistyle short and straight; outer dististyle a flattened black blade, terminating in a black spine; inner dististyle a divided blade, the inner arm elongate, the beak terminating in two unequal spines.

Male. Length about 8 mm.; wing 8.5 mm.

Female. Length about 6.5 mm.; wing 7 mm.

Rostrum and palpi black, the former nearly as long as the remainder of head. Antennæ black throughout; flagellar segments oval to long-oval. Head black.

Pronotum yellow. Mesonotal præscutum black medially on anterior third, the posterior third uniformly black, the intermediate part fulvous, forming a broad crossband at near midlength; scutum black, the region of the suture more reddened; scutellum yellow; postnotum reddish. Pleura with the mesepisternum polished black, the propleura and mesepimeron yellow; meron black; dorsopleural region chiefly yellow. Halteres black throughout. Legs with all coxæ black; trochanters brownish yellow, darker beneath, the posterior pair more uniformly so; fore femora with the bases broadly yellow, the outer half or more black; middle femora with outer two-thirds black, the posterior femora entirely blackened; tibiæ and tarsi black; posterior basitarsi a trifle enlarged on proximal fourth. Wings with the restricted ground pale yellow, the basal region more conspicuously flavous; a broad and conspicuous dark brown pattern, restricting the ground to the bases of the Anal cells, and X-shaped mark before cord, and an incomplete band beyond cord; veins dark brown, yellow in the brightened areas. Costal fringe (male) normal. Venation: Sc_1 ending shortly beyond midlength of *Rs;* veins R_{1+2} and R_2 subequal; branches of *Rs* virtually parallel to one another for their entire lengths.

Abdomen black, the basal sternites restrictedly yellowed. Pocket of fifth sternite of male an oval area densely set with microscopic points; sixth sternite with a group of mesally directed setæ on either side of midline; seventh sternite with a few similar setæ, scarcely forming a pocket. Male hypopygium with the apical spine of basistyle short and straight. Outer dististyle a flattened black blade that terminates in a slightly curved black spine, the inner angle of the blade produced into a small point; style with numerous setæ, the outer ones large and conspicuous. Inner dististyle a blackened divided blade, the main body or beak terminating in two unequal spines, the posterior lobe elongate, bearing several strong setæ on its expanded outer end. Aedeagus with the apical spine longitudinal in position, almost in alignment with the main axis; two long setæ on outer part of ædeagus, with a group of about four others on the axis before the spine.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953. Allotopotype, ♀, pinned with type. Paratopotypes, ♂ ♀.

Teucholabis (*Teucholabis*) *cybele* is most similar to *T.* (*T.*) *decora* Alexander, differing in the pattern of the wings and in all details of the male hypopygium.

Genus *Gnophomyia* Osten Sacken

Gnophomyia (Gnophomyia) toleranda new species

General coloration of mesonotum light brown, the præscutum with three darker brown stripes; posterior sclerites of notum dark brown, the apex of the scutellum broadly paler; femora yellow with a nearly terminal light brown ring; wings yellow, weakly patterned with darker, including brown seams over cord and outer end of cell *1st* M_2; *vein* R_2 at or very close to fork of R_{2+3+4}; *m-cu* about its own length beyond the fork of *M;* abdominal tergites vaguely bicolored; male hypopygium with the posterior margin of the tergite long-produced medially; outer dististyle a relatively narrow flattened blade, its tip obtuse; phallosome blackened, the outer margin vaguely lobed.

Male. Length about 7 mm.; wing 7.5 mm.

Female. Length about 8 mm.; wing 8 mm.

Rostrum brown; palpi black. Antennæ dark brown, relatively long; flagellar segments passing through oval to long-oval. Head ochreous in front and behind, the vertex chiefly dark brown; anterior vertex broad, nearly twice the diameter of the scape.

Pronotum darkened medially, broadly light yellow on sides. Mesonotal præscutum with the ground light brown, with three darker brown stripes, the lateral borders somewhat more brightened; scutum dark brown; scutellum darkened medially, the apex broadly paler; postnotum dark brown. Pleura and pleurotergite dark brown dorsally, the ventral part broadly yellow. Halteres short, the stem infuscated, the large knobs yellow. Legs with the coxæ and trochanters yellow; femora yellow, with a nearly terminal light brown ring; tibiæ and tarsi yellow, the outer tarsal segments darkened. Wings with the proximal third weakly infuscated, the remainder of the ground more yellowed; a further vague brown pattern at origin of *Rs* and more extensively along the outer end of vein *Cu;* stigma and seams over the cord and outer end of cell *1st* M_2 darker brown; veins yellow in the ground, darker in the patterned areas. Venation: *Sc* long, Sc_1 ending shortly beyond R_2, the latter at or very close to fork of R_{2+3+4}; *r-m* at fork of *Rs,* vein R_5 being in direct longitudinal alignment with *Rs; m-cu* about its own length beyond the fork of *M;* cell *2nd A* broad.

Abdominal tergites vaguely bicolored, reddish brown, the posterior and lateral borders darker brown; sternites more uniformly brownish yellow; hypopygium scarcely more brightened . Male hypopygium with the posterior border of the tergite long-produced medially. Basistyle short and stout. Outer dististyle a relatively narrow flattened blade, the narrowly darkened tip obtuse; inner dististyle with the outer part long-oval, with several long setæ. Phallosome a transverse blackened structure, its outer margin vaguely lobed. Aedeagus short.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953.

Allotopotype, ♀, pinned with type.

Gnophomyia (*Gnophomyia*) *toleranda* is most similar to species such as *G.* (*G.*) *argutula* Alexander, *G.* (*G.*) *duplex* Alexander, and *G.* (*G.*) *laticincta* Alexander, differing from all in the details of coloration, venation, and structure of the male hypopygium.

Genus *Molophilus* Curtis

Molophilus (Molophilus) sponsus new species

Belongs to the *plagiatus* group; general coloration of thorax reddish brown, the pleura with a conspicuous brownish black longitudinal stripe; antennæ short; male hypopygium with the beak of the basistyle slender, black; basal dististyle unequally bifid, the main axis a long gently curved spine, the inner arm shorter; phallosome an oval glabrous plate.

Male. Length about 3.7 — 4.2 mm.; wing 4.5 — 5 mm.; antenna, about 1.1 — 1.2 mm.

Rostrum dark brown; palpi black. Antennæ short; scape and pedicel light brown, flagellum black; flagellar segments subcylindrical to long-oval, with very long verticils. Head grayish white.

Pronotum and pretergites whitened. Mesonotal præscutum, scutum and scutellum reddish brown, the humeral region of the præscutum pale yellow; postnotum darker brown, its posterior end blackened. Pleura yellow, with a conspicuous brownish black longitudinal stripe extending from the cervical region to the postnotum, more or less interrupted on the propleura and pteropleurite. Halteres pale yellow. Legs with all coxæ and trochanters pale yellow; fore legs chiefly dark brown, remaining femora obscure yellow, the tips vaguely more darkened; tibiæ darkened; tarsi passing into black; glandular ring on fore tibia of male distinct. Wings pale yellow, the prearcular and costal regions more saturated; macrotrichia darker. Venation: R_2 lying distad of level of *r-m;* petiole of cell M_3 about twice *m-cu;* vein *2nd A* elongate, gently arcuated, ending about opposite one-third the length of the petiole of cell M_3.

Abdomen dark brown; hypopygium brownish yellow. Male hypopygium with the beak of the basistyle slender, black, the tip gently decurved. Outer dististyle with the unequal arms blackened, the stem horn-yellow. Basal dististyle unequally bifid, the main axis a long gently curved spine, the inner arm a shorter straight spine that is about one-third as long, the common base subequal in length to the shorter arm; a few scattered setæ on axial spine and, in cases, on base of lateral one. Phallosome a long-oval plate, its apex obtuse, surface glabrous. Aedeagus long and slender.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953.

Paratopotypes, ♂♂.

Most similar to species such as *Molophilus* (*Molophilus*) *cladocerus* Alexander and *M.* (*M.*) *gymnocladus* Alexander, differing especially in the structure of the male hypopygium.

Genus *Toxorhina* Loew

Toxorhina (Ceratocheilus) revulsa new species

General coloration of thorax gray, the præscutum with three darkened stripes, the central one more blackened; rostrum shorter than body; knobs of halteres weakly darkened; legs black; wings with a strong dusky tinge, the prearcular region and base of costal field more whitened; veins delicate; *Sc* short, Sc_1 ending immediately beyond origin of *Rs;* inner end of cell *1st* M_2 pointed, the first section of vein M_{1+2} long; male hypopygium with spine of basistyle and arms of ædeagus relatively slender, the latter terminating in hyaline membrane.

Male. Length, excluding rostrum, about 6 — 6.3 mm.; wing 6.5 — 7 mm.; rostrum about 5 — 5.2 mm.

Rostrum shorter than the wing or the remainder of body, black. Antennæ black throughout. Front, anterior vertex and narrow orbits gray, the remainder of vertex dark brown; anterior vertex broad, about three times the diameter of scape.

Cervical region and pronotum black. Mesonotal præscutum with the central region blackened, narrowly divided at posterior end; lateral stripes a little paler than the central area, lateral borders buffy gray; scutal lobes dark brown, the median region and scutellum more pruinose; postnotum and dorsal pleurites blackened, the ventral pleurites with a broad dark gray stripe. Halteres with stem and base of knob brownish white, the apex of the latter more infuscated. Legs with the coxæ blackened, sparsely pruinose; remainder of legs black. Wings with a strong dusky tinge, the prearcular region and base of costal field more whitened; veins brown, paler in the prearcular area. Veins more delicate than in *vulsa*. Venation: *Sc* short, Sc_1 ending immediately beyond origin of *Rs,* the latter a little longer than the basal section of R_5; inner end of the cell *1st* M_2 pointed, with *m-cu* slightly basad of the fork; first section of M_{1+2} long, equal to the second section. In the paratype, cell M_2 open by the atrophy of *m*.

Abdomen, including hypopygium, black. Male hypopygium with the apical spine of basistyle relatively slender. Base of outer dististyle less expanded than in *vulsa*. Arms of ædeagus darkened, relatively slender, terminating in hyaline membrane.

Holotype, ♂, El Limbo, Cochabamba, 2000 meters, March 1953.

The present fly differs from *Toxorhina* (*Ceratocheilus*) *vulsa* Alexander, of Peru, in the coloration and venation of the wings, the more delicate veins, and in slight details of structure of the male hypopygium.

Toxorhina (Ceratocheilus) revulsa macrorhyncha new subspecies

Female. Length, excluding rostrum, about 9 mm.; wing 7.5 mm.; rostrum about 6.2 mm.

Generally as in typical *revulsa* new species, differing in the longer rostrum and in slight details of coloration and venation.

Rostrum only a little shorter than the wing, black throughout. Præscutal stripes virtually confluent to form a single discal area; scutellum and postnotum clear light gray. Wings with veins heavier and more conspicuous, brownish black. *Rs* nearly straight, subequal to the basal section of R_5; inner end of cell *1st* M_2 less pointed; basal section of vein M_{1+2} shorter than the second section. Wings less heavily suffused with darker, the prearcular field paler but not abruptly so.

Holotype, ♀, El Limbo, Cochabamba, 2000 meters, March 1953.

GAYLORD CROSSETTE HALL, 1871-1954

Gaylord C. Hall, former member of the New York Entomological Society and its treasurer from 1929 to 1936 died in a convalescent home in Quakertown, Pennsylvania on March 21, 1954. For the following facts about Mr. Hall's parents, his youth, his travels and business interests, I am greatly indebted to his brother Robert W. Hall of Bethlehem, Pennsylvania.

Gaylord, who was born in Cincinnati, Ohio, on January 26, 1871, was one of three brothers, the others being Robert William, born in 1872 and Norman Fisher, born in 1878. Their father was Ephraim Gaylord Hall, a graduate, at the age of 18, from the University of Michigan from which he also received his M.A., in 1866. Following his graduation he, with other classmates, volunteered in a Michigan regiment as a private and finally became a captain. In the Battle of Stone-River he was left for dead on the battlefield after a musket ball had passed through his neck. After recovery he was put in Libby Prison for three months until exchanged, whereupon he returned to the Union Army, serving until the end of the war.

Captain Hall married Alice Cogswell Crossette daughter of Rev. Robert Crossette and Dorothea Fisher Crossette in 1869. While a young girl Alice C. Crossette was supervisor of music for the Cincinnati public schools, and in addition to being an artist she wrote and illustrated many magazine articles, and was the author of one novel. Owing to the moves of his parents Gaylord during his boyhood attended schools at Cincinnati, Kent, Hockingport, and Cincinnati again, all in Ohio, and Washington, D.C. It was at Hockingport, a small village on the Ohio River that Gaylord, aged 10, and his brother Robert became interested in butterflies, an interest that remained with them for practically their whole lives.

About 1875 their father Captain Hall began to suffer from the wound that he had received during the Battle of Stone-River. This was thought to have completely healed but an injury to the base of the brain developed and spread until the Captain became physically and mentally helpless. This culminated in his death in 1881.

In 1885, Mrs. Hall, perhaps in view of her interest in art and literature, took her sons to Europe on a visit originally planned for two years but that lengthened into five. Christmas was spent on the ocean and after reaching Hamburg they went on to Heidelberg where they lived for the winter. The boys attended the Realschule and got their first German lessons. Later Gaylord and Robert attended the same schools and engaged more or less in the same activities, their brother Norman being too young. In the words of Robert Hall, their arrival in Heidelberg coincided with "the gorgeous celebration of the five hundredth anniversary of the founding of the University. But tragedy lurked in Heidelberg; it was so damp that drops of water collected on the walls and they did not glimpse the sun for twenty-one days, with the result that Gaylord developed tuberculosis of one lung. Even after he recovered it had an effect on his later life in that, fearing recurrence, he decided he must never marry, and he never did. The immediate result was doctor's orders for them to move to the most noted resort of those suffering from tuberculosis, Davos, in German Switzerland. September, 1886 found them there. The village itself is almost as high as the top of Mount Washington, with peaks about it up to ten and eleven thousand feet. They thought they faced a year but it stretched out to a winter, a summer and another winter.

"The second winter Gay was allowed to attend a regular school and he and his brother Robert went to a noted one, run by Germans, the Friederichsianum (see Thomas Mann's "The Magic Mountain"). In summer there were butterfly and plant collecting and some mountain climbing (moderate on Gay's part). In winter there were sledding and skating. Below the village was a moderate sized rink, freshly flooded each night by a mountain stream. On sunny days they skated in straw hats! A picture of that rink recently appeared in 'Life'; it is now the world's largest and of worldwide fame.

"In May, 1888 they left Davos. And what an experience that was, seeing spring rush on them as they were driven down the mountain side. When they passed the lake (Davoser See) it was frozen over and there was plenty of snow about, but when they arrived at Lucerne that evening the blackbirds were singing among the blossoms of the horse chestnut trees.

"They did not stay long in Lucerne, but moved for the summer to Gersau, a quaint little village, by the way, mentioned in Schiller's "William Tell." In the autumn they went to Vevey and then to Montreaux, where they attended the "College de Montreaux." Their apartment was on the shore of the lake with the Castle in full view and of course they made frequent visits and saw the deep path in the solid stone made by the naked feet of poor Bonivard as described in Byron's "Castle of Chillon."

"That brings us to the early summer of 1889 when they went to Champéry, a typical French-Swiss village in a valley at the base of the Dent du Midi.

"In the fall it was on to Paris and a term in the Lycé Janson de Sailly, a rather prominent municipal school. Their apartment was on the Avenue Victor Hugo, diagonally across from Hugo's home. Unfortunately he had been dead some two years. The Arc de Triomphe was only about a half block away and still better, the Bois de Boulogne was near enough to afford an almost country playground. A real bit of luck was that their arrival coincided with the opening of the great international exposition of 1889 and the completion of the Eiffel Tower. In the summer of 1890 there were some weeks at Ostend, with a few day's trip to England and then back to America! Gay then busied himself in electrical concerns and then entered the Massachusetts Institute of Technology with the class of '96."

Later he went to Chicago with the Metropolitan Elevated Railway, with Stone and Webster of Boston, the Boston Elevated Railway, the Manhattan Railway Company, and The Interborough Rapid Transit Company of New York where he was superintendent of motive power and had a staff of over ninety men and women. In the mid-thirties he entered the National Arts Club where he lived among a wide circle of friends for nearly the balance of his life. For some years he was chairman of the House Committee. His interest in art, literature, etc., is indicated by his membership in the Salmagundi Club, the Commonwealth Club of Montclair, the Appalachian Mountain Club, the Shakespeare, McDowell and Technology clubs, Water Color Society, The American Museum of Natural History, and the American Institute of Electrical Engineers.

After his retirement around 1941, his main hobby was his interest in his great grandfather, Jonathan Fisher, father of Dorothea Fisher Crossette, and versatile clergyman of Blue Hill, Maine. He made many visits to the small sea-side village and published two pamphlets about his ancestor. Dr. Mary Ellen Chase dedicated her book "Jonathan Fisher, Maine Parson" to Gaylord C. Hall and stated that without his help she could not have written it.

As has been stated Mr. Hall's interest in butterflies began when he was a boy of ten. He was an active member of the local collecting group during his residence in New York City and made collecting trips with Frank E. Watson, another lepidopterist who was on the staff of The American Museum of Natural History. According to Dr. A. B. Klots, he was probably the first of the New York collectors to get an automobile. Watson recorded in one of his notebooks his first collecting trip via automobile to Lake Hopatcong, N.J., with Mr. Hall. Dr. Klots also recalls that inspired by the descriptions and painting of Carl Rungius, who was a friend, Hall was the first to collect butterflies in the wild interior country at timberline in the Wind River Range, Wyoming. Among other things he found there *Boloria pales* (Denis & Schiffermueller) a circumpolar butterfly not previously known from North America south of Alaska. Dr. Klots visited the same place in 1939 and took a very large series which he named *Boloria pales halli.* Cook and Watson named an aberration of *Limenitis archippus floridensis halli* after him and he himself named *Nymphalis j-album* subsp. *watsoni* and *Lycæna epixanthe* subsp. *phædrus,* the latter now generally considered a subjective synonym of *amicetus* Scudder. The types are in The American Museum of Natural History, to which his collection of butterflies went. This included many local specimens as well as some very valuable material of his own and other peoples' collecting in Europe, Canada, and the West.

Cyril F. dos Passos communicated with Mr. Hall in 1935 about

Argynnis but it was only from 1947 on that he met him occasionally at The American Museum of Natural History. As a result of these meetings Mr. dos Passos purchased some spread butterflies and papered material that Mr. Hall had collected mostly in Wyoming and a few in Newfoundland and British Columbia, as well as some by well-known, old collectors, also three specimens of *Oeneis aello* that Hall had collected when a boy of 16 in Switzerland, and in addition an interesting aberration of *Lycaena hypophlæas* collected by him at Woods Hole, Massachusetts. Some of the material received by dos Passos was turned over to the Museum as a donation from Hall.

Herbert F. Schwarz, of The American Museum of Natural History, knew Mr. Hall over many years and within recent ones he would drop into Mr. Schwarz's office for a friendly visit and to talk over old times. My own contacts with Mr. Hall were business rather than entomological ones. As treasurer of the New York Entomological Society, he paid the bills that I incurred as editor of the Society's Journal. Mr. Hall succeeded the late William T. Davis as treasurer of the Society and of course they knew each other quite well. "Willie" T. Davis a well-known, versatile naturalist and historian of Staten Island was quite bald on the top of his head and in the middle of the bald patch a wart reposed. This excrescence annoyed Mr. Davis and he decided to get rid of it. Not, however, by visiting a physician, but by enlisting the aid of Gaylord C. Hall, who put a binocular microscope without a stage on top of "Willie's" head and neatly sliced off the offending wart with a sharp scalpel. This little operation probably took place in the attic of the Museum of the Staten Island Institute of Arts and Sciences, where Mr. Davis held forth surrounded by his natural history collections. It is not known if the head and scalpel were sterilized before the excision but no ill effects followed.

Mr. Hall attended the meetings of the New York Entomological Society quite regularly, as I recall, and was a contemporary of the older entomologists, many of whom died before Mr. Hall. If they were alive, I am sure they could add to this account many recollections of his entomological activities. Personally, I recall Mr. Hall as a very pleasant, rather quiet and friendly gentleman, of slight build, with various interests aside from his butterflies. My last correspondence with him took place when he was working on his "Supplement to the Biographical Sketch of the Rev. Jonathan Fisher", and dealt with "metamorphoses", popular among children a hundred and fifty years ago.

Mr. Hall was hospitalized during the Christmas holidays of 1948. In 1951 he suffered from a coronary thrombosis and had a long siege in a hospital. According to his brother Robert, he made a fair recovery but had to be careful about his exercise. During the latter part of 1953 he had several hospitalizations because his condition became worse. In January 1954, he was so weakened that his doctor advised constant care and so on January 30, 1954 his brother Robert had him removed from the hospital in New York City to his own home in Bethlehem, Pennsylvania, and then to a convalescent home in Quakertown, Pennsylvania, that was close enough for Robert to pay him frequent visits. After lingering on for nearly two months, Gaylord C. Hall died in the early morning of March 21. He was buried in the Nisky Hill Cemetery of Bethlehem. Mr. Hall's publications that I know about, are listed below. As no extended search has been made he may have been the author of others.

Distribution of *Argynnis atlantis* and *Aphrodite.* Jour. N.Y. Ent. Soc., 21:162. 1913.

Limenitis ursula var. *albo fasciata.* Jour. N.Y. Ent. Soc., 24:93. 1916.

Aglais j-album Boisduval and Leconte. Jour. N.Y. Ent. Soc., 29:57. 1921.

Notes on *Polygonia j-album, Cercyonis alope, Phyciodes tharos, Heodes epixanthe* and *Euphydryas gilletti.* Jour. N.Y. Ent. Soc., 32:109-111. 1924.

Biographical Sketch of the Rev. Jonathan Fisher of Blue Hill, Maine, 1768-1847. New York, N. Y. 1945. 20p. 15 plates. Privately printed.

Supplement to the Biographical Sketch of the Rev. Jonathan Fisher of Blue Hill, Maine. New York, N. Y. 1946. 22 pages. frontispiece and 2 plates. Privately printed.

Harry B. Weiss

Highland Park, N. J.

BOOK NOTICE

Insect Fact and Folklore by Lucy W. Clausen. The Macmillan Company, New York. June, 1954. 194 pages + 45 figures. $3.50.

This collection of insect facts and folklore has been many years in the making. It is the result of a fervor, nurtured and expressed during the waiting period, in whatever manner at hand, to convert anyone who might have a few minutes to spare to the study of Dr. Clausens friends, the insects. The president of our Society, and the first female to hold that office, is a crusader of real ability in the field of promotion of interest in nature and particularly in insect study. In her work in the Department of Public Instruction in the American Museum of Natural History, she has been vitally aware of need for an authentic and interesting presentation of Insects as they effect man and his works.

The book is not lengthy, yet it is well constructed in a requisite number of chapters for good coverage of the field of popular inquiry into entomology. The fifteen chapters summarize the field from taxonomy to insecticides, with singular lack of prosaism. Her dragonflies are Master Aerialists, her wasps are Anesthetists and her termites are Undercover Workers.

It is not meant to stamp this book as having only popular appeal. It is needed in every entomological library because it is primarily a capable summary of much of the interesting background of the insects. As extra dividends there are 45 refreshingly original figures, by Jan B. Fairservis, as well as a number of proverbs, anecdotes, beliefs and superstitions on the subects of her chapters.

If, as Dr. Clausen states, the purpose of this book is ". . . . to make people aware of the fact that the majority of insects are interesting, necessary and do play an important part in the everyday life of all peoples", then she has had an admirable success in her first effort. I know her first teacher, "Andy" Mutchler, would join me in offering congratulations on her contribution toward a better understanding of the insect, entomology and the entomologist.—F. A. S.

NOTES ON SOME SIPHONAPTERA FROM ALBANY COUNTY, NEW YORK

By Edward D. Cummings

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This is the second in a projected series of papers on the Siphonaptera of eastern New York. Sturm (1953) has reported on a small collection of fleas from Fulton County. The present paper deals with a collection of 241 fleas collected in Albany County during 1952 and 1953.

I am grateful to Dr. Allen H. Benton, N.Y.S. College for Teachers, Albany, for advice and assistance throughout the progress of this study; to Arnold Dansky, who collected most of the mammals from which the parasites were taken; and to John Wilcox, N. Y. State Museum, Albany, for assistance in the indentification of certain critical specimens.

Nomenclature follows Jellison et. al. (1953), with the exception of *Peromyscopsylla scotti* Fox, which Dr. Jellison informs me was inadvertently omitted from the list.

Family Pulicidae

Cediopsylla simplex (Baker)—Slingerlands, February, 1953: nine males, 16 females, from cottontail rabbit, *Sylvilagus floridanus*. Albany, no date: one male, from house cat, *Felis domestica*.

Ctenocephalides f. felis (Bouché)—Colonie, no date: 11 males, 17 females, from *Felis domestica*.

Family Hystrichopsyllidae

Hystrichopsylla tahavuana Jordan—Albany, October 28, 1952: one female from short-tailed shrew, *Blarina brevicauda*.

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Stenoponia americana (Baker)—Albany, Sept. 25, 1952: one male from *Blarina brevicauda;* Sept. 26, 1952: one female from the deermouse, *Peromyscus leucopus noveboracensis;* March 12, 1953: one female, same host. These are the only New York records of this flea. *Epitedia wenmanni* (Rothschild)—Albany, Sept. 27, 1952: one female from *Blarina brevicauda;* Oct. 29, 1952: one male from *Peromyscus leucopus noveboracensis.*

Ctenophthalmus p. pseudagyrtes Baker—This common flea occurred on practically every species of small mammal taken. Forty-five specimens were taken as follows: Albany, March, 1953: nine males and 12 females from nests of meadow mouse, *Microtus p. pennsylvanicus;* Sept. 24, 1952: one male from *Peromyscus leucopus noveboracensis;* No date: two females, one male, same host; Oct. 14, 1952: one male, one female, from *Blarina brevicauda;* Oct. 15, 1952: one female, same host; Oct. 25, 1952: one male, same host; Oct. 28, 1952: two males, same host; Oct. 30, 1952: two males, four females, same host; Slingerlands, Oct. 31, 1952: four males, three females from *Parascalops breweri;* Nov. 20, 1952, one female from star-nosed mole, *Condylura cristata.*

Doratopsylla blarinae Fox—Albany, Oct. 28, 1952: five males, six females, from *Blarina brevicauda;* Oct. 29, 1952: eight males, three females, same host; Oct. 30, 1952: seven males, two females, same host; Slingerlands, Nov. 12, 1952: two males, one female, from *Parascalops breweri.*

Nearctopsylla genalis laurentina Jordan and Rothschild—Albany, Oct. 28, 1952: one male, two females, from *Blarina brevicauda;* Oct. 29, 1952: two males, same host; Oct. 30, 1952: two males, two females, same host.

Holland (1949) has summarized the taxonomic problem in this species. Our specimens agree perfectly wtih the description and illustrations of *N. g. laurentina.* The shape of sternum IX of the male is very constant in our specimens. Sternum VII of the females is more variable, but approaches that illustrated by Holland.

Family Ceratophyllidae

Orchopeas leucopus (Baker)—Albany, Sept. 25, 1952: two females, from *Peromyscus leucopus noveboracensis;* Sept. 26, 1952: three females, same host; Oct. 29, 1952: nine males, 14 females, same host; March 12, 1953: six females, same host; March 18, 1953: one male, nine females, same host; March 19, 1953: three males, two females, from nest which was supposed to be that of *Microtus p. pennsylvanicus,* but which may have been occupied by deer mice.

Orchopeas h. howardii (Baker)—Albany, Oct. 15, 1952: four males, ten females, from gray squirrel *Sciurus carolinensis leucotis;* February, 1953: four males, five females, same host.

Females of the genus *Orchopeas* are often exceedingly difficult to identify, for the distinguishing characters are highly variable. Often the host animal is the best clue to identification, since these fleas are rather host-specific; but even this guide is not always helpful, since fleas occasionally find their way onto accidental hosts. Most keys, e. g. Fox (1940) and Holland (1949) utilize the presence or absence of the frontal row of bristles to separate the mouse fleas from the squirrel-infesting species, *O. caedens* and *O. howardii.* Hubbard (1947) gave no key to the females of this genus, but showed, (Fig. 36, p. 102), a complete frontal row of bristles on *O. c. durus.* None of our specimens of *O. c. durus* shows this characteristic, but one female, which otherwise agrees with *O. howardii,* has a complete frontal row of bristles. While this is certainly not the normal state of affairs, it apparently may occur in both these species.

Holland (1949) further stated that the sinus in sternum VII of *O. howardii* "appears to be very constant, there being a small but distinct sinus, situated low down." In our collection, this character is highly variable. Figure 1 shows the range of variation in this character among females taken from a single gray squirrel at Albany. It appears that this character is nearly as variable in this species as in other species of the genus.

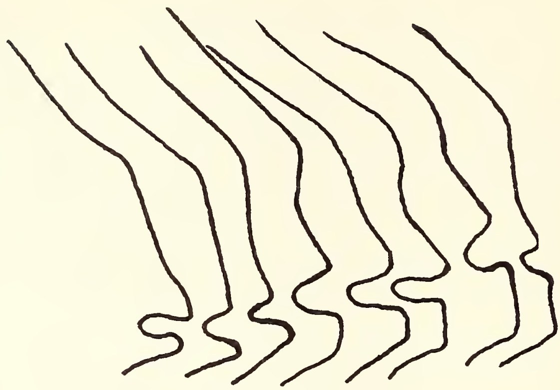

FIGURE I—VARIATION IN STERNUM VII OF ORCHOPEAS HOWARDII

Megabothris a. asio (Baker)—Albany, Oct. 15, 1952: one female, from *Microtus p. pennsylvanicus;* Oct. 16, 1952: one male, same host; March 19, 1953: one male, two females, same host; March 19, 1953: four males, eight females, from nest of same host.

This species, while difficult to secure by normal trapping methods, can be taken readily from nests of its host. Nests collected and placed in glass jars in a warm room will produce adult fleas over a period of several weeks in most cases.

Peromyscopsylla scotti I. Fox—This flea has been taken only a few times in the northeast, *P. h. hesperomys* being far more common in most collections. Specimens taken were: Albany, Sept. 26, 1952: one male, three females, from *Peromyscus leucopus noveboracensis.*

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THE FANEUIL HALL GRASSHOPPER AND SHEM DROWN

Apropos of the note on entomological signboards in the December 1948 issue of this Journal, the late Dr. William Procter while passing through Boston about 25 years ago, noticed the old grasshopper weather-vane on Faneuil Hall. Upon making inquiry the librarian of the State House supplied the following information, which Dr. Procter passed on to Harry B. Weiss.

Shem Drown was born at Kittery, Maine in 1683. His father, Leonard Drown, born 1646, came to Kittery from the west of England, the first of the family to come over to those shores. On account of the French and Indian wars he moved with his family to Boston in 1692, where he died October 31, 1729, and was buried at Copp's Hill.

Shem Drown was made a deacon of the First Baptist Church in 1721. He died January 13, 1774, aged ninety-one years.

In 1721 he made a cockerel for the vane of the "new brick church" on Hanover Street, which was built the year before. In 1873 this cockerel, or rooster, was moved to the Shepard Memorial Church, Cambridge, where he still greets the dawn and guards the Washington Elm.

The grasshopper on Faneuil Hall was made in 1742 of hammered copper. When it was down for repairs about fifty years ago, a paper was found inside of it, which read in part as follows:

Shem Drown Made Itt, May 25, 1742

To my Brethren and
Fellow Grasshopper

Fell in ye year 1755 November 15th day from ye Market by a great Earthquake [repaired] by my old master above.

Again like to have met with my utter Ruin by Fire, but Hopping Timely from my Publick Scitation came off with Broken bones, and much Bruised, Cured and again fixed by Old Master's Son Thomas Drown, June 28th, 1763.

On the evening of Evacuation day, 1889, the "Bird" as it is called, was knocked from its perch by the carelessness of the men taking in the flag and fell to the street, losing its eyes, horns and two feet. It was soon repaired by E. B. Badger & Sons Company and, feeling very proud in a new coat of goldleaf, it gave a reception in the historic hall before getting back on the perch from which it had been missed.

In 1899 the "Bird" left the perch again, while the old wooden cupola that had long been considered a "fire trap" was replaced by a copper and steel one, erected by E. B. Badger & Sons Company.

Deacon Drown also made the Indian Chief, with bent bow and arrow drawn, which for nearly one hundred years did duty as a vane on the cupola of the Province House. It is now in the rooms of the Massachusetts Historical Association.—H. B. W.

THE ODONATA OF CAPE COD, MASSACHUSETTS[1]

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Comparatively few workers have studied the Odonata of Cape Cod. Such well-known odonatists as Hagen, Kellicott, and Calvert apparently collected a few dragonflies, but only Howe and Gray did any systematic collecting. A remnant of Gray's collection, which appears to have been limited to the Woods Hole region, is now in the museum of the Marine Biological Laboratory. His only published contribution (1937) concerned *Anax longipes.* Howe was the principal student of the Odonata of Cape Cod (and that of New England), but his collecting was limited to the eastern portion (Howe, 1920). His listing of New England records (Howe, 1917, 1918, 1917-21), however, brought together the available records, and his paper on distribution of New England Odonata (Howe, 1921) contains some pertinent ideas on Cape Cod.

During the summers of 1950 through 1953 the present authors made 115 collections at 55 localities on the Cape. Seventy-two species were found, of which nineteen are new for Cape Cod and two (*Enallagma recurvatum* and *Ladona deplanata*) are new to both Massachusetts and New England. Of those listed by other authors, we failed to collect thirteen species. This represents the only recorded systematic collection of Odonata covering the major part of Cape Cod.

As a faunal area, Cape Cod is interesting for several reasons. First, it is formed almost entirely of glacial moraine and outwash plain and, principally for this reason, represents the northernmost extension of

[1]Cape Cod is here defined as the isolated area from the Cape Cod Canal to the spit at Provincetown. This excludes a small triangle east of the Plymouth moraine which is influenced by streams from the mainland.

the Coastal Plain (Fenneman, 1938). Long Island is of very similar formation. From New Jersey southward the true Coastal Plain becomes broader, the fall line marking approximately its inner boundary. Second, Cape Cod marks the most southerly terminus of the second and last substage of the Wisconsin glacier (Woodworth and Wigglesworth, 1934). Thus the species inhabiting it must have become established since the last retreat, a gradual succession of faunas with differing temperature and habitat requirements doubtless having occurred as the climate became warmer. Third, the surrounding ocean, due to the influence of the cold Labrador current and the warm Gulf Stream, is a region of crowded isotherms, causing a faunal break which may be reflected on the land.

From these factors, it might be expected that Cape Cod would be a meeting place of northern and southern forms, and that, due to the coastal plain habitat, the southern would predominate. Northern species may be those at the margin of their range which can tolerate certain more favorable habitats, may have become established by accident, or may be relict populations. Southern species, although marginal, are doubtless entirely immigrants which are expanding their range northward. Howe (1921) records 58 species from Cape Cod, of which 39 are of southern affinities. In his Manual (1917-21), however, 69 species are recorded from Cape Cod, of which 46 are southern. Of the 72 species collected by the present authors, 46 are southern. Howe (1921) stated that the moraine which extends from near Plymouth to Woods Hole was the only faunal barrier in New England. He may have believed that this low line of hills was effective in preventing many New England species from invading Cape Cod. In support of this he listed 28 species whose ranges ended abruptly at the moraine. We have collected eighteen of these on Cape Cod, and of them only *Pantala flavescens* appears to be transient. Most were breeding populations. Of the remaining ten, four river-inhabiting species of northern affinities would be hard-put to find suitable streams, and three more species are recorded by Howe, himself, in his Manual (1917-21). The moraine might be considered a barrier, but only in the sense that it demarcates a type of habitat distinct from the rest of New England, but similar to the Coastal Plain of Long

Island and New Jersey. Evidence of this is the occurrence, predominantly on the Coastal Plain, of several comparatively rare species, such as *Enallagma laterale* and *Ischnura kellicotti,* which have been found on the Cape and Long Island (Davis, 1913; Thomas W. Donnelly, pers. comm.), and *Enallagma recurvatum* and *pictum,* which have been found in New Jersey (Beatty, 1945, 1946) as well. It must be admitted that, of these, *Enallagma recurvatum* alone has been taken *only* in Coastal Plain; the others have been found sparingly in other places. The northern Coastal Plain nevertheless seems to be their center of distribution.

There are five general habitat types suitable for Odonata on Cape Cod. The most prominent are the kettle holes, formed by deposition of glacial outwash material about unmelted blocks of ice. These and a few depression ponds will be designated as ponds. The large lakes, which may be very large kettles, depressions, or former coves, form a different habitat. A few bogs, some small streams, and many brackish water areas occur. Some species appear confined to a given habitat. *Argia mœsta, Enallagma exsulans, Dromogomphus spinosus,* and *Epicordulia princeps* were found only in large lakes, possibly requiring the greater wave action which occurs or the greater amount of oxygen due to comparative lack of organic detritus and to better mixing. These are commonly stream species. *Agrion maculatum, Amphiagrion saucium,* and *Sympetrum semicinctum* occurred only near running water. Kettle holes showed all stages in transition from sandy-bottomed ponds to true bogs. Several species with bog affinities, therefore, were found also in boggy portions of ponds. Bog species were *Enallagma cyathigerum, Nehalennia gracilis, Gomphaeschna furcillata, Dorocordulia lepida, Libellula quadrimaculata,* and *Nannothemis bella.* Since all these are northern species, the relative constancy of the bog habitat may permit their survival southward. *Erythrodiplax berenice* and *Libellula needhami* were taken only near brackish water habitat. Many species had very limited distributions even within a habitat type, often occurring in widely separated areas. This was noticeably true of *Enallagma recurvatum, laterale,* and *pictum,* which occurred in only a few ponds of the great number. Others were nearly cosmopolitan, occurring widely in one or more habitats.

One climatic factor seems important enough to be mentioned. Rainfall in the spring of 1953 was apparently quite heavy, for the water level in all the ponds previously visited was approximately a foot and a half higher than normal. Even when collecting was ended, in early August, the levels were still well above normal. This was accompanied by a marked absence of several species which had formerly been locally common. *Leucorrhinia frigida* was a notable example. At Flashy Pond it had previously been extremely common, the exuviae covering the emergent rush stems. In 1953 only four were caught in four trips. Since the normally emergent vegetation was covered, perhaps there were not enough places to allow the nymphs to transform. The same was true for *Celithemis elisa* and *martha* and *Lestes disjunctus* and *forcipatus* at Flashy Pond.

DESCRIPTION OF LOCALITIES

The names given in the following descriptions are those found on the U. S. Geological Survey topographic maps. No attempt is made to name ponds not named on these sheets.

Larger lakes. These are usually both larger and deeper than those designated as ponds. They are sandy to the shore line, seldom with boggy edges, and are often populated with sport fishes. Blue flag (*Iris versicolor)* occurred in the marginal water, but was never seen on a small pond. Water lobelia (*Lobelia dortmanna*) and swamp candle (*Lysimachia terrestris*) were also common emergents, but were found in some of the ponds which had sandy margins. All except Oyster Pond are described in the Massachusetts Fisheries Report for Barnstable County (1951).

1. Ashumet Pond. Mashpee and Falmouth Townships. A smaller pond connected to it by a narrow ditch at high water will be distinguished in the species accounts. Eleven collections. June 10-July 30, 1953.

2. Lawrence Pond. Sandwich Township. July 25, 1953.

3. Oyster Pond. Falmouth Township. Slightly brackish at least in places, having at one time been a cove. This is quite a different

habitat than the other lakes, partly because the margins slope steeply, thus allowing no gradual transition of littoral zones. Visited, but not collected, on several occasions. Collected June 15, 1953.

4. Snake Pond. Sandwich Township. July 25, 1953.

5. Wakeby Pond. Mashpee Township. July 25, 1953.

Ponds. These are generally small in size, but a few reach several acres in area. They usually have at least some accumulation of peat and initiation of bog formation at the edges. Commonly they have a heavy accumulation of organic debris. *Nymphæa, Utricularia, Scirpus,* and *Juncus* are common plants.

6. Deep Pond. Falmouth Township. July 27, 1951.

7. Deer Pond. Falmouth Township. June 18, 1953. Deeper than most. A heavy population of bullheads (*Ameiurus nebulosus*).

8. Duck Pond. Barnstable Township. About a mile west of Hyannis airport. June 13, 1953.

9. Elisha Pond. Yarmouth Township. August 22, 1951.

10. Emery Pond. Chatham Township. August 23, 1951.

11. Flashy Pond. Mashpee Township. Twelve collections in 1951-1953, June 10-August 24. An extremely productive small pond to which special attention was given.

12. Flax Pond. Bourne Township. Near Barnstable County Sanitorium. Nine collections in 1950-1953, June 6-September 2. Now being called "Picture Pond."

13. Flax Pond. Falmouth Township. Part of L. W. Francis Estate in Quisset. Four collections in 1951 and 1953, June 9-August 2.

14. Fresh Pond. Barnstable Township. About a half mile west of Hyannis airport. July 15, 1951. Very little water at time visited.

15. Grassy Pond. Falmouth Township. Just south of Ashumet Pond. June 25, 1951.

16. Greenough Pond. Yarmouth Township. August 22, 1951.

17. Hawksnest Pond. Harwich Township. Three collections in 1951 and 1953, June 25-August 4. Good bog development at one end, sandy beach at other.

18. Unnamed Pond. Brewster Township. In deep depression northeast of Sheep Pond. August 4, 1951.

19. Horse Pond. Yarmouth Township. August 22, 1951.

20. Unnamed Pond. Barnstable Township. About a mile northeast of Hyannis airport. June 13, 1953. Almost a bog.

21. Martha Pond. Mashpee Township. June 29, 1951.

22. Mary Dunn Pond. Barnstable Township. About a mile north of Hyannis airport. July 15, 1951.

23. Miles Pond. Falmouth Township. On Sippewisset Road. June 11, 1953. Used by Cahoon's Ice Plant. Edges drop off abruptly.

24. Jabinette's Pond. Yarmouth Township. Three collections in 1951 and 1953, June 13-July 15. Well-developed bog areas as well as sandy beach. Sunfish (*Lepomis gibbosus*) very common.

25. Mill Pond. Harwich Township. At east end of Long Pond. August 4, 1951.

26. Unnamed Pond. Mashpee Township. Just south of John's Pond. Two collections on September 4, 1951 and June 29, 1952. Very small, often with no standing water in late summer.

27. Unnamed Pond. Chatham Township. Southwest of Lovers Lake. August 23, 1951.

28. Randall Pond. Falmouth Township. Two collections on July 17, 1952 and June 24, 1953.

29. Unnamed Pond. Falmouth Township. At Old Silver Beach. Three collections in 1950 and 1951, June 17-September 2.

30. Sols Pond. Falmouth Township. June 15, 1953.

31. Spectacle Pond. Falmouth Township. August 23, 1951.

32. Unnamed Pond. Mashpee Township. Southeast of John's Pond. Three collections in 1950, 1951, and 1953, June 29-September 4. Quite boggy at the edges.

33. Twinings Pond. Orleans Township. In most southeasterly portion of township. August 22, 1951.

34. Walker's Pond. Harwich Township. August 4, 1951.

35. Weeks Pond. Sandwich Township. July 25, 1953.

36. Unnamed Pond. Falmouth Township. In woods north of Ransom Road. Locally called Whittemore Pond. Five collections in 1951 and 1953, June 11-August 4. *Myriophyllum, Nymphæa,* and *Brasenia* are abundant plants.

Bogs. Only two localities were visited which could be called definitive bogs. Both have quaking bottoms, but otherwise present different aspects.

37. Woods Hole Cedar Bog. Falmouth Township. Six collections in 1951-1953, June 8-July 25. Largely shaded by cedars and has an abundance of *Sphagnum.* A deep bog lake is surrounded by *Decadon* and *Andromeda.*

38. Gifford Bog. Falmouth Township. Just west of Long Pond. Five collections in 1952 and 1953, June 15-August 20. An *open* bog with *Juncus, Vaccinium* (a highbush blueberry), and *Rhexia* around the edges and *Sagittaria* and *Xyris* on slightly emergent islands. *Nymphæa* and *Utricularia* occur in open water.

Streams and running water. All but Silver Spring Brook are associated with cranberry bogs above the collected areas and have sandy bottoms. All are fairly small, no large freshwater streams occurring on Cape Cod.

39. Silver Spring Brook. Wellfleet Township. At Austin Ornithological Research Station. July 21, 1951.

40. Coonamessett River. Falmouth Township. North of Great Pond at highway 151 crossing. Two collections on July 7, 1951 and June 8, 1953.

41. Mills River. Barnstable Township. Just south of Mill Pond. July 15 and August 22, 1951. This includes an extensively widened portion, much like a pond, with a heavy accumulation of detritus.

42. Quashnet River. Mashpee Township. At highway 151 crossing. July 1, 1951.

43. Mashpee River. Mashpee Township. At highway 151 crossing. July 7, 1951.

Brackish habitat. The Odonata collected here may not spend their nymphal life in brackish water, but the abundance of some species and the lack of completely fresh water point to this condition.

44. Eastham tidal beach. Eastham Township. Mud flat on inner bay. July 21, 1951.

45. Nauset Bay. Eastham Township. August 18, 1951.

46. Tidal marsh off Eel Pond, Woods Hole. Falmouth Township. Two collections on June 30, 1951 and July 26, 1953.

47. Sippewisset Beach. Falmouth Township. On Buzzard's Bay. Three collections in 1951 and 1953, July 4-26. A small freshwater pond is also present.

Other localities. These cannot be classified as any of the previous habitat types, but may be located near such areas.

48. Wet meadow in dry bed of Childs River. Mashpee Township. Just south of John's Pond. Two collections on June 29 and July 11, 1951.

49. Road west of Elbow Pond. Brewster Township. August 4, 1951.

50. Ponds of Sandwich Fish Hatchery. Sandwich Township. July 19, 1952.

51. Goodwill Park. Falmouth Township. Near Long Pond. July 10, 1952.

52. Sippewisset Road, Quisset. Falmouth Township. Near Flax Pond of L. W. Francis estate. July 30, 1952.

53. Telegraph Hill. Sandwich Township. July 25, 1953.

54. Cultivated cranberry bog near Wing Pond. Falmouth Township. July 9, 1952.

55. Woods Hole. Falmouth Township. July 26, 1951.

LIST OF SPECIES

The dates recorded are the earliest and latest on which we have caught or positively identified the species. Since our own extreme dates are June 6 and September 4, and since all areas were not given seasonal coverage, our collecting does not necessarily indicate the season on many species.

Suborder Zygoptera

Family Agrionidæ

Agrion maculatum Beauvais. Loc. 41, 42, 43. July 1-August 22. Restricted to running water. Common at Mills River.

Hetaerina americana (Fabricius). Reported by Howe (1917-21).

Family Lestidæ

Lestes congener Hagen. Loc. 35. July 25, 1953. One male.

Lestes disjunctus Selys. Loc. 1(pond), 9, 11, 12, 14, 16, 17, 32, 33, 35, 37, 38. July 1-August 24. Walker (1952) believed that southern New England would be an area of intergradation between the subspecies *d. disjunctus* and *d. australis.* Our forms appear referable to the subspecies *disjunctus* and show no intergradation.

Lestes forcipatus Rambur. Loc. 1(pond), 9, 11, 13, 14, 26, 28, 32, 35, 36, 38, 48. June 15-August 24. In accordance with Walker's (1952) observations, we collected *forcipatus* earlier than *disjunctus* in this region where both species are common.

Lestes inequalis Walsh. Loc. 28. June 24, 1953. One male. First Cape Cod record

Lestes eurinus Say. Loc. 8, 11, 15, 21, 32, 38. June 10- July 27.

Lestes rectangularis Say. Loc. 9, 11, 13, 17, 21, 35, 36, 37, 38, 41. June 29-August 22.

Lestes dryas Kirby. Recorded by Howe (1917-21).

Lestes unguiculatus Hagen. Loc. 1(pond). June 29, 1953. One male.

Lestes vigilax Hagen. Loc. 1(pond), 8, 10, 11, 12, 13, 16, 17, 18, 20, 22, 24, 25, 27, 29, 33, 36, 37, 39. June 13-September 2.

Family Cœnagrionidæ

Argia mœsta (Hagen). Loc. 1(lake), 2, 4, 5. June 20-July 30. Collected only at large lakes.

Argia violacea (Hagen). Loc. 4, 9, 13, 17, 18, 23, 24, 25, 28, 31, 35, 36, 40, 41, 51. June 11-August 24.

Enallagma aspersum (Hagen). Loc. 1(pond), 11, 12, 14, 20, 24, 32, 35, 36. June 10-August 6. Taken only in company with other *Enallagmas,* and always outnumbered by at least one of these species.

Enallagma civile (Hagen). Loc. 1(lake), 2, 3, 4, 5, 47. June 10-July 30. Collected only on large lakes except for Sippewisset Beach, where it was abundant.

Enallagma doubledayi Selys. Loc. 1(pond), 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 20, 22, 24, 25, 27, 32, 33, 34, 35, 36, 37, 38. June 6-August 24. The most abundant damselfly on the Cape. At Ashumet Pond, where the similar species *E. civile* was common on the lake, *doubledayi* occurred only in the adjoining pond. Neither was collected in the other habitat. This contrasts with the observations of Beatty (1945, 1946), who found them flying together in New Jersey.

Enallagma cyathigerum (Charpentier). Loc. 38. June 15 and 24, 1953. Pairs were seen in tandem, indicating a probable permanent breeding population.

Enallagma durum (Hagen). Reported by Calvert (1894).

Enallagma exsulans (Hagen). Loc. 1(lake), 4, 5. June 19-July 30. Found on large lakes only.

Enallagma geminatum Kellicott. Loc. 9, 13, 16, 17, 24, 25, 28, 33, 35, 36, 38, 39. June 20-August 22. First Cape Cod record. Seldom numerous.

Enallagma hageni (Walsh). Loc. 11. June 17, 1951. One male. First Cape Cod record.

Enallagma laterale Morse. Loc. 17, 24, 38. June 13-25. First Cape Cod record. Abundant around the edge of Jabinette's Pond on June 13, 1953. Pairs in tandem were taken, representing the first females on record. These will be described elsewhere. On June 25 none could be found here. This species apparently has a widespread, but local distribution. It has been taken in Massachusetts

(Morse, 1895; Howe, 1916), Indiana (Muttkowski, 1910), Maine (Borror, 1940) and New York (Davis, 1913; Donnelly, pers. comm.). Early spring collecting will probably show it to be far more common on Cape Cod, though with a short flying season.

Enallagma minusculum Morse. Loc. 1(lake), 2, 4, 7, 12, 17, 22, 24, 27. June 10-August 23. Probably the most common early damselfly, becoming less so later.

Enallagma pictum Morse. Loc. 17, 25, 28, 36. July 11-August 4. First Cape Cod record. Common at Hawksnest Pond after mid-July. This species preferred to remain near lily pads, either resting on them or flying a short distance above them. It was never seen close to the shore line, whereas other *Enallagmas* with it were commonly found in the rushes or on the shrubby edge.

Enallagma recurvatum Davis. Loc. 12, 15, 17, 24. June 13-25. First Cape Cod and New England record. Like *laterale* this seems to be an early spring species with a short flying season. Abundant around Flax (Picture) Pond on June 16, 1953. Ten days previously none were found. The species has been collected on Long Island (Davis, 1913; Donnelly, pers. comm.) and in New Jersey (Beatty, 1945, 1946). Thus it seems limited to sandy, coastal plain habitat. Early collecting may reveal it farther south.

Enallagma signatum (Hagen). Loc. 3. 13, 16, 18, 24, 27, 36, 39. June 15-August 22.

Enallagma vesperum Calvert. Loc. 1(lake), 4, 13, 17, 18, 25, 27, 36. July 21-August 23. First Cape Cod record.

Nehalennia gracilis Morse. Loc. 37, 38. June 6-July 25. First Cape Cod record. Found only in bogs. Very abundant at Woods Hole Cedar Bog.

Nehalennia irene Hagen. Reported by Howe (1917-21, 1920).

Amphiagrion saucium (Burmeister). Loc. 40, 41, 43. June 8-July 15. First Cape Cod record. Restricted to streams.

Ischnura kellicotti Williamson. Loc. 17, 24, 33, 36. June 20-August 22. First Cape Cod record. Common at Jabinette's Pond on July 15, 1951, but not seen at two earlier dates in 1953. Besides males, only orange females have been seen. This seems to be another widespread species with local distribution. It has been recorded from Indiana (Williamson, 1898), Rhode Island (Needham and Heywood, 1929), Long Island (Donnelly, pers. comm.), New Jersey (Calvert, 1898), North Carolina (Westfall, 1942), and Florida (Davis and Fluno, 1938; Westfall, 1941).

Ischnura posita (Hagen). Loc. 1 (pond), 8, 13, 16, 24, 33, 36, 37, 38, 39, 40, 41, 42. June 6-August 22.

Ischnura ramburii Selys. Recorded by Howe (1917-21).

Ischnura verticalis (Say). Loc. 1 (pond), 8, 11, 12, 13, 14, 15, 16, 17, 20, 22, 24, 25, 27, 28, 29, 30, 31, 33, 35, 36, 37, 38, 39, 40, 41, 47, 48. June 6-August 24.

Chromagrion conditum (Hagen). Recorded by Howe (1917-21).

Anomalagrion hastatum (Say). Loc. 36. August 2, 1951. One male.

Suborder Anisoptera

Family Gomphidæ

Gomphus abbreviatus Hagen. Recorded by Hagen (Selys, 1878).

Gomphus exilis Selys. Loc. 1 (lake), 11, 12, 17, 23, 40, 51, 54. June 10-July 10. A large emergence occurred at Ashumet Pond on June 10, 1953. On the following day, only one specimen was found. Not uncommon on the Cape.

Gomphus spicatus Hagen. Recorded by Howe (1922).

Dromogomphus spinosus Selys. Loc. 1, 5. June 29-July 25. Common at Ashumet Pond during emergence in late June, when many exuviæ were found on emergent vegetation and tenerals were found in the surrounding scrubby woods. Probably common on large lakes.

Progomphus obscurus (Rambur). Recorded by Howe (1920, 1917-21).

Family Aeschnidæ

Anax junius (Drury). Loc. 1 (both), 11, 12, 13, 15, 17, 20, 22, 24, 25, 26, 28, 29, 30, 32, 33, 36, 37, 38, 39, 47, 48. June 6-September 4.

Anax longipes Hagen. Loc. 11, 13, 22. June 19-August 6. This seldom-caught species is apparently locally common on the Atlantic Coastal Plain. Many authors have reported it from the United States from Mississippi and Florida to Massachusetts and inland to Ohio and Indiana. Hagen (1884) and Gray (1937) have previously recorded it from Woods Hole. At Flashy Pond we often saw five or six in a day. We took three males, one with a shotgun, one knocked into the water by another male, and a third by net. Our single female, with abdomen similar in color to that of females of *A. junius,* was taken while ovipositing alone. The females seem to be dimorphic, as one individual with a brick-red abdomen was observed, apparently ovipositing. Unlike *junius,* they lay their eggs in the absence of the male.

Boyeria vinosa (Say). Recorded by Howe (1922).

Basiaeschna janata (Say). Loc. 1 (lake). Two males on June 10 and 11, 1953. First Cape Cod record.

Gomphaeschna furcillata (Say). Loc. 37. June 8, 1953. Another Woods Hole record, possibly from the same bog, is recorded by Gloyd (1940, p. 3), which is the first Cape Cod record.

Aeshna canadensis Walker. Loc. 10, 11, 33, 55. July 26-August 23. First Cape Cod record.

Aeshna clepsydra Say. Loc. 9, 11, 27, 32, 33, 38. August 6-September 4.

Aeshna tuberculifera Walker. Loc. 38, 52. July 30-August 20. This species was abundant hawking along a short stretch of Sippewisset Road in the evening of July 30, 1952, but was not seen there again.

Aeshna umbrosa Walker. Recorded by Howe (1917-21, 1920).

Aeshna verticalis Hagen. Recorded by Howe (1917-21).

Family Corduliidæ

Didymops transversa (Say). Loc. 11. June 10, 1953. A mating pair. First Cape Cod record.

Macromia illinoiensis (Say). Loc. 1(lake), 51, 53. July 4-25. Exuviae found at Ashumet Pond.

Epicordulia princeps (Hagen). Loc. 1, 2, 5, 47, 49. June 26-August 4 A very large emergence occurred at Ashumet Pond during the last week in June. Hundreds of exuviae were found clinging to emergent vegetation; yet even in the surrounding woods, adults were uncommon.

Tetragoneuria cynosura (Say). Loc. 1, 11, 13, 24, 37, 51. June 6-July 10. No attempt is made to distinguish the subspecies *cynosura* from *simulans;* their status as subspecies arouses considerable doubt.

Dorocordulia lepida (Hagen). Loc. 11, 17, 24, 37, 38. June 15-July 7. Found at bogs or quite boggy ponds.

Family Libellulidæ

Libellula auripennis Burmeister. Loc. 1(pond), 11, 12, 13, 14, 17, 24, 28, 29, 32, 35, 36, 38. June 10- September 4. Common at ponds.

Libellula needhami Westfall. Loc. 46, 47. June 30-August 2. This species, only recently distinguished from *auripennis* (Westfall, 1943), was found only near salt water, whereas *auripennis* was common, but only at inland ponds. Westfall's records show very few *needhami* from localities far from the coast except in Florida. *Auripennis,* however, seems to be found both inland and coastally. Perhaps the habitat segregation on Cape Cod is indicative of factors which led to their speciation and to which each is adapted.

Libellula cyanea Fabricius. Loc. 1(pond), 11, 13, 24, 28, 29, 32, 35, 38, 39, 40, 41, 46, 50, 51, 54. June 10-September 2.

Libellula incesta Hagen. Loc. 1(pond), 6, 9, 11, 12, 13, 17, 24, 25, 28, 31, 32, 33, 34, 36, 39, 51. June 25-August 24. An examination of the penes of several specimens thought to be *vibrans,* as based on color characters, showed only this species.

Libellula vibrans Fabricius. Recorded by Kellicott (1884) and Howe (1917-21). Probably refers to *L. incesta.*

Libellula luctuosa Burmeister. Loc. 3, 47, 51. July 10-July 26. Uncommon. Collected only on July 10, 1952 at Goodwill Park, Falmouth.

Libellula pulchella Drury. Loc. 1(pond), 11, 12, 13, 14, 26, 29, 35, 37, 38, 39, 40, 41, 43, 46, 47, 50, 54. June 6-September 4.

Libellula quadrimaculata Linne. Loc. 37, 38, 40. June 6-June 15. All but one specimen came from bogs.

Libellula semifasciata Burmeister. Loc. 37, 38, 46. June 6-July 26. Uncommon.

Ladona exusta (Say). Loc. 1(pond), 11, 12, 20, 24, 28, 29, 30, 32, 36, 37, 38, 40. June 6-July 4.

Ladona deplanata (Rambur). Loc. 1(pond), 7, 8, 11, 12, 14, 20, 24, 32. June 10-July 17. This represents a northward extension of the range of this species and a first record for Cape Cod and New England. A cursory study of Ladona *exusta, deplanata,* and *julia* has convinced us that *exusta* and *deplanata* are definitely good species, and that *julia* probably is also. The distal end of the penis (median lobes) of *deplanata,* as seen from the side, is concave, with extended ends. That of *exusta* is convex and not at all extended. The abdomen of adult *exusta* becomes white-pruinose, the dorsum of the thorax becoming gray or not at all pruinose. *Deplanata* becomes uniformly gray-pruinose on thorax and abdomen. All the *exusta* studied had the supratriangle of the fore wing crossed, while only about a quarter of the *deplanata* had such a crossvein. The dark basal markings of the wings are generally smaller and divided by a clear streak in *deplanata,* but this is not constant. *Julia* seems closer to *exusta,* the penis being convex distally, but the lobes extending more. The abdomen becomes white-pruinose only on the anterior segments, and the dorsum of the thorax becomes white. The supratriangle is crossed, and the wing markings are small, but without the clear streak of *deplanata.*

Plathemis lydia (Drury). Loc. 11, 14, 28, 32, 37, 38, 40, 41, 46, 54. June 8-August 24.

Perithemis tenera (Say). Loc. 9, 16, 17, 25, 29, 33, 39. July 1-August 22. Never common.

Nannothemis bella (Uhler). Loc. 38. July 4, 1952. Two males, one female.

Erythrodiplax berenice (Drury). Loc. 14, 39, 44, 45, 47. June 30-August 6.

Erythemis simplicicollis (Say). Loc. 1(pond), 4, 6, 8, 11, 12, 13, 14, 17, 20, 21, 22, 25, 28, 29, 30, 32, 33, 35, 36, 37, 38, 39, 41, 46, 47, 50, 51. June 10-September 4.

Pachydiplax longipennis (Burmeister). Loc. 11, 13, 25, 28, 29, 32, 37, 38, 39. June 15-September 2.

Sympetrum corruptum (Hagen). Recorded by Howe (1917-21).

Sympetrum costiferum (Hagen). Recorded by Howe (1917-21).

Sympetrum obtrusum (Hagen). Recorded by Howe (1917-21).

Sympetrum rubicundulum (Say). Loc. 1(pond), 9, 11, 13, 14, 17, 21, 22, 24, 25, 26, 28, 29, 32, 34, 35, 37, 38, 50, 51. June 29-September 2.

Sympetrum semicinctum (Say). Loc. 11, 39, 41. July 15-August 22. First Cape Cod record. Seems to prefer the vicinity of running water.

Sympetrum vicinum (Hagen). Loc. 9, 10, 11, 16, 17, 19, 25, 31, 32, 33, 35, 36, 41. August 4-24.

Leucorrhinia intacta (Hagen). Loc. 1(pond), 17, 20, 24, 37, 38. June 6-25.

Leucorrhinia frigida (Hagen). Loc. 11, 15, 22, 29. June 10-July 27. Abundant at Flashy Pond in 1951 and 1952; scarce in 1953.

Celithemis elisa (Hagen). Loc. 1(pond), 2, 4, 7, 9, 11, 12, 13, 15, 17, 19, 20, 21, 22, 24, 26, 27, 30, 31, 32, 33, 34, 35, 36, 38, 39, 51. June 10-August 24.

Celithemis eponina (Hagen). Loc. 10, 25, 33. August 4-23.

Celithemis martha Williamson. Loc. 1(pond), 9, 11, 12, 13, 14, 17, 25, 31, 32, 33, 35, 40, 43, 48. June 25-September 2. First Cape Cod record. On July 1, 1951, this species had emerged in numbers at Flashy Pond. The height of the breeding season here was around August 6, when great numbers of tandem pairs were seen. Males retained a hold on the female as she dipped her abdomen to lay eggs. July 30 was the height of emergence at the small pond adjoining Ashumet Pond in 1953. A series of nymphs was collected here.

Celithemis ornata (Rambur). Recorded by Howe (1917-21, 1920). This is probably *C. martha.*

Celithemis monomelaena Williamson. Loc. 9. One male, another seen. First Cape Cod record.

Pantala flavescens (Fabricius). Loc. 45. August 18, 1951. One male, probably a transient. First Cape Cod record.

Tramea carolina (Linne). Loc. 1(pond), 8, 11, 12, 13, 17, 35, 48, 52. June 10-August 6.

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ANDREW S. FULLER, EARLY ECONOMIC ENTOMOLOGIST OF NEW JERSEY, 1828 - 1896

By Harry B. Weiss

From a biographical viewpoint some of our early writers on insects have been neglected in our entomological literature in favor of their more prolific and outstanding contemporaries. Andrew S. Fuller was one of such persons. Only a brief mention was made of him in Entomological News (June, 1896, p. 192) shortly after his death. The only other biographical reference to him in entomological literature occurs in L. O. Howard's "History of Applied Entomology", (Washington, D. C., 1930), in which his portrait is reproduced on plate 5.

Fuller, an editor, horticulturist, amateur entomologist and writer was born at Utica, New York, on August 3, 1828, and brought up in a region devoted to fruit growing. His parents moved to a small farm near Barre, New York, where he attended a country school and helped around the farm. After his parents had moved to Milwaukee, Wisconsin, in 1846 he learned carpentering and with his interest in plants he started to devote his activities to the construction of greenhouses, becoming in 1855 the manager of the greenhouses belonging to W. R. Prince of Flushing, Long Island. This position he held for two years. He then moved to Brooklyn, New York, and began to cultivate small fruits, paying particular attention to strawberry improvement. Soon he began to write articles on horticulture for "Life Illustrated," the "New York Tribune" and other papers. The "Tribune" at one time distributed, as circulation premiums, 300,000 of Fuller's strawberry plants. And in 1862 his first book "The Illustrated Strawberry Culturist" appeared. In 1851 he married Jennie Clippens and in 1860 he moved to Ridgewood, New Jersey, and bought a tract of land which he improved and then used for experimental purposes.

His articles continued to appear in the agricultural and horticultural press. During 1866 and 1867 he edited Woodward's "Record of Horticulture." From 1868 until 1894 he was editor of the "Weekly

Sun" and while connected with this paper he was responsible for the distribution of seed white potatoes with subscriptions. In 1871 he became the associate editor of "Moore's Rural New Yorker" later the "Rural New Yorker", becoming part owner and editor-in-chief in 1876. However within a year he severed these connections. He was a member of various organizations and when the New Jersey State Horticultural Society was organized for the second time in 1875 he was one of its founders and its vice-president from Bergen County. At the January, 1876, meeting of this society, in a paper on entomology and its relation to horticulture, he stressed the need for knowledge about injurious insects and said that future progress depended largely upon success in controlling insects.

His books include "The Grape Culturist", 1864; "The Forest Tree Culturist", 1867, which was translated into the German language; "Practical Forestry", 1884; "The Propagation of Plants", 1887; and the "Nut Culturist", 1896.

In addition to the accumulation of a large horticultural library, he collected insects and minerals. He specialized in the Coleoptera, for his collection of which he built a special house. His interests also embraced the study of prehistoric American pottery. At the time of his death from a heart attack on May 4, 1896 he was a staff writer for the "Florists' Exchange," the "American Agriculturist" and the "American Gardener".

From 1868 to 1896 he was the author of some 28 papers on a wide range of economic insects as may be noted by his list of titles in Henshaw's "Bibliography of American Economic Entomology" Parts IV and V, 1895 and 1896. He was also the author of a paper on "Collecting Insects, How to Collect and Transport Them", 5 pages, 22½ cm., with no place or date of publication.

Fuller frequently sent insect specimens or descriptions of insects to the editors of the "American Entomologist" for identification. In the "Answers to Correspondents" in the columns of that magazine and its successors, Fuller's questions and the editors' answers may be found in Vol. 1, Nos. 3, 4, 10, 11; Vol. 2, Nos. 4, 8, 10. Similar references may be found in the "Practical Entomologist", Vol. 2, No. 9, and in "Insect Life" Vol. 1, page 86. Of Fuller's inquiries nearly all dealt with species injurious to grapes, strawberries, seeds, blackberries, etc. On July 16, 1888, he wrote to C. V. Riley about insects confused with the Hessian fly prior to the Revolution and Riley replied in "Insect Life" that there was no evidence of the existence of that insect in America at that early period. At times, various writers have confused the work of the Angoumois grain moth with that of the Hessian fly. [See Journ. Econ. Ent. Vol. 37, page 838]

When the "American Entomologist" began for a second time in January 1880, after a lapse of ten years, Andrew S. Fuller was assistant editor, and C. V. Riley was editor. However the October, 1880, issue contained only Riley's name as editor, with the announcement that Fuller had retired from his editorial duties. During the summer of 1880, Fuller had been in New Mexico where his interests were likely to call him at any time.

In 1875 Fuller sent specimens of a beetle that he had collected in Montana to Dr. George H. Horn who described it as *Aramigus fulleri* in 1876. Since then it has been known as Fuller's rose beetle. In his "History of Entomology" Essig gives an interesting account of the spread of this beetle over the world. It was originally collected by Crotch on brambles at Fayal on the island of Horta, Azores, in 1866 and described by him in 1867 in the Proceedings of the Zoölogical Society of London. It received little attention until it appeared in many parts of the United States and was described again by Horn.

Andrew S. Fuller died on May 4, 1896. An obituary presumably written by Frederick Allen Eddy and published in a Bangor, Maine, newspaper shortly after his death refers to Fuller's home in Ridgewood, New Jersey, having been transformed from a barren waste to one of the finest places in Bergen County all through the efforts of Mr. Fuller who was an enthusiast in botany and other natural sciences. Upon his Ridgewood home specimens of nearly every nut tree in the world were growing, as well as other trees and plants.

After her husband's death Mrs. Fuller, around December 7, 1897, sold her husband's collection of Coleoptera to Frederick Allen Eddy of Bangor, Maine, and it became a part of, or perhaps the basis of Mr. Eddy's large beetle collection which came to the Museum of Comparative Zoölogy at Harvard College, Cambridge, Massachusetts, after Eddy's death in 1935. Dr. P. J. Darlington, Jr., Curator of Insects, Museum of Comparative Zoölogy, to whom I am indebted for the above and the following information advised me that according to a note left by Eddy the Fuller material was in 112 boxes and included some 4,500 species and 15,000 or 20,000 specimens. Eddy paid $1,050 for it. The Fuller collection included much rare material identified by good specialists. Some of it was material from Prof. Snow of Kansas. Mr. Eddy combined the Fuller collection with his own and at the Museum of Comparative Zoölogy the Eddy specimens are being incorporated in the general collection of North American beetles. The Fuller specimens were not labelled as such by Eddy and as he received specimens from many other sources it is difficult to identify, exactly, the Fuller beetles. However it is assumed that most of the specimens in the Eddy collection bearing only state abbreviations as localities and not labelled by Eddy, are Fuller's. Such specimens now bearing the label "Frederick Allen Eddy Collection" in the general collection are probably those of Fuller.

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AN ANNOTATED LIST OF THE BUTTERFLIES AND SKIPPERS OF CUBA

(LEPIDOPTERA, RHOPALOCERA)

BY SALVADOR LUIS DE LA TORRE Y CALLEJAS
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(Continued from VOL. LXII, NO. 2

Pyrameis cardui cardui?: Berger, 1939: 196.

Illustrations.—Clark, 1932: pl. 8, f. 1, pl. 64, f. 3; J. H. Comstock & A. B. Comstock, 1936: pl. XXVI, f. 5, 6; Holland, 1942: pl. I, f. 1, pl. III, f. 37, pl. IV, f. 60-62, (chrysalis); Schwarz, 1949: pl. IV, f. 33-35?.

Genus *Hypanartia* Hübner

Hypanartia Hübner, 1821.

Genotype: *Hypanartia demonica* Hübner, 1821 (=*Papilio lethe* Fab., 1793).

99. HYPANARTIA PAULLUS (FABRICIUS)

Papilio paullus Fabricius, 1793.

Hypanartia paullus: Gundlach, 1881: 38; Bates, 1935: 166; Comstock, 1944: 451; Avinoff & Shoumatoff, 1946: 278.

Illustration.—Comstock, 1944: pl. 6, f. 11.

Genus *Junonia* Hübner

Precis Hübner, 1819: 33.

Junonia Hübner, 1819: 34.

Genotype: *Papilio lavinia* Cramer, 1775.

100. JUNONIA EVARETE CŒNIA Hübner

Junonia cœnia Hübner, 1822; Holland, 1916: 492; id., 1942: 156; Showalter, 1927: 107; Fazzini, 1934: 55; J. H. Comstock & A. B. Comstock, 1936: 160; Hoffmann, 1940c: 681.

Junonia genoveva: Gundlach, 1881: 65.

Junonia lavinia cœnia: Forbes, 1928: 306, 316; Clark, 1932: 79; Eliot, 1947: 230.

Junonia lavinia: Hoffmann, 1933: 235; Brown, 1945: 32.

Precis cœnia: Bates, 1935: 167; Field, 1938b: 89.

Junonia evarete cœnia: Comstock, 1944: 453; S. L. de la Torre, 1949c: 186.

Illustrations.—Showalter, 1927: pl. 3, f. 5; Clark, 1932: pl. 7, f. 1-4; Fazzini, 1934: p. 55, fig. not numbered; J. H. Comstock & A. B. Comstock, 1936: pl. XXIV, f. 3; Holland, 1942: pl. III, f. 29, 30, (larva), pl. IV, f. 56, 57, 65-67, (chrysalis), pl. XX, f. 7; Comstock, 1944: pl. 6, f. 8.

101. junonia evarete zonalis Felder & Felder

Junonia zonalis Felder & Felder, 1867; Avinoff & Shoumatoff, 1946: 279.

Junonia lavinia: Gundlach, 1881: 64; Holland, 1942: 156.

Junonia cœnia genoveva: Holland, 1916: 492.

Junonia lavinia zonalis: Forbes, 1928: 307, 316.

Precis zonalis: Bates, 1935: 168; Dethier, 1941: 70.

Precis lavinia zonalis: Berger, 1939: 197.

Junonia genoveva: Holland, 1942: 156.

Junonia evarete zonalis: Comstock, 1944: 454; Beatty, 1944: 156; J. A. Ramos, 1946: 52; S. L. de la Torre, 1949c: 186; Munroe, 1951: 56.

Illustrations.—Dethier, 1941: pl. V, f. 1, 5, (head of larva), pl. VI, f. 7, (para-dorsal spine from the first abdominal segment of larva); Holland, 1942: pl. XX, f. 8, (*lavinia*), f. 9, (*genoveva*); Comstock, 1944; pl. 6, f. 9.

102. junonia evarete zonalis f. incarnata Felder

Junonia lavinia zonalis var. *incarnata*: Forbes, 1928: 307.

Junonia evarete zonalis form *incarnata*: Comstock, 1944: 455; S. L. de la Torre, 1949c: 186.

Junonia evarete incarnata: Beatty, 1944: 156.

This form was captured at Bellamar beach, Matanzas province, by the writer.

103. JUNONIA EVARETE ZONALIS f. CONSTRICTA Felder

Junonia lavinia zonalis form *constricta*: Forbes, 1928: 309, 316.
Junonia evarete zonalis form *constricta*: Comstock, 1944: 455; S. L. de la Torre, 1949c: 186.

This form was annotated for Cuba by Forbes in 1928 (See Journ. N. Y. Ent. Soc., vol. 36, p. 309), and by Wm. P. Comstock in 1944 (See Insects of Porto Rico and the Virgin Islands, p. 455).

Genus *Anartia* Hübner

Anartia Hübner, 1819.
Genotype: *Papilio jatrophae* Johansson, 1763.

104. ANARTIA JATROPHÆ GUANTANAMO Munroe

Anartia jatrophæ guantanamo Munroe, 1942: 2; S. L. de la Torre, 1949c: 177.

Anartia jatrophæ, Gundlach, 1881: 59; id., 1891: 448; Holland, 1916: 492; d'Almeida, 1941: 310; id., 1944c: 46.

Anartia jatrophae jamaicensis: Bates, 1935: 169; Dethier, 1941: 71; Comstock, 1944: 457; Bruner, Scaramuzza & Otero, 1945: 99, 108.

This subspecies was described by E. Munroe in 1942 (See Amer. Mus. Novitates, No. 1179, p. 2).

Illustrations.—Dethier, 1941: pl. V, f. 3, 6, (head of larva), pl. VI, f. 1, (prothoracic segment of larva), f. 2, (fourth abdominal segment of larva), f. 6, (para-dorsal spine from the first abdominal segment of larva); d'Almeida, 1944c: pl. 3, f. 5, (pupa), f. 6, (larva).

105. ANARTIA LYTREA CHRYSOPELEA Hübner

Anartia chrysopelea Hübner, 1825.
Anartia lytrea: Gundlach, 1881: 60; Holland, 1916: 492.
Anartia lytræa: Hoffmann, 1940c: 681.
Anartia lytrea chrysopelea: Bates, 1935: 169; Dethier, 1941: 73.
Illustrations.—Dethier, 1941: pl. V, f. 2, (head of larva), pl. VI, f. 3, (prothoracic segment of larva), f. 4, (fourth abdominal segment

of larva), f. 5, (prespiracular spine from the prothoracic segment of fourth instar larva), f. 8, (para-dorsal spine from the second thoracic segment of larva), f. 11, (spine from head of larva).

Genus *Metamorpha* Hübner

Metamorpha Hübner, 1819.
Victorina Blanchard, 1840.
Genotype: *Metamorpha elissa* Hübner, 1819 (=*Papilio sulpitia* Cramer, 1780; homonym of *Papilio sulpitia* Cramer, 1779).

106. METAMORPHA STELENES INSULARIS (Holland)

Victorina steneles var. *insularis* Holland, 1916: 493.
Victorina stehnelus: Gundlach, 1881: 66.
Metamorpha stelenes insularis: Bates, 1935: 170; Dethier, 1940: 16; Comstock, 1944: 460; S. L. de la Torre, 1946b: 117; id., 1949b: 193.
Victorina steneles: Holland, 1942: 171.
Illustrations.—Dethier, 1940: pl. III, f. 2, (para-dorsal spine), f. 10, (second instar head capsule).

107. METAMORPHA STELENES INSULARIS f. LAVINIA (Fabricius)

Papilio lavinia Fabricius, 1775: 450.
This is the summer form of that species, which fly in July and August (See Comstock, 1944: 458).

Genus *Marpesia* Hübner

Marpesia Hübner, 1818.
Athena Hübner, 1819.
Megalura Blanchard, 1840.
Timetes Doubleday, 1844.
Tymetes Boisduval, 1846?.
Genotype: *Marpesia eleuchea* Hübner, 1818.

(To be continued)

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New York Entomological Society

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DECEMBER, 1954

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MYODOPSYLLA SETOSA AND TIARAPSYLLA BELLA, NEW SPECIES OF FLEAS FROM PERU

By
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Although twenty species of fleas have been described from Peru, the specimens were collected during only a small number of surveys, and it is likely that the forms described below represent but a small percentage of undescribed species still to be found in Peru. Included in the present paper are descriptions of two new species representing two families of Siphonaptera, and records and a short redescription of *Tiarapsylla titschacki* Wagner, 1937. The specimens of *T. titschacki,* taken by Dr. C.C. Sanborn, constitute the first records of this species since the type collection.

I am grateful to Mr. F.G.A.M. Smit of British Museum (Tring) who generously lent a pair of *Myodopsylla isidori* (Weyenbergh, 1881) for study. The drawings of *M. isidori* are taken from the male of this pair *ex Myotis nigricans,* Argentina, Patagonia, Rio Colorado. Drawings of *M. wolffsohni* subsp. were taken from a specimen *ex* "various bats", Paraguay, Sapucay, 1901, W. Foster collector.

Ischnopsyllidæ: Ischnopsyllinæ

Myodopsylla setosa, new species
(figs. 1,2,6,8,10,12,13)

TYPE DATA. - Male holotype, female allotype *ex* "bat", Peru: Yucay, 29 Dec. 1937, J. Soukup collector. Deposited in the collections of the United States National Museum.

DIAGNOSIS. - Near *Myodopsylla isidori* (Weyenbergh, 1881) and *M. wolffsohni* subsp. Male separable from *Myodopsylla wolffsohni* and *M. isidori* in having distinct false combs on abdominal terga one through three (fig. 6); not with false combs only on terga one and two (figs. 3 and 5). Further separable from *wolfsohni* in that the posteroventral extension of the immovable process of the clasper is long, with dorsal and ventral margins parallel (fig. 13, *P.*); not with this portion of process broad and subtriangulate (fig. 11, *P.*); and by the shape of the distal arm of the ninth sternum and the dorsal extension of the crochet (figs. 2, 4, *DA.9* and *CR.*); in *setosa* n. sp. the crochet bears a narrow, pointed apical process, whereas *wolffsohni* lacks this process. Male further distinct from *isidori* in that the posteroventral extension of the immovable process of the clasper is about the same width as the dorsal process (fig. 13, *P.*) not markedly narrower than dorsal extension (fig. 9, *P.*); and the two apical bristles on posteroventral process very long and "coiled" apically in *setosa* n. sp., not much smaller and lacking the apical curl as in *isidori*; also the crochet with triangular lobe just below dorsoapical extension (fig. 2, *CR.*), not with this lobe rectangular (fig. 7, *CR.*). Female separable from *wolffsohni* in having a distinct false comb on tergum three, not lacking such a comb. Apparently no valid differences are to be found separating *setosa* n. sp. females from *isidori* females.

DESCRIPTION

HEAD (fig. 1): Much as in other members of the genus. Pale area on frons with a row of small bristles which become minute as they progress anteroventrally. A row of three large bristles along anterior margin of antennal groove, bristle just above eye much the largest; other than these, with several small scattered bristles between antennal groove and pale area of frons. Eye vestige visible but pale in color. Second antennal segment with apical row of small bristles.

THORAX (fig. 8): Mesepisternum (MPS.) with anterior margin almost vertical, not strongly inclined anteriad; mesepisternal rod (EP.R. - I) quite distinct. Metanotum (MTN.) with false comb of seven or eight close-set flattened bristles on a side. Lateral metanotal area (L.M.) with one large median bristle plus a small bristle near ventral margin. Metepimere (MTM.) with eight or nine bristles set in three irregular rows, bristles of first row small, last row of two medium-sized bristles inserted on posterior margin of sclerite.

ABDOMEN: First tergum (fig. 6, IT.) with well-developed false comb of six or seven bristles on a side. Terga two and three in male also with distinct false combs of four to five bristles on a side (fig 6, 2T. and 3T.); in female false comb on tergum three represented by only three or four flattened bristles on the two sides together.

MALE (fig. 10): Antesensilial bristle (A.B.) set on small protuberance, dorsally this protuberance no longer than width of bristle base. Sensilium (SN.) ovate viewed laterally, lacking a posterolateral extension occurring in certain other species of this genus. Eighth tergum (8T.) with marginal bristles as follows: dorsal margin with six or seven small pale bristles inserted on mesal surface, plus two larger submarginal bristles on lateral surface; at posterodorsal angle and just ventrad to this angle with three long bristles and two small pale bristles between the dorsal and the median long bristles; below large bristles a row of six or seven pale bristles which are twice as long as pale bristles on dorsal margin. Below bristles, the apical (posterior) margin of eighth tergum is distinctly serrate its entire length. Basal portion of eighth sternum (8S.) roughly square, anterodorsal angle rounded, posterodorsal angle acute, posterior margin slightly concave; ventrocaudal process of eighth sternum lightly sclerotized, with several pale lateral bristles ventroapically; two "brushes" of mesal bristles. Distal arm of ninth sternum (DA.9 and fig.2) with rounded apex; bearing three equidistant bristles on or near posterior (ventral) margin as follows: just below apex a small submarginal bristle followed by narrow wing-like extension which extends to largest bristle which is halfway between small subapical bristle and medium-sized bristle present ventrally on a narrow lobe. Immovable process of clasper (P. and fig. 13) with posteroventral extension rectangular, more than two times as long as broad, dorsal and ventral margins parallel and straight, width of posteroventral extension about the same as width of dorsal extension of process, the two apical large bristles on posteroventral extension flagellate, coiled apically. Moveable finger (F. and fig. 13) triangular, dorsal angle acute, posteroventral angle of about 90°. Aedeagal apodeme (AE.A.) about five times as long as broad, apex acute. Penis rods (P.R.) forming a complete circle. Crochets (fig. 2, CR.) divided into two processes, the upper process with narrow acute dorsoapical extension, below this a subtriangular lobe; lower process with caudally expanded apex.

FEMALE (fig. 12): Similar to modified segments of related species. Spermatheca (SP.) and seventh sternum (7S.) as shown in figure.

LENGTHS: Holotype 2.4mm., allotype 2.3mm.

Stephanocircidæ: Craneopsyllinæ

Tiarapsylla bella, new species
(figs. 15-17, 19)

TYPE DATA. - Holotype female, three paratype females *ex "Felis pajaros garleppi"* (*Felis colocolo garleppi*), Peru: Dept. of Puno, Picotani, 22 Sept. 1941, C.C. Sanborn collector. Holotype female deposited in the collections of the Chicago Natural History Museum, two paratype females in collection of Robert Traub, remaining paratype female in the collections of British Museum (Natural History), Tring.

Felis colocolo is undoubtedly an abnormal host, the true host probably being *Lagidium* (viscacha) as with *T. titschacki* Wagner 1937. The cat from which the type specimens of *T. bella* were taken was observed hunting viscachas at the time of capture.

DIAGNOSIS. - Separable from *Tiarapsylla argentina* Jordon, 1942 in lacking an entire row of pale pseudosetae on inner aspect of mesonotal flange, the pseudosetae being only three or four in number on the two sides together and confined to the dorsum of the flange (fig. 19, PS.S.); and second antennal segment with fringe of long bristles extending well beyond apex of head; not lacking such bristles. Close to *T. titschacki* Wagner, 1937; some of the differences as follows: a larger flea (*bella*-5mm., *titschacki*-3.7-4.4mm.); helmet comb of *bella* n. sp. with base evenly convex, formed of eight or nine spines and ending well short of ventral head margin (fig. 16); not with ten to twelve spines (usually 11-12) in a sinuate row extending almost to ventral head margin (fig. 14). Small bristles on helmet posterior to the comb confined to area behind dorsal two spines in *bella* n. sp., not behind upper three or four spines as in *titschacki.* Second antennal segment with its apical flange longer than in *titschacki,* extending over basal two segments of antennal club.

DESCRIPTION

HEAD (fig. 16): Helmet comb of 8 - 9 spines, its base slightly convex, not markedly sinuate; the ventral spine separated from ventral margin of helmet by at least the width of its base. Posterior margin of helmet above comb with row of small bristles. Small bristles present on helmet posterior to upper two helmet spines. Postantennal area with five rows of bristles. First antennal segment with row of about six medium-sized bristles; second antennal segment with apical flange extending over basal two segments of club and with apical row of long bristles extending well beyond apex of club. Genal comb of six long, apically rounded spines; genal process above comb of varying size and shape, about as long as comb spines. Labial palpus two-thirds length of procoxa. Maxillary palpus with basal segment approximately two times as long as second segment.

THORAX (fig. 19): Pronotum (fig. 16, PRN.) with two rows of bristles, first row irregular, plus some anterior bristles; pronotal comb with 25-29 spines in all (holotype with 29 spines, paratypes with 25, 26 and 27 spines). Mesonotum

(MSN.) with five rows of bristles; first four rows very irregular; three or four dorsal pseudosetæ present under flange. Mesepisternum (MPS.) and mesepimere (MPM.) with approximately 30 bristles in all. Metanotum (MTN.) with three rows of bristles, first two rows scattered. Lateral metanotal area (L.M.) with 6 - 8 small and large bristles. Metepisternum (MTS.) with one large bristle. Metepimere (MTM.) with three scattered rows of bristles.

LEGS: Protibia with seven dorsal notches, including apical, bearing bristles as follows (base to apex): 2-2-2-4-4-4-4 (holotype); 2-2-2(3)-4(3)-4(5)-3(4,5)-4 (5) (paratypes). Mesotibia with eight dorsal notches containing bristles as follows: 2-2-3-3-3-4-4-4 (holotype); 2-2-2(1)-3(4)-4 (3)-4-4(3)-4 (paratypes). Metatibia also with eight dorsal notches containing bristles as follows 2-2-2-3-3-4-4-4 (holotype); 2-2-2-3(4)-3(4)-4(3)-4(3)-4 (paratypes).

ABDOMEN: First tergum (fig. 19, *1T.*) with three rows of bristles, first short; terga 2 - 6 with two rows of bristles, second row always extending below spiracle; seventh tergum with three rows, first row short. Basal sternum with clump of 5 - 6 ventral subapical bristles. Other unmodified sterna with one row of bristles, at times plus one or two anteroventral bristles. Holotype and two paratypes with two antesensilial bristles on each side, one paratype with two such bristles on one side, one on other.

MODIFIED SEGMENTS (fig. 17): Seventh sternum (7S.) with two rows of bristles; its posterior margin lacking sinus. Eighth tergum (8T.) lacking bristles above spiracle; an irregular row of bristles from just below spiracle to level of bursa copulatrix (B.C.); ventrally with two scattered rows of bristles and with a thick patch of dark subspiniform bristles apically, ventrad to ventral anal lobe; no more than one bristle present laterally between apical clump and anterior row. Dorsal and ventral anal lobes (D.A.L. and V.A.L.) with many small bristles. Anal stylet (A.S.) about two times as long as broad, with two or three short apical bristles, one of which may be longer than others. Spermatheca (SP. and fig. 15) with tail at least one and one-half times as long as body; body usually sharply rounded dorsally near insertion of tail; body and apical half of tail pigmented. Bursa copulatrix (B.C.) sinuate, narrow; ductus obturatus (D.O.) with basal third as thick as bursa, apical two-thirds narrow.

LENGTH: 5.0mm.

Tiarapsylla titschacki Wagner, 1937
(figs. 14, 18)

Tiarapsylla titschacki Wagner, 1937, Zeits. Parasit. 9:709, figs. 9 - 15. Wagner, 1939, Aphanipt.:76, fig. 76.

TYPE DATA. - Type series: one male, two females *ex* "vizchaca", Peru: Tayapampa (Dept. of La Libertad, Tayabamba?), about 4,000m., 13 April 1936, E. Titschack collector.

NEW RECORDS. - One female *ex Lagidium peruanum* subsp., Peru: Dept. of Puno, Picotani, 14 Sept. 1941, C. C. Sanborn collector; in the collection of Robert Traub. One female *ibid.* but *ex Lagidium peruanum inca,* Dept. of Junin, Capillsa, 22 kilom. from Carhuamayo, 16,000 ft., 19 Feb. 1946; in the collections of the Chicago Natural History Museum. DIAGNOSIS. - Separable from *Tiarapsylla argentina* Jordan, 1942 by lacking complete lateral row of mesonotal pseudosetæ and by presence of long bristles apically on second antennal segment. Distinct from *T. bella* n. sp. by characters given above in the diagnosis of the species.

DESCRIPTION

HEAD (fig. 14): Helmet comb with markedly sinuate margin; the spines numbering 10 - 12 (11 - 12 in the type specimens; present specimen from Puno with 11 spines on one side, 10 on the other; Junin specimen with 12 spines on both sides). Most ventral spine of helmet comb set very near ventral margin of helmet, distance from this margin to ventral comb spine less than one-half width of base of this spine. Small bristles posterior to helmet comb present opposite dorsal three or four spines of helmet comb. Genal comb of five or six spines, the spines proportionately shorter and more squared apically than in *T. bella* n. sp. Flange of second antennal segment not covering more than basal segment of club.

THORAX: Pronotal comb of 22 - 24 spines in all (specimens at hand with 22 - 23 spines). Remainder of thorax as in *T. bella* n. sp.; generally with somewhat fewer bristles.

LEGS and ABDOMEN with chaetotaxy similar to *T. bella* n. sp.

MODIFIED SEGMENTS, FEMALE: very similar to *T. bella* n. sp. Two or three antesensilial bristles (Puno specimen with three on both sides; Junin specimen with three on one side, two on the other.). Eighth tergum with vertical row of bristles below spiracle doubled part of its length and with several bristles scattered over an area between this row and the apical clump of bristles present on posterior margin just ventrad to vental anal lobe. Spermatheca body (fig.18) with dorsal margin broadly rounded or somewhat concave near insertion of tail; tail not more than one and one-half times as long as body.

LENGTHS. - Junin female 3.7mm.; Puno female 4.4mm.

LIST OF ABBREVIATIONS

A.A.R.	Aedeagal apodemal rod	PL.A.	Pleural arch.
A.B.	Antesensilial bristle.	P.R.	Penis rod.
AE.A.	Aedeagal apodeme.	PRN.	Pronotum.
A.S.	Anal stylet, female.	PS.S.	Pseudosetæ.
B.C.	Bursa copulatrix.	SN.	Sensilium.
CR.	Crochet.	SP.D.	Spermathecal duct.
D.A.L.	Dorsal anal lobe.	SQ.	Squamulum.

D.A.9	Distal arm of ninth sternum, male.
D.O.	Ductus obturatus, female.
E.F.	Proepisternal flange.
EP.R. - I	Mesepisternal rod.
F.	Movable finger of clasper, male.
FU. - I	Mesosternal furca.
L.M.	Lateral metanotal area.
MB.	Manubrium of clasper, male.
MPM.	Mesepimere.
MPS.	Mesepisternum.
MSN.	Mesonotum.
MST.	Mesosternum.
MTM.	Metepimere.
MTN.	Metanotum.
MTS.	Metepisternum.
MTT.	Metasternum.
P.	Immovable process of clasper, male.
PEG.	Peg of crochet, aedeagus.
T.AP.9	Tergal apodeme of segment nine, male.
V.A.L.	Ventral anal lobe.
1T.	First abdominal tergum.
2T.	Second abdominal tergum.
3T.	Third abdominal tergum.
4T.	Fourth abdominal tergum.
7S.	Seventh abdominal sternum.
7T.	Seventh abdominal tergum.
8S.	Eighth abdominal sternum.
8T.	Eighth abdominal tergum.
9S.	Ninth abdominal sternum.
9T.	Ninth abdominal tergum.

PLATE VII

Fig. 1 *Myodopsylla setosa* n. sp.: Head and prothorax, holotype

Fig. 2 Ibid.: Distal arm of ninth sternum and crochet, holotype.

Fig. 3 *M. wolffsohni* subsp.: Abdominal terga 1-3, male.

Fig. 4 Ibid.: Distal arm of ninth sternum and crochet, male.

Fig. 5 *M. isidori* (Weyenbergh, 1881): Abdominal terga 1-3, male.

Fig. 6 *M. setosa* n. sp.: Abdominal terga 1-4, holotype.

Fig. 7 *M. isidori* (Weyenbergh, 1881): Distal arm of ninth sternum and crochet, male.

Fig. 8 *M. setosa* n. sp.: Meso - and metathorax, holotype.

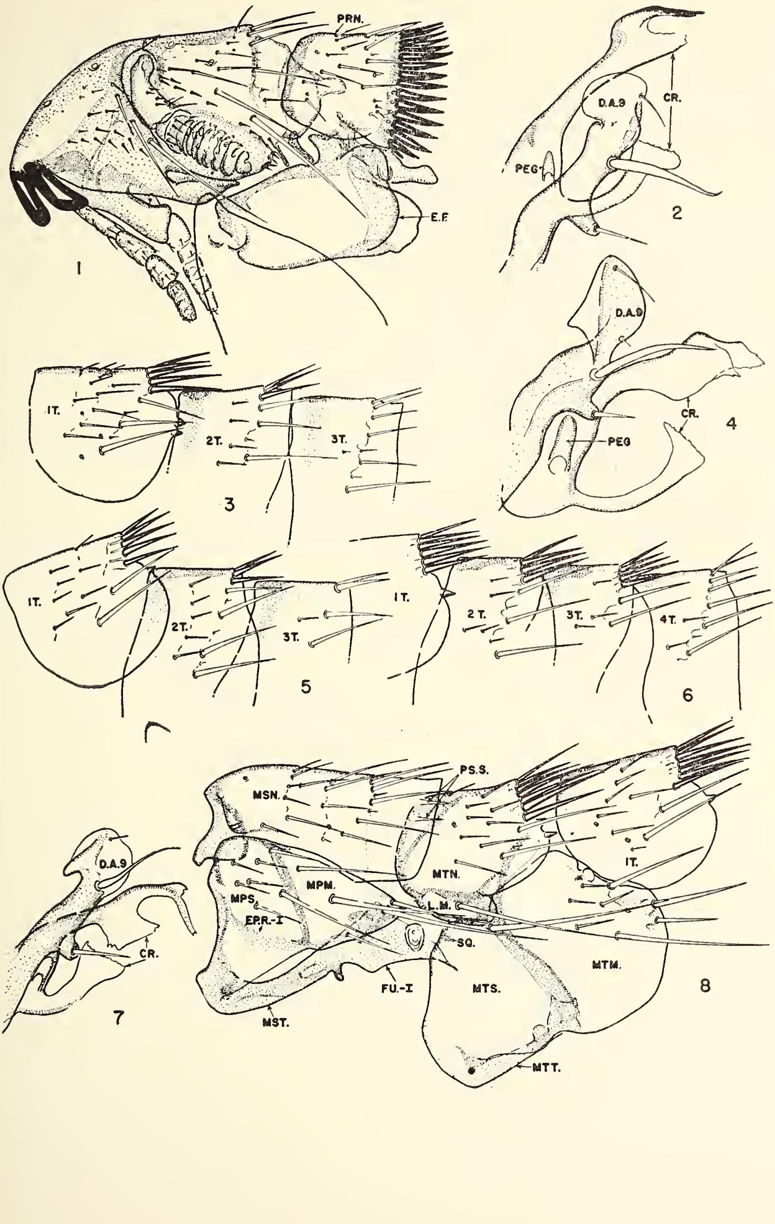
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PLATE VIII

Fig. 9 *Myodopsylla isidori* (Wegenberg, 1881): Process and movable finger of clasper, male.

Fig. 10 *M. setosa* n. sp.: Modified segments, holotype.

Fig. 11 *M. wolffsohni* subsp.: Process and movable finger of clasper, male.

Fig. 12 *M. setosa* n. sp.: Modified segments, allotype.

Fig. 13 Ibid.: Process and movable finger of clasper, holotype.

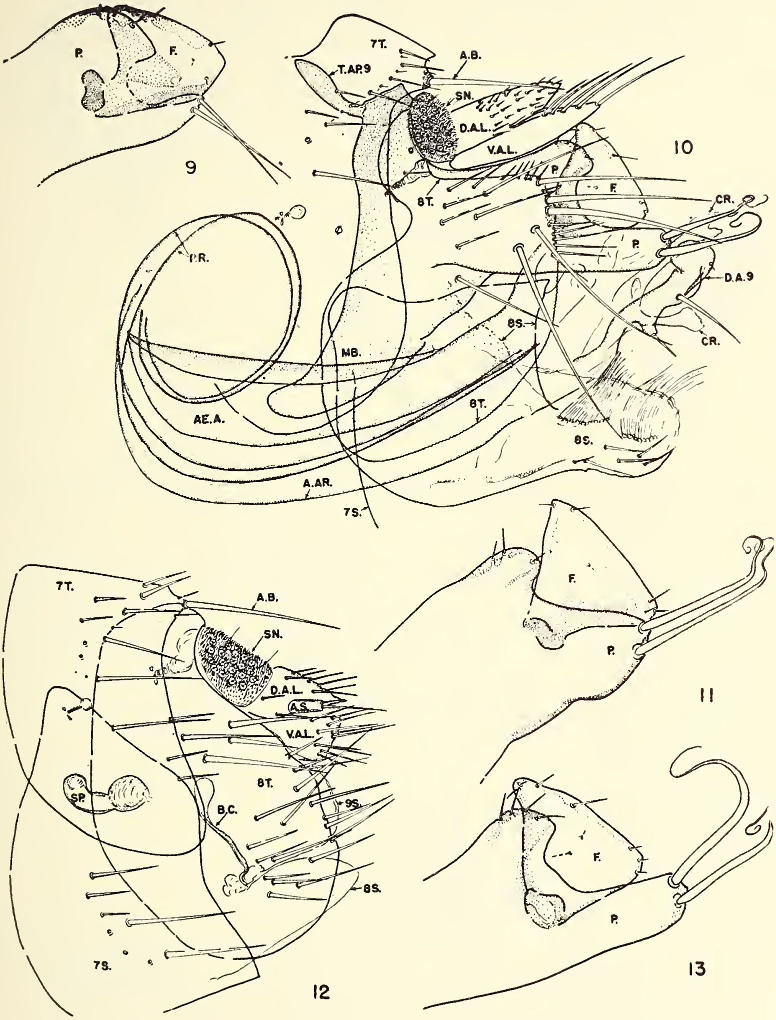
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PLATE IX

Fig. 14 *Tiarapsylla titschacki* Wagner, 1937: Head and prothorax, female

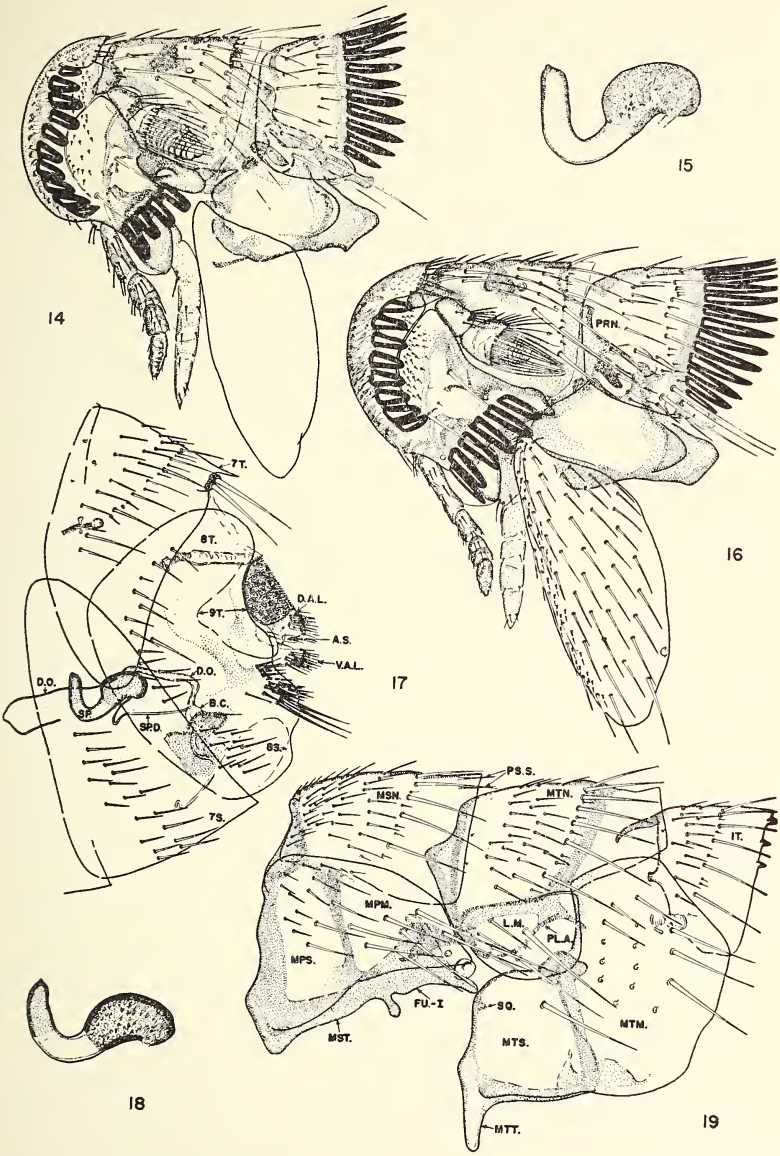
Fig. 15 *T. bella* n. sp.: Spermatheca, holotype.

Fig. 16 Ibid.: Head and prothorax, holotype.

Fig. 17 Ibid.: Modified segments, holotype.

Fig. 18 *T. titschacki* Wagner, 1937: Spermatheca.

Fig. 19 *T. bella* n. sp.: Meso - and metathorax, holotype.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The American Museum of Natural History has announced the establishment of The Southwestern Research Station. It is located on the eastern slope of the Chiricahua Mountains, near Portal, Cochise County, in southeastern Arizona. The property is within the limits of the Coronado National Forest at an elevation of 5400 feet.

The station was established for the purpose of making available research facilities for scientists and students in all branches of science, who have problems that can be investigated through the utilization of the faunal, floral and geological features of the area. It will be open during the entire year.

It is operated by the American Museum of Natural History, Central Park West at 79th Street, New York 24, New York and under the direction of Dr. Mont A. Cazier, Chairman and Curator of the Department of Insects and Spiders, to whom all inquiries should be addressed. Anyone interested in the station should write to the above named individual for the booklet which gives the details of the operation and a general description of the area. — F. A. S.

AN ANNOTATED LIST OF THE BUTTERFLIES AND SKIPPERS OF CUBA (LEPIDOPTERA, RHOPALOCERA)

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(Continued from Vol. LXII, No. 3)

108. MARPESIA MARIUS (Cramer)

Papilio marius Cramer, (not Stoll), 1779 (See Brown, 1941: 130).
Marpesia chiron: Gundlach, 1881: 35; Comstock, 1944: 463; Avinoff & Shoumatoff, 1946: 280; Munroe, 1951: 56.
Athena (Timetes) chiron: Hoffmann, 1933: 236.
Athena chiron: Bates, 1935: 171; Field, 1938b: 93; Holland, 1942. 162; Bruner, Scaramuzza & Otero, 1945: 23, 39.
Timetes chiron: Hoffmann, 1940c: 687; Brown, 1945: 42.
Marpesia marius: d'Almeida, 1941: 312; S. L. de la Torre, 1949c: 190.

We adopt the name *Marpesia marius* Cr. seeing that *Papilio chiron* Fabr., 1775, is homonymous with *Papilio chiron* Rott., 1775.

Illustrations.—Bates, 1935: f. 2, (outline of wing); Holland, 1942: pl. XXI, f. 4; Comstock, 1944: pl. 7, f. 7; Oiticica Filho, 1946: f. 8, 9, (genital).

109. MARPESIA ELEUCHEA ELEUCHEA Hübner

Marpesia eleuchea Hübner, 1818; Comstock, 1944: 462.
Marpesia eleucha: Gundlach, 1881: 35.
Timetes eleucha: Holland, 1916: 493.
Athena eleuchea eleuchea: Bates, 1935: 172; Bruner, Scaramuzza & Otero, 1945: 76, 78.
Megalura eleucha: Hall, 1936: 277.

Genus *Hypolimnas* Hübner

Hypolimnas Hübner, 1821.
Diadema Boisduval, 1832; preoccupied in Crustacea.

Genotype: *Papilio pipleis* Linnaeus, 1758 (= ♂ *Papilio pandarus* L, 1758).

110. HYPOLIMNAS MISIPPUS (Linnæus)

Papilio misippus Linnæus, 1764.

Hypolimnas misippus: Gundlach, 1881: 42; Bates, 1935: 172; Hall, 1936: 277; Holland, 1942: 145; Comstock, 1944: 463; J. A. Ramos, 1946: 53; Avinoff & Shoumatoff, 1946: 282.

Hypolimnas missipus: M. Sánchez Roig & G. S. Villalba, 1934b: 33.

Hypolimnas missippus: Beatty, 1944: 156.

Hypolimnas misippus misippus: Munroe, 1951: 56.

Illustrations.—M. Sánchez Roig. & G. S. Villalba, 1934b: f. 5; Holland, 1942: pl. XXI, f. 9, 10; Comstock, 1944: pl. 7, f. 4, (♀), f. 13, (♂).

Genus *Historis* Hübner

Historis Hübner, 1819: 35.

Coea Hübner, 1819: 48.

Aganisthos Boisduval & Leconte, 1836?.

Genotype: *Papilio odius* Fabricius, 1775.

111. HISTORIS ODIUS ODIUS (Fabricius)

Papilio odius Fabricius, 1775.

Aganisthos odius: Gundlach, 1881: 68; Holland, 1916: 493.

Historis odius odius: Bates, 1935: 173; Comstock, 1944: 464; Bruner, Scaramuzza & Otero, 1945: 35; S. L. de la Torre, 1952: 64.

Historis odius: Avinoff & Shoumatoff, 1946: 282.

Illustration.—Comstock, 1944: pl. 8, f. 1.

112. HISTORIS ACHERONTA SEMELE (Bates)

Coea acheronta semele Bates, 1939: 4.

Megistanis acheronta: Gundlach, 1881: 36.

Coea acheronta: Bates, 1935: 173.

Historis acheronta semele: Comstock, 1944: 467; S. L. de la Torre, 1952: 64.

This subspecies was described by Marston Bates in 1939 (See Memorias Sociedad Cubana de Hist. Nat., vol. XIII, p. 4).

Illustration.—Comstock, 1944: pl. 6, f. 2.

Genus *Colobura* Billberg

Colobura Billberg, 1820.

Gynoecia Doubleday, 1844.

Gynaecia Doubleday, 1850.
Genotype: *Papilio dirce* Linnæus, 1758.

113. colobura dirce clementi Comstock

Colobura dirce Clementi W. P. Comstock, 1942d: 284; S. L. de la Torre, 1949c: 184.
Gynaecia dirce: Gundlach, 1881: 48; id., 1891: 448.
Colobura dirce: Bates, 1935: 174; Bruner, Scaramuzza & Otero, 1945: 35; Alayo, 1950: 97.

This subspecies was described by Wm. P. Comstock in 1942 (See Journal N. Y. Ent. Soc., vol. L, p. 284).
Illustration.—Bruner, Scaramuzza & Otero, 1945: pl. V, f. 3, (larva).

Genus *Lucinia* Hübner

Lucinia Hübner, 1823.
Genotype: *Lucinia sida* Hübner, 1823.

114. lucinia sida Hübner

Lucinia sida Hübner, 1823; Gundlach, 1881: 69; Bates, 1935: 175; Bruner, Scaramuzza & Otero, 1945: 70.
Lucinia cadma: Holland, 1916: 492; Avinoff & Shoumatoff, 1946: 281.

Genus *Eunica* Hübner

Evonyme Hübner, 1819: 61.
Eunica Hübner, 1819: 61.
Faunia Poey, 1847; preoccupied in Diptera.
Genotype: *Papilio monima* Stoll, 1784.

The name *Evonyme* precedes *Eunica* on page 61 of Hübner's Verzeichniss, but we use the second name considering that this name has been used during a century in almost all books upon butterflies.

115. eunica tatila tatilista Kaye

Eunica tatila tatilista Kaye, 1926; Comstock, 1942d: 287; id., 1944: 469; Beatty, 1944: 156; Avinoff & Shoumatoff, 1946: 280; S. L. de la Torre, 1952: 69.
Eunica tatila: Gundlach, 1881: 50; Holland, 1942: 158.

Eunica tatila tatila: Bates, 1935: 176.

Illustrations.—Holland, 1942: pl. LIX, f. 29; Comstock, 1944: pl. 7, f. 2.

116. EUNICA MONIMA (Stoll)

Papilio monima Stoll (not Cramer), 1784 (See Brown, 1941: 130).

Eunica monima: Gundlach, 1881: 51; Hoffmann, 1940c: 684; Holland, 1942: 158; Comstock, 1944: 469; Brown, 1945: 39; J. A. Ramos, 1946: 53; Avinoff & Shoumatoff, 1946: 280; S. L. de la Torre, 1952: 69.

Eunica monima modesta: Hoffmann, 1933: 237.

Eunica monima habanae: Bates, 1935: 176.

Evonyme monima: Orfila, 1951: 52.

According to Comstock (1944: 469), there are no important differences among the specimens of Mexico, Central-America, Venezuela, Brazil, Porto Rico, Hispaniola and Cuba, so that we must not divide the species *monima* into subspecies.

Illustrations.—Holland, 1942: pl. XXI, f. 7, 8; Comstock, 1944: pl. 7, f. 3.

117. EUNICA PUSILLA FAIRCHILDI Bates

Eunica pusilla fairchildi Bates, 1935: 177; Bruner, 1947: 28.

118. EUNICA MACRIS HERACLITUS Eschscholtz

Eunica heraclitus: Gundlach, 1881: 52.

Eunica macris heraclitus: Bates, 1935: 177.

Genus *Dynamine* Hübner

Dynamine Hübner, 1819.

Genotype: *Papilio mylitta* Cramer, 1779.

119. DYNAMINE EGÆA CALAIS Bates

Dynamine egæa calais Bates, 1936: 226; Bruner, Scaramuzza & Otero, 1945: 142.

Dynamine serina: Gundlach, 1881: 47.

Dynamine egæa zetes?: Bates, 1935: 178.

This subspecies was described by Marston Bates in 1936 (See Mem. Soc. Cub. Hist. Nat., vol. IX, p. 226).

120. DYNAMINE MYLITTA BIPUPILLATA Röber

Dynamine mylitta ab. *bipupillata* Röber in Seitz, 1915.
Dynamine postverta: Gundlach, 1881: 46.
Dynamine mylitta bipupillata: Bates, 1935: 179.

Genus *Hamadryas* Hübner

Hamadryas Hübner, 1806.
Ageronia Hübner, 1819.
Genotype: *Papilio amphinome* Linnaeus, 1767.

121. HAMADRYAS AMPHINOME MEXICANA (Lucas)

Peridromia mexicana Lucas, 1853.
Ageronia amphinome mexicana: Hoffmann, 1933: 239; id., 1940c: 686; Bates, 1936: 227; Brown, 1945: 42; Bruner, 1947: 27.
Hamadryas amphinome mexicana: S. L. de la Torre, 1949: 65.

This species was reported by M. Bates in 1936 (See Memorias Soc. Cub. Hist. Nat., vol. IX, p. 227).
Illustration.—Bates, 1936: f. 1.

122. HAMADRYAS FEROX DIASIA (Fruhstorfer)

Ageronia ferox diasia Fruhstorfer, 1916.
Ageronia februa?: Hoffmann, 1933: 238; id., 1940c: 685.
Ageronia ferentina diasia: Bates, 1936: 228; Bruner, 1947: 27.
Ageronia februa februa?: Berger, 1939: 199.
Ageronia feronia: Holland, 1942: 161.
Hamadryas ferox diasia: Comstock, 1944: 471; J. A. Ramos, 1946: 53; S. L. de la Torre, 1949: 65.

This species was reported by M. Bates, in 1936 (See Memorias Soc. Cub. Hist. Nat., vol. IX, p. 228).
Illustrations.—Holland, 1942: pl. XXIV, f. 4; Comstock, 1944: pl. 6, f. 10.

Genus *Doxocopa* Hübner

Doxocopa Hübner, 1819.
Chlorippe "Boisduval" Doubleday, 1844.
Genotype: *Papilio agathina* Cramer, 17—.

123. DOXOCOPA LAURE DRURYI (Hübner)

Catargyria druryi Hübner, 182—.
Apatura druryi: Gundlach, 1881: 61.
Doxocopa laure druryi: Bates, 1935: 180; Bruner, Scaramuzza & Otero, 1945: 31; S. L. de la Torre, 1946b: 121.

Genus *Limenitis* Fabricius

Najas Hübner, 1806.
Limenitis Fabricius, 1807.
Limonetes Billberg, 1820.
Nymphalus Boitard, 1828.
Nympha Krause, 1839.
Basilarchia Scudder, 1872.
Parathyma Moore, 1898.
Genotype: *Papilio populi* Linnaeus, 1758.

The name *Najas* Hbn., which was published in the "Tentamen" in 1806, is invalid in Opinion 97 of the International Commission on Zoological Nomenclature.

According to R. Chermock (1950: 536), *Adelpha* Hbn., 1819, is a subgenus of *Limenitis,* and the name *Heterochroa* Boisd., 1836, is considered as a synonym of *Adelpha.*

124. LIMENITIS (LIMENITIS) ARCHIPPUS FLORIDENSIS (Strecker)

? archippus floridensis Strecker, 1878.
Basilarchia floridensis: J. H. Comstock & A. B. Comstock, 1936: 173; Holland, 1942: 165.
Basilarchia archippus floridensis: Field, 1938b: 58.
Limenitis archippus floridensis: R. L. Chermock, 1947: 1; id., 1950: 566; S. L. de la Torre, 1949: 65; id., 1949c: 181.

This species was captured by Mr. José Cabrera in Cotorro, Havana province, on August 7, 1933, and reported in March, 1934, under the name *Basilarchia missippus* (L.) (See Mem. Soc. Cub. Hist. Nat., vol. VIII, p. 34).

Illustrations.—J. H. Comstock & A. B. Comstock, 1936: pl. XXVIII, f. 4; Holland, 1942: pl. LXXIII, f. 1, 2; Chermock, 1950: f. 30, (genital).

125. LIMENITIS (ADELPHA) IPHICLA IPHIMEDIA (Fruhstorfer)

Adelpha iphicla iphimedia Fruhstorfer, 1915; Bates, 1935: 180; Bruner, Scaramuzza & Otero, 1945: 27.
Adelpha basilea: Gundlach, 1881: 29.
Adelpha iphicla: Holland, 1916: 493.

Genus *Asterocampa* Röber

Asterocampa Röber, 1916.
Celtiphaga Barnes & Lindsey, 1922.
Genotype: *Asterocampa celtis* (Boisduval & Leconte, 1833).

126. ASTEROCAMPA ARGUS IDYJA (Geyer)

Doxocopa idyja Geyer, 1828; Gundlach, 1881: 62.
Asterocampa lycaon idyja: Bates, 1935: 181; Bruner, Scaramuzza & Otero, 1945: 126.
Asterocampa argus idyja: Comstock, 1944: 473; S. L. de la Torre, 1952: 64.
Illustration.—Comstock, 1944: pl. 7, f. 9.

Genus *Prepona* Boisduval

Prepona Boisduval, 1836.
Genotype: *Nymphalis demodice* Godart, 1821 (=*Morpho omphale* Hbn., 1819)

127. PREPONA ANTIMACHE CRASSINA Fruhstorfer

Prepona antimache crassina Fruhstorfer, 1904; Bates, 1935: 182; Comstock, 1944: 475.
Prepona amphitoe: Gundlach, 1881: 33.

Genus *Siderone* Hübner

Siderone Hübner, 1823.
Genotype: *Siderone ide* Hübner, 1823.

128. SIDERONE NEMESIS (Illiger)

Papilio nobilis nemesis Illiger, 1801.
Siderone nemesis: Gundlach, 1881: 32; Hoffmann, 1933: 240; id.,

1940c: 691; Comstock, 1944: 475.
Siderone ide: Holland, 1916: 493.
Sdierone nemesis nemesis: Bates, 1935: 182; Bruner, Scaramuzza & Otero, 1945: 31; Bruner, 1947: 28; Munroe, 1951: 56.
Illustration.—Comstock, 1944: pl. 7, f. 10.

Genus *Hypna* Hübner

Hypna Hübner, 1819.
Genotype: *Papilio clytemnestra* Cramer, 1779.

According to Johnson and Comstock (See Journal N. Y. Ent. Soc., vol. XLIX, p. 331), we separate the genera *Hypna* and *Anaea* on account of the differences that exist in the genitals of their species.

129. HYPNA CLYTEMNESTRA IPHIGENIA Lucas

Hypna clytemnestra var. *iphigenia* Lucas, 1857; Gundlach, 1881: 33.
Hypna iphigenia: Hall, 1917: 173.
Anaea clytemnestra iphigenia: Bates, 1935: 183.
Hypna clytemnestra iphigenia: Johnson & Comstock, 1941: 331; S. L. de la Torre, 1952: 64.

Genus *Anæa* Hübner

Paphia Fabricius, 1807; preoccupied in Mollusca.
Anæa Hübner, 1819.
Memphis Hübner, 1819.
Corycia Hübner, 1825; preoccupied in the family *Noctuidae.*
Cymatogramma Doubleday, 1849.
Pyrrhanaea Schatz, 1892.
Genotype: *Papilio troglodyta* Fabricius, 1775.

130. ANÆA AIDEA CUBANA (Druce)

Perrhanæa cubana Druce, 1905.
Anæa troglodyta: Gundlach, 1881: 30.
Anæa troglodyta cubana: Bates, 1935: 183.
Anæa aidea cubana: Johnson & Comstock, 1941: 307; S. L. de la Torre, 1952: 64.
Illustrations.—Johnson & Comstock, 1941: pl. IX, f. 8, 9, (genital), pl. XII, Map 1.

131. ANÆA ECHEMUS (Westwood & Hewitson)

Cymatogramma echemus Westwood & Hewitson, 1850 (See Brown, 1941: 133).

Anæa echemus: Gundlach, 1881: 31; Johnson & Comstock, 1941: 328; S. L. de la Torre, 1952: 64.

Anæa echemus: Gundlach, 1881: 31; Johnson & Comstock, 1941: 328; S. L. de la Torre, 1952: 64.

Anæa verticordia echemus: Bates, 1935: 185.

Illustrations.—Bates, 1935: f. 13, (venation); Johnson & Comstock, 1941: pl. XI, f. 42, 43, (genital), pl. XII, Map 3; S. L. de la Torre, 1951c: f. 2, p. 337.

132. ANÆA ECHEMUS f. AGUAYOI S. L. Torre

Anaea echemus f. *aguayoi* S. L. de la Torre, 1951c: 336; id., 1952: 64.

This form was described by the writer in 1951 (See Proc. Ent. Soc. Washington, vol. 53, p. 336).

Illustration.—S. L. de la Torre, 1951c: f. 1, p. 337.

Family Libytheidæ

Subfamily Libytheinæ

Genus *Libytheana* Michener

Libytheana Michener, 1943: 1.

Genotype: *Libythea bachmanii* Kirtland, 1852.

New genus created by Dr. C. D. Michener in 1943 for the American species of the family *Libytheidæ,* which heretofore had been placed, together with the species of the Old World, into the genus *Libythea* Fabricius, 1807 (See American Museum Novitates, No. 1232).

133. LIBYTHEANA MOTYA (Hübner)

Hecaerge motya Hübner, 1823.

Libythea terena: Gundlach, 1881: 70.

Libythea carinenta motya: Bates, 1935: 186; S. L. de la Torre, 1946: 106.

Libythea motya: Field, 1938b: 130.

Libytheana motya: Michener, 1943b: 1; Comstock, 1944: 483; S. L. de la Torre, 1949c: 179.

Illustrations.—Bates, 1935: f. 14, (venation); S. L. de la Torre, 1946: pl. 10, f. 63-67, (scales).

134. libytheana bachmanii bachmanii (Kirtland)

Libythea bachmanii: Clark, 1932: 128; Garth, 1950: 29.

Libythea carinenta bachmani: M. Sánchez Roig & G. S. Villalba, 1934: 110; id., 1934b: 33.

Libythea bachmani: Fazzini, 1934: 36.

Hypatus bachmanii: J. H. Comstock & A. B. Comstock, 1936: 210.

Libythea bachmanii bachmanii: Field, 1938: 124; id., 1938b: 131.

Libythea bachmanni: Holland, 1942: 210.

Libytheana bachmanii: Michener, 1943b: 1; Comstock, 1944: 482.

Libytheana bachmanii bachmanii: Breland, 1948: 128; S. L. de la Torre, 1949: 65; id., 1949c: 179.

This species was captured in June, 1933 by Dr. M. Sánchez Roig and G. S. Villalba in "La Lisa", Havana prov. (See Mem. Soc. Cub. Hist. Nat., vol. VIII, p. 110).

Illustrations.—Clark, 1932: pl. 6, f. 2, 3; Fazzini, 1934: p. 26, fig. not numbered; M. Sánchez Roig & Villalba, 1934b: f. 4; J. H. Comstock & A. B. Comstock, 1936: text fig. 38; Holland, 1942: pl. V, f. 23, 24, (chrysalis), pl. XXVIII, f. 1, 2; Michener, 1943b: f. 4-6, (chrysalis).

Family Riodinidæ

Subfamily Riodininæ

Genus Apodemia Felder & Felder

Apodemia Felder & Felder, 1865.

Genotype: *Lemonias mormo* Felder & Felder, 1859.

135. apodemia carteri ramsdeni (Skinner)

Mesosemia remsdeni Skinner, 1912.

Apodemia carteri ramsdeni: Bates, 1935: 187.

Illustration. — Comstock, 1944: text fig. 12, (venation).

Family LYCÆNIDÆ

Subfamily THECLINÆ

Genus EUMÆUS Hübner

Eumæus Hübner, 1819.
Eumenia Godart, 1824.
Genotype: *Rusticus Adolescens minijas* Hübner, 1809.

136. EUMÆUS ATALA ATALA (Poey)

Eumenia atala Poey, 1832.
Eumaeus atala: Gundlach, 1881: 80; Holland, 1916: 494; Showalter, 1927: 111; Bates, 1935: 189; Dethier, 1941: 75; Bruner, Scaramuzza & Otero, 1945: 63, 111, 188.
Eumæus atala atala: Comstock & Huntington, 1943: 59.
Illustrations.—Poey: 3 figs. not numbered; Showalter, 1927: pl. 7, f. 2; Dethier, 1941: pl. V, f. 4, (head of larva), pl. VI, f. 9, 10, (Clypeus of larva); Bruner, Scaramuzza & Otero, 1945: pl. VI, f. 6, (larva), pl. VIII, f. 1.

Genus *Thecla* Fabricius

Thecla Fabricius, 1807.
Genotype: *Papilio betulæ* Linnæus, 1758.

The species *Thecla favonius* (=*Strymon favonius*), included by Bates (1935: 193) and by Holland (1916: 495), and *Thecla tollus* (=Strymon *tollus*) noted by Bates on page 237 as doubtful, are not found in Cuba.

137. THECLA CŒLEBS Herrich-Schäffer

Thecla cœlebs Herrich-Schäffer, 1862; Gundlach, 1881: 74; Comstock & Huntington, 1943: 61; Comstock, 1944: 485; S. L. de la Torre, 1949c: 187.
Strymon cœlebs: Bates, 1935: 192; Bruner, Scaramuzza & Otero, 1945: 176.
Strymon tollus: Bates, 1935: 237.

138. THECLA MARTIALIS Herrich-Schäffer

Thecla martialis Herrich-Schäffer, 1864; Gundlach, 1881: 76: Holland, 1916: 495; id., 1942: 236; Showalter, 1927: 111; Comstock &

Huntington, 1943: 68; Avinoff & Shoumatoff, 1946: 285; S. L. de la Torre, 1949c: 187.

Strymon martialis: Bates, 1935: 192.

Illustration.—Showalter, 1927: pl. VII, f. 11.

139. thecla acis casasi Comstock & Huntington

Thecla acis casasi Comstock & Huntington, 1943: 66; S. L. de la Torre, 1949c: 187.

Strymon acis: Bates, 1935: 192.

This subspecies was described by Comstock and Huntington in 1943 (See Ann. N. Y. Acad. Sci., vol. XLV, p. 66).

Illustration.—Comstock & Huntington, 1943: pl. I, f. 1.

140. thecla simæthis simæthis (Drury)

Papilio simæthis Drury, 1770.

Thecla simæthis: Gundlach, 1881: 79; Hoffman, 1940c: 716; Holland, 1942: 232.

Strymon simæthis: Bates, 1935: 193; Hall, 1936: 277.

Thecla simæthis simæthis: Berger, 1939: 202; Comstock & Huntington, 1943: 73; Comstock, 1944: 488; Beatty, 1944: 157; S. L. de la Torre, 1949c: 187.

Illustrations.—Comstock & Huntington, 1943: pl. I, f. 6; Comstock, 1944: pl. 9, f. 12.

141. thecla mæsites mæsites Herrich-Schäffer

Thecla mæsites Herrich-Schäffer, 1864; Gundlach, 1881: 80.

Strymon mæsites: Bates, 1935: 194; Clench, 1941: 1.

Thecla mæsites mæsites: Comstock & Huntington, 1943: 72; Comstock, 1944: 487; S. L. de la Torre, 1949c: 187.

Illustration.—Comstock, 1944: pl. 9, f. 6.

142. thecla celida celida Lucas

Thecla celida Lucas, 1857; Gundlach, 1881: 79.

Strymon celida: Bates, 1935: 194.

Thecla celida celida: Comstock & Huntington, 1943: 75; Comstock, 1944: 489; S. L. de la Torre, 1949c: 187.

143. thecla columella cybira Hewitson

Thecla cybira Hewitson, 1874; Gundlach, 1881: 77.

Thecla columella: Holland, 1916: 495.
Strymon columella: Bates, 1935: 194 (in part).
Thecla columella cybira: Comstock & Huntington, 1943: 81; Avinoff & Shoumatoff, 1946: 285; S. L. de la Torre, 1949c: 187.
Illustrations.—Bates, 1935: f. 15, (venation); Comstock & Huntington, 1943: pl. I, f. 15.

144. THECLA LIMENIA Hewitson

Thecla limenia Hewitson, 1868; Gundlach, 1881: 77; Comstock & Huntington, 1943: 86; Comstock, 1944: 491; Avinoff & Shoumatoff, 1946:285; S. L. de la Torre, 1949: 65; id. 1949c: 187.
Strymon columella: Bates, 1935: 194 (in part).
Illustration.—Comstock, 1944: pl. 9, f. 8.

145. THECLA ANGELIA ANGELIA Hewitson

Thecla angelia Hewitson, 1874; Gundlach, 1881: 78.
Strymon angelia: Bates, 1935: 195.
Strymon favonius: Bates, 1935: 193.
Thecla angelia angelia: Comstock & Huntington, 1943: 68; Comstock, 1944: 487; S. L. de la Torre, 1949c: 187.

146. THECLA BAZOCHII GUNDLACHIANUS (Bates)

Strymon gundlachianus Bates, 1935: 195.
Thecla sp.: Gundlach, 1881: 441.
Thecla bazochii gundlachianus: Comstock & Huntington, 1943: 89; S. L. de la Torre, 1949c: 187.

Subfamily *Plebejinæ*

Genus *Hemiargus* Hübner

Hemiargus Hübner, 1818.
Genotype: *Hemiargus antibubastus* Hübner, 1818 (=*Hemiargus hanno antibubastus* Hübner).

147. HEMIARGUS HANNO FILENUS (Poey)

Polyommatus filenus Poey, 1832.
Cupido hanno: Gundlach, 1881: 71.
Lycaena hanno: Holland, 1916: 495.
Hemiargus filenus: Bates, 1935: 196: Dethier, 1940: 24.

Hemiargus hanno filenus: Comstock & Huntington, 1943: 108; Comstock, 1944: 498.

Illustrations.—Poey, 1832: 3 figs. not numbered; Bates, 1935: f. 16, (venation).

148. HEMIARGUS AMMON AMMON (Lucas)

Lycaena ammon Lucas, 1857; Holland, 1916: 495.

Cupido ammon: Gudlach, 1881: 72.

Hemiargus ammon: Bates, 1935: 197; Clench, 1941b: 407; Bruner, Scaramuzza & Otero, 1945: 24.

Hemiargus ammon ammon: Comstock & Huntington, 1943: 95; Comstock, 1944: 495.

Illustration.—Comstock & Huntington, 1943: pl. 1, f. 22.

Genus *Brephidium* Scudder

Brephidium Scudder, 1876.

Genotype: *Lycæna exilis* Boisduval, 1852.

149. BREPHIDIUM EXILIS ISOPHTHALMA (Herrich-Schäffer)

Lycæna isophthalma Herrich-Schäffer, 1862.

Cupido isophthalma: Gundlach, 1881: 74.

Brephidium isophthalma: Bates, 1935: 198; Avinoff & Shoumatoff, 1946: 287

Brephidium exilis isophthalma: Comstock & Huntington, 1943: 110.

Genus *Leptotes* Scudder

Leptotes Scudder, 1876.

Genotype: *Lycæna theonus* Lucas, 1857.

150. LEPTOTES CASSIUS THEONUS (Lucas)

Lycæna theonus Lucas, 1857; Holland, 1916: 495.

Cupido cassius: Gundlach, 1881: 73.

Leptotes cassius: Bruner, 1935: 41.

Leptotes theonus: Bates, 1935: 198; Bruner, Scaramuzza & Otero, 1945: 93, 135.

Lycaena theona: Holland, 1942: 272.

Leptotus cassius theonus: Clench, 1942: 244; Comstock & Huntington, 1943: 92; Comstock, 1944: 493; Avinoff & Shoumatoff, 1946:286.

Illustrations.—Bruner, 1935: pl. 2, f. 6; Comstock & Huntington, 1943: pl. 1, f. 26, 27; Comstock, 1944; text fig. 15, (venation), pl. 9, f. 16.

Superfamily HESPERIOIDEA

Family Hesperiidæ

Subfamily Pyrginæ

Genus *Phocides* Hübner

Phocides Hübner, 1819: 103.
Erycides Hübner, 1819: 110.
Dysenius Scudder, 1872: 67.
Genotype: *Phocides cruentus* Hübner, 1819 (=*Papilio palemon* Cramer, 1777; homonym of *Papilio palaemon* Pallas, 1771).

151. phocides batabano batabano (Lucas)

Eudamus batabano Lucas, 1857.
Erycides batabano: Gundlach, 1881: 171.
Phocides batabano: Holland, 1916: 501; id., 1942: 327; Sinner & Ramsden, 1923: 308.
Phocides batabano batabano: Bates, 1935: 202.
Illustrations.—Holland, 1942: text fig. 163, (neuration), pl. XLIX, f. 1.

Genus *Chioides* Lindsey

Chioides Lindsey, 1921.
Genotype: *Eudamus albofasciatus* Hewitson, 1867.

152. chioides marmorosa (Herrich-Schäffer)

Goniurus marmorosa Herrich-Schäffer, 1865; Gundlach, 1881: 171; Bates, 1935: 203.
Eudamus marmorosa: Skinner & Ramsden, 1923: 308.
Chioides marmorosa: S. L. de la Torre, 1949c: 182.

Genus *Urbanus* Hübner

Urbanus Hübner, 1807.
Goniurus Hübner, 1819.
Eudamus Swainson, 1831.
Genotype: *Papilio proteus* Linnæus, 1758.

153. urbanus dorantes santiago (Lucas)

Eudamus santiago Lucas, 1857; Holland, 1916: 500; Skinner & Ramsden, 1923: 308.

Goniurus santiago: Gundlach, 1881: 170.

Goniurus dorantes santiago: Bates, 1935: 204.

Goniurus dorantes: Dethier, 1942: 4.

Urbanus dorantes santiago: Comstock, 1944: 547: S. L. de la Torre, 1949c: 181.

Illustration.—Holland, 1916: pl. 31, f. 6.

154. urbanus proteus (Linnæus)

Papilio proteus Linnæus, 1758.

Goniurus proteus: Gundlach, 1881: 169; Showalter, 1927: 113; Clark, 1932: 252; Fazzini, 1934: 59; Bates, 1935: 204; Bruner, 1935: 40; d'Almeida, 1944c: 50.

Eudamus proteus: Holland, 1916: 500; id., 1942: 331; Skinner & Ramsden, 1923: 308; J. H. Comstock & A. B. Comstock, 1936: 292.

Goniurus (Eudamus) proteus: Hoffmann, 1933: 242.

Urbanus proteus proteides: Hall, 1936: 277.

Eudamus proteus proteus: Berger, 1939: 203.

Urbanus proteus proteus: Schweizer & Webster Kay, 1941: 20.

Urbanus proteus: Hoffmann, 1941: 242; Comstock, 1944: 545; Beatty, 1944: 158; Bruner, Scaramuzza & Otero, 1945: 132, 136; Bell, 1946: 78; J. A. Ramos, 1946: 54; Avinoff & Shoumatoff, 1946: 287; S. L. de la Torre, 1949c: 181; Miles Moss, 1949: 40; Munroe, 1951: 55.

Illustrations.—Showalter, 1927: pl. 8, f. 10; Clark, 1932: pl. 50, f. 1, 2; Fazzini, 1934: p. 59, fig. not numbered; Bruner, 1935: pl. 2, f. 8; J. H. Comstock & A. B. Comstock, 1936: pl. XLIV, f. 1; Holland, 1942: pl. II, f. 34, pl. VI, f. 23, pl. XLV, f. 6; d'Almeida, 1944c: pl. 3, f. 4, (larva); Miles Moss, 1949: pl. III, f. 12, (larva).

Genus *Proteides* Hübner

Proteides Hübner, 1819: 104.

Epargyreus Hübner, 1819: 105.

Dicranaspis Mabille, 1872.

Genotype: *Papilio mercurius* Fabricius, 1787.

155. PROTEIDES (EPARGYREUS) EXADEUS MAYSI (Lucas)

Eudamus maysi Lucas, 1857.
Goniloba maysi: Gundlach, 1881: 156.
Epargyreus maysi: Holland, 1916: 501; Skinner & Ramsden, 1923: 309.
Proteides exadeus maysi: Bates, 1935: 205.
Proteides exadeus: Bell, 1946: 88.
Proteides (Epargyreus) exadeus maysi: S. L. de la Torre, 1952: 65.

Mr. Bell does not consider *maysi* a subspecies of *exadeus* and thinks that *maysi* and *exadeus* should be studied separately.

Illustrations.—Holland, 1916: pl. 31, f. 11, 12.

156. PROTEIDES (PROTEIDES) MERCURIUS SANANTONIO (Lucas)

Eudamus sanantonio Lucas, 1857.
Goniloba san antonio: Gundlach, 1881: 156.
Proteides idas var. *san antonio*: Holland, 1916: 502.
Proteides san-antonio: Skinner & Ramsden, 1923: 309.
Proteides mercurius sanantonio: Bates, 1935: 206; Comstock, 1944: 544; Bell & Comstock, 1948: 3.
Proteides (Proteides) mercurius sanantonio: S. L. de la Torre, 1952: 65.
Illustrations.—Holland, 1916: pl. 31, f. 1, 2.

Genus *Aguna* Williams

Aguna Williams, 1927.
Genotype: *Eudamus camagura* Williams, 1926.

157. AGUNA ASANDER (Hewitson)

Eudamus asander Hewitson, 1867.
Epargyreus asander: Holland, 1916: 502; Skinner & Ramsden, 1923: 309.
Proteides asander: Bates, 1935: 206; Avinoff & Shoumatoff, 1946: 288.
Aguna asander: Hoffmann, 1941: 244; Bell, 1946: 83; Freeman, 1949: 41; S. L. de la Torre, 1952: 65.

Genus *Polygonus* Hübner

Polygonus Hübner, 1825.
Acolastus Scudder, 1872; preoccupied in Coleoptera.

Nennius Kirby, 1902.
Genotype: *Polygonus lividus* Hübner, 1825.

158. polygonus lividus savigny (Latreille)

Hesperia savigny Latreille, 1822.
Goniloba amyntas: Gundlach, 1881: 159; id., 1891: 458.
Nennius amyntas: Holland, 1916: 502; Skinner & Ramsden, 1923: 309.
Acolastus amyntas: Riley, 1926: 233; Hall, 1936: 278.
Polygonus lividus: Bates, 1935: 207; Dethier, 1942: 5; Beatty, 1944: 158; Bell, 1946: 89; Bell & Comstock, 1948: 5.
Polygonus amyntas: Holland, 1942: 328; Avinoff & Shoumatoff, 1946: 289.
Polygonus lividus savigny: Comstock, 1944: 542.
Illustrations.—Bates, 1935: f. 17a, (antenna), f. 18, (venation); Holland, 1942: text fig. 165, (neuration), pl. XLIX, f. 5; Bell & Comstock, 1948: f. 2, (genital).

Genus *Astraptes* Hübner

Astraptes Hübner, 1819: 103.
Telegonus Hübner, 1819: 104.
Creteus Westwood, 1852.
Euthymele Mabille, 1878.
Genotype: *Papilio narcosius* Stoll, 1791 (=*Papilio aulestes* Cramer, 1780; homonym of *Papilio aulestes* Cramer, 1777).

159. astraptes talus (Cramer)

Papilio talus Cramer, 1779.
Goniloba talus: Gundlach, 1881: 158.
Goniurus talus: Skinner & Ramsden, 1923: 309.
Telegonus talus: Bates, 1935: 208; Bruner, Scaramuzza & Otero, 1945: 27, 85, 177.
Astraptes talus: Hoffmann, 1941: 246; Comstock, 1944: 549; Bell, 1946: 85; S. L. de la Torre, 1952: 67.

160. astraptes anaphus anausis (Godman & Salvin)

Telegonus auausis Godman & Salvin, 1896; Avinoff & Shoumatoff, 1941: 317.
Telegonus alpistus cubana: Skinner & Ramsden, 1923: 310.

Telegonus anaphus race *cubana*: Williams & Bell, 1934: 19.
Telegonus anaphus cubanus: Bates, 1935: 210.
Astraptes anaphus anausis: Berger, 1939: 205; Comstock, 1944: 548; S. L. de la Torre, 1952: 67.
Telegonus roysi Avinoff & Shoumatoff, 1941: 316.

161. ASTRAPTES CRETELLUS (Herrich-Schäffer)

Eudamus cretellus Herrich-Schäffer, 1869.
Aethilla jariba Butler, 1870.
Goniloba cassander: Gundlach, 1881: 155.
Telegonus geronæ Holland, 1916: 503.
Telegonus jariba: Skinner & Ramsden, 1923: 311; Williams & Bell, 1933: 71.
Telegonus jariba jariba: Bates, 1935: 210.
Telegonus cretellus: Williams & Bell, 1934: 22.
Astraptes cretellus: S. L. de la Torre, 1952: 67.
Illustration.—Williams & Bell, 1934: pl. I, f. 10, (genital).

162. ASTRAPTES XAGUA (Lucas)

Eudamus xagua Lucas, 1857.
Goniloba jagua: Gundlach, 1881: 157.
Telegonus xagua: Skinner & Ramsden, 1923: 310; Bates, 1935: 211.
Astraptes xagua: S. L. de la Torre, 1952: 67.

163. ASTRAPTES HABANA HABANA (Lucas)

Eudamus habana Lucas, 1857.
Goniloba habana: Gundlach, 1881: 158; id., 1891: 457.
Telegonus habana: Holland, 1916: 503; Skinner & Ramsden, 1923: 310; Williams & Bell, 1933: 79.
Telegonus alardus habana: Bates, 1935: 211; Bruner, Scaramuzza & Otero, 1945: 72.
Astraptes habana habana: S. L. de la Torre, 1952: 67.

Mr. E. Bell annotates the following distribution for *Astraptes alardus*: Mexico, Central America, South America to Argentina, not pointing the Antilles.

Illustration.—Bates, 1935: f. 19, (venation).

Genus *Cabares* Godman & Salvin

Cabares Godman & Salvin, 1894.
Genotype: *Thanaos potrillo* Lucas, 1857.

164. CABARES POTRILLO POTRILLO (Lucas)

Thanaos potrillo Lucas, 1857.
Nisoniades potrerillo: Gundlach, 1881: 141; id., 1891: 456.
Cabares potrillo: Skinner & Ramsden, 1923: 313; Dethier, 1940: 24; Hoffmann, 1941: 251; Holland, 1942: 338; Bell, 1946: 95; Avinoff & Shoumatoff, 1946: 291.
Cabares potrillo potrillo: Bates, 1935: 212.
Illustrations.—Dethier, 1940: pl. III, f. 7, 8, (micropyle rosette of egg).

Genus *Echelatus* Godman & Salvin

Echelatus Godman & Salvin, 1894.
Genotype: *Anastrus varius* Mabille, 1883.

165. ECHELATUS SEMPITERNUS DILLONI Bell & Comstock

Echelatus sempiternus dilloni Bell & Comstock, 1948: 8; S. L. de la Torre, 1950: 72; id., 1952: 63.
Pellicia simplicior Möschler, 1876 (female).
Echelatus simplicior: Avinoff & Shoumatoff, 1946: 290.

Möschler, in his description of *simplicior*, stated that his type material was a male from Paramaribo, Dutch Guiana, and a female from Cuba. As he did not designate either as the type, Bell and Comstock (1948: 9) select the male from Paramaribo as the lectotype of *simplicior*, and suppose that the female, which Möschler possessed, from Cuba apparently belongs to the Antillean subspecies, *dilloni*.
Illustrations.—Bell & Comstock, 1948: f. 3, 4, 6, 7, (genital).

Genus *Achlyodes* Hübner

Achlyodes Hübner. 1819.
Eantis Boisduval, 1836.
Sebaldia Mabille, 1903.
Genotype: *Papilio busirus* Cramer, 1779.

166. ACHLYODES PAPINIANUS PAPINIANUS (Poey)

Hesperia papinianus Poey, 1832.
Achlyodes papinianus: Gundlach, 1881: 145; id., 1891: 457.
Eantis papinianus: Skinner & Ramsden, 1923: 314.
Achlyodes thraso papinianus: Bates, 1935: 212; Bruner, Scaramuzza & Otero, 1945: 50, 188.
Achlyodes papinianus papinianus: Comstock, 1944: 554; Bell & Comstock, 1948: 9.
Achlyodes thraso: Avinoff & Shoumatoff, 1946: 291.

Mr. Bell annotates the following distribution for *Achlyodes thraso*: Texas and Mexico in North America, Central America, and in South America from Venezuela to Brazil; not mentioning the Antilles (See "A Catalogue of the Hesperioidea of Venezuela": 1946: 119).

Illustrations.—Poey, 1832: 7 figs. not numbered; Bates, 1935: f. 17b, (antenna), f. 20, (venation); Holland, 1942: text fig. 175, (neuration of *Eantis thraso*); Comstock, 1944: pl. 2, f. 2, (genital of *A. thraso*).

Genus *Ephyriades* Hübner

Ephyriades Hübner, 1819.
Oileides Hübner, 1825.
Brachycoryne Mabille, 1883.
Melanthes Mabille, 1904.
Genotype: *Papilio arcas* Drury, 1770 (=*Papilio otreus* Cramer, 1780).

167. EPHYRIADES BRUNNEA BRUNNEA (Herrich-Schäffer)

Nisoniades brunnea Herrich-Schäffer, 1864; Gundlach, 1881: 142.
Melanthes otreus var. *brunnea*: Holland, 1916: 504.
Ephyriades otreus: Skinner & Ramsden, 1923: 312.
Ephyriades zephodes zephodes: Bates, 1935: 215; Bruner, Scaramuzza & Otero, 1945: 105.
Melanthes brunnea: Holland, 1942: 348.
Ephyriades brunnea: Comstock, 1944: 556.
Ephyriades brunnea brunnea: Bell & Comstock, 1948: 17; S. L. de la Torre, 1949c: 183.

Illustrations.—Holland, 1916: pl. 31, f. 3-5, Comstock, 1944: pl. 4, f. 1, 2, (genital).

168. EPHYRIADES ARCAS ARCAS (Drury)

Papilio arcas Drury, 1773.
Antigonus arcas: Gundlach, 1881: 147.
Brachycorene arcas: Holland, 1916: 506.
Brachycoryne arcas: Skinner & Ramsden, 1923: 312.
Ephyriades arcas: Bates, 1935: 215; Comstock, 1944: 554; Beatty, 1944: 158; Bruner, Scaramuzza & Otero, 1945: 70; Bell, 1946: 132; J. A. Ramos, 1946: 54; Bell & Comstock, 1948: 17.

The subspecies that inhabits Jamaica is *Ephyriades arcas jamaicensis* Moeschler, according to Avinoff and Shoumatoff (See Ann. Carnegie Museum, vol. XXX, p. 290).

Illustrations.—Comstock, 1944: pl. 3, f. 1, 2, (genital), pl. 11, f. 6.

169. EPHYRIADES CUBENSIS Skinner

Ephyriades cubensis Skinner, 1913; Skinner & Ramsden, 1923: 312; Bates, 1935: 216.

Genus *Burca* Bell & Comstock

Burca Bell & Comstock, 1948: 10.
Genotype: *Nisoniades concolor* Herrich-Schäffer, 1864.

This genus was established by Bell and Comstock in 1948 (See Am. Mus. Novitates, No. 1379, p. 10).

170. BURCA CONCOLOR (Herrich-Schäffer)

Nisoniades concolor Herrich-Schäffer, 1864; Gundlach, 1881: 144.
Bolla concolor: Skinner & Ramsden, 1923: 313.
Pholisora concolor: Bates, 1935: 216; Bruner, Scaramuzza & Otero, 1945: 93.
Burca concolor: Bell & Comstock, 1948: 10; S. L. de la Torre, 1949c: 182.
Illustration.—Bell & Comstock, 1948: f. 13, (genital).

171. BURCA BRACO (Herrich-Schäffer)

Nisoniades braco Herrich-Schäffer, 1864; Gundlach, 1881: 141.
Bolla braco: Skinner & Ramsden, 1923: 314.
Pholisora braco: Bates, 1935: 216; Bell, 1946: 185.
Burca braco: Bell & Comstock, 1948: 10; S. L. de la Torre, 1949c: 182.
Illustration.—Bell & Comstock, 1948: f. 11, (genital).

Genus *Chiomara* Godman & Salvin

Chiomara Godman & Salvin, 1899.
Genotype: *Achlyodes mithrax* Möschler, 1878.

172. CHIOMARA MITHRAX (Möschler)

Achlyodes mithrax Möschler, 1878.
Cyclogypha gundlachi Skinner & Ramsden, 1923: 314.
Chiomara mithrax: Bates, 1935: 217; Hoffmann, 1941: 264; Bell, 1946: 131; Miles Moss, 1949: 67.
Illustrations.—Miles Moss, 1949: pl. V, f. 11, (head of larva), f. 14, (larva).

Genus *Erynnis* Schrank

Erynnis Schrank, 1801.
Thymele Fabricius, 1807.
Thymale Oken, 1815.
Astycus Hübner, 1822.
Thanaos Boisduval, 1834.
Genotype: *Papilio tages* Linnaeus, 1758.

173. ERYNNIS GESTA (Herrich-Schäffer)

Thanaos gesta Herrich-Schäffer, 1863; Holland, 1942: 349.
Nisoniades gesta: Gundlach, 1881: 145; id., 1891: 456.
Chiomara gesta: Skinner & Ramsden, 1923: 315; Avinoff & Shoumatoff, 1946: 291; Miles Moss, 1949: 67.
Erynnis gesta: Bates, 1935: 218; Hoffmann, 1941: 264; Bruner, Scaramuzza & Otero, 1945: 93; Bell, 1946: 133.
Erynnis gesta gesta: Schweizer & Webster, 1941: 22.
Illustration.—Holland, 1942: pl. LI, f. 1, 2.

174. ERYNNIS ZARUCCO (Lucas)

Thanaos zarucco Lucas, 1857; Skinner & Ramsden, 1923: 314.
Nisoniades jaruco: Gundlach, 1881: 143.
Erynnis zarucco: Bates, 1935: 218; Comstock, 1944: 556.
Illustration.—Bates, 1935: f. 21, (venation).

Genus *Pyrgus* Hübner

Pyrgus Hübner, 1819.
Syrichtus Boisduval, 1834.

Scelotrix Rambur, 1858.

Genotype: *Papilio malvae* Linnaeus, 1758 (=*Papilio alveolus* Hbn., 1802).

175. PYRGUS SYRICHTUS (Fabricius)

Papilio syrichtus Fabricius, 1775.

Pyrgus syrichtus: Gundlach, 1881: 139; Williams & Bell, 1930: 135; Hoffmann, 1933: 244; id., 1936: 262; id., 1941: 260; Bates, 1935: 220; Hall, 1936: 278; Dethier, 1940: 24; id., 1942: 6; Comstock, 1944: 550; Beatty, 1944: 158; J. A. Ramos, 1946: 54; Avinoff & Shoumatoff, 1946: 291; Miles Moss, 1949: 68.

Hesperia syrichtus Holland, 1916: 506; id., 1942: 341; Skinner & Ramsden, 1923: 315.

Hesperia syrichtus syrichtus: Berger, 1939: 205.

Illustrations.—Williams & Bell, 1930: pl. VIII, f. 1, (genital), f. 2, (costal portion of hindwing); Dethier, 1940: pl. III, f. 4, (branched hair); Holland, 1942: pl. L, f. 16, 17; Comstock, 1944: pl. 12, f. 4; Miles Moss, 1949: pl. V, f. 12, (larva).

176. PYRGUS CRISIA CRISIA Herrich-Schäffer

Pyrgus crisia Herrich-Schäffer, 1864; Gundlach, 1881: 140; Bates, 1935: 220.

Hesperia crisia: Skinner & Ramsden, 1923: 315.

Pyrgus crisia crisia: Comstock, 1944: 551.

Subfamily HESPERIINÆ

Genus *Ancyloxypha* Felder

Ancyloxypha Felder, 1862.

Genotype: *Hesperia numitor* Fabricius, 1793.

177. ANCYLOXYPHA NANUS (Herrich-Schäffer)

Thymelicus nanus Herrich-Schäffer, 1865; Gundlach, 1881: 148.

Ancyloxypha nanus: Holland, 1916: 506; Skinner & Ramsden, 1923: 316; Bates, 1935: 220.

Genus *Thymelicus* Hübner

Thymelicus Hübner, 1819.

Adopæa Billberg, 1820.

Thymelinus Stephens, 1835.

Pelion Kirby, 1858.
Genotype: *Papilio acteon* Rottemberg, 1775.

178. THYMELICUS MAGDALIA (Herrich-Schäffer)

Pamphila magdalia Herrich-Schäffer, 1863; Gundlach, 1881: 153.
Adopaea magdalia: Skinner & Ramsden, 1923: 316; Bates, 1935: 221.
Thymelicus magdalia: S. L. de la Torre, 1949c: 188.

Genus *Hylephila* Billberg

Hylephila Billberg, 1820.
Euthymus Scudder, 1872; preoccupied in Hymenoptera.
Genotype: *Papilio phyleus* Drury, 1770.

179. HYLEPHILA PHYLEUS (Drury)

Papilio phyleus Drury, 1770.
Pamphila philæus: Gundlach, 1881: 150 and XIX (Fe de errata).
Hylephila phylæus: Holland, 1916: 507; id., 1942: 377; Skinner & Ramsden, 1923: 316; Clark, 1932: 220; Hall, 1936: 278; Field, 1938b: 247; Hoffmann, 1941: 267; Schweizer & Webster, 1941: 22; Dethier, 1942b: 167; Bell, 1946: 137; Garth, 1950: 41.
Hylephila phyleus: Bates, 1935: 221; Comstock, 1944: 557; Avinoff & Shoumatoff, 1946: 292; Miles Moss, 1949: 69; Munroe, 1951: 55.
Hylephila phylæus phylæus: Berger, 1939: 206.
Illustrations.—Clark, 1932: pl. 53, f. 13, 14; Holland, 1942: pl. VI, f. 39, (chrysalis), pl. XLVI, f. 18, 19, pl. XLVII, f. 40; Comstock, 1944: pl. II, f. 9.

Genus *Atalopedes* Scudder

Atalopedes Scudder, 1872: 78.
Pansydia Scudder, 1872: 81.
Genotype: *Hesperia campestris* Boisduval, 1852 (=*Hesperia huron* Edwards, 1863).

180. ATALOPEDES MESOGRAMMA MESOGRAMMA (Godart)

Hesperia mesogramma Godart, 1822 (See Brown, 1941: 131); Poey, 1832.
Pamphila alameda: Gundlach, 1881: 148.
Atalopedes cunaxa: Holland, 1916: 507.

Atalopedes mesogramma: Skinner & Ramsden, 1923: 316; Riley, 1926: 239; Bates, 1935: 222.

Atalopedes mesogramma mesogramma: Comstock, 1944: 560; Bell & Comstock, 1948: 21.

Illustrations.—Poey, 1832: 3 figs. not numbered; Holland, 1916: pl. 31, f. 14; Bates, 1935: f. 17c, (antenna), f. 22, (venation).

Genus *Polites* Scudder

Polites Scudder, 1872: 78.

Hedone Scudder, 1872: 79.

Limochores Scudder, 1872: 80.

Pyrrhosidia Scudder, 1874.

Genotype: *Hesperia peckius* Kirby, 1837.

181. POLITES BARACOA (Lucas)

Hesperia baracoa Lucas, 1857.

Pamphila baracoa: Gundlach, 1881: 152.

Limochores baracoa: Holland, 1916: 507.

Polites baracoa: Skinner & Ramsden, 1923: 316; Bates, 1935: 224; Holland, 1942: 381; Dethier, 1942b: 167.

Illustration.—Holland, 1916: pl. 31, f. 15.

Genus *Wallengrenia* Berg

Wallengrenia Berg, 1897.

Catia Godman, 1900.

Genotype: *Hesperia premnas* Wallengren, 1860.

182. WALLENGRENIA OTHO MISERA (Lucas)

Hesperia misera Lucas, 1857.

Pamphila misera: Gundlach, 1881: 153.

Catia misera: Holland, 1916: 507; Skinner & Ramsden, 1923: 317; Bates, 1935: 224; Dethier, 1942b: 167.

Wallengrenia otho misera: Watson, 1937: 3; Comstock, 1944: 562; S. L. de la Torre, 1949c: 189.

Genus *Atrytone* Scudder

Atrytone Scudder, 1872: 77.

Euphyes Scudder, 1872: 80.

Paratrytone Godman & Salvin, 1900.

Anatrytone Dyar, 1905.
Genotype: *Hesperia arogos* Boisduval & Leconte, 1833 (=*Hesperia iowa* Scudder, 1872).

183. ATRYTONE SINGULARIS SINGULARIS (Herrich-Schäffer)

Goniloba singularis Herrich-Schäffer, 1865; Gundlach, 1881: 168; Skinner & Ramsden, 1923: 318; Bates, 1935: 238.
Atrytone singularis: Bell, 1947b: 2.
Atrytone singularis singularis: S. L. de la Torre, 1949: 65; id., 1949c: 180.

Bates cites this species as doubtful, but Mr. Pastor Alayo collected many specimens in Oriente province.

Illustration.—Bell, 1947: f. 1, (genital).

184. ATRYTONE CORNELIUS (Godart)

Hesperia cornelius Godart, 1822 (See Brown, 1941: 131).
Goniloba cornelius: Gundlach, 1881: 167.
Amblyscirtes insulæ-pinorum Holland, 1916: 508.
Lerema cornelius: Skinner & Ramsden, 1923: 317; Bates, 1935: 226; Dethier, 1942b: 167; id., 1942c: 177, 178.
Euphyes cornelius: Riley, 1926: 238.
Atrytone cornelius: S. L. de la Torre, 1949c: 181.
Illustrations.—Holland, 1916: pl. 31, f. 7, 8; Dethier, 1942c: pl. 27, f. 1-3, (head of larva).

Genus *Choranthus* Scudder

Choranthus Scudder, 1872.
Genotype: *Hesperia radians* Lucas, 1857.

185. CHORANTHUS RADIANS (Lucas)

Hesperia radians Lucas, 1857.
Pamphila radians: Gundlach, 1881: 151.
Choranthus radians: Skinner & Ramsden, 1923: 319; Holland, 1942: 370; Comstock, 1944: 565; S. L. de la Torre, 1949c: 182.
Poanes radians: Bates, 1935: 225; Dethier, 1942b: 167.
Illustration.—Holland, 1942: pl. LI, f. 47.

186. CHORANTHUS RADIANS F. AMMONIA (Plötz)

Hesperia ammonia Plötz, 1883.

Choranthus radians f. *ammonia*: Comstock, 1944: 565; S. L. de la Torre, 1949c: 182.

Choranthus radians ammonia: S. L. de la Torre, 1949: 65.

Mr. Pastor Alayo captured several specimens of *ammonia* form in Rancho Mundito, Pinar del Rio province, in June, 1947, which were identified by Mr. Ernest L. Bell.

Genus *Calpodes* Hübner

Calpodes Hübner, 1819.

Genotype: *Papilio ethlius* Stoll, 1784.

187. CALPODES ETHLIUS (Stoll)

Papilio ethlius Stoll, 1784 (See Brown, 1941: 130).

Goniloba ethlius: Gundlach, 1881: 160; id., 1891: 457.

Calpodes ethlius: Skinner & Ramsden, 1923: 319; Showalter, 1927: 113; Clark, 1932: 233; Fazzini, 1934: 58; Bates, 1935: 228; J. H. Comstock & A. B. Comstock, 1936: 285; Hall, 1936: 278; Field, 1938b: 267; Hoffmann, 1941: 273; Dethier, 1942d: 203; Holland, 1942: 399; Comstock, 1944: 567; Beatty, 1944: 158; Bruner, Scaramuzza & Otero, 1945: 27, 109; Avinoff & Shoumatoff, 1946: 294; Bell, 1946: 144; Miles Moss, 1949: 69.

Calpodes ethlius ethlius: Schweizer & Webster, 1941: 24.

Illustrations.—Showalter, 1927: pl. 8, f. 9; Clark, 1932: pl. 50, f. 7, 8; Fazzini, 1934: p. 58, f. not numbered; J. H. Comstock & A. B. Comstock, 1936: pl. XLII, f. 2; Holland, 1942: pl. VI, f. 48, (chrysalis), pl. XLV, f. 3; Miles Moss, 1949: pl. V, f. 4, (larva).

Genus *Panoquina* Hemming

Panoquina Hemming, 1934.

Prenes Scudder, 1872; preoccupied in fishes.

Genotype: *Hesperia panoquin* Scudder, 1863.

188. PANOQUINA SYLVICOLA SYLVICOLA (Herrich-Schäffer)

Goniloba sylvicola Herrich-Schäffer, 1865; Gundlach, 1881: 166.

Prenes nero?: Holland, 1916: 509.

Prenes sylvicola: Skinner & Ramsden, 1923: 320.

Prenes nero sylvicola: Bates, 1935: 229; Dethier, 1942b: 167, 172; Bruner, Scaramuzza & Otero, 1945: 125, 163, 173.

Panoquina sylvicola sylvicola: Watson, 1937: 7; Berger, 1939: 206; Comstock, 1944: 569; S. L. de la Torre, 1949c: 189.

Panoquina sylvicola: Hoffmann, 1941: 273; Dethier, 1942d: 203; Bell, 1946: 145.

Illustrations.—Bates, 1935: f. 23, (venation); Dethier, 1942d: f. 1, (section of a larva).

189. PANOQUINA OCOLA (Edwards)

Hesperia ocola Edwards, 1863.

Prenes ocola: Holland, 1916: 509; id., 1942: 398; Skinner & Ramsden, 1923: 319; Clark, 1932: 233; Bates, 1935: 231.

Panoquina ocola: Field, 1938 b: 269; Hoffmann, 1941: 273; Comstock, 1944: 570; Avinoff & Shoumatoff, 1946: 295; S. L. de la Torre, 1949c: 189.

Calpodes ocola: Schweizer & Webster, 1941: 24.

Illustrations.—Holland, 1942: pl. XLVI, f. 34, pl. LIV, f. 22; Comstock, 1944: pl. 12, f. 5.

190. PANOQUINA PANOQUINOIDES PANOQUINOIDES (Skinner)

Pamphila panoquinoides Skinner, 1891.

Prenes panoquinoides: Skinner & Ramsden, 1923: 319; Bates, 1935: 231; Holland, 1942: 398.

Panoquina panoquinoides panoquinoides: Comstock, 1944: 571; Beatty, 1944: 158; S. L. de la Torre, 1949c: 189.

Illustrations.—Holland, 1942: pl. LIV, f. 23; Comstock, 1944: pl. 12, f. 8.

191. PANOQUINA NYCTELIA COSCINIA (Herrich-Schäffer)

Goniloba coscinia Herrich-Schäffer, 1865.

Goniloba brettus: Gundlach, 1881: 164.

Prenes ares: Skinner & Ramsden, 1923: 320.

Prenes nyctelius coscinia: Bates, 1935: 231; Dethier, 1942b: 167, 170; Bruner, Scaramuzza & Otero, 1945: 123, 125, 163.

Panoquina nyctelius: Schweizer & Webster, 1941: 24; Bell, 1947: 139.

Panoquina vala: Bell, 1946: 145 (See Corrections of errata by the author, 1947: 139).

Panoquina nyctelia: Comstock, 1944: 568; Beatty, 1944: 158; J. A. Ramos, 1946: 54; Avinoff & Shoumatoff, 1946: 295.

Panoquina nyctelia coscinia: L. S. Dillon, 1947: 102; S. L. de la Torre, 1949c: 189.

Illustrations.—Dethier, 1942b: pl. 26, f. 10, 11, (head of larva); Comstock, 1944: pl. 12, f. 1; Bruner, Scaramuzza & Otero, 1945: pl. VIII, f. 2.

192. panoquina nero corrupta (Herrich-Schäffer)

Goniloba corrupta Herrich-Schäffer, 1865; Gundlach, 1881: 165.

Prenes corrupta: Holland, 1916: 509; Skinner & Ramsden, 1923: 320; Bates, 1935: 232.

Panoquina nero corrupta: Watson, 1937: 6; Comstock, 1944: 569; S. L. de la Torre, 1949c: 189.

Panoquina corrupta: Bell, 1942: 4.

Illustration.—Holland, 1916: pl. 31, f. 13.

Genus *Asbolis* Mabille

Asbolis Mabille, 1904.

Genotype: *Eudamus capucinus* Lucas, 1857.

193. asbolis capucinus (Lucas)

Eudamus capucinus Lucas, 1857.

Goniloba capucinus: Gundlach, 1881: 163.

Asbolis sandarac: Holland, 1916: 509.

Asbolis capucinus: Skinner & Ramsden, 1923: 320; Bates, 1935: 232; Bruner, Scaramuzza & Otero, 1945: 55, 67, 155, 156.

Illustration.—Holland, 1916: pl. 31, f. 9.

Genus *Pyrrhocalles* Mabille

Pyrrhocalles Mabille, 1904.

Genotype: *Pamphila antiqua* Herrich-Schäffer, 1863.

194. pyrrhocalles antiqua antiqua (Herrich-Schäffer)

Pamphila antiqua Herrich-Schäffer, 1863; Gundlach, 1881: 150.

Phemiades antiqua: Holland, 1916: 509; Munroe, 1951: 55.

Pyrrhocalles antiqua: Skinner & Ramsden, 1923: 318.
Pyrrhocalles orientis: Skinner & Ramsden, 1923: 319.
Phemiades antiqua antiqua: Bates, 1935: 226.
Pyrrhocalles antiqua antiqua: S. L. de la Torre, 1949c: 188.
Illustration.—Holland, 1916: pl. 31, f. 10.

Genus *Lerodea* Scudder

Lerodea Scudder, 1872: 80.
Cymaenes Scudder, 1872: 82.
Megistias Godman, 1900.
Genotype: *Hesperia eufala* Edwards, 1869.

195. LERODEA EUFALA (Edwards)

Hesperia eufala Edwards, 1869.
Cobalus dispersus: Gundlach, 1881: 154.
Lerodea eufala: Holland, 1916: 508; id., 1942: 396; Skinner & Ramsden, 1923: 317; Bates, 1935: 227; Field, 1938b: 266; Schweizer & Webster, 1941: 23; Hoffmann, 1941: 280; Dethier, 1942b: 167; Bruner, Scaramuzza & Otero, 1945: 122; Avinoff & Shoumatoff, 1946: 294.
Illustration.—Holland, 1942: pl. XLVI, f. 33.

196. LERODEA TRIPUNCTA TRIPUNCTA (Herrich-Schäffer)

Cobalus tripunctus Herrich-Schäffer, 1865; Gundlach, 1881: 154.
Lerodea tripuncta: Holland, 1916: 508; Skinner & Ramsden, 1923: 317; Bates, 1935: 228; Comstock, 1944: 566; Beatty, 1944: 158; Bruner, Scaramuzza & Otero, 1945: 19, 163; J. A. Ramos, 1946: 54.
Lerodea tripunctus: Bell, 1941: 6; id., 1946: 166; Dethier, 1942b: 167, 168; id., 1942d: 203.

In Jamaica the subspecies *Lerodea tripuncta jamaca* Schaus is very common according with Avinoff and Shoumatoff (1946: 293).

Illustrations.—Dethier, 1942b: pl. 26, f. 1-9, (head of larva); Comstock, 1944: pl. 12, f. 9.

Genus *Paracarystus* Godman

Paracarystus Godman, 1900.
Genotype: *Cobalus hypargyra* Herrich-Schäffer, 1869.

197. PARACARYSTUS CUBANA (Herrich-Schäffer)

Goniloba cubana Herrich-Schäffer, 1865; Gundlach, 1881: 166; id., 1891: 458.

Paracarystus cubana: Skinner & Ramsden, 1923: 320; Bates, 1935: 235; Bruner, Scaramuzza & Otero, 1945: 28.

Genus *Synapte* Mabille

Synapte Mabille, 1904.
Godmania Skinner & Ramsden, 1923; preoccupied in Hemiptera.
Genotype: *Hesperia silius* Latreille, 1822 (=*Carystus salenus* Mabille).

198. SYNAPTE MALITIOSA (Herrich-Schäffer)

Goniloba malitiosa Herrich-Schäffer, 1865; Gundlach, 1881: 165.

Godmania malitiosa: Skinner & Ramsden, 1923: 321; Bates, 1935: 235; Watson, 1937: 10; Hoffmann, 1941: 281.

Synapte malitiosa: S. L. de la Torre, 1949c: 190; Freeman, 1949: 41.

Genus *Callimormus* Scudder

Callimormus Scudder, 1872.
Genotype: *Callimormus juventus* Scudder, 1872.

199. CALLIMORMUS RADIOLA (Mabille)

Ancyloxypha radiola Mabille, 1878.

Callimormus filata: Skinner & Ramsden, 1923: 321; Bates, 1935: 237.

Callimormus radiola: Bell, 1946: 176.

This species is cited by Bates as doubtful, since there are no new records after the specimens described under the name *Apaustus filata* by Plötz in 1884.

Genus *Thracides* Hübner

Thracides Hübner, 1819.
Genotype: *Papilio phidon* Cramer, 1779.

200. THRACIDES TELEGONUS (Esper)

Papilio Plebeius Urbanus Telegonus Esper, 1780.
Thracides longirostris: Skinner & Ramsden, 1923: 321; Hoffmann, 1933: 245; id., 1941: 283; Miles Moss, 1949: 78.
Thracides telegonus: Bates, 1935: 236.
Illustration.—Miles Moss, 1949: pl. V, f. 3, (larva).

Genus *Perichares* Scudder

Perichares Scudder, 1872.
Genotype: *Hesperia phocion* Fabricius, 1793 (=*Papilio coridon* Fab., 1775).

201. PERICHARES PHOCION PHOCION (Fabricius)

Hesperia (*Urbicolae*) *phocion* Fabricius, 1793.
Goniloba corydon: Gundlach, 1881: 162.
Perichares coridon: Skinner & Ramsden, 1923: 320; Hoffmann, 1941: 283; Avinoff & Shoumatoff, 1946: 295.
Perichares corydon: Hoffmann, 1933: 245.
Perichares coridon coridon: Bates, 1935: 233; Dethier, 1942b: 167, 174; Bruner, Scaramuzza & Otero, 1945: 17, 19, 123, 125, 163.
Perichares phocion phocion: Comstock, 1941: 371; id., 1944: 571; Munroe, 1951: 55.
Perichares phocion: Bell, 1946: 183.

The name *Papilio coridon* Fabricius, 1775, is preoccupied by *Papilio coridon* Poda, 1761, in the family *Lycaenidae,* and so we must adopt the name *Hesperia phocion* Fabricius for this species.

Illustrations.—Bates, 1935: f. 24, (venation); Comstock, 1944: text fig. 29, (venation), pl. 11, f. 13.

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CONTENTS OF VOLUME LXIII

Journal of the
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STANLEY WILLARD BROMLEY, 1899–1954

Dr. Bromley, one of the past presidents of the New York Entomological Society, a contributor to its "Journal," and well-known to the entomological world, was born December 7, 1899 at Sunny Valley Farm, close to Charlton, Worcester County, Massachusetts. He was the only son of James Willard and Lizzie Knowles Bromley. After graduating from high school in 1918, he entered the then Massachusetts Agricultural College where he majored in entomology under Dr. H. T. Fernald and Dr. G. C. Crampton. He graduated in 1922 with his B.S. degree and received his M.S. degree from the same institution in 1924 after completing his graduate work. From Ohio State University he received the Doctor of Philosophy degree in 1934.

Dr. Bromley became interested in natural history at an early age. His first paper, "Asilids and their prey" written at the age of 13, appeared in "Psyche," 21: 192–198, in 1914. Thirty-two years afterward, the late Professor C. T. Brues referred to this paper in his chapter on Predatory Insects in his book "Insect Dietary" published in 1946. It is quite unusual for entomologists to get into print so young and have their early work referred to after such a long time. In the paper in question, 18 species of Asilidæ are recorded with 463 records of capture. Early in life, the author exhibited a degree of patience and a keenness of observation that were to characterize all his later works. It was not until nine years later that his second paper was published in "Psyche" on the feeding habits of robber flies. The Asilidæ upon which he was an authority occupied part of Dr. Bromley's attention for the remainder of his life, his last paper being a description of 32 new species.

During the summer of 1922 he worked on fruit insects at Wallingford, Connecticut for the Federal Bureau of Entomology. The American Cyanamid Company employed him between 1923 and 1928 in connection with the development of cyanogas for the control of insect pests and rodents and liquid hydrocyanic acid gas for fumigation work in warehouses. At this time his office was in New York City.

In January of 1929, he became associated with the F. A. Bartlett Tree Expert Company, later the Bartlett Tree Research Laboratories of Stamford, Connecticut, as chief entomologist, where he investigated insecticides and the life histories of nursery and forest insect pests, and where he taught various courses at the Bartlett School of Tree Surgery. He also built up a collection of tree and shrub insects, with specimens of their injury. Dr. Bromley remained with the firm until he retired, December 31, 1951, on account of illness.

During Dr. Bromley's work on the taxonomy of the Asilidæ, on which he published around 50 papers, he built up a collection of well over 35,000 Diptera specimens, nearly 28,000 of which are Asilidæ. Type specimens numbered 1,868. This collection is now in the Smithsonian Institution. "Index VII to the Literature of American Economic Entomology, 1940 to 1944" was edited by Dr. Bromley with the help of his wife, Dr. Helen B. Bromley, an authority on the taxonomy of fresh-water algæ. This was published in 1948 by the American Association of Economic Entomologists.

Dr. Bromley kept in touch with many entomologists and belonged to the Entomological Society of America of which he was a fellow, to the American Association of Economic Entomologists, the Ecological Society of America, the New York Entomological Society of which he was vice president in 1945 and president in 1946, to the entomological societies of Washington, Brooklyn and Cambridge, and to the American Association for the Advancement of Science. At the time of his death he was a member of the board of governors of the National Shade Tree Conference and a member of the Connecticut Tree Protective Association.

His death occurred in the Stamford Hospital on February 16, 1954, after a long illness characterized by high blood pressure. He was buried in Long Ridge Union Cemetery, Stamford, Connecticut. At Columbus, Ohio, in 1935 he was married to Dr. Helen Jean Brown, who at that time was on the staff of the department of botany of the Ohio State University. He is survived by his wife, to whom I am indebted for most of the above information, by his son James Robert, born at Stamford on April 9, 1936 and now a student at Yale, and by his mother. In the obituary of Dr. Bromley by Charles P. Alexander that appeared in the Annals of the Entomological Society of America, vol. 47, No. 2, June, 1954, it is stated that in 1910, when he was 11 years of age he visited the museum of the Boston Society of Natural History and became acquainted with the late Charles W. Johnson, a dipterologist of note with whom Dr. Bromley was friendly until Johnson died in 1932. It is further stated that "Mr. and Mrs. Johnson were so impressed by the personality and potentialities of the youngster that they took the preliminary steps to legally adopt him, a course that proved impossible." Mrs. Helen J. Bromley has advised me that Dr. Bromley's mother who is still living denies that such a course was ever considered.

The following bibliography was supplied by Mrs. Helen J. Bromley. It was prepared except for the last three titles, by Dr. Bromley who apparently considered that it represented his most important writings, and except for twenty-two titles that I have been able to add on shade trees and shade tree pests in order to show the scope of his interests. During the years that I knew Dr. Bromley and during our meetings, usually in connection with the meetings of the New York Entomological Society and the Eastern Branch of the American Association of Economic Entomologists, I was always impressed by his serious and deep interest in entomology, by his desire to be helpful and by his friendliness. He always merited the scientific and personal esteem in which we held him.—HARRY B. WEISS

The Writings of Stanley Willard Bromley*

1914. Asilids and their prey. Psyche. **21**: 192–198.

1923. Observations on the feeding habits of robber flies. Psyche. **30**(2): 41–45.

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* This may not be complete because an extended search has not been made.

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PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

The last Proceedings of the Society to appear in the Journal were in Vol. 56, No. 3, Sept. 1953, which issue was published Nov. 20, 1953. Failure of the Proceedings to appear in subsequent issues must be blamed on the failure of the Secretary to provide complete minutes to the Editor, even to the present time, January, 1957. On many occasions during the three year interval, the Editor, the Officers and the Executive Committee have requested the Secretary to give proper attention to this duty of his office, but without the desired result.

The Journal can no longer delay publication of its proceedings and although minutes for a number of 1953, 1954 and 1955 meetings have not been submitted, we publish herewith the material available with the understanding that the remaining minutes will be published at later date, if and when they are received.

—F. A. SORACI.

MEETING OF OCTOBER 7, 1952

A regular meeting of the Society was held at the American Museum of Natural History. There were 13 members and seven guests present. The Secretary received a letter dated October 6, 1952 advising that Albro T. Gaul had vacated the post of President of the Society by resignation. Therefore in accordance with Article V, Section 2 of the By-Laws, Vice-President Dr. Lucy Clausen occupied the Chair. The minutes of the previous meeting were read and approved.

The Secretary informed the Society of the death of one of its Life Members and past President, Mr. Andrew J. Mutchler. President Clausen appointed a committee composed of J. D. Sherman, Jr. and H. B. Weiss to prepare a biographical note to be published in the Journal.

Dr. Hagan reported on a visit to the Olsens at Nyack, N. Y. and commented upon the success of the Olsen family in a radio quiz program held in New York City. He also told the membership that Mr. Olsen is now preparing a giant model of a lampyrid beetle; this will be his second giant model of a beetle.

Dr. Vishniac then introduced the speaker of the evening, Dr. Collins, Entomologist of the State of New York who spoke on "The tick problem on Long Island."

In his address Dr. Collins pointed out the unreliability of the legend of the introduction of the ticks on Long Island by Theodore Roosevelt's Rough

(*Continued on page 16*)

CHANGES IN THE CONCENTRATION OF REDUCING SUBSTANCES DURING THE METAMORPHOSIS OF THE HOUSEFLY (MUSCA DOMESTICA LINNAEUS)*

By Robert J. DelVecchio
Department of Blology, Fordham University

Frew (1929) studied changes in the glucose content during metamorphosis of the blowfly (species not given). His results indicate that glucose increases in concentration just prior to pupation, and decreases rapidly immediately afterward. He also reported the occurrence of sudden increases in glucose content for definite points during pupal life. These results have been interpreted as indicating that a synthesis of glucose occurs during metamorphosis. Frew suggests that the glucose is derived from protein during the first half and from fat the last half of the pupal period. Courtois-Drilhon (1931) reported an increase in the glucose content of the early pupae of three species of Lepidoptera (*Attacus pernyi, Sphinx ligustri* and *Saturnia pyri*). This increase continued from the time of pupation in August, until December, and was followed by a steady decrease until emergence the following April. Crescitelli and Taylor (1935) studied the bee-moth, *Galleria mellonella,* and found that the period of spinning (prepupal stage) is one during which increasing concentrations of reducing substances are found. During pupal life, which lasted for seven days at 30° C., the concentration of reducing substances decreases at first, then rises. A final drop in concentration occurs just prior to the emergence of the adult. Ludwig and Rothstein (1949) found that in the Japanese beetle, *Popillia japonica,* the glucose content decreased from 0.52 per cent in the 3rd instar larva to 0.42 per cent in the early prepupa, but increased in the newly-molted pupa to 0.79 per cent. During the first day of pupal life, at 25° C., there was a small but significant

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The author is indebted to Professor Daniel Ludwig under whose direction this investigation was carried out, and to Doctor Bertram A. Sacktor, from whom the insects were obtained.

drop to 0.68 per cent. It remained constant for about 2 days and then increased slowly throughout the remainder of the pupal stage, reaching a value of 0.86 per cent in the 9-day pupa. Emergence was associated with an actual loss of glucose but, because of the loss of weight which occurs at that time, the percentage value increased. The increase in glucose and glycogen which was observed at the time of pupation was considered by the authors to be the result of a breakdown of insoluble proteins which occurs at that time, the degradation products being temporarily stored as carbohydrates.

This review indicates that the concentrations of reducing compounds may vary greatly in different insects during metamorphosis. In some forms there is an actual loss of this constituent; whereas in other forms its concentration increases significantly. Because of this variation, it was decided to study the changes in reducing compounds during the growth, metamorphosis and imaginal life of the housefly, *Musca domestica*.

MATERIAL AND METHODS

The larvae of the housefly were raised on whole milk. A fingerbowl containing cotton saturated with whole milk served as the feeding medium. Twenty-four hours after the eggs were laid on this saturated cotton, they were transferred to a humidifier regulated at approximately 30° C. and a humidity near saturation. The eggs hatched in approximately 24 hours under these conditions, and the time of hatching was recorded. In this manner carefully timed records, within 24 hours, were obtained for each group of experimental animals. Readings on glucose were made on groups of five larvae at the following stages: one, two, three, four, five and six days after hatching; on groups of four pupae, one, two, three and four days after puparium formation; and on groups of two newly-emerged adults and groups of two old-adults (7 to 10 days after emergence).

Determinations of reducing substances, expressed as glucose, were made by the Hagedorn and Jensen procedure (see Hawk, Oser and Summerson, 1947, p. 528).

OBSERVATIONS

The results of the glucose determinations are given in Table 1. The table contains the average weights of the insects and the average percentages (by weight) of glucose present at each day of growth and metamorphosis. These values are averages obtained from ten determinations. Since the amount of glucose is greater in the larger insects, the percentage values at different stages are considered more reliable than those for weights. There is no difference in the amount of glucose present in the one- and two-day larva. However, between the second and third days there is a decrease from 0.36 to 0.23 per cent. This decrease is followed by an increase in concentration in the four-day larva to 0.26 per cent.

TABLE 1

Stage in development	Number of insects	Average weight in mg. per group	Average weight of glucose in mg per group	Glucose as per cent weight and standard errors
1-day larvae	50	25.	9.0	0.36 ± .0085
2-day larvae	50	72.	25.7	0.36 ± .0289
3-day larvae	50	124.	28.0	0.23 ± .0066
4-day larvae	50	89.	23.4	0.26 ± .0106
5-day larvae	50	33.	5.5	0.17 ± .0069
6-day larvae	50	75.	20.6	0.27 ± .0117
1-day pupae	40	53.	19.5	0.37 ± .0142
2-day pupae	40	54.	21.0	0.39 ± .0157
3-day pupae	40	53.	21.3	0.40 ± .0174
4-day pupae	40	40.	16.9	0.42 ± .0177
newly-emerged adults	20	37.	31.2	0.84 ± .0108
old adults	20	17.	20.4	1.20 ± .0075

A second drop to 0.17 per cent occurs in the five-day larva, followed by an increase in the six-day larva to 0.27 per cent. The glucose then rises to its former value of 0.37 per cent following puparium formation. There is a steady increase in the concentration of glucose in the pupal stage reaching a high of 0.42 per cent in the four-day pupa. There is an increase in weight exhibited by the newly emerged adults, within the first 24 hours after emergence. This increase may be explained by the fact that these adults had already fed. However, as the adult ages, it loses weight resulting in a further increase in the percentage value of glucose. Glucose increases in the adult stage from 0.84 in the newly-emerged to 1.20 per cent in the old adult.

In Table 2 is given a statistical analysis of these results. Beginning with the second day, there are significant changes between successive days of the larval period. In the pupal period, the

TABLE 2

Stages compared	Difference between means	Standard error of difference	Difference Standard error of difference
LARVAE			
1 and 3 day	0.13	±.0107	12.0
3 and 4 day	0.03	±.0125	2.4
4 and 5 day	0.09	±.0126	7.1
6 and 1 day pupa	0.10	±.0184	5.4
PUPAE			
1 and 2 day	0.02	±.0211	0.9
2 and 3 day	0.01	±.0234	0.4
3 and 4 day	0.02	±.0248	0.8
1 and 4 day	0.05	±.0231	2.1
ADULTS			
newly-emerged and old adults	0.36	±.0131	27.5

only statistical significance observed is that found when the one and four-day pupae are compared. A significant change is also found between the newly-emerged and old adults.

DISCUSSION

The irregular increases and decreases in the concentration of glucose throughout growth may have significance when correlated with the physiological activities of the organism. Thus, for example, an increase in the percentage of glucose from 0.37 per cent in the one-day pupa to 1.20 per cent in the old adult may be indicative of an endogenous synthesis of glucose, or other reducing compounds. Moreover, decreases in the concentration of glucose can similarly be associated with carbohydrate utilization.

The results indicate a gradual increase in the concentration of reducing compounds during the pupal period. Similar increases

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STANLEY WILLARD BROMLEY, 1899–1954

Dr. Bromley, one of the past presidents of the New York Entomological Society, a contributor to its "Journal," and well-known to the entomological world, was born December 7, 1899 at Sunny Valley Farm, close to Charlton, Worcester County, Massachusetts. He was the only son of James Willard and Lizzie Knowles Bromley. After graduating from high school in 1918, he entered the then Massachusetts Agricultural College where he majored in entomology under Dr. H. T. Fernald and Dr. G. C. Crampton. He graduated in 1922 with his B.S. degree and received his M.S. degree from the same institution in 1924 after completing his graduate work. From Ohio State University he received the Doctor of Philosophy degree in 1934.

Dr. Bromley became interested in natural history at an early age. His first paper, "Asilids and their prey" written at the age of 13, appeared in "Psyche," 21: 192–198, in 1914. Thirty-two years afterward, the late Professor C. T. Brues referred to this paper in his chapter on Predatory Insects in his book "Insect Dietary" published in 1946. It is quite unusual for entomologists to get into print so young and have their early work referred to after such a long time. In the paper in question, 18 species of Asilidæ are recorded with 463 records of capture. Early in life, the author exhibited a degree of patience and a keenness of observation that were to characterize all his later works. It was not until nine years later that his second paper was published in "Psyche" on the feeding habits of robber flies. The Asilidæ upon which he was an authority occupied part of Dr. Bromley's attention for the remainder of his life, his last paper being a description of 32 new species.

During the summer of 1922 he worked on fruit insects at Wallingford, Connecticut for the Federal Bureau of Entomology. The American Cyanamid Company employed him between 1923 and 1928 in connection with the development of cyanogas for the control of insect pests and rodents and liquid hydrocyanic acid gas for fumigation work in warehouses. At this time his office was in New York City.

In January of 1929, he became associated with the F. A. Bartlett Tree Expert Company, later the Bartlett Tree Research Laboratories of Stamford, Connecticut, as chief entomologist, where he investigated insecticides and the life histories of nursery and forest insect pests, and where he taught various courses at the Bartlett School of Tree Surgery. He also built up a collection of tree and shrub insects, with specimens of their injury. Dr. Bromley remained with the firm until he retired, December 31, 1951, on account of illness.

During Dr. Bromley's work on the taxonomy of the Asilidæ, on which he published around 50 papers, he built up a collection of well over 35,000 Diptera specimens, nearly 28,000 of which are Asilidæ. Type specimens numbered 1,868. This collection is now in the Smithsonian Institution. "Index VII to the Literature of American Economic Entomology, 1940 to 1944" was edited by Dr. Bromley with the help of his wife, Dr. Helen B. Bromley, an authority on the taxonomy of fresh-water algæ. This was published in 1948 by the American Association of Economic Entomologists.

Dr. Bromley kept in touch with many entomologists and belonged to the Entomological Society of America of which he was a fellow, to the American Association of Economic Entomologists, the Ecological Society of America, the New York Entomological Society of which he was vice president in 1945 and president in 1946, to the entomological societies of Washington, Brooklyn and Cambridge, and to the American Association for the Advancement of Science. At the time of his death he was a member of the board of governors of the National Shade Tree Conference and a member of the Connecticut Tree Protective Association.

His death occurred in the Stamford Hospital on February 16, 1954, after a long illness characterized by high blood pressure. He was buried in Long Ridge Union Cemetery, Stamford, Connecticut. At Columbus, Ohio, in 1935 he was married to Dr. Helen Jean Brown, who at that time was on the staff of the department of botany of the Ohio State University. He is survived by his wife, to whom I am indebted for most of the above information, by his son James Robert, born at Stamford on April 9, 1936 and now a student at Yale, and by his mother. In the obituary of Dr. Bromley by Charles P. Alexander that appeared in the Annals of the Entomological Society of America, vol. 47, No. 2, June, 1954, it is stated that in 1910, when he was 11 years of age he visited the museum of the Boston Society of Natural History and became acquainted with the late Charles W. Johnson, a dipterologist of note with whom Dr. Bromley was friendly until Johnson died in 1932. It is further stated that "Mr. and Mrs. Johnson were so impressed by the personality and potentialities of the youngster that they took the preliminary steps to legally adopt him, a course that proved impossible." Mrs. Helen J. Bromley has advised me that Dr. Bromley's mother who is still living denies that such a course was ever considered.

The following bibliography was supplied by Mrs. Helen J. Bromley. It was prepared except for the last three titles, by Dr. Bromley who apparently considered that it represented his most important writings, and except for twenty-two titles that I have been able to add on shade trees and shade tree pests in order to show the scope of his interests. During the years that I knew Dr. Bromley and during our meetings, usually in connection with the meetings of the New York Entomological Society and the Eastern Branch of the American Association of Economic Entomologists, I was always impressed by his serious and deep interest in entomology, by his desire to be helpful and by his friendliness. He always merited the scientific and personal esteem in which we held him.—HARRY B. WEISS

The Writings of Stanley Willard Bromley*

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PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

The last Proceedings of the Society to appear in the Journal were in Vol. 56, No. 3, Sept. 1953, which issue was published Nov. 20, 1953. Failure of the Proceedings to appear in subsequent issues must be blamed on the failure of the Secretary to provide complete minutes to the Editor, even to the present time, January, 1957. On many occasions during the three year interval, the Editor, the Officers and the Executive Committee have requested the Secretary to give proper attention to this duty of his office, but without the desired result.

The Journal can no longer delay publication of its proceedings and although minutes for a number of 1953, 1954 and 1955 meetings have not been submitted, we publish herewith the material available with the understanding that the remaining minutes will be published at later date, if and when they are received.

—F. A. SORACI.

MEETING OF OCTOBER 7, 1952

A regular meeting of the Society was held at the American Museum of Natural History. There were 13 members and seven guests present. The Secretary received a letter dated October 6, 1952 advising that Albro T. Gaul had vacated the post of President of the Society by resignation. Therefore in accordance with Article V, Section 2 of the By-Laws, Vice-President Dr. Lucy Clausen occupied the Chair. The minutes of the previous meeting were read and approved.

The Secretary informed the Society of the death of one of its Life Members and past President, Mr. Andrew J. Mutchler. President Clausen appointed a committee composed of J. D. Sherman, Jr. and H. B. Weiss to prepare a biographical note to be published in the Journal.

Dr. Hagan reported on a visit to the Olsens at Nyack, N. Y. and commented upon the success of the Olsen family in a radio quiz program held in New York City. He also told the membership that Mr. Olsen is now preparing a giant model of a lampyrid beetle; this will be his second giant model of a beetle.

Dr. Vishniac then introduced the speaker of the evening, Dr. Collins, Entomologist of the State of New York who spoke on ''The tick problem on Long Island.''

In his address Dr. Collins pointed out the unreliability of the legend of the introduction of the ticks on Long Island by Theodore Roosevelt's Rough

(*Continued on page 16*)

CHANGES IN THE CONCENTRATION OF REDUCING SUBSTANCES DURING THE METAMORPHOSIS OF THE HOUSEFLY (MUSCA DOMESTICA LINNAEUS)*

By Robert J. DelVecchio
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Frew (1929) studied changes in the glucose content during metamorphosis of the blowfly (species not given). His results indicate that glucose increases in concentration just prior to pupation, and decreases rapidly immediately afterward. He also reported the occurrence of sudden increases in glucose content for definite points during pupal life. These results have been interpreted as indicating that a synthesis of glucose occurs during metamorphosis. Frew suggests that the glucose is derived from protein during the first half and from fat the last half of the pupal period. Courtois-Drilhon (1931) reported an increase in the glucose content of the early pupae of three species of Lepidoptera (*Attacus pernyi, Sphinx ligustri* and *Saturnia pyri*). This increase continued from the time of pupation in August, until December, and was followed by a steady decrease until emergence the following April. Crescitelli and Taylor (1935) studied the bee-moth, *Galleria mellonella,* and found that the period of spinning (prepupal stage) is one during which increasing concentrations of reducing substances are found. During pupal life, which lasted for seven days at 30° C., the concentration of reducing substances decreases at first, then rises. A final drop in concentration occurs just prior to the emergence of the adult. Ludwig and Rothstein (1949) found that in the Japanese beetle, *Popillia japonica,* the glucose content decreased from 0.52 per cent in the 3rd instar larva to 0.42 per cent in the early prepupa, but increased in the newly-molted pupa to 0.79 per cent. During the first day of pupal life, at 25° C., there was a small but significant

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The author is indebted to Professor Daniel Ludwig under whose direction this investigation was carried out, and to Doctor Bertram A. Sacktor, from whom the insects were obtained.

drop to 0.68 per cent. It remained constant for about 2 days and then increased slowly throughout the remainder of the pupal stage, reaching a value of 0.86 per cent in the 9-day pupa. Emergence was associated with an actual loss of glucose but, because of the loss of weight which occurs at that time, the percentage value increased. The increase in glucose and glycogen which was observed at the time of pupation was considered by the authors to be the result of a breakdown of insoluble proteins which occurs at that time, the degradation products being temporarily stored as carbohydrates.

This review indicates that the concentrations of reducing compounds may vary greatly in different insects during metamorphosis. In some forms there is an actual loss of this constituent; whereas in other forms its concentration increases significantly. Because of this variation, it was decided to study the changes in reducing compounds during the growth, metamorphosis and imaginal life of the housefly, *Musca domestica.*

MATERIAL AND METHODS

The larvae of the housefly were raised on whole milk. A fingerbowl containing cotton saturated with whole milk served as the feeding medium. Twenty-four hours after the eggs were laid on this saturated cotton, they were transferred to a humidifier regulated at approximately 30° C. and a humidity near saturation. The eggs hatched in approximately 24 hours under these conditions, and the time of hatching was recorded. In this manner carefully timed records, within 24 hours, were obtained for each group of experimental animals. Readings on glucose were made on groups of five larvae at the following stages: one, two, three, four, five and six days after hatching; on groups of four pupae, one, two, three and four days after puparium formation; and on groups of two newly-emerged adults and groups of two old-adults (7 to 10 days after emergence).

Determinations of reducing substances, expressed as glucose, were made by the Hagedorn and Jensen procedure (see Hawk, Oser and Summerson, 1947, p. 528).

OBSERVATIONS

The results of the glucose determinations are given in Table 1. The table contains the average weights of the insects and the average percentages (by weight) of glucose present at each day of growth and metamorphosis. These values are averages obtained from ten determinations. Since the amount of glucose is greater in the larger insects, the percentage values at different stages are considered more reliable than those for weights. There is no difference in the amount of glucose present in the one- and two-day larva. However, between the second and third days there is a decrease from 0.36 to 0.23 per cent. This decrease is followed by an increase in concentration in the four-day larva to 0.26 per cent.

TABLE 1

Stage in development	Number of insects	Average weight in mg. per group	Average weight of glucose in mg per group	Glucose as per cent weight and standard errors
1-day larvae	50	25.	9.0	0.36 ± .0085
2-day larvae	50	72.	25.7	0.36 ± .0289
3-day larvae	50	124.	28.0	0.23 ± .0066
4-day larvae	50	89.	23.4	0.26 ± .0106
5-day larvae	50	33.	5.5	0.17 ± .0069
6-day larvae	50	75.	20.6	0.27 ± .0117
1-day pupae	40	53.	19.5	0.37 ± .0142
2-day pupae	40	54.	21.0	0.39 ± .0157
3-day pupae	40	53.	21.3	0.40 ± .0174
4-day pupae	40	40.	16.9	0.42 ± .0177
newly-emerged adults	20	37.	31.2	0.84 ± .0108
old adults	20	17.	20.4	1.20 ± .0075

A second drop to 0.17 per cent occurs in the five-day larva, followed by an increase in the six-day larva to 0.27 per cent. The glucose then rises to its former value of 0.37 per cent following puparium formation. There is a steady increase in the concentration of glucose in the pupal stage reaching a high of 0.42 per cent in the four-day pupa. There is an increase in weight exhibited by the newly emerged adults, within the first 24 hours after emergence. This increase may be explained by the fact that these adults had already fed. However, as the adult ages, it loses weight resulting in a further increase in the percentage value of glucose. Glucose increases in the adult stage from 0.84 in the newly-emerged to 1.20 per cent in the old adult.

In Table 2 is given a statistical analysis of these results. Beginning with the second day, there are significant changes between successive days of the larval period. In the pupal period, the

TABLE 2

Stages compared	Difference between means	Standard error of difference	Difference Standard error of difference
LARVAE			
1 and 3 day	0.13	±.0107	12.0
3 and 4 day	0.03	±.0125	2.4
4 and 5 day	0.09	±.0126	7.1
6 and 1 day pupa	0.10	±.0184	5.4
PUPAE			
1 and 2 day	0.02	±.0211	0.9
2 and 3 day	0.01	±.0234	0.4
3 and 4 day	0.02	±.0248	0.8
1 and 4 day	0.05	±.0231	2.1
ADULTS			
newly-emerged and old adults	0.36	±.0131	27.5

only statistical significance observed is that found when the one and four-day pupae are compared. A significant change is also found between the newly-emerged and old adults.

DISCUSSION

The irregular increases and decreases in the concentration of glucose throughout growth may have significance when correlated with the physiological activities of the organism. Thus, for example, an increase in the percentage of glucose from 0.37 per cent in the one-day pupa to 1.20 per cent in the old adult may be indicative of an endogenous synthesis of glucose, or other reducing compounds. Moreover, decreases in the concentration of glucose can similarly be associated with carbohydrate utilization.

The results indicate a gradual increase in the concentration of reducing compounds during the pupal period. Similar increases were found by Frew (1929); Crescitelli and Taylor (1935) and Ludwig and Rothstein (1949). In the present study, there is no evidence of increases followed by decreases in concentration such as reported by Frew (1929); Courtois-Drilhon (1931); Crescitelli and Taylor (1935) and Ludwig and Rothstein (1949). Hitchcock and Haub (1941) in the blowfly *Phormia regina,* found a steady decrease in the concentration of reducing substances during the pupal period. These findings are in direct opposition with those found in the present study. However, there is agreement in the fact that the concentration of reducing substances increases with the transition from the pupa to the adult.

Frew (1929), correlated the marked synthesis of glucose during the pupal stage, with the respiratory quotient. If this glucose were all oxidized to CO_2 and H_2O, the expected respiratory quotient would be about 0.7 to 0.8 depending on whether the glucose is formed from protein or fat. Frew postulated that it is improbable that the glucose formed is entirely used in respiration; some must almost certainly be used in building up the growing imaginal tissue. Frew further stated that there is definite evidence of a vigorous synthesis of glucose during the whole of the pupal period. He holds that this must be regarded as the most probable explanation of the low respiratory quotient obtained, namely, 0.651. Ludwig (1931) showed a decrease in the rate of oxygen consumption during the last four or five days of the prepupal stage, which continued for several days of the pupal stage. The respiratory quotient of the larva varied from 0.7 to 0.97. It gradually decreased during metamorphosis and, in the pupa, varied from 0.4 to 0.7. He also stated that the low respiratory quotients may possibly be associated with the synthesis of glucose from protein or fat. Since the work of Ludwig and Rothstein (1949) indicates that glycogen supplies the energy required during the pupal stage, there seems to be no definite correlation between the respiratory quotient and the type of metabolism occurring in the insect. Taylor and Steinbach (1931) also give a discussion of the respiratory quotient and its importance during pupal metabolism. These authors point out that the oxidation of fats cannot occur without the oxidation of carbohydrate. Hence, it is false to assume that a quotient of 0.69 (the value obtained in their work) represents an exclusive oxidation of fat.

Schneiderman (1953) studying the respiration of diapausing pupa of the moth, *Platysamia cecropia,* found that metabolic carbon dioxide is retained within the insect and released during brief periods. He further states that the discontinuous release of carbon dioxide is apparently a widespread phenomenon in diapausing pupa. Schneiderman goes on to say that this fact is evidently responsible for the extremely low and apparently erroneous values reported for the respiratory quotients for diapausing pupa (0.78 found by Schneiderman, over a two day period). Buck, Keister and Specht (1953) confirm these results using pupae of *Agapema* (species not given), during diapause.

To the author's knowledge no other studies have been made on the concentration of reducing compounds during the larval growth of insects.

SUMMARY

Determinations were made on the glucose content of the housefly *Musca domestica,* at the following stages: one, two, three, four, five and six-day larvae; one, two, three and four-day pupae; newly-emerged and old adults.

The glucose content of the one-day larva was 0.36 per cent. It decreased to 0.23 per cent in the three-day larva, and to 0.17 in the five-day larva. It then increased to 0.37 per cent in the one-day pupa. The per cent of glucose increased during the pupal stage, reaching 0.42 per cent in the four-day pupa. At the time of emergence there is a loss of weight. However, the percentage value of glucose is increased from 0.84 in the newly-merged adults to 1.20 per cent in the late adults.

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CHANGE IN PUBLICATION ARRANGEMENTS

Beginning with Volume 62 of the Journal, the Society found it necessary to change publishers. Announcement of and reasons for the change were given in Vol. 62, (2) June, 1954, p. 98.

Unfortunately, it soon became apparent that equal service to that provided by the former publishers could not be achieved. Unreasonable delays occurred, in spite of every effort on the parts of the editor and the various officers of the Society to maintain a reasonable publication schedule. The four issues of volume 62 were published over a period of more than two years. Obviously this was not fair to the subscribers nor to the Society and it became necessary finally, to again make a change in publishers.

The situation has been met by return of the Journal to the previous publishers, Business Press Inc. The entire Volume 63 is here presented in one issue. It is planned also to publish Volume 64 (1956) in one issue and, if possible, to revert back to four separate issues with the 1957 Volume, 65.

Throughout this difficult period your officers have been very much encouraged with the show of patience and understanding by the subscribers. It is the desire of the editor, other officers and Business Press to present the Journal on time, just as soon as possible.

The Volume Title Page, Table of Contents and Index to the Volume were omitted from the December 1954 issue. Publication in that issue would have resulted in further delay. This volume carries Title Pages, Tables of Contents and Indices for both Volumes 62 and 63. It is hoped that this might prove satisfactory for those subscribers who desire to bind the Journal. —F. A. Soraci.

(*Continued from page 8*)

Riders. He reviewed the history of rocky mountain spotted fever on the island and traced the tick-host relationships. His most interesting and controversial contribution was the fact that ticks are present only in limited areas, chiefly along roadsides. As a result, periodical applications of insecticides with hand sprayers and spray trucks are much more effective and economical than airplane dusting.

A lively discussion on tick problems in neighboring States followed and brought out the fact that there is a considerable lack of knowledge in regard to tick habits and habitats in the eastern United States.

Dr. Collins' talk was illustrated with slides and motion-pictures.

The meeting adjourned at 9:50 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF OCTOBER 21, 1952

A regular meeting of the Society was held at the American Museum of Natural History; Dr. Clausen presiding. There were 7 members present. The minutes of the previous meeting were read and approved.

Members present then proceeded to report on their respective collecting activities during the past summer period.

Dr. Vishniac has been photographing plankton in full color for an illustrated magazine article. He had to solve numerous interesting problems in the course of this undertaking, involving underwater photography and even taxonomy. Standard descriptions of plankton are based on formalin-preserved specimens and taxonomists cannot, with any certainty, identify living material.

Dr. Hagan spent the summer preparing two papers on *Eciton*, an army ant, particularly making studies on the ovarioles and oocytes of the queen.

Dr. Clausen exhibited kodachromes of lepidoptera, coleoptera and some other insects. She also called attention to the membership of a new Laboratory Manual by Drs. Mullen and Marks.

At this point Dr. Vishniac assumed the Chair.

Soraci reported the presence of the alfalfa weevil, *Hypera postica*, in New Jersey. This is a new record for the State. The weevil is a serious pest in some localities. The assumption is that the infestation started with the importation of mountain hay for race horses at local tracks. He also called attention to Mr. Teale's new book ''Green Treasury,'' an anthology of natural history writing.

Dr. Rehn then spoke of his work for the U. S. Army, particularly in the matter of tick control at Forts Dix, Drum and Devens. He mentioned that a DC-3 airplane will not give adequate coverage when using insecticides. A helicopter is far superior for this purpose. He mentioned that the year 1952 was a heavy house-fly year. None of the flies at the various military posts showed any resistance to DDT. He postulates that inadequate coverage and poor testing accounts for the real reason for the existence of the so-called resistant strains. Dr. Rehn also reported on the occurrence of the Lone Star tick on Staten Island, the first such appearance since 1850.

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OBSERVATIONS ON PSEUDOMYRMEX ELONGATA MAYR (HYMENOPTERA: FORMICIDAE)

BY WM. S. CREIGHTON
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The purpose of this note is to report the presence of *Pseudomyrmex elongata* Mayr in southern Texas and northeastern Mexico and to attempt a clarification of certain points in the taxonomy of this species. During 1951 and 1952 the writer took seven colonies of *elongata*, all of them in areas from which the insect has not been previously reported.[1] These records are as follows:

TEXAS: Monte Alto (60′) Hidalgo County, one colony in *Prosopis juliflora.*
26 miles north of Raymondsville, one colony in *Quercus virginiana.*

NUEVO LEON: El Pastor (2200′) west of Montemorelos, two colonies in *Quercus fusiformis.*

TAMAULIPAS: Canyon de el Abra (1000′) north of Antiguo Morelos, one colony in hollow stem.

SAN LUIS POTOSI: 3 miles north of Ciudad Valles (300′), one colony in hollow twig.
Rio Amahac, Tamazunchale (300′), one colony in dead twig.

The above records are of interest since they extend the range of *elongata* on the western side of the Gulf of Mexico by almost fifteen hundred miles. The previous northern record for this region was Costa Rica. It is now clear that *elongata* reaches approximately the same latitude on either side of the Gulf, for the Texas stations and those where *elongata* has been secured in southern Florida are all close to Latitude 26°. This makes necessary a modification of the view that the writer published in 1950 (1) that *elongata* probably reached Florida by way of the Antilles. The writer still feels that the above explanation is the most likely one, but the presence of *elongata* in northeastern Mexico and south Texas makes it possible that at one time the

[1] Field work done on a Guggenheim Fellowship.

range of *elongata* included the entire Gulf Coast. If so, its presence in southern Florida could be due to a regression to the south rather than to a migration to the north.

Because slight structural variations were found in the material coming from Texas and Mexico, the writer examined all available material belonging to this species. This examination has led to a different view from that which I published in 1950. At that time I accepted Wheeler's concept that the Cuban and Antillean representatives of *elongata* (the variety *cubaensis* Forel) were significantly different from the Florida population, which Wheeler treated as the typical *elongata*. I no longer believe this to be the case. Since I have seen no material of *elongata* coming from the southern part of its range, which extends to Colombia, the observations which follow may not apply to such specimens, although it seems probable that they do. But the population of *elongata* which occurs in southern Florida, the Bahamas, Cuba, Haiti, Jamaica, south Texas and northeastern Mexico cannot, in my opinion, be divided into geographical races. It is not that this population is invariable in structure, for there are minor differences in size, color, the width of the head and the shape of the petiolar node. But these differences occur in all parts of the range mentioned above. Unfortunately, these same variations were used by Forel as the basis for the recognition of the varieties *cubaensis* and *tandem*. Thus *cubaensis* was supposedly marked by a narrower head and a narrower and lower petiole, while *tandem* represented the opposite condition where the head is broader and the petiole shorter and higher. There is no difficulty in recognizing the variants that Forel described, but to assign to either of them a distinctive geographical range seems to the writer to be impossible. I propose, therefore to treat *cubaensis* and *tandem* as synonyms of the typical *elongata*. The synonymy of this species would be as follows:

Ps. elongata Mayr, Sitz. ber. Akad. Wien, Vol. 61, p. 413 (1870) ☿ Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 21, p. 85 (1905) ☿♀♂.

Ps. elongata var. *cubaensis* Forel, Ann. Soc. Ent. Belg. Voy. 45, p. 342 (1901) ☿. NEW SYNONYMY.

Ps. elongata var. *tandem* Forel, Ibid. Vol. 50, p. 228 (1906) ☿. NEW SYNONYMY.

The insect which Wheeler and Mann described in 1914 (2) as *Ps. elongata* subsp. *subatra* is clearly a separate species which should never have been assigned to *elongata.*

Despite the variations mentioned above, *elongata* is an easy species to recognize. It is small, dark in color and very densely sculptured, so that the surface presents a dull, matte-like appearance. Coupled with these characters is an unusually narrow head, with the large eyes extending to the level of the median ocellus and a short and high petiolar node (even in the variants where it is said to be "lower and longer"). This ease of recognition may account for the fact that neither Forel nor Wheeler ever failed to appreciate the salient characteristics of *elongata,* although neither worker was willing to discount the slight variations which mark this species over much of its range. It is interesting to note that in 1932 (3) Wheeler stated that there are "several varieties" of *elongata* in Cuba. Fortunately, he did not elect to name them.

There follows a key to the species of *Pseudomyrmex* which occur in the United States. This key is based on major structural characters as well as on the differences of color and pilosity which the writer employed as criteria in the key published in 1950.

1. The maximum diameter of the head (eyes included) distinctly greater than the distance from the occipital margin to the anterior edge of the clypeus; anterior peduncle of the petiole slender, distinct from the node and at least one-third as long as the node; erect body hairs everywhere abundant; length 8 mm. or more .... *gracilis mexicana*

   The maximum diameter of the head (eyes included) no more and usually much less than the distance from the occipital margin to the anterior edge of the clypeus; anterior peduncle of the petiole short, thick and often not clearly distinguishable from the node; erect body hairs sparse; length 6 mm. or less 2
2. The median ocellus lying at or very close to the level of the posterior border of the eyes; appressed pubescence abundant .... *elongata*

   The median ocellus lying well behind the level of the posterior border of the eyes; appressed pubescence dilute or absent 3
3. Thorax seen in profile with a broad and deep impression at the mesoepinotal suture; sides of the postpetiole, seen from above slightly concave giving a short but distinct anterior peduncle to the node; color dark brown, the head, pronotum and petiolar nodes more or less marked with yellow .... *brunnea*

   Thorax seen in profile with the mesoepinotal suture unimpressed or feebly and narrowly impressed; sides of the postpetiole, seen from above, slightly convex, the node without an anterior peduncle; color golden yellow to pale yellow 4

4. Greatest length of the eye a little less than one-half the distance from the insertion of the mandible to the occipital margin; cephalic sculpture heavy enough to dull the surface; worker 5–6 mm., female 7–8 mm. *apache*

Greatest length of the eye a little more than one-half the distance from the insertion of the mandible to the occipital margin; cephalic sculpture fine, not dulling the surface; worker 4–4.5 mm., female 5.5–6 mm. *pallida*

In conclusion it may be said that *elongata* is a rather timid and inoffensive ant compared to most species of *Pseudomyrmex.* It rarely stings and has a habit of dodging around to the rear of a twig if an attempt is made to pick it up. The colonies never seem to be very populous. There are rarely more than a hundred workers in a colony and usually the number is less. In most colonies a single female is present. It is noteworthy that *elongata* and *brunnea* will sometimes nest in the same limb. Most species of *Pseudomyrmex* are by no means so tolerant and ferociously exclude any other ants from the areas where they are nesting.

Literature Cited

1. Creighton, W. S. 1950. Bull. Mus. Comp. Zool. Harvard. **104**. p. 80.
2. Wheeler, W. M., and W. M. Mann. 1914. Bull. Amer. Mus. Nat. Hist. **33**: p 19.
3. Wheeler, W. M. 1932. Jour. N. Y. Ent. Soc. **40**. p. 4.

(*Continued from page 16*)

Mrs. Hopf displayed some abnormal chrysalids of the monarch butterfly from Bucks County, Penna.

The meeting adjourned at 9:30 P.M.

Louis S. Marks, *Secretary*

Meeting of November 18, 1952

A regular meeting of the Society was held at the American Museum of Natural History; Dr. Clausen presiding. There were 15 members and seven guests present. The previous minutes were read and after some minor amendments were accepted.

Mr. Elbert Dixon of the United States Bureau of Entomology and Plant Quarantine was proposed for membership.

(*Continued on page 42*)

GROWTH AND POLYMORPHISM IN THE LARVA OF THE ARMY ANT (ECITON (E.) HAMATUM FABRICIUS)[1,2]

BY JOHN F. TAFURI[3]

The army ant *Eciton* (*E.*) *hamatum* has been one of two species in the genus subjected to systematic investigation by Schneirla (1933, 1938, 1949a, 1949b). These investigations, directed primarily at behavioral analysis, have brought to light the significance of the unique broods and of events centering around brood development in these interesting ants. Although the adult worker of this species was described by Fabricius in 1781 and by Latreille in 1802, the developmental biology of the brood has escaped specialized attention in the literature except for a preliminary report by G. C. Wheeler (1943) on the external morphology of the worker larva. The present study was undertaken to investigate systematically the characteristics of development in the larval stages of this species.

Eciton hamatum exhibits the not uncommon phenomenon among ants of polymorphism in the adult worker series. That is, in this species the worker population ranges from the smallest worker minor to the large soldier form. The most general characteristic of this population series is overall size, and further quantitative differentiation through the series is found in characteristics such as mandibular and head patterns. Although in detail the series exhibits a considerable amount of quantitative

1 This paper represents a portion of a dissertation presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Biology at Fordham University.

2 This investigation was supported in part through a contract (NR 160–174) between the Office of Naval Research and the American Museum of Natural History, New York (Dr. T. C. Schneirla, project director). The studies were carried out at the Department of Animal Behavior of the American Museum of Natural History, New York. The author expresses his appreciation for the use of these facilities.

The author wishes to express his sincere gratitude to Dr. James Forbes, of Fordham University, for his untiring encouragement and guidance throughout this investigation. He is also indebted to Dr. T. C. Schneirla, of the American Museum of Natural History, for his counsel at all stages, and for supplying field data and material, and to Mr. M. Palekar, statistician, and to Rev. Dr. R. W. Allen, S.J., of the Mathematics Department, Xavier University.

3 The author's present address is Xavier University, Cincinnati, Ohio.

variation, there is a smooth series or regular transition in body length from the smallest to the largest form. In order to find what differences in the larval stages of development might forecast adult polymorphism, it was essential to examine closely the condition of all types of individuals in the brood at various representative stages of development.

To appreciate the specialized nature of the problems confronting this investigation, it is imperative to bear in mind the rather unique nature of a "brood" in *E. hamatum* and other species of *Eciton* (*Eciton*). After descriptions by Schneirla (1933, 1938, 1944) an Eciton worker brood may be defined as an immense series of individuals developing more or less in step from eggs laid within the same period of a few days. Schneirla's studies have revealed a regular pattern of behavior with the colony alternating between a nomadic phase and a statary phase. The army ant queen lays a new batch of eggs within the space of several days beginning about one-third through each statary phase. Thus the ages of all individuals in one generation vary by only a few days. In *E. hamatum,* immense broods of twenty-five thousand or more eggs appear approximately every thirty-six days through the season. Most of the larval development is accomplished during the nomadic phase which commonly lasts sixteen or seventeen days in this species. At the end of the nomadic phase the larvae enclose and the colony enters the statary phase. With such material all possibility of confusing individuals of different generations is eliminated, hence Eciton appears to be an ideal form for investigations of larval development and larval polymorphism. The dorylines are the only social insects with broods of this description.

As would be expected, classification of the larvae taken from such broods at different times of development represents a formidable problem. The literature offers no convenient or satisfactory scheme for separating the larva into instars such as those which have been worked out for other holometabolous insects. G. C. Wheeler (1938) with relatively limited material, designated army-ant larvae as "young (?) or immature and as mature," with body length used as the index of maturity. However, as a single criterion body length is an uncertain and misleading characteristic in the larvae of these ants, for actually, as it proves, a difference in body length between two randomly selected larvae can be due to a difference in polymorphic status, in developmental stage (i.e., age), or in both of these. For example, when larvae are preserved from the same brood at different stages, a major-type larva arrested at an early stage of development may have the same body length as a minor-type larva arrested at a later stage of development (see Plate III, fig. 9, and Plate IV, fig. 10). Only when the developmental stage is known can the significance of body length be evaluated correctly in Eciton larvae.

The problem required working out a reliable means of allocating single larval specimens or small samples of larvae from broods of unknown status to their respective growth stages. The problem thus stated would be insoluble if body length were relied upon as our exclusive criterion, for in body length the larvae presents a smooth series or regular transition from the smallest to the largest forms, as does the adult population. However, to anticipate, in our examination of external morphology in a series of large brood samples of known status, detailed structural differences have emerged which prove diagnostic for developmental stages. The size and developmental range of these samples have made possible a scheme for classifying Eciton larvae as to developmental stage. These studies of the external morphology paved the way for a differential study of the internal changes, to be reported in a further paper.

MATERIAL AND METHODS

The observations in this paper were obtained chiefly from Bouin-fixed larvae of the colony H-1, 1947, collected on Barro Colorado Island, Canal Zone, during November 1947 (Schneirla and Brown, 1950). Specimens from other colonies HB, 1946 Schneirla, 1949a) and H-11, 1948 (Schneirla and Brown, 1950) were also studied for purposes of comparison.

The material collected in the field represents samples taken from a particular brood of a colony at regular intervals from early larval development to larval maturity. An attempt was made to get representative samples, i.e., to include all the polymorphic forms, and care was exercised to limit the size of successive samples so as not to interfere with the general brood condition. The successive samples were collected from colony H-1, between November 7 to November 21, during one of its nomadic phases. The first sample was collected an estimated three days after the onset of nomadism. This sample contained more than 300 specimens consisting of eggs and newly hatched larvae. The second sample was collected two days after the first, i.e., on the fifth nomadic day, and contained about 70 larvae. The third sample was collected on the seventh nomadic day, two days after the second sample had been collected. This sample contained between 200 and 300 larvae. Similar samples were collected on the ninth, tenth, twelfth, fourteenth, sixteenth and seventeenth nomadic days and each sample contained between 200 and 300 larvae. The samples collected on the seventeenth nomadic day contained large and intermediate larvae that had become enclosed; the small larvae of this sample had not yet enclosed. A sample collected on November 23, two days after the seventeenth nomadic day, contained only enclosed larvae. This sample was taken on the second day of the statary phase when the brood was entering the prepupal stage (Schneirla, 1949b) and is, therefore, not considered in this paper.

The imaginal leg discs, antennal discs, gonopodal discs, head capsule, and degree of pilosity were some of the external structures studied. Measurements were made on most of these structures, but since the measurements of the leg discs proved most useful in relation to the main task, our attention in this paper is confined to them. Measurements were made with an ocular micrometer.

The following method was employed for selecting larvae for the leg disc measurements. The larval sample under study for each successive day collected during the nomadic phase was emptied as a whole into a Petri dish. Then with the aid of a dissecting microscope an attempt was made to select the five smallest and the five largest larvae, as well as the five larvae closest to the intermediate size. This procedure was designed to insure observation and examination of the extremes in the size of the larvae for each sample collected for the nomadic phase. Then successive samples could be studied comparatively in terms of corresponding points, viz., comparing the characteristics of the larvae of same size at the different stages of development during the nomadic phase. Since the distribution of the small, intermediate and large forms in any one larval series of any one sample was not critical for the purposes of this investigation, a random sampling technique was not employed.

OBSERVATIONS AND RESULTS

Preliminary observations of various structures of the army ant larvae indicated that the imaginal leg discs were the most important structures for separating the larvae into stages. In *Eciton hamatum* the leg discs are found in all stages, and, more-

TABLE 1

IMAGINAL LEG DISC SIZES FOR EACH POLYMORPHIC GROUP OF LARVAE COLLECTED DURING THE NOMADIC PHASE

Nomadic Day	Larvae	Body Length in mm.	Leg Discs Length in mm.	Leg Discs Width in mm.
3rd	All Small	0.50 to 1.40	0.021 to 0.028	0.021 to 0.042
5th	Small	0.70 to 1.30	0.021 to 0.028	0.021 to 0.028
	Inter.*	2.50 to 2.90	0.042 to 0.060	0.051 to 0.084
	Large	3.60 to 4.50	0.079 to 0.084	0.098 to 0.105
7th	Small	0.90 to 1.40	0.028 to 0.028	0.028 to 0.042
	Inter.	2.30 to 3.10	0.042 to 0.060	0.051 to 0.070
	Large	3.70 to 5.50	0.098 to 0.126	0.098 to 0.112
9th	Small	4.50 to 5.20	0.103 to 0.133	0.126 to 0.135
	Inter.	6.30 to 6.50	0.147 to 0.168	0.140 to 0.145
	Large	7.60 to 8.20	0.168 to 0.173	0.145 to 0.173
10th	Small	2.90 to 4.30	0.084 to 0.107	0.084 to 0.126
	Inter.	6.60 to 7.00	0.175 to 0.217	0.163 to 0.187
	Large	8.60 to 9.50	0.241 to 0.210	0.162 to 0.201
12th	Small	3.40 to 4.10	0.084 to 0.112	0.084 to 0.126
	Inter.	6.80 to 7.50	0.226 to 0.236	0.173 to 0.196
	Large	8.40 to 9.60	0.280 to 0.280	0.210 to 0.224
14th	Small	4.40 to 4.90	0.203 to 0.217	0.149 to 0.156
	Inter.	6.60 to 7.50	0.306 to 0.352	0.217 to 0.254
	Large	9.00 to 10.0	0.420 to 0.420	0.287 to 0.280
15th	Small	4.60 to 4.80	0.226 to 0.268	0.163 to 0.175
	Inter.	8.20 to 8.70	0.446 to 0.509	0.254 to 0.320
	Large	10.0 to 10.8	0.445 to 0.515	0.273 to 0.303
16th	Small	4.10 to 5.00	0.259 to 0.287	0.182 to 0.201
	Inter.	6.50 to 7.30	0.336 to 0.420	0.227 to 0.247
	Large	8.40 to 9.20	0.351 to 0.470	0.271 to 0.305
17th	Small	4.80 to 5.50	0.327 to 0.403	0.203 to 0.210
	Inter.	Enclosed ---	--------------	--------------
	Large	Enclosed ---	--------------	--------------

* Abbreviation used in this table to indicate the intermediate larvae.

over, these are one of the few structures readily accessible to measurement, which are found to display a growth rate independent of overall size. In contrast, a statistical evaluation of our data shows that the head capsule bears a direct relationship to body length regardless of the stage of development. It is otherwise for the leg discs in relationship to body length (Text-figures 1, 2, and 3).

In very young or immature larvae the size of all three pairs of imaginal leg discs is approximately the same. The respective sizes of the leg discs, furthermore, are the same for larvae of similar body length and the same stage of development. In other words there is little, if any, individual difference in the size of the leg discs in very young larvae. In more mature larvae the three pairs of leg discs may vary slightly in size in any one specimen and may also vary to a small degree in the larvae of similar body length taken from the same stage of development. There is a greater degree of intra- and inter-individual differences in these thoracic structures in the more mature larvae. These size differences in the leg discs of the more mature larvae, however, do not mitigate the usefulness of these structures for separating the larvae into more definite stages.

Table I represents the smallest and largest body length size for each polymorphic group of larvae. The figures for the leg discs represent the average size of leg discs measured for five larvae in each of the three polymorphic groups, i.e., the polymorphic small, intermediate and large larvae. An examination of Table I indicates that larvae of the same body length but of different nomadic days have leg discs of consistently different size increasing with age (Plate III, fig. 9, and Plate IV, fig. 10). This is clearly evident if a 6.6 mm. larva of the tenth nomadic day is compared with a 6.6 mm. larva of the fourteenth nomadic day. Small larvae may be collected near the end of the nomadic phase which have larger leg discs than large larvae collected at an early stage of nomadism, clearly indicating the more advanced age of the former and their polymorphic specialization. This fact is made quite clear when the leg discs of 4.8 mm. larva of the seventeenth day is compared with those of a 9.6 mm. larva of the twelfth nomadic day. However, the most critical test comes when the size of the leg discs is compared at successive

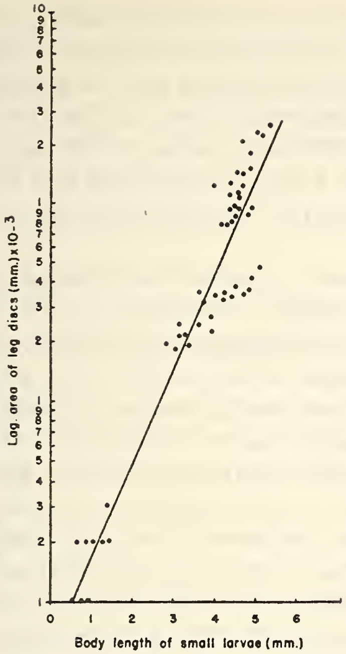

FIG. 1. Growth curve for the imaginal leg discs of polymorphic small *E. hamatum* larvae. The calculated slope is 2.864.

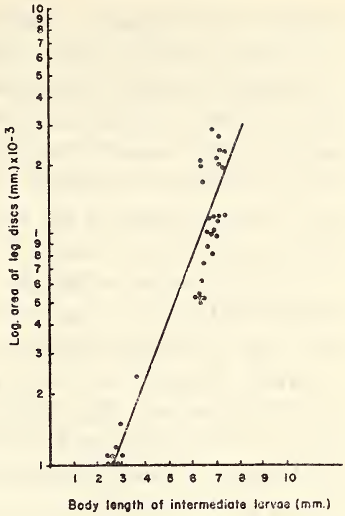

FIG. 2. Growth curve for the imaginal leg discs of the polymorphic intermediate *E. hamatum* larvae. The calculated slope is 1.785.

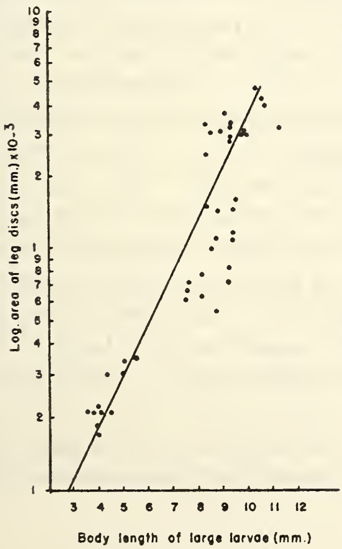

FIG. 3. Growth curve for the imaginal leg discs of the large *E. hamatum* larvae. The calculated slope is 1.635.

stages of development; for example, at the tenth, twelfth and fourteenth nomadic days. This is even a more exacting test than is the one in which earlier stages are compared since in samples taken after the tenth nomadic and especially from the fourteenth nomadic day onward, inter-stage differences in the size of the leg buds become more marked. Table I shows that despite this fact there is an increase in the leg discs in all types of larvae through the more advanced stages.

In order to get a graphic representation of the relationship which the leg discs bear to body length of the larvae, values for the area of the leg discs were plotted against the body lengths for each nomadic day for five larvae in each of the three polymorphic groups. The original data was plotted on arithmetic paper. The points plotted indicated that an exponential curve of the type $y = a\,b^x$ would best fit the relationship between body length and the area of the leg disc. In this formula y represents the area of the imaginal leg disc, x represents the body length of the larva, and a and b are constants. Each polymorphic group of larvae seems to have its own exponential curve. This was further brought out when the data was plotted on semi-logarithmic paper. A linear relationship was obtained when the leg disc area for each corresponding body length was thus plotted for the three polymorphic groups (Text-figures 1, 2, and 3). The rate of growth of the leg disc area with respect to the body length clearly varied among the three polymorphic groups of larvae, and was smallest for the large larvae, greater for the intermediate larvae, and greatest for the polymorphic small larvae. The constants a and b determine the type of exponential curve for each of the polymorphic groups. These constants were determined by the least square method. The exponential equations of the forms are for the polymorphic small larvae, $y = 0.0005801\ (2.864)^x$; for the polymorphic intermediate larvae, $y = 0.0021919\ (1.785)^x$; and for the polymorphic large larvae $y = 0.0025832\ (1.636)^x$. The larger b is, the greater is the rate of increase in the leg discs with respect to body length. The larger a is, the larger is the initial leg disc area, i.e., at the earliest stages of development.

An inspection and explanation of the figures in this paper will serve to demonstrate the most important external structures which, when correlated with leg disc size, were used for separating out the larvae into stages.

Plate I, figures 1, 2, 3, and 4, simply illustrates extremes in body length of the larvae of the third, fifth, twelfth, and fifteenth nomadic days. The extremes in body length for any one nomadic day and the overlapping of these body sizes into other days of the nomadic phase is indicative from size alone of at least three polymorphic types. The larvae collected on the third nomadic day, however, are characterized by all forms being small, transparent and anteriorly truncated. Most of the internal organs are visible through the body cuticle. The head segment in these larvae is poorly developed (Plate I, fig. 1). Plate II, figure 5, on the other hand, illustrates a typical head of a twelfth nomadic day larva which is well developed and tapering anteriorly. Sensilla turrets are clearly visible on this head segment. The head segment of the intermediate larvae of the fifth nomadic day has already assumed this shape and lost its truncated appearance. The small larvae of the fifth nomadic day possess antennal and gonopodal imaginal discs which differentiate them from any larvae of the third nomadic day.

Plate II, figure 6, illustrates another morphological character used for separating the larvae into stages, namely, the presence of a peripodal cavity which surrounds the leg discs and is present first in the large seventh nomadic day larvae.

The phenomenon of the leg discs overlapping the posterior margin of the thoracic segment in which they are found was still another character used for separating the larvae. Some of the intermediate larvae of the tenth nomadic day possess leg discs showing a precocious overlapping of these posterior margins. Only one or sometimes more than one leg disc may overlap the posterior margin of the segment. In most of the intermediate larvae of this group, however, the leg discs extend only to the posterior margin of the segment in which they are located. In the intermediate larvae of the twelfth nomadic day, the leg discs overlap the posterior margin of their segment (Plate II, fig. 7), as is the case in all larvae of succeeding nomadic days.

Segmentation of the leg discs is the last major morphological character used in separating the larvae and appears first in the intermediate fourteenth nomadic day larvae (Plate II, fig. 8).

In these specimens the leg discs appear segmented and have two or three marginal furrows which extend obliquely through the leg discs from the lateral to the median margin. The larvae of all succeeding groups also show this characteristic.

In addition to the more significant characteristics already mentioned it should be kept in mind that as the polymorphic types become mature the body width of all larvae increase in size. This is especially true for larvae collected after the fourteenth nomadic day, which have greater body widths than larvae of comparable body lengths collected prior to this period.

On the basis of larval morphological observations and data collected for leg disc sizes and body lengths, the following tentative key is proposed for separating the larvae into developmental periods based on nomadic days. It is realized that the key in its present form applies specifically to the material which was studied and variations in the measurements of the leg discs will undoubtedly occur when other *hamatum* larvae are applied. However, the measurements included are expected to be used as an aid in determining the position of the larvae with respect to the development of the other visible structures.

KEY TO THE LARVAL GROWTH STAGES OF E. HAMATUM

A. Leg discs oval or round without peripodal cavity; head segment larger than prothoracic segment .... B

B. Gonopodal discs and antennal discs absent; larvae transparent, gut and entire nerve cord visible through cuticle; body cuticle smooth C

C. Body length 0.021 mm. to 0.028 mm. in length and width .... N-3*, N-5 Small

CC. Body length approximately the same as in C but leg discs up to 0.028 mm. in length and 0.028 mm. to 0.042 mm. in width; mouth parts slightly better differentiated and sensilla turrets present .... N-7 Small

BB. Gonopodal discs and antennal discs present; larvae not transparent but first few ganglia of the ventral nerve cord visible through cuticle; body covered with irregularly arranged papillae; body lengths from 2.30 mm. to 4.50 mm., with leg disc lengths from 0.042 mm. to 0.084 mm. and widths from 0.060 mm.to 0.105 mm. .... N-5 Intermediate, N-5 Large, N-7 Intermediate

AA. Leg discs oval or round with a peripodal cavity; the prothoracic segment larger than the head segment .... B

* N-number, represents nomadic day.

B. Leg discs not overlapping the posterior margin of body segment .. C

C. Body segments sparsely covered with short hairs and the first few ganglia of the ventral nerve cord visible through cuticle; body lengths from 3.70 mm. to 5.50 mm. with leg disc lengths from 0.084 mm. to 0.126 mm. .... N-7 Large, N-10 Small

CC. Body segments uniformly covered with short hairs and first few ganglia of the ventral nerve cord not visible through cuticle .... D

D. Body lengths from 3.49 mm. to 5.50 mm. with leg disc lengths from 0.084 mm. to 0.133 mm. and widths from 0.084 mm. to 0.135 mm. .... N-9 Small, N-12 Small

DD. Body lengths greater than in D .... E

E. Body lengths from 6.30 mm. to 8.20 mm. with leg disc lengths from 0.147 mm. to 0.173 mm. and widths from 0.140 mm. to 0.173 mm. .... N-9 Intermediate, N-9 Large

EE. Body lengths from 6.60 mm. to 9.50 mm. with leg disc lengths from 0.175 mm. to 0.210 mm. and widths from 0.163 mm. to 0.201 mm. .... N-10 Intermediate, N-10 Large

BB. Leg discs overlapping posterior margin of body segment C

C. Leg discs not segmented .... D

D. Body lengths from 4.40 mm. to 4.90 mm. with leg disc lengths from 0.203 mm. to 0.217 mm. and widths from 0.149 mm. to 0.156 mm. .... N-14 Small

DD. Body lengths greater than in D .... E

E. Body lengths from 6.80 mm. to 7.50 mm. with leg disc lengths from 0.226 mm. to 0.236 mm. and widths from 0.173 mm. to 0.196 mm. .... N-12 Intermediate

EE. Body lengths from 8.40 mm. to 9.60 mm. with leg disc length averaging 0.280 mm. and widths from 0.210 mm. to 0.224 mm. .... N-12 Large

CC. Leg discs segmented .... D

D. Body lengths from 4.10 mm. to 5.50 mm. .... E

E. Leg disc lengths from 0.226 mm. to 0.268 mm. and widths from 0.163 mm. to 0.175 mm. .... N-15 Small

EE. Leg disc lengths and widths larger than in E ...... F

F. Leg disc lengths from 0.259 mm. to 0.287 mm. and widths from 0.182 mm. to 0.201 mm. .... N-16 Small

FF. Leg disc lengths from 0.327 mm. to 0.403 mm. and widths from 0.203 mm. to 0.210 mm. .... N-17 Small

DD. Body lengths from 6.50 mm. to 7.50 mm. .... E
E. Leg disc lengths from 0.306 mm. to 0.352 mm. and widths from 0.217 mm. to 0.254 mm. .... N-14 Intermediate
EE. Leg disc lengths from 0.336 mm. to 0.420 mm. and widths from 0.227 mm. to 0.247 mm. .... N-16 Intermediate
DDD. Body lengths from 8.20 mm. to 10.80 mm. and leg disc lengths from 0.420 mm. to 0.515 mm. and widths from 0.250 mm. to 0.305 mm. .... N-14 Large, N-15 Intermediate and Large, ... N-16 Large

DISCUSSION

In the past the study of growth processes in the larvae of social insects as the ant has been neglected by entomologists, who have turned mainly to the non-social insect for such studies. Consequently, development in social insects has not been as clearly understood as in other holometabolic insects. Reasons for this neglect are understandable. In a social organization developmental forms are confined to nests or hives, and the egg-laying of the queen is usually continuous during the warmer seasons. Hence, the larval population consists of a heterogenous mixture of individuals of mixed castes, ages and stages, often complicated by extensive worker differences in species which manifest polymorphism. Before the enigma proposed by individual differences on the adult level can be clarified, corresponding immature forms must be studied at reliably differentiated stages.

In *E. hamatum* the adult polymorphic workers form a continuous series from the smallest worker minor to the large soldier form, and appears, therefore, to involve an incomplete polymorphism. It is possible that further studies will reveal the presence of an incomplete dimorphic type of polymorphism as suggested by Wilson (1953). In the adult worker forms, as has been previously stated, beside differences in size there are apparent qualitative differences in this series marked primarily by exceptional hooked mandibles and head pattern of the major worker. However, in samples of *E. hamatum* larvae collected on successive days of the nomadic phase, characteristics such as are found in the adults to differentiate the polymorphic series, are not noticeably apparent. The obvious overlapping in the range of body sizes of the larvae for any one sample as compared with earlier or later samples collected during the nomadic phase which together with structural similarities, at first seems to defy differentiation of the larvae into growth stages. In actual fact any distinction of growth stages is impossible on the basis of body size alone. It has been further found that Dyar's rule and Prizbram's rule (Wigglesworth, 1939) are not applicable in determining the number of instars for the larvae and, therefore, the particular growth stage of the larva. Dyar's rule shows that the head capsule of caterpillars grow in a geometrical progression, increasing in width by a ratio which is constant for a given species. Prizbram's rule implies a harmonic growth where the dimensions of a part of a body increase at each moult by the same ratio as the body as a whole. Growth in all these larvae is actually disharmonic or allometric, i.e., the parts of the body grow at rates peculiar to themselves. The extremes in size in the larvae of *E. hamatum* and the over-lapping of these sizes during the different periods of the nomadic phase indicate polymorphism and is not due to instar growth.

A study of the morphological changes which accompany larval growth supports the hypothesis of polymorphism in the larvae. The norm for designating stages of larval development is based on the days of the nomadic phase as worked out by Schneirla (1938, 1949a). In terms of this norm it is possible to correlate specific characters with growth for different polymorphic larvae during the different days of the nomadic phase. However, these results show some limitations. Eggs are laid during the statary phase and embryonic development and a small amount of larval development takes place during this phase. The greatest part of larval development, however, occurs during the nomadic phase. In samples collected on the third nomadic day the most advanced members of this group were larvae measuring about 1.5 mm. in length, the least advanced members were eggs in various stages of embryonic development. Unfortunately, because of limitations in the range of our material, the earliest stages of larval development occurring prior to the nomadic phase were not available in the series used.

A visual method of selecting specimens from samples such as was employed in this study does not always insure the selection of true intermediate larvae. In some cases there is overlapping of structural characteristics of these larvae with structural characteristics of the smaller or larger forms, which would probably be indicated if polymorphism is of the incomplete dimorphic type. This difficulty might be more easily resolved if the intermediate specimens were selected at equal intervals of the size range of the sample. However, since the larvae like the adult workers apparently form a smooth series from the smallest to the largest forms, it was considered adequate to select specimens on a visual basis into categories representing the extremes and the median in body sizes. Conditions under which field samples are taken do not always permit representative samples to be obtained, hence the polymorphic extremes which make up a small percent of the population may be inadequately represented in some samples. This is the case with the measurements reported in Table I for the small larvae of the ninth nomadic day. A comparison of the ninth nomadic day larvae with those of the tenth and twelfth nomadic days indicates there must have been smaller larvae in the population than those actually obtained for the ninth nomadic day. Hence, the smallest ninth nomadic day larvae in this material shows a precocious morphological development normally present in the smallest larvae of later samples.

In appraising the present results minor visual errors must also be considered in measuring and examining small structures. The averages obtained for specimens of given size and growth stage show a consistency despite intra- and inter-individual differences in the imaginal leg disc sizes recorded for individual specimens. It is presumed that over and above the expected observer's error in measuring the leg discs for any one individual an actual growth differential exists in this respect. The nature of this growth differential is suggested in our results by a size gradient in leg disc pairs ranging from the smallest in the first pair to the largest in the third pair.

A precocious overlapping of the posterior margin of the segments by the imaginal leg discs was first observed in some of the intermediate tenth nomadic day larvae but not in the polymorphic large larvae of this group. Why this overlapping was not found in the smallest and largest larvae is not clear.

Wheeler (1938) investigated the leg vestiges in *E. hamatum* and other army ant larvae. These structures are subcircular, convex, slightly elevated cuticular papillae, which lie ventral to the imaginal discs. His figures 2, 3, and 5, show the close relationship between these vestiges and the imaginal leg discs, but the present paper is not concerned with the study of the leg vestiges. These structures were seen in many of the larvae but were not always discernible and consequently, not applicable for use as a distinguishing character.

The principle employed in this study for separating the larvae into stages and establishing the existence of polymorphism in these forms was based on the heterogonic growth of the imaginal leg discs. This principle is not a new one and has often been employed in such studies.

Investigators have observed that certain organs increase in relative size with the absolute size of the body that bears them, but Huxley (1932) was first to demonstrate the significant relationship between the magnitudes of the two variables by his heterogony formula, $y = b\ x^k$, later revised to $y = bx^a$ (Huxley and Teissier, 1936). In this revised formula, as applied to the present study, y represents leg-disc dimension, x represents body length, and b and a are growth constants, a representing the equilibrium constant and b the value of y when $x = 1$, i.e., the initial growth index. Huxley was first to show that problems in polymorphism in ants can be related to problems in allometric growth in other animals. For example, he finds that the morphological relationship of the chelae of many male and some female Decapods and other appendages of various crustacea follow the rule of constant differential growth ratios. Dudich (1923) finds that *Cyclommatus tarandus* has marked heterogenic male mandibles. Coleopterists distinguish main types based on mandible characters. Prizbram (1930) finds that the legs in Orthoptera also obey this rule. The earwig, *Forficula auricularia,* bears at the end of the abdomen a pair of cerci named "pincers" which vary with sex (Paulian, 1937). Measurements of the pincers show that two polymorphic types are present in the male.

In neuter social insects that show polymorphism, Huxley states that such series are characterized by relative increase of head, and especially mandible size, with an absolute increase in total size. He believes workers and soldiers represent a series of size forms of a single genetic type possessing a mechanism for heterogony or allometry of mandible and head. In ants the absolute size range appears to be greater than for other holometabolous insects, the size differences being brought about by the amount of food fed the larvae by their nurses. The largest larval forms are fed to the limit; the smallest are deprived of food and forced to pupate while still small larvae. Emery (1921) has shown this behavior to be true for ants. Wesson's work (1940) goes one step further and gives evidence that overfeeding plays an important role in the production of the large queens as against the smaller workers. More recently the studies of such invesigators as S. F. Light (1942, 1943) on the social insects, that of R. E. Gregg's (1942) on Pheidole, M. V. Brian's (1951, 1952) studies on caste determination in *Myrmica rubra,* and A. Ledoux's (1950) work in *Oecophylla longineda,* reveal evidence of caste determination during the larval stages. Flanders (1945, 1952), on the other hand, has suggested that caste determination may occur in the eggs at the period of maturation or at the time of laying. The results obtained in this investigation support caste differentiation during the larval period. Cohic (1946), making use of the rule of constant differential growth ratios, finds in the workers of *Dorylus* (*Anomma*) *nigricans* evidence for a mechanism for heterogony of the head, mandible, scape of the antenna, and leg parts and on the basis of his results separated the workers of this species into four types.

It would appear from the observations in this investigation that in the case of determination of castes in *E. hamatum,* growth trends are fixed during the larval stage and proceed without interruption to form the adult ant. The main features of adult caste formation are dependent on the differential growth of such structures as the imaginal leg discs, which possess specific growth rate potentials in the larva. The growth of the larval tissues apart from the imaginal discs is approximately regulated to allow final expression of the leg disc potentials.

On the basis of three distinct growth curves and different slopes in at least the small and large larvae good evidence is offered for believing that the size of the leg discs in relation to body length of a particular polymorphic group may provide an index of larval age, or in other terms, offer a clue to the time in the nomadic phase when a given sample was taken.

SUMMARY

A morphological study was made on several stages of worker larvae of *Eciton* (*E.*) *hamatum* to determine evidences of larval polymorphism. Specific external characters are correlated with growth and development of the larvae.

The extreme range in the body sizes permitted the separation of the larvae arbitrarily into three groups; small, intermediate and large.

The size and development of the leg discs, the shape of the head segment, the appearance of the imaginal discs, degree of transparency, and pilosity were noted for the different size larvae of each group. These characteristics are correlated with the days of the nomadic phase which have been used to designate successive stages of larval development.

The results obtained are tabulated, and a key for separating the larvae according to nomadic day is proposed. The limitations of this key have been discussed.

A comparison of the leg discs with body length indicates that these structures have an independent growth rate in the small, intermediate, and large larvae. These results are represented graphically. This independent growth rate makes possible the separation of the larvae of similar body lengths but different development stages into different polymorphic groups. It also indicates larval age.

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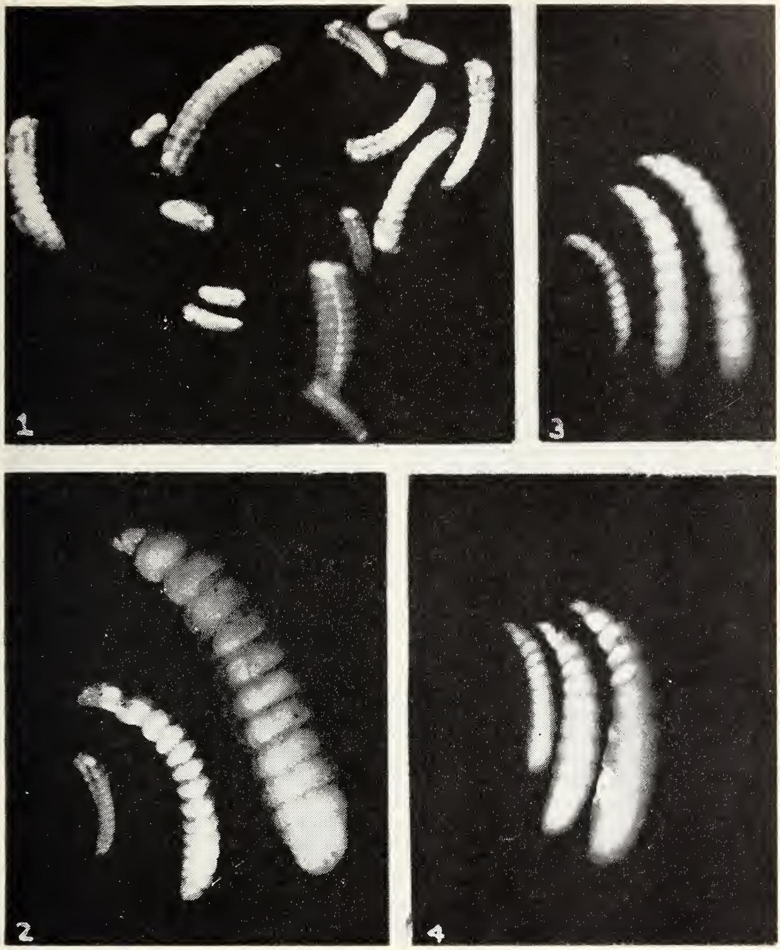

PLATE I

FIG. 1. Third nomadic day larvae of *E. hamatum*. ×19.

FIG. 2. Small, intermediate, and large fifth nomadic day *E. hamatum* larvae. ×14.

FIG. 3 Small, intermediate, and large twelfth nomadic day *E. hamatum* larvae. ×4.5.

FIG. 4. Small, intermediate, and large fifteenth nomadic day *E. hamatum* larvae. ×4.5.

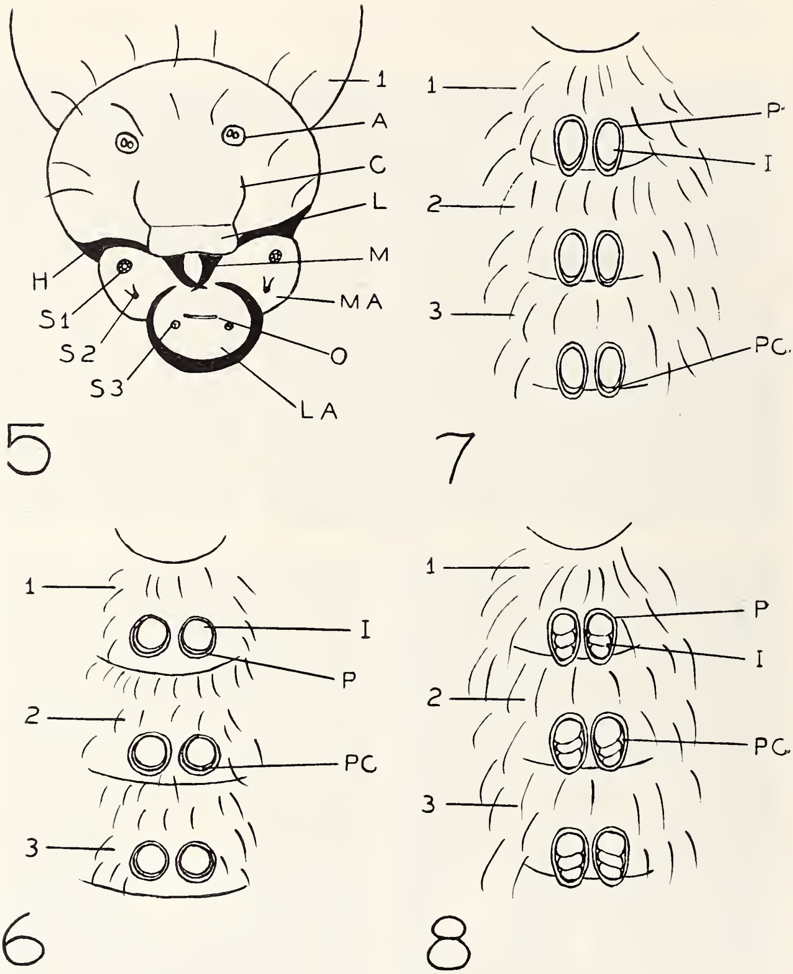

Plate II

Fig. 5. Head of twelfth nomadic day *E. hamatum* larvae. 1, first thoracic segment; A, antennal disc; C, clypeus; H, habena maxilla; L, labrum; LA, labium; M, mandible; MA maxilla; O, opening of the spinning gland; S_1, S_2, S_3, sensilla turrets.

Fig. 6. Ventral view of the thoracic segments of a large seventh nomadic day *E. hamatum* larva. 1,2,3, first, second, and third thoracic segments; I, imaginal leg discs; P, peripodal membrane; PC, peripodal cavity.

Fig. 7. Ventral view of the thoracic segments of an intermediate twelfth nomadic day *E. hamatum* larva. 1,2,3, first second, and third thoracic segments; I, imaginal leg discs; P, peripodal membrane; PC, peripodal cavity.

Fig. 8. Ventral view of the thoracic segments of an intermediate fourteenth nomadic day *E. hamatum* larva. Labelling the same as in figures 6 and 7.

(JOUR. N. Y. ENT. SOC.), VOL. XVIII (PLATES III, IV)

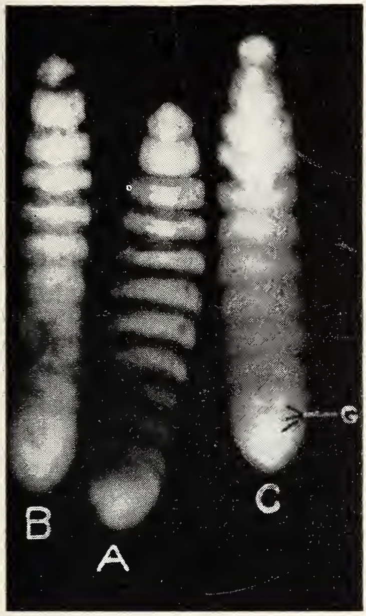

PLATE III

PLATE IV

PLATE III. A comparison of the size of the leg discs in 5.5 mm. *E. hamatum* larvae of different nomadic days. ×14. A, large larva of the seventh nomadic day; B, small larva of the twelfth nomadic day; C, small larva of the seventeenth nomadic day; G, gonopodal discs.

PLATE IV. A comparison of the size of the leg discs of large and intermediate *E. hamatum* larvae of different nomadic days but of nearly similar body lengths. ×14. A, large larva (8.3 mm.) of the ninth nomadic day, leg discs within the margin of the segment; B, large larva (8.5 mm.) of the twelfth nomadic day, leg discs overlap the posterior margin of the segment; C, intermediate larva (7.9 mm.) of the fifteenth nomadic day, leg discs segmented and overlap the posterior margin of the segment.

(*Continued from page 20*)

Dr. Forbes moved for the suspension of the By-Laws and proposed that Mr. Dixon be elected to membership at this meeting. The proposal was approved.

Dr. Vishniac introduced Dr. Roeder of Tufts College, the speaker of the evening. Dr. Roeder's topic was "Experimental methods applied to the study of insect physiology".

By means of lantern slides Dr. Roeder demonstrated the efficiency and mode of operation of electronic devices and circuits in the study of insect flight. As a result of his work he proposed that insects be grouped into two flight classes. Dr. Roeder's remarks were followed by extensive discussion.

The meeting adjourned at 9:45 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF DECEMBER 2, 1952

A regular meeting of the Society was held at the American Museum of Natural History; Dr. Clausen presiding. There were 15 members and nine guests present. The minutes of the previous meeting were read and approved.

The minutes of the recent meeting of the Executive Committee were read. In these minutes note was made of a gift to the Society of $500.00 by Mr. Herbert F. Schwarz. The gift is to be used to help defray the indebtedness accrued through the publication of the Journal. Dr. Clausen publicly thanked Mr. Schwarz for his contribution on behalf of the entire Society.

Dr. Clausen appointed a nominating committee consisting of Dr. Forbes (Chairman), Mr. Schwarz and Dr. Cazier.

The Secretary called attention to the several notices regarding the Society and its members activities as broadcast over the French edition of the Voice of America by our fellow member, Lucien L. Pohl.

Dr. Vishniac then introduced Mr. John C. Pallister of the American Museum staff who spoke on his recent exploring and collecting expedition to Yucatan, Mexico. The trip was made under the auspices of the Explorers' Club of New York. The talk was illustrated with many kodachromes and three reels of motion pictures, the last of which, through an unforeseen breakdown of the projection apparatus, was only partly shown. As a result of this very fine presentation the members of the Society went away with a better understanding of the ecology, geography and natural history of Yucatan.

The meeting adjourned at 9:40 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF DECEMBER 16, 1952

A regular meeting of the Society was held at the American Museum of Natural History; Dr. Clausen presiding. There were 8 members and 6 guests present. The minutes of the previous meeting were read and approved.

(*Continued on page 52*)

THE EFFECT OF SUBMERGED PINE NEEDLES ON THE OVIPOSITION AND DEVELOPMENT OF ANOPHELES QUADRIMACULATUS SAY[1]

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INTRODUCTION

A study of the effect of submerged pine needles on the oviposition and development of mosquitoes was instigated by a report from T. J. Roe, CWO, USN. Mr. Roe noticed that sand buckets filled with rain water and containing pine needles harbored no mosquito larvae, while those without needles produced several hundred larvae of *Culex quinquefasciatus* Say. It was hypothesized that the submerged pine needles could either cause the water to be unsuitable for oviposition, or to retard or inhibit larval development.

Various products from pine trees have been utilized as insect repellents and insecticides. Davis and Turner (1918) found that pine sawdust had a decidedly repellent effect on cutworms. Bishopp et al (1923) noted that various pine oils have a definite repellent value against flies, and Cory (1928) stated that volatile emanations from crude pine oil alone and in emulsions were markedly repellent to ants. Pine oil possesses definite repellent value against certain *Aedes* mosquitoes according to MacNay (1939), although not as effective as other materials tested. Studies by Blagoveschenskii and coworkers (1943) on d-x-pinene, obtained as a waste product in the process of purification of juniper oil in Central Asia, indicated that it was repellent to mosquitoes. With reference to insecticidal properties of pine tree products, Headlee (1929) found one of the fractions obtained by the de-

This work is not to be construed as necessarily reflecting the views of the Department of the Navy.

[1] The author wishes to express his appreciation to LCDR R. S. Leopold, MSC, USN; LCDR M. R. Lewis, MSC, USN; LTJG R. H. Kathan, MSC, USN; G. H. Amerine, T/Sgt, USMC; L. L. Buck, HN, USNR; and Miss E. McIntosh for their kind assistance in the conduct of this study.

[2] CDR MSC USN.

structive distillation of pine stumps, roots and branches with caustic soda to be effective in trunk treatments to kill overwintering codling moth larvae. Barnes (1925) showed that "pine oil, though very toxic to mosquito larvae is not suitable for use on water, as the film it forms breaks up too rapidly for practical purposes." He concluded that pine oil has a powerful soporific or paralyzing effect upon the larvae and pupae and results in their death either directly or apparently by drowning while under the effects of the drug. According to Shugar and Wyrap (1942) and Shesterikova and Bushurova (1942) extracts from the distillation of pine wood are toxic to mosquito larvae.

Very little is to be found in the literature about the insecticidal properties of pine needles. Lagereva (1947) discussed the freeing of cattle of *Psoroptes* by rubbing the affected parts with a liniment prepared from pine needles and crude cresol. Barnes (1925) found that the eggs of *Anopheles quadrimaculatus* are not uniformly destroyed by the film formed by pine oil and kerosene.

With reference to the composition of pine oil, Wirth (1943) stated that it is obtained by the steam distillation of the wood of *Pinus palustris* Miller and other species of *Pinus*. It is a volatile oil composed chiefly of tertiary and secondary terpene alcohols. Pearson (1935) gives its composition as mainly terpenes, alcohols, ethers and ketones. According to Bau (1921) the residue left by steam distillation of pine needles is a wax containing cetyl, ceryl and myricly alcohols; palmitic, phdroxypalmitic (A) and steric acids; phytesterol; obeitic acid; dihydroxystearic acid and lower fatty acids, including butyric. Working with Philippine pine needle oil from *Pinus insularis* de Santos, West and Esquerra (1931) gave an analysis of the oil as largely *A* and *B* pinene and a small percent of esters calculated as bornyl acetate.

MATERIALS

Tests with submerged pine needles were conducted with *Anopheles quadrimaculatus* Say. eggs, larvae, pupae and adults. The needles were from large Loblolly pine trees, *Pinus taeda* L. Oviposition studies were conducted by placing pine needles in Petri dishes containing tap water in cages with adult female mosquitoes. Larval and pupal studies were conducted in 250 ml. beakers and 8 by 12 inch stainless steel pans. The larvae were fed measured amounts of ground commercial dog food. All experiments were carried on at room temperature 76–80° F. The pine needles averaged seven inches in length and included the encircling sheath at the base (groups of three needles).

PROCEDURE

Oviposition preference was determined by placing 10, 20, and 30 pine needles in separate Petri dishes containing tap water. The needles were cut into approximately one-fourth inch lengths. The three dishes were placed three inches apart in a line across the center of the floor of a 19 by 19 inch screened cage containing approximately 500 adult *Anopheles quadrimaculatus*. Three dishes containing tap water as controls were placed individually in front and against each of the dishes containing the needles also three inches apart. All dishes were left overnight in the cage and removed after 21 hours. The results are shown in Table 1.

TABLE 1

EFFECT OF SUBMERGED PINE NEEDLES ON OVIPOSITION AND EARLY LARVAL DEVELOPMENT OF *Anopheles quadrimaculatus*

Number of needles	Number of eggs	Number hatched	Per cent hatched	Mortality of larvae age in days					Per cent dead
				1	2	3	4	5	
10	259	206	79.5	142	184	198	204	206	100
Control	4,155	3,812	91.7		58	81	150	160	4.2
20	313	200	63.9	143	192	200			100
Control	1,607	1,470	91.5		44	61			4.1
30	204	68	33.3	57	68				100
Control	3,086	2,831	91.7		50				1.8

Collectively, the three dishes containing pine needles contained 776 eggs compared with 8,848 in the controls or only eight per cent of the eggs were deposited on the pine needle water. However, subsequent tests involving 30 pine needles indicated that the mosquitoes laid as many eggs in the pine needle water as they did in the controls. The number of eggs laid on the water in the three dishes containing needles were not appreciably different. An average of 61 per cent of the eggs laid in the pine needle water ultimately hatched, compared with 92 per cent in the controls. In individual cases, the percentage of eggs that hatched decreased from 80 per cent in the dish with 10 pine needles to 33 in the one with 30 needles, while the controls remained constant at 92 per cent hatch. Apparently, the eggs that were laid during the first few hours were deposited on the water before the wax film was completely formed. Those deposited later were on top of the film, and although slightly moist, did not hatch. This would account for the decreased percentages of hatch as the number of needles increased, forming a film more rapidly and of greater density. The number of days to complete larval mortality decreased from five days for 10 needles to two for 30 needles, indicating a more rapid death rate with increased numbers of needles.

In preliminary tests with older larvae, a large number of green and dry (fallen) pine needles (300 each, 7 inches long) were cut into one-half inch lengths, ground separately in 200 ml. tap water and sand with mortar and pestle, and the supernatant liquid was placed in 250 ml. beakers. Fifty larvae 2 days old were placed in each beaker. Those in the liquid from green pine needles showed 68 per cent apparently dead in 2 hours and those in the liquid from dry needles, 50 per cent. In five hours, the green needle-water produced 72 per cent mortality while the dry needle water remained at the 50 per cent level. In twenty-one hours (over night) all were dead in both groups while the controls attained only 15 per cent mortality. Subsequent tests on the basis of whole green and dry needles indicated that the green needles produced greater mortality in 48 hours than the dry. For this reason all further observations were conducted with green needles. The results for green needles are given in Table 2.

In order to determine the number of needles necessary to produce mortality in five day old larvae, 5, 10, 20, 30, 40, 50 needles cut into half inch lengths were placed in separate 250 ml. beakers containing 200 ml. of water. Fifty larvae were placed in each beaker. The larvae were fed measured amounts of ground dog food. As shown in Table 2, ninety-six to ninety-eight per cent mortality was produced in nine days with 30 to 40 needles respectively. Fifty needles yielded 100 per cent mortality in five

TABLE 2

Mortality of Larvae Exposed to Submerged Green Pine Needles

Number needles	Length of cut needles	Type container	Volume water	No. larvae	Mortality in days									Per-cent dead
					1	2	3	4	5	6	7	8	9	
5	0.5 inch	250 ml. beaker	200 ml.	50	1	6	10	10	12	15	19	19	19	38
10	"	"	"	"	9	9	9	9	13	18	21	23	23	46
20	"	"	"	"	13	13	13	13	13	21	23	23	23	46
30	"	"	"	"	22	22	25	26	33	41	43	47	48	96
40	"	"	"	"	25	38	38	45	46	48	49	49	49	98
50	"	"	"	"	32	40	41	46	50					100
Control	—	"	"	"	0	4	5	5	7	7	7	7	7	14
30	0.25 inch	"	"	"	48	48	48	49	50					100
50	"	"	"	"	49	50								100
70	"	"	"	"	41	50								100
100	"	"	"	"	50									100
Control	—	"	"	"	0	0	4	4	10					20
100	0.25 inch	8″ × 12″ pan	800 ml.	100	58	71	84	90	92	92	98	100		100
200	"	"	"	200	104	156	180	196	197	199	200			100
300	"	"	"	200	110	160	183	199	200					100
Control	—	"	"	200	2	12	12	12	12	12	14	21		11

days. Fourteen per cent mortality occurred in the controls. Seven day old larvae exposed to 30, 50, 70 and 100 one-fourth inch needles under the same conditions reached 100 per cent mortality in five, two, two and one day respectively with 20 per cent mortality in the controls after five days.

Since needles cut into one-fourth inch lengths produced mortality in a shorter time than those one-half inch long, tests were made in 8×12 inch stainless steel pans containing 800 ml. of water to determine the mortality over a larger surface area. One hundred to 200 five day old larvae were used per pan. The needles in one-fourth inch lengths were placed in the pans at the rates of 100, 200, and 300 needles per pan. The mortality reached 100 per cent in eight, seven and five days respectively with 11 per cent dead in the controls. Fifty-two pupae developed in the controls, but none developed in the pans containing pine needles.

The results indicate that *Anopheles quadrimaculatus* larvae in 800 ml. of water with a surface area of 96 square inches do not reach maturity in the presence of 100 pine needles under laboratory conditions, and that the time necessary for death decreases as the number of needles is increased.

The needles produce a wax-like film over the surface of the water which is similar to a coating of very thin paraffin. The actions of the larvae in attempting to remain at the surface of the water, indicate that drowning may play a part in causing death, although the decrease in egg hatch may indicate a toxic action also. Oviposition will occur on water saturated with turpentine, but very few eggs hatch. In very dilute solutions of turpentine, the eggs hatch, but the larvae die shortly thereafter. It is possible, therefore, that the terpene alcohols may be a prominent factor in larval mortality. Starvation may also be a factor since the larvae were unable to feed at the surface and food would not spread over the surface.

In order to determine the effect of pine cones on larval development, 15 young cones one inch long by one-fourth inch in diameter were placed in 200 ml. of water in a 250 ml. beaker with 50 larvae. Ninety-six per cent of the larvae were dead in four days.

Pine gum in water did not cause mortality to larvae.

One-half inch lengths of one-fourth inch diameter limbs (from section of limb eight inches long producing pine needles) gave 28 per cent mortality to 50 larvae in 200 ml. of water (250 ml. beaker) in 48 hours and only 66 per cent in 11 days.

Pupal mortality was determined by placing 100 pupae in 800 ml. of tap water in each of three 8 by 12 inch pans containing 100, 200 and 300 submerged green pine needles respectively. The needles were cut into approximately one-fourth inch lengths. The pupae were from larvae that had pupated within 24 hours of the experiment. The control consisted of 100 pupae in the same type pan in tap water. Mortality counts were made 24, 48, and 72 hours following initiation of the test. The results are given in Table 3.

TABLE 3

The Effect of Submerged Pine Needles on Pupal Mortality and Adult Emergence

Number of needles	Number of pupae	Percent pupal mortality by days			Percent adults from remaining pupae		
		1	2	3	1 day	2 days	3 days
100	100	7	24*	25*	.01	86.8	100
200	100	8	15**	19*	.00	63.5*	100
300	100	5	21*	26*	.01	56.9*	100
Control	100	4	7	7	.01	82.8	100

* Significant at the .001 percent level of confidence (Significance of difference between proportions).

** Significant at the .01 percent level of confidence.

The pupal mortality in each of the pans containing submerged needles was significantly greater than the mortality in the control pan on the second and third days. On the second day the adult emergence from the pan containing 100 needles was not significantly greater than the controls, but the emergence from the pans containing 200 and 300 needles was significantly less than the emergence from the 100 needle and control pans. This indicates that submerged pine needles cause some increase in mortality and retard adult emergence. However, 100 per cent of the remaining pupae had produced adults by the third day in all cases.

In order to observe the effect of pine needle water on adult mosquitoes, 290 green needles were boiled for 30 minutes in a loosely capped beaker. Twenty adult females were sprayed with the supernatant fluid with an atomizer until the insects were wet. There was no mortality in 24 hours. Similarly 20 females sprayed with supernatant fluid from uncut needles allowed to stand in water 24 hours produced no mortality. Material from green pine needles cut into one-half inch lengths and ground in water with sand produced no mortality when sprayed on adult females. The controls were sprayed with tap water and remained normal. Organic solvent extraction might help clarify the question of insecticidal activity against adult mosquitoes and the mode of action on larval forms since the material released by the needles is relatively insoluble in water.

CONCLUSIONS

Anopheles quadrimaculatus females exhibit no aversion to oviposition on water containing green pine needles. The needles produce a wax-like cover over the surface of the water. The number of eggs that hatch decrease as the number of pine needles in the water is increased. The death rate of the larvae increases as the number of pine needles becomes greater. The larvae are killed in water containing either green or dry needles, but greater mortality is produced by the green needles. The detrimental action of needles is enhanced by cutting them into one-fourth inch lengths. One hundred needles are required to kill larvae in nine days in 800 ml. of water with a surface area of 96 square inches. The time is reduced to five days when 300 needles are utilized.

Since egg hatch and larval mortality are adversely affected by dilute solutions of turpentine, it is possible that terpene alcohols in the pine needles may be a prominent factor in larval mortality. Drowning, due to the film over the water, and starvation, due to inability to obtain surface food, may also contribute to mortality.

Young pine cones have been shown to inhibit larval development. Small branches cut into short lengths show some detrimental effect on larvae. Pine gum did not cause larval mortality.

Submerged pine needles caused some pupal mortality on the second and third days, and retarded emergence on the second day. However, all remaining pupae emerged on the third day.

There is no evidence that the water from submerged pine needles is toxic when sprayed on adult mosquitoes. Organic solvent extracts might clarify the question of insecticidal activity since the material released by the needles is relatively insoluble in water.

Field tests of this method of mosquito control are warranted, and it appears to provide an alternate method of field control under certain conditions. However, rain, wind, and other factors could conceivably nullify the effect of the wax film on the water.

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(*Continued from page 42*)

Dr. Clausen appointed an Auditing Committee consisting of Dr. Gertsch and Mr. Huntington.

The paper of the evening was given by Dr. Harold Hagan of the College of the City of New York, a past President of the New York Entomological Society. His topic was "Evolutionary Sequences in the Development of Reproductive Systems".

Dr. Hagan distinguishes between what he calls balanced and unbalanced systems. A balanced system is one which has all parts and organs equipped to perform a function to get an end product. An unbalanced system is one which has lost one or more of these factors, be it an organ or a function. By use of the development of the reproductive systems of various orders of insects, Dr. Hagan was able to show certain trends that have taken place. The primitive reproductive system utilized only mesoderm in its origin and was laid down metamerically, terminating in a primitive gonopore. Later modifications utilize the invagination of ectodermal tissue, at least twice in the phylogeny of the system resulting in subsequent displacement of the original primitive gonopore.

A discussion followed the presentation of this paper.

The meeting adjourned at 9:45 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF JANUARY 6, 1953

The annual meeting of the Society was held at the American Museum of Natural History; Dr. Clausen presiding. There were 11 members and 10 guests present. The minutes of the previous meeting were read and approved. The Secretary certified that a quorum was present. There were no officers' reports.

Dr. Forbes reporting for the Nominating Committee proposed the following slate of officers for the coming year:

President—Dr. Lucy Clausen
Vice President—Dr. Roman Vishniac
Secretary—Dr. Louis S. Marks
Asst. Secretary—Dr. Frederick Rindge
Treasurer—Mr. Arthur Roensch
Asst. Treasurer—Mrs. Patricia Vaurie
Editor—Mr. Frank Soraci
Editor Emeritus—Dr. Harry B. Weiss
Asst. Editor—Mr. Herbert F. Schwarz
Trustees—Messrs. Huntington, Teale, Drs. Klots and Cazier.

There were no other nominations and those presented were seconded and duly elected.

Dr. Vishniac introduced the speaker of the evening, Mr. Jay Fox of Seaford, Long Island, who spoke on "Motion Picture Photograph in Nature." He illustrated his remarks with prize-winning motion pictures which utilized

(*Continued on page 58*)

A PRELIMINARY STUDY OF PENNSYLVANIA MECOPTERA

BY S. W. FROST AND JOANNE PEPPER BROWN

HISTORY

Early references were made to Mecoptera by Pliny and Aristotle. They spoke of them as winged scorpions which no doubt referred to these insects. The first definite reference to Mecoptera is that of Aldrovandi (1602) who placed them in the Diptera. In the tenth edition of Systema Naturae (1758) Linnaeus grouped them in the genus Panorpa and the order Neuroptera. Latrielle (1801) placed them in a separate family, the Panorpatae. The order Mecaptera was established by Packard (1886) and this was changed by Comstock (1895) to Mecoptera as it stands today.

The Mecoptera form a small group and comparatively few papers have been published on this order. The best and most comprehensive is that by Carpenter (1931) on the revision of the Nearctic species. Setty (1940) contributed considerable on the family Bittacidae. Carpenter and Tillyard have published several articles on the fossil species. Many notes on individual species have been published, but no extensive papers have appeared since 1931.

IMPORTANCE OF GROUP

They are interesting insects and at times and in certain localities are frequently abundant. However, they have been collected and studied by comparatively few entomologists. This is partly due to the fact that they are of little economic importance except as food for other animals or in their capacity as scavengers. Although not of direct importance to man, it is significant that they do not destroy foliage or vegetation and do not bite or inconvenience him in any way.

The Mecoptera are valuable in fundamental taxonomic studies. Their primitive structure and ancient origin has aided in study-

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ing the development of morphological structures in closely related orders. As a matter of fact, these studies have served to bring this, one of the smallest of insect orders, into prominence. Based on numerous fossil remains obtained from the Carboniferous, Permian, Triassic and Jurassic periods, Tillyard (1935) has shown that the Trichoptera, Lepidoptera, Diptera and probably the Siphonaptera have all originated with the Mecoptera from a common ancestor. It is also interesting to note that the Mecoptera were more abundant during the Permian period than at the present. Carpenter (1930) gives figures to show that they constituted 9.0 per cent of the total insects in the Permian, 3.3 per cent in the Tertiary and only .035 per cent at the present.

CLASSIFICATION

Approximately 300 species of Mecoptera are known from the world. Three-fourths of them are found in temperate and subtropical regions. Their distribution includes Australia, New Zealand, Europe, Central, South and North America. About 70 species have been described from North America and twenty-three are definitely known from Pennsylvania.

Six families of Mecoptera are recognized: The Notiothaumidae, Nannochoristidae, Meropidae, Bittacidae, Panorpidae, and Boreidae. Only the last four of these occur in Pennsylvania. The largest number of species belong to the family Panorpidae which is found over the entire Holarctic region and in parts of the tropics. The Bittacidae is the next largest family and is found in both the temperate and tropical regions of both hemispheres. The Boreidae are represented by 12 species in Europe and North America. Only a single species of the Family Meropidae is known and this occurs in Eastern United States.

COMMON NAMES

The Mecoptera are popularly known as scorpion flies, however, only the males of the Panorpidae have a scorpion-like appearance. Some workers therefore prefer to call them snout flies. The Boreidae are frequently called snow scorpion flies or snow fleas because they are commonly found on the snow. The Bittacidae, which resemble craneflies in their manner of hanging by their front legs, are often called hanging snout flies.

HABITATS

Mecoptera are generally found in damp, shady and well forested areas especially near streams. They are frequently associated with blackberry, nettle, jewelweed, goldenrod, ferns, grasses, mosses and broad leaved plants. On the other hand they are sometimes collected in open sunny places. The Bittacidae hang from the undersides of the foliage and when disturbed fly close to the ground for some distance and eventually hide in dead leaves or dense foliage. They resemble certain craneflies in their flight and are often mistaken for them. They are essentially predacious and feed primarily upon Diptera, consuming the body fluids and softer parts. The Panorpidae usually rest on the upper surface of the leaves and after being disturbed either drop to the ground or fly a short distance returning to the same general area. They are principally saprophagous, feeding upon disabled or freshly killed insects. Caterpillars and adult flies make up the larger part of their diet but they occasionally feed on nectar, pollen and parts of flowers or fruit. The Boreidae are found in moss at the bases of trees and are most readily located when there is snow on the ground. They frequent the higher elevations in wooded areas. These snout flies are phytophagous but may feed on Podura, Collembola and other tiny animals in the moss where they occur.

The larvae of all species are difficult to locate. They inhabit mosses, dead leaves and soil cover in wooded places.

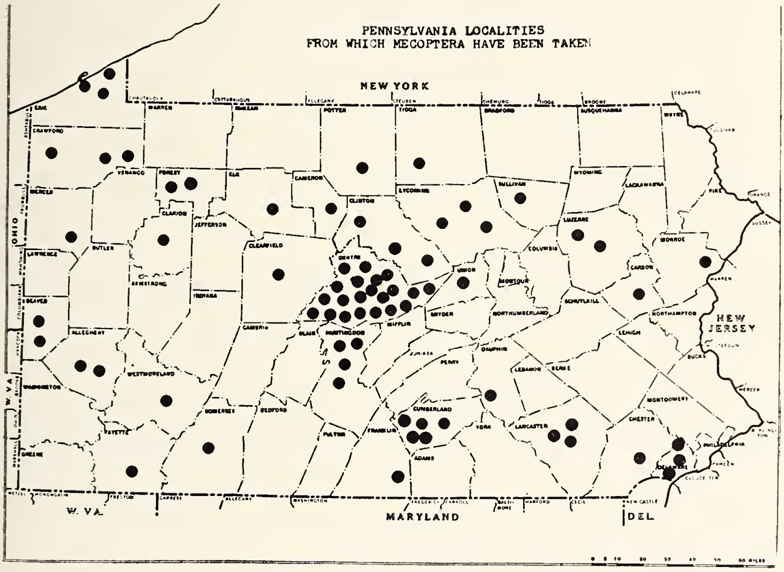
Over 12,000 specimens of Mecoptera have been collected from 73 localities and 30 counties in Pennsylvania representing a relatively large part of the state as indicated on the accompanying map. These studies have been based on several hundred specimens in the collection of the Pennsylvania State University; numerous specimens in the collection of the Pennsylvania Academy of Natural Sciences, Philadelphia; those in the collection of the Bureau of Plant Industry, Harrisburg; and a rather sizeable collection in the Carnegie Museum, Pittsburgh. Records published by Carpenter (1931) and Hine (1901) have also been included. Twenty-three species have been taken in Pennsylvania as indicated by Table 1. Most of these were collected individually. At times some species such as *Panorpa maculosa* Hagen or *Bittacus apicalis* Hagen were obtained accidentally in sweeping low vegetation. On one occasion 10 to 12 specimens of the latter species were taken with practically every sweep of the net. Some species were collected in light or bait traps. The numbers from these latter sources were small. *Merope tuber* Newm. was taken twice from the surface of water in a bucket. Once, this somewhat rare species flew into an open window at night.

Mecoptera Taken in Pennsylvania

Species	Number of localities	Range of collections	Abundance
Panorpa acuta Carp.	21	6/ 4–8/28	V. common
Panorpa bifida Carp.	2	7/18–31	Rare
Panorpa canadensis Banks	33	5/18–9/11	V. common
Panorpa claripennis Hine	1	5/29	V. rare
Panorpa decorata Carp.	1	7/4	V. rare
Panorpa elaborata Carp.	3	6/ 9–7/15	V. rare
Panorpa latipennis Hine	4	5/11–7/15	Rare
Panorpa maculosa Hagen	28	5/23–8/30	V. common
Panorpa mirabilis Carp.	1	6/6	Rare
Panorpa nebulosa Westw.	18	5/30–9/ 2	V. common
Panorpa rufescens Ramb.	4	6/ 6–8/18	V. rare
Panorpa signifer Banks	10	6/27–9/17	Rare
Panorpa subfurcata Westw.	6	6/ 9–6/30	Rare
Panorpa submaculosa Carp.	17	5/26–8/15	Common
Panorpa venosa Westw.	12	5/30–8/10	Rare
Bittacus apicalis Hagen	5	6/18–7/21	Common
Bittacus occidentalis Walker	1	9/ 4–9/19	V. rare
Bittacus pilicornis Westw.	19	6/ 4–8/15	Common
Bittacus stigmaterus Say	3	7/14	V. rare
Bittacus strigosus Hagen	9	7/ 1–8/13	Common
Boreus brumalis Fitch	2	1/ 5–2/23	Common
Boreus nivoriundus Fitch	3	1/ 5–2/23	Rare
Merope tuber Newm.	4	6/19–9/ 7	Rare

Most of the species are generally distributed throughout the state; however some seem to be limited. *Bittacus apicalis* has been taken only in the central and western part of the state. It is recorded from Lycoming, Fayette and Beaver counties and at times is very abundant. As the species is readily identified, it is doubtful if it could have been overlooked in other areas. *Merope tuber* seems to be limited to the central and western part of the state. It has been taken only in Clearfield, Allegheny and Fayette counties. This species, unlike the former, is rare and as previously stated all specimens were accidental catches.

Only individual specimens of *Panorpa claripennis* and *Bittacus occidentalis* have been taken in Pennsylvania. It is interesting to note that a single Pennsylvania specimen of *Bittacus occidentalis,* which was taken in Erie county now rests in the British Museum.



In addition to the species listed in Table 1, several which have been taken in New York and New Jersey might be expected to occur in Pennsylvania. These include *Panorpa americana* Swed., *P. banksi* Hine, *P. chelata* Carp., *P. dissimilis* Carp., and *P. virginia* Banks.

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many highly specialized (and expensive) pieces of apparatus usually used by professional photographers.

The meeting adjourned at 9:30 P.M.

Louis S. Marks, *Secretary*

Meeting of January 20, 1953

A regular meeting of the Society was held at the American Museum of Natural History; Dr. Clausen presiding. There were 17 members and six guests present. The minutes of the previous meeting were read and approved.

The Treasurer's report was received.

The President announced, with sorrow, the death of Mrs. John D. Sherman, Jr. The Secretary was empowered to send to the Sherman family a proper letter of condolence.

The feature of the evening was a "Symposium on Lepidoptera" led by Dr. Frederick Rindge, lepidopterist of the Department of Insects and Spiders of the American Museum of Natural History.

Dr. Rindge said that the Lepidoptera are divided into about 190 families and that those of North America and Europe are relatively well known. In North America, north of Mexico there are about 10,000 species representing 70 families. Dr. Rindge pointed out that, in contrast to the western states, the eastern part of the country has been very poorly collected. He based his statements on the series of specimens in the American Museum collections. He then outlined the salient features of the order.

Dr. George Rawson contributed some notes on his recent trip to the arctic, specifically in the vicinity of Point Barrow, Alaska. He pointed out that in the arctic the Diptera replace the Lepidoptera as flower pollinators.

A lively discussion followed on the proclivity of bats in eating Lepidoptera with participation by Treat, Rindge, Hessel, Rawson and Ziegler. Other contributors to the discussion were Mullen, Marks, Hopf and Clausen.

The meeting adjourned at 9:30 P.M.

Louis S. Marks, *Secretary*

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THE SPIDER GENERA CHRYSSO AND TIDARREN IN AMERICA (ARANEÆ: THERIDIIDÆ)

By Herbert W. Levi
University of Wisconsin, Wausau Extension Center, and the Department of Zoology, Madison

This revision of two genera of comb-footed spiders, *Chrysso* and *Tidarren,* was made possible through the generous loan by Dr. W. J. Gertsch of material from the collection of the American Museum of Natural History. Dr. Gertsch not only supplied the majority of specimens, but also gave valuable advice and read the manuscript. I want to extend my sincere thanks to him and also to Dr. A. M. Chickering of Albion College, who loaned large collections from Panama, Dr. P. J. Darlington, Jr. for specimens from the Museum of Comparative Zoology, Mrs. D. Frizzell (Dr. Harriet Exline) for *Tidarren* from South America, and my wife who helped with the paper.

The types of the new species have been deposited in the American Museum of Natural History, with the exception of *Chrysso vallensis,* the holotype of which is in the Museum of Comparative Zoology. Paratypes of this species are in the American Museum of Natural History.

Chrysso O. P.—Cambridge

Chrysso O. P.—Cambridge, 1882, Proc. Zool. Soc. London, p. 429.
Type species: *Chrysso albomaculata* O. P.—Cambridge.

Small to medium sized theridiid spiders (1 to 5 mm. total length.) Carapace slightly longer than wide. Anterior eye row slightly procurved, posterior row straight, or slightly pro or recurved. Anterior median eyes separated by their diameter or more, by less from laterals. Posterior median eyes usually slightly closer to each other than to laterals. Eyes subequal in size or anterior medians slightly larger or smaller than others. Shape of carapace and clypeus quite variable. Length of cheliceræ about equal to height of carapace. Anterior margin of cheliceræ armed with two large teeth (sometimes difficult to see). Sternum truncate between posterior coxæ, which are separated by their diameter. First legs longest; each patella with a retrolateral tubercle. A tarsal comb on fourth tarsus. Abdomen longer than wide or high, extending beyond spinnerets, and with characteristic furrows or stripes on sides (figs. 10, 14, 16, 18, 19). Colulus absent.

Epigynum a more or less sclerotized plate, the openings indistinct. The internal genitalia with sacs (figs. 25, 26), or short connecting ducts (which do not correspond in length to the embolus of the male palpus). One pair of seminal receptacles present. Male palpus with a radix (R in fig. 4). Base of embolus (E) seemingly curves the same direction as in *Achæaranea.* Its length is supported by the radix, its tip by the radix and conductor (C). The only indication of the paracymbial hook is a depression in the alveolus of the cymbium. The hæmatodocha attaches the bulb to only the most proximal portion of the alveolus of the cymbium (Y).

Chrysso is probably related to *Achæaranea,* but differs in having a radix in the palpus. The shape of the abdomen, its lateral furrows, the structure of the internal female genitalia and the male palpi differentiate *Chrysso* from other related genera, including *Theridion.*

Chrysso is found only in America; no species have been described from other parts of the world. While there are a number of species in northern South America and Central America, only one, *C. albomaculata,* is found in North America. The genitalia of the different species are all quite similar, and all are of about the same size. There are, however, striking differences in coloration between many sympatric species.

The following species have been described in *Chrysso,* but do not belong to it:

C. nigripalpus Banks, 1929, Bull. Mus. Comp. Zool., 69: 85, figs. 46, 72 (♀) is *Coleosoma flavipes* O. P.—Cambridge. New synonymy.

C. nigrosternum Keyserling, 1891, Die Spinnen Amerikas, Brasilianische Spinnen, p. 206, pl. 7, fig. 148 (♂ ♀), probably belongs in *Achæaranea.*

C. perblexum Keyserling, 1886, ibid., Theridiidæ 2: 242. pl. 20, fig. 296 (♂).

C. quadratum O. P.—Cambridge, 1882, Proc. Zool. Soc. London, p. 430; pl. 30, fig. 7 (♂ ♀) found in Ceylon and Sumatra.

Chrysso splendida Banks, 1898, Proc. California Acad. Sci., ser. 3, 1: 237, pl. 14, fig. 13 (♀), is *Achæaranea vittata* (O. P.—Cambridge), 1894 (*Theridion cambridgei* Petrunkevitch, 1911). New synonymy.

Chrysso albomaculata O. P.—Cambridge
Figs. 1–4, 18, 19, 25–27

Chrysso albomaculata O. P.—Cambridge, 1882, Proc. Zool. Soc. London, p. 429, fig. 6 (♂ ♀). Keyserling, 1884, Die Spinnen Amerikas, Theridiidae, 1: 152, pl. 7, fig. 94 (♂ ♀). Marx, 1890, Proc. U. S. Natl. Mus., 12: 523. Banks, 1904, Proc. Acad. Nat. Sci. Philadelphia, 56: 128; 1910, Bull. U. S. Natl. Mus., 72: 20. Chickering, 1936, Trans. Amer. Micros. Soc., 55: 451. Chamberlin and Ivie, 1944, Bull. Univ. Utah, biol. ser., 8(5): 37. Bryant, 1948, Bull. Mus. Comp. Zool., 100: 382. (probably not Bryant, 1940, Bull. Mus. Comp. Zool., 86: 311, figs. 78, 81, ♂ ♀).

Theridion albomaculatum, Simon, 1894, Histoire naturelle des Araignées, 1: 535. Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 190. Bishop and Crosby, 1926, Jour. Elisha Mitchell Sci. Soc., 41: 181. Roewer, 1942, Katalog der Araneæ, 1: 501.

Steatoda albomaculata, F. O. P.—Cambridge, 1902, Biologia Centrali-Americana, Araneidea, 2: 385, pl. 36, figs. 18, 19 (♂ ♀).

Steatoda voluta F. O. P.—Cambridge, 1902, ibid., 2: 386, pl. 36, fig. 20 (♂). New synonymy.

Theridion volutum, Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 210. Roewer, 1942, Katalog der Araneæ, 1: 500. New synonymy.

Achæa luculenta Bryant, 1940, Bull. Mus. Comp. Zool., 86: 310, figs. 83, 84 (♀). New synonymy.

Chrysso davisi Bryant, 1945, Trans. Connecticut Acad. Sci., 36: 202, figs. 4, 11 (♂). Archer, 1946, Pap. Alabama Mus. Nat. Hist., 22: 55. New synonymy.

FEMALE: Carapace, sternum orange, eye region and area behind eyes black. Legs orange-white, distal segments darker; anterior and posterior sides darker. Palpi black. Abdomen orange-white, usually with a number of dorsal white spots and five lateral white spots. Posterior tip of abdomen black (figs. 18, 19). Archer (1946) indicates that live spiders are red, but their color fades rapidly in alcohol. Eye spacing variable. Posterior median eyes of a Florida specimen separated by one diameter, by one and one-third diameters from laterals. In others, eyes of posterior row equally spaced. Eyes subequal in size, sometimes anterior or posterior medians slightly smaller or larger than others. Height of clypeus equals two diameters of anterior median eyes. First legs longest, second or fourth legs next in length. Epigynum an oval convex plate or variable shape (fig. 27). Seminal receptacles on dorsal surface of sclerotized sacs, (figs. 25, 26). Total length, 2.5–4.5 mm. A female from Bay County, Florida, measured total length, 2.7. Carapace 1.00 long, 0.85 wide, 0.32 high. First femur, 1.95; patella and tibia, 1.82; metatarsus, 1.52; tarsus, 0.63. Second patella and tibia, 1.06; third, 1.04; fourth, 1.24.

MALE: Coloration like that of female, white abdominal spots less distinct or absent. Eyes slightly farther apart. Large epigastric plate orange. Palpus quite variable in shape (figs. 1–3). Total length of males, 1.9 to 3.1 mm. A male from Bay County, Florida, measured total length, 2.4. Carapace, 1.10 long, 0.91 wide, 0.39 high. First femur, 2.00; patella and tibia, 1.93; metatarsus, 1.70; tarsus, 0.65. Second patella and tibia, 1.17; third, 0.78; fourth, 1.30.

Size, coloration, eye spacing and sizes, leg length and genitalia of this species vary greatly. None of these characters could be correlated with the geographic distribution. However, the variation in color seems greater in northern specimens, which sometimes lack abdominal spots and appear similar to *C. vexabilis*. Central American specimens all had abdominal spots and could be separated readily from *C. vexabilis*. Some individuals from Florida have the anterior median eyes slightly larger; others have the eyes subequal in size.

According to Archer (1946), this species makes webs "on under surfaces of leaves of hard-leaved shrubs" and occurs in open fields, on wooded edges and open woods. Bishop and Crosby (1926) found an egg sac under a *Liquidambar* leaf. It was "spherical, 2mm. in diameter, and composed of fine silk, tightly woven to form a firm tissue. It contained 23 eggs."

Type localities: Syntypes of *C. albomaculata* came from the Amazon, the male holotype of *Steatoda voluta* from Guatemala. The female holotype of *Achæa luculenta* came from Ciénaga de Zapata, Central Covadonga, Cuba, September 13, 1936 (Davenport) and the male holotype of *C. davisi* from Winter Park, Florida, April, 1934 (E. M. Davis). The first two are in the British Museum (Natural History) and the last two in the Museum of Comparative Zoology.

Records: NORTH CAROLINA: Carteret Co.: Boque Bank (R. D. Barnes). SOUTH CAROLINA: Charleston Co. GEORGIA: (Bishop and Crosby, 1926); Lowndes Co. FLORIDA: (Banks, 1904); Calhoun Co.; Bay Co.; Alachua Co.; Putnam Co.; Marion Co.;

Pasco Co.; Orange Co.; Sarasota Co. ALABAMA: (Archer, 1946). MISSISSIPPI: George Co. LOUISIANA: Grant Par. TEXAS: Newton Co. SAN LUIS POTOSÍ: Tamazunchale. NAYARIT: San Blas. HIDALGO: Chapulhuacán. COLIMA: Cuyutlán; Boca de Pascuales; Las Humedades Armería. GUERRERO: Lo Bajo. OAXACA: Soyaltepec. TABASCO: (F. O. P.—Cambridge, 1902). CAMPECHE: Campeche; San José. YUCATÁN: Chichén-Itzá; Colonia Yucatán. QUINTANA ROO: Cozumel. COSTA RICA: Cartago. PANAMA: Bocas del Toro; Summit; Arraiján. CUBA: Vega Alta; Santa Clara; Pinar del Río; Sierra de Anafe. HAITI: (Bryant, 1948). TRINIDAD: Gasparee. COLOMBIA: Turbaco.

Chrysso vexabilis Keyserling. Figs. 5, 6, 23, 24

Chrysso vexabilis Keyserling, 1884, Die Spinnen Amerikas, Theridiidæ, 1: 155, pl. 7, fig. 96 (♂ ♀). Banks, 1929, Bull. Mus. Comp. Zool., 69: 85.

Theridion vexabile, Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist. 29: 209. Mello-Leitão, 1941, An. Acad. Brasileira Cienc., 13: 250. Roewer, 1942, Katalog der Araneæ, 1: 500.

Chrysso lyparus Chamberlin and Ivie, 1936, Bull. Univ. Utah, biol. ser., 3(5): 35, pl. 10, fig. 84 (♀). New synonymy.

Theridion lyparum, Roewer, 1942, Katalog der Araneæ, 1: 494. New synonymy.

This species is very close to *C. albomaculata.* Both males and females differ from Central American *C. albomaculata* by the coloration of the abdomen, which is sooty black, gray or sometimes nearly white. No white spots are visible although there may be whitish (to reddish) areas on the anterior portion of the venter and the sides; one individual had a black spot on the posterior tip of the abdomen. The epigynum is a light area, quite variable, sometimes translucent. The internal genitalia differ from those of *C. albomaculata* in that the sacs are lobed behind and less sclerotized (fig. 23). The lobes may be touching. The contracted palpus is much like that of *C. albomaculata* except for slight differences in the tegulum (fig. 5). When expanded, the radix lacks the mesal flange and distal hook (fig. 6).

None of the specimens studied approached the total length given by Keyserling (4.7 mm.). Although Keyserling's other measurements and description agreed with specimens on hand, his key character, carapace much shorter than the fourth tibia, did not. This species is nevertheless considered to be Keyserling's and the longer fourth tibia the peculiarity of an individual specimen.

Type locality: Male and female types of *Chrysso vexabilis* from Nueva Granada, Colombia; female holotype of *C. lyparus* from Barro Colorado Island, Panama, in the University of Utah collection.

Records: PANAMA: Porto Bello; Old Panama City; El Valle; Summit; Frijoles; Barro Colorado Island; Madden Dam Forest; Pedro Miguel; Gamboa; Experimental Gardens; Boquete; Forest Reserve; Arraiján; Ft. Sherman; Chilibre.

Chrysso huanuco, new species. Figs. 20–22

FEMALE: Carapace, sternum dark brown. Coxae, proximal portions of femora white; other segments and distal portions of femora brown. Abdomen dusky yellow with longitudinal dark gray band on dorsum and on venter (fig. 20). Epigastric area dark brown. Eyes small and subequal in size. Anterior median eyes separated by one and one-half diameters, one diameter from laterals. Posterior median eyes separated by one and one-half diameters, one and three-quarters diameters from laterals. Height of clypeus equals two diameters of anterior medians. Anterior lip of epigynum, anterior to a depression, which in turn is followed by a raised area (fig. 22). Internal genitalia (fig. 21) as in the preceding two species. Total length, 3.9 mm. Carapace, 1.20 long, 0.95 wide. First femur, 2.41; patella and tibia, 2.08; metatarsus, 1.97; tarsus, 0.77. Second patella and tibia, 1.35; third, 0.78; fourth, 1.41.

The coloration and small eyes differentiate this species from *C. albomaculata.*

Type locality: Female holotype from Tingo María, Huánuco, Peru, 670 m. (W. Weyrauch).

Chrysso vallensis, new species. Figs. 7, 8, 28, 29

FEMALE: Carapace, sternum orange; region between anterior eyes, portions of clypeus dusky. Legs yellow, each with a pro and retrolateral black line; metatarsi and tarsi dusky. Abdomen gray with white and black spots (fig. 8), the latter so large in some specimens that they fuse so that whole posterior portion is black. Eyes subequal in size. Posterior eye row straight. Anterior median eyes separated by one and one-quarter diameters, one quarter diameter from laterals. Posterior median eyes separated by three-quarters diameters, a little more than one diameter from laterals. Height of clypeus equals one and one-half diameters of anterior medians. The epigynum (fig. 29) distinguishes this species from *C. diplosticha.* Total length, 1.8 to 2.4 mm. Total length of holotype, 2.3; carapace, 0.87 long; 0.69 wide. First femur, 1.30; patella and tibia, 1.36; metatarsus, 1.13; tarsus, 0.52. Second patella and tibia, 0.91; third, 0.55; fourth, 0.95.

MALE: Coloration and structure much like that of female. Abdomen nearly all black in both males. Palpus (fig. 7) similar to that of *C. diplosticha* but differing in shape of radix and ectal hook. In one specimen, portions of ectal hook are hidden by embolus. Total length, 1.8 mm. Carapace, 0.94 long, 0.78 wide. First femur, 1.56; patella and tibia, 1.55; metatarsus, 1.35; tarsus, 0.52. Second patella and tibia, 0.99; third, 0.62; fourth, 1.08.

Type locality: Female holotype, male allotype, fourteen female paratypes and one male paratype from El Valle, Panama, July, 1936 (A. M. Chickering).

Chrysso diplosticha Chamberlin and Ivie. Figs. 9, 30, 31

Chrysso diplostichus Chamberlin and Ivie, 1936, Bull. Univ. Utah, biol. ser., 3(5): 36, fig. 83 (♀).

Theridion diplostichum, Roewer, 1942, Katalog der Araneæ, 1: 491.

FEMALE: Similar in coloration to *C. vallensis.* Eyes large. Posterior median eyes separated by slightly more than one diameter, two-thirds diameter from laterals. Height of clypeus equals diameter of anterior median eyes. Epigynum (fig. 31) readily distinguishes this species from related ones. Total length, 2.0 to 2.9 mm. A specimen from Barro Colorado Island measured: total length, 2.7. Carapace, 0.88 long, 0.73 wide. First femur, 1.53; patella and tibia, 1.49; metatarsus, 1.21; tarsus, 0.52. Second patella and tibia, 0.91; third, 0.52; fourth, 0.97.

MALE: Clypeus as high as two diameters of anterior median eyes. Palpus illustrated by figure 9. Total length, 1.6 to 2.1 mm. A specimen from Barro Colorado Island measured: total length, 2.00. Carapace, 0.89 long, 0.68 wide. First femur, 1.53; patella and tibia, 1.44; metatarsus, 1.02; tarsus, 0.59. Second patella and tibia, 1.01; third, 0.56; fourth, 1.04.

Although the abdomen of females is like that of *C. vallensis* in structure, one specimen had a tail as in *C. indicifer.*

Type locality: Female holotype from Barro Colorado Island, Panama, in the University of Utah collection.

Records: PANAMA: Barro Colorado Island (many collections); Fort Davis; Porto Bello; Fort Randolph; Fort Sherman. PERU: Divisoria, Dept. of Huánuco (F. Woytkowski).

Chrysso nigriceps Keyserling. Figs. 16, 32, 33

Chrysso nigriceps Keyserling, 1884, Die Spinnen Amerikas, Theridiidæ, 1: 154, pl. 7, fig. 95 (♀).

Theridion keyserlingi Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 198 (new name for *C. nigriceps,* not *Theridion nigriceps* Keyserling, 1891). Mello-Leitão, 1941, An. Acad. Brasileira Cienc., 13: 250. Roewer, 1942, Katalog der Araneæ, 1: 494.

FEMALE: Carapace, sternum light orange yellow; head region dusky to black; clypeus black. Palpi dark. Legs yellowish, distal ends of femora dusky, other segments slightly dusky. Abdomen with two white spots on each side, a large black spot on posterior end (fig. 16). Carapace wide in front, lower margin of clypeus projecting. Anterior median eyes slightly smaller than others and separated by one and one-half diameters, a little farther from laterals. Posterior median eyes separated by one diameter, one and one-third diameters from laterals. Height of clypeus equals four diameters of anterior median eyes. Epigynum illustrated by figure 33. Total length of a specimen from Ecuador, 3.5 mm. Carapace, 1.36 long, 1.16 wide. First femur, 2.72; patella and tibia, 2.25; metatarsus, 2.06; tarsus, 0.97. Second patella and tibia, 1.50; third, 0.98; fourth, 1.79.

Type locality: Female type from Santa Fé de Bogotá, Colombia.

Records: ECUADOR: Runtun Trail, Baños, 2000 m., Nov. 26, 1939 (F. M. Brown), 1 ♀.

Chrysso ecuadorensis, new species. Figs. 10, 38–39

FEMALE: Carapace, sternum dark brown. Coxæ, legs white; first tarsi brownish. Abdomen gray, black and white (fig. 10). Carapace low. Eyes small, subequal in size. Anterior medians separated by one and one-half diameters, two diameters from laterals. Posterior medians separated by one diameter, two and one-third diameters from laterals. Height of clypeus equals five diameters of anterior medians. Legs very long. Epigynum diagnostic, illustrated by figure 39. Total length, 4.7 mm. Carapace, 1.66 long, 1.20 wide. First femur, 4.5; patella and tibia, 3.6; metatarsus, 3.9; tarsus, 1.3. Second patella and tibia, 2.15; third, 1.10; fourth, 2.48.

Type locality: Female holotype and one paratype from Runtun Trail, Baños 2000 m., Ecuador, November 26, 1939 (F. M. Brown).

Chrysso indicifer Chamberlin and Ivie.
Figs. 11, 12, 17, 34, 35

Chrysso indicifer Chamberlin and Ivie, 1936, Bull. Univ. Utah, biol. ser., 3(5): 36, figs. 82, 96 (♀).

Theridion indiciferum, Roewer, 1942, Katalog der Araneæ, 1: 494.

FEMALE: Carapace, sternum brown. Legs yellow-white. Abdomen gray, black and white (fig. 17). Eyes subequal in size. Posterior medians separated by two-thirds their diameter, three-quarters diameter from laterals. Height of clypeus equals one and one-half diameters of anterior medians.

Abdomen with a tail-like extension. Epigynum illustrated by figure 35. Total length of females, 2.5–3.5 mm. Total length of one specimen, 3.3. Carapace, 0.98 long, 0.73 wide. First femur, 1.95; patella and tibia, 1.82; metatarsus, 1.56; taruss, 0.65. Second patella and tibia, 1.07; third, 0.65; fourth, 1.20.

MALE: Posterior median eyes three-quarters diameter apart, one diameter from laterals. Abdomen short (fig. 12). Palpus illustrated by figure 11. Total length, 2.00 mm. Carapace, 0.91 long, 0.72 wide. First femur, 1.82; patella and tibia, 1.64; metatarsus 1.56; tarsus, 0.63. Second patella and tibia, 1.15; third, 0.65; fourth, 1.24.

Type locality: Female holotype from Barro Colorado Island, Panama, in the University of Utah collection.

Records: PANAMA: Barro Colorado Island (many collections); Forest Reserve.

Chrysso sicki, new species. Figs. 14, 36, 37

FEMALE: Carapace and sternum orange-yellow. Legs, yellow-white. Abdomen white with some dusky pigment on dorsum, sides with white pigment spots. Two black spots on dorsum near posterior tip (fig. 14). Eyes subequal in size. Anterior eye row straight, posterior slightly recurved. Anterior medians separated by one diameter, less than one diameter from laterals. Posterior medians separated by one diameter, same distance from laterals. Height of clypeus equals three diameters of anterior median eyes. Epigynum (fig. 37) and internal genitalia (fig. 36) distinguish this species. Total length, 2.5 mm. Carapace, 0.84 long, 0.78 wide. First femur, 1.25; patella and tibia, 1.17; metatarsus, 0.91; tarsus, 0.59. Second patella and tibia, 0.77; third, 0.60; fourth, 0.82.

Type locality: Female holotype from Teresópolis, (Rio de Janeiro), Brazil, 1600–1800 m., March 16, 1946 (H. Sick).

Chrysso sulcata (Keyserling). Fig. 13

Helvibis sulcata Keyserling, 1884, Die Spinnen Amerikas, Theridiidæ, 1: 175, pl. 8, fig. 106 (♂).

Chrysso sulcata, Keyserling, 1886, ibid., 2: 243.

Theridion sulcatum, Petrunkevitch, 1911, Bul. Amer. Mus. Nat. Hist., 29: 207. Roewer, 1942, Katalog der Araneæ, 1: 499.

MALE: Carapace orange, area between anterior eyes dusky; dusky triangle (pointing toward cheliceræ) on clypeus. Sternum orange with a central black spot. Legs orange. Abdomen yellow-white with a series of lateral and dorsal white spots. Spinnerets and posterior tip of abdomen black. Eyes subequal in size; anterior medians separated by one and one-quarter diameters, one-third diameter from laterals. Posterior medians three-quarters diameter from each other, two-thirds diameter from laterals. Height of clypeus equals two diameters of anterior medians. Palpus (fig. 13) shows a mesal tooth, part of the median apophysis. Total length, 2.3 mm. Carapace, 1.00 long, 0.70 wide. First femur, 2.60; patella and tibia, 2.52; metatarsus, 2.21; tarsus, 0.65. Second patella and tibia, 1.54; third, 0.73; fourth, 1.45.

Keyserling's figure 106 shows the mesal tooth in the palpus. The measurements and descriptions agree with those given in the original description.

Type locality: Male holotype from Amazonas, Brazil (O. P.—Cambridge).

Record: PERU: San Martín: Bella Vista, Dec. 11, 1946 (J. C. Pallister), 1 ♂.

Chrysso mariæ, new species. Fig. 15

MALE: Sternum, carapace orange; dusky between anterior eyes. Legs orange-yellow. Abdomen yellow-white with white spots on sides and dorsum, several black spots above lateral white spots; posterior tip black. Carapace similar to that of *C. diplosticha*. Posterior eye row slightly recurved. Eyes subequal in size. Anterior medians separated by on diameter, one-fourth diameter from laterals. Posterior medians separated by one-half diameter, less than one diameter from laterals. Height of clypeus equals one and one-half diameters of anterior median eyes. Palpus (fig. 15) clearly differentiates this species from *C. diplosticha* and other related species. Total length, 2.2 mm. Carapace, 1.00 long, 0.74 wide. First femur, 2.09. Second patella and tibia, 1.17; third, 0.66; fourth, 1.28.

Type locality: Male holotype from Tingo María, Huánuco, Peru, October 21, 1946 (J. C. Pallister).

Chrysso elegans (Taczanowski).

Argyrodes elegans Taczanowski, 1872, Horæ Soc. Ent. Rossicæ, 9: 118, pl. 5, fig. 11 (♀)*.

Chrysso elegans, Keyserling, 1884, Die Spinnen Amerikas, Theridiidæ, 1: 151, p. 7, fig. 93 (♀). Mello-Leitão, 1948, An. Acad. Brasileira Cienc., 20: 156.

?*Steatoda elegans*, F. O. P.—Cambridge, 1902, Bioligia Centrali-Americana, Araneidea, 2: 386.

Theridion elegans, Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 194. (not *T. elegans*, Blackwall, 1862).

Theridion emendatum Roewer, 1942, Katalog der Araneæ, 1: 492. (New name for *T. elegans* Taczanowski.)

* Reference not seen

FEMALE: Carapace, legs yellow. Abdomen light gray-brown with five to six white spots on each side, and a white dorsal band which narrows to a point posteriorly; posterior tip black. Eyes subequal in size, separated by their diameter, except for laterals which are touching, and anterior medians which are one-half their diameter from laterals. Total length, 3.1 mm. Carapace, 1.2 long, 1.0 wide. First femur, 2.7; patella and tibia, 2.6; metatarsus, 2.1; tarsus, 0.9. Second patella and tibia, 1.5; third, 0.9; fourth, 1.7.

(After Keyserling's description.)

Type locality: Female type from Uassa in French Guiana in the collection of the University of Warsaw, Poland.

Records: BRITISH GUIANA: Cane Grove (Mello-Leitão, 1948). GUATEMALA: (Keyserling, 1884).

Tidarren Chamberlin and Ivie

Tidarren Chamberlin and Ivie, 1934, Bull. Univ. Utah, biol. ser., 2(4): 4. Type species: *Theridion fordum* (= *sisyphoides* Walckenaer, not *fordum* Keyserling).

Theridiid spiders with females of medium size (3 to 9 mm.), but with minute males (less than 2 mm. total length). Female carapace longer than wide, highest near middle, narrow in front. Anterior eye row slightly procurved as seen from front, posterior row straight or slightly procurved as seen from above. Eyes subequal in size. Anterior medians separated by one diameter or slightly less, one-quarter to two-thirds diameter from laterals. Posterior medians separated by slightly more or less than one diameter, about one diameter from laterals. Clypeus as high as two to four diameters of anterior median eyes; lower border sometimes bulging and projecting. Dorsum of carapace with a characteristic pattern of dusky marks on yellowish background (fig. 42). Sternum slightly longer than wide, truncate between posterior coxæ, which are separated by their width; yellow to brown with a dark border whose inner margin has an irregular outline. First legs longest, fourth second in length, third shortest. Small tubercle on retrolateral face of each patella. A comb present on fourth tarsus. Abdomen higher than long, sometimes with a tubercle; resembling *Achæaranea* in markings, but female has a distinctive narrow white line between the spinnerets and the highest point of the dorsum, (figs. 41, 42). All species examined have some individuals dark, while others may be yellow-white with only faint indications of pattern. Colulus absent. Abdomen sometimes quite hairy. Epigynum with a protruding beak (figs. 44, 45, 47, 48), one pair of seminal receptacles present.

Males very small in size. Carapace hardly longer than wide, quite high. Eyes appear large, but are separated by about same distances as in female. Height of clypeus equals one and one-half to two diameters of anterior median eyes. Sternum convex. Abdomen higher than long, with a pattern of black spots on gray background. Only one very large palpus present.

After the penultimate molt, either palpus is twisted off by the spider (Branch, 1942). It does not regenerate.

Conductor (C on figure 59) of palpus large; radix (R) present, lying below embolus (E). Median apophysis (M) fits into paracymbial hook (P) of alveolus of cymbium (Y), holding bulb in cymbium.

Tidarren can be separated from *Achæaranea* and other theridiid genera by the difference in size between males and females, the characteristic beak shaped epigynum, the presence of a single palpus in the male, and the placement of the palpal parts.

While in most theridiid genera the shape of the median apophysis, conductor or embolus is diagnostic, these structures differ little in species of Tidarren. The cymbium, a conservative structure rarely modified in closely related species, differs considerably in the two species of males known.

In habits and habitat, *Tidarren* is similar to *Achæaranea tepidariorum* (Gertsch, 1949). While females are abundant, the males are rarely collected, probably because of their small size.

Although the species described in this genus are all American, Dr. G. Schmidt (in letter) told me that members of this genus occur in the North African region.

Species placed in *Tidarren* by Chamberlin and Ivie (1934) but probably belonging to *Achæaranea* are: *Theridion passivum* Keyserling, 1891, Die Spinnen Amerikas, Brasilianische Spinnen, p. 195, pl. 7, fig. 141 (♀), and *Theridion migrans* Keyserling, 1884, ibid., Theridiidæ, 1: 18, pl. 1, fig. 6 (♀).

Tidarren sisyphoides (Walckenaer). Figs. 41–45, 58–60

Theridion ansatum Walckenaer, 1841, Histoire naturelle des Insectes Aptères 2: 320 (sub. *Theridium*). Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 191. Roewer, 1942, Katalog der Araneæ, 1: 501 (sub. *anasatum*). Chamberlin and Ivie, 1944, Bull. Univ. Utah, biol., ser., 8(5): 47 fig. 43 (♀).

Theridion sisyphoides Walkenaer, 1841, Histoire naturelle des Insectes Aptères, 2: 321.

Theridion fordum, Banks, 1898, Proc. California Acad. Sci., 3rd ser., 1(7): 236; 1904, ibid., 3(13): 344; 1910, Bull. U. S. Natl. Mus., 72: 19. Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 196 (in part). Comstock, 1912, The Spider Book, p. 346, fig. 344 (♀). Moles and Johnson, 1921, Jour. Ent. Zool., 13: 41. Bishop and Crosby, 1926, Jour. Elisha Mitchell

Sci. Soc., 41: 182. ?Petrunkevitch, 1930, Trans. Connecticut Acad. Sci., 30: 194, fig. 39 (♀). Chickering, 1937, in the Geology and Biology of the San Carlos Mountains, p. 274. Bryant, 1940, Bull. Mus. Comp. Zool., 86: 319. Comstock, 1940, The Spider Book, rev. ed., p. 361, fig. 344 (♀). not *T. fordum* Keyserling).

Steatoda forda, F. O. P.—Cambridge, 1902, Biologia Centrali-Americana, Araneidea, 2: 382, pl. 36, fig. 7 (♀).

Tidarren fordum, Chamberlin and Ivie, 1933, Bull. Univ. Utah, biol. ser., 2(4): 5, figs. 1–9, 11–23 (♂ ♀). Fox, 1940, Proc. Biol. Soc. Wash., 53: 44. Chamberlin and Ivie, 1941, Bull. Univ. Utah, biol. ser., 6(3): 12. Roewer, 1942, Katalog der Araneæ, 1: 508 (in part). Kraus, 1955, Abh. Senckenbergischen Naturf. Gesell., 493: 19. (not *T. fordum* Keyserling).

Tidarren sisyphoides, Chamberlin and Ivie, 1944, Bull, Univ. Utah, biol. ser. 8(5): 57. Archer, 1946, Pap Alabama Mus. Nat. Hist., 22: 33.

FEMALE: Coloration and structure typical. Height of clypeus equals about three diameters of anterior median eyes; lower margin bulging and projecting. Abdomen without a tubercle although minute indications of it may be present. Beak of epigynum diagnostic, having posterior face swollen (figs. 44, 45). Ratio of length of carapace to first patella and tibia 10: 15 in northern specimens, 10: 19 in specimens from the southern part of the range. Total length, 5.8 to 8.6 mm. A specimen from Georgia measured: Total length, 6.2; carapace, 2.5 long, 2.2 wide. First femur, 4.5; patella and tibia, 4.0; metatarsus, 4.3; tarsus, 1.4. Second patella and tibia, 2.7; third, 2.0; fourth, 3.2.

MALE: Cymbium of palpus funnel shaped (figs. 58, 59). Total length, 1.3 to 1.4 mm. Total length of a male from Mississippi, 1.4. Carapace, 0.63 long, 0.60 wide, 0.34 high. First femur, 1.04; patella and tibia, 0.94; metatarsus, 0.78; tarsus, 0.35. Second patella and tibia, 0.66; third, 0.50; fourth, 0.67.

Type locality: Both *T. ansatum* and *T. sisyphoides* came from Georgia, and the descriptions are based on Abbot's manuscript drawings p. 15, figs. 149, 150, and p. 25, fig. 313, respectively. The manuscript is in the British Museum (Natural History).

Records: KENTUCKY: Breathitt Co.: Quicksand (S. C. Bishop). GEORGIA: (Chamberlin and Ivie, 1944); Bibb Co.; Ware Co. FLORDIA: Gadsden Co.; Liberty Co.; Alachua Co.; Pasco Co.; Orange Co.; Highlands Co.; De Soto Co.; Dade Co. ALABAMA: (Archer, 1946); Marion Co.; MISSISSIPPI: Forrest Co.; Wilkinson

Co.; Covington Co. LOUISIANA: Saint Landry Par. TEXAS: Polk Co.; Wise Co.; Newton Co.; Montgomery Co.; Panola Co.; Hidalgo Co.; Cameron Co. ARIZONA: Santa Cruz Co.; Pima Co. CALIFORNIA: Santa Clara Co.; Monterey Co.; San Luis Obispo Co,; Los Angeles Co.; San Bernardino Co.; San Diego Co. BAJA CALIFORNIA: (Banks, 1898). NUEVO LEÓN: 15 and 25 mi. S. of Monterrey. TAMAULIPAS: Villagrán; El Mante; Jaumave; El Limón; San Carlos Mts. DURANGO: Nombre de Dios. NAYARIT: Tepic; San Blas. SAN LUIS POTOSÍ: Picolo; Pujal; Tamazuchale. HIDALGO: Chapulhuacán. DISTRÍTO FEDERAL: México. VERACRUZ: La Buena Ventura; Franca Vieja; Region del Chapo; Orizaba; Alto Lucero; Huatusco; Tiapacoyan; Jalapa; Martínez del la Torre. PUEBLA: Acatlán; Tohuacán. GUERRERO: 62 mi. N. of Acapulco. OAXACA: Oaxaca; Tolosa. CHIAPAS: La Zacualpa; Mapastepec; north of Huixtla. YUCATÁN: Chichén-Itzá. EL SALVADOR: (Kraus, 1955). COSTA RICA: San José. PANAMA: Barro Colorado Island; Forest Reserve. HAITI: in mts. 25 mi. from Aux Cayes. CUBA: (Bryant, 1940); Tapaste. PUERTO RICA: (Petrunkevitch, 1930). PERU: Dept. Piura; Quebrada Songora (D. H. Frizzell).

Tidarren mixtum (O. P.—Cambridge). Figs. 40, 46–48

Theridion mixtum O. P.—Cambridge, 1896, Biologia Centrali-Americana, Araneidea, 1: 206, pl. 24, fig. 11 (♂). Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 200. Chickering, 1936, Trans. Amer. Micros. Soc., 55: 451. Banks, 1902, Proc. Washington Acad. Sci., 4: 59 (a doubtful record). Reimoser, 1939, Ann. Naturhist. Museum, Wien, 50: 346.

Steatoda mixta, F. O. P.—Cambridge, 1902, Biologia Centrali-Americana, Araneidea, 2: 383, pl. 36, fig. 8 (♀).

Tidarren mixtum, Chamberlin and Ivie, 1934, Bull. Univ. Utah, biol. ser., 2(4): 9, figs. 26–27 (♂). Roewer, 1942, Katalog der Araneæ, 1: 508.

FEMALE: Coloration of abdomen with little contrast, usually dark with indistinct stripes. Abdomen hairy, usually with a large tubercle (fig. 40). Area posterior to epigynal beak sclerotized (figs. 46, 47). Legs short. Ratio of length of carapace to first patella and tibia 10: 14 to 10: 15. Total length, 4.5 to 5.5 mm. A female from Guatemala measured: Total length, 5.0; carapace, 1.87 long, 1.61 wide. First femur, 2.82; patella and tibia, 2.62; metatarsus, 2.08; tarsus, 0.75. Second patella and tibia, 1.90; third, 1.43; fourth, 2.24.

Type locality: Female holotype from Chiacam, Guatemala (Sargent) in the British Museum (Natural History).

Records: SAN LUIS POTOSÍ: Tamazunchale; Río Frío. VERACRUZ: La Buena Ventura. GUERRERO: Acapulco. CHIAPAS: Tonalá; Tapachula. GUATEMALA: San Jerónimo. COSTA RICA: (Reimoser, 1939); San José. GALAPAGOS ISLANDS: (Banks, 1902, a doubtful record).

Tidarren fordum (Keyserling). *Figs. 49–57, 61–64

Theridion fordum Keyserling, 1884, Die Spinnen Amerikas, Theridiidæ 2: 382, pl. 1, fig. 9 (♀). Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 196 (in part). Banks, 1929, Bull. Mus. Comp. Zool. 69: 84. Mello-Leitão, 1947, Arq. Paranænse, 6: 237. Reimoser, 1939, Ann. Naturhist. Museum, Wien, 50: 346.

Theridion elevatum Banks, 1897, Canad. Ent., 29: 195; 1898, Proc. California Acad Sci., 1(7): 237. (sub. *Theridium,* not *T. elevatum* Thorell, 1881). New synonymy.

Steatoda elevata, F. O. P.—Cambridge, 1902, Biologia Centrali-Americana, Araneidea, 2: 387. New synonymy.

Theridion fordulum Banks, 1909, Proc. Acad. Nat. Sci. Philadelphia, 61: 203. (sub. *Theridium*). Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 196. Roewer, 1942, Katalog der Araneæ, 1:493. New synonymy.

Theridion texanum Banks, 1910, Bull. U. S. Natl. Mus., 72: 20. (sub. *Theridium,* new name for *elevatum,* preoccupied). Petrunkevitch, 1911, Bull. Amer. Mus. Nat. Hist., 29: 208. Roewer, 1942, Katalog der Araneæ, 1: 499. New synonymy.

Tidarren minor Chamberlin and Ivie, 1934, Bull. Univ. Utah, biol. ser. 2(4): 10, figs. 10, 24–25 (♀). Fox, 1940, Proc. Biol. Soc. Washington, 53: 44. Roewer, 1942, Katalog der Araneæ, 1: 508. Chamberlin and Ivie, 1944, Bull. Univ. Utah, biol. ser., 8(5): 57. Archer, 1946, Pap. Alabama Mus. Nat. Hist., 22: 33; 1950, ibid., 30: 15, pl. 2, fig. 2 (♂). New synonymy.

Tidarren fordum, Mello-Leitão, 1940, Rev. Mus. La Plata (n. s.) 2: 34. Roewer, 1942, Katalog der Araneæ; 1: 508 (in part). Mello-Leitão, 1943, Arq. Mus. Nac., Rio de Janeiro, 37: 171.

?*Tidarren sisyphoides,* Mello-Leitão, 1945, Rev. Mus. La Plata (n. s.) 4: 216 (prob. not *T. sisyphoides* Walckenaer).

* South American references incomplete.

Tidarren mixtum, Kraus, 1955, Abh. Senckenbergischen Naturf. Gesell., 493: 19. (not *T. mixtum* O. P.—Cambridge).

Female: Coloration and structure typical. Height of clypeus equals two and one-half to three diameters of anterior median eyes. Abdominal tubercle lacking or very small. Epigynum of variable shape, only beak and a small area anterior to it are sclerotized (figs. 49–57). Total length of females, 2.4–7.0 mm. A female from Baños, Ecuador, measured 5.0, total length. Carapace, 2.16 long, 1.87 wide. First femur, 4.2; patella and tibia, 3.7; metatarsus, 3.7; tarsus, 1.4. Second patella and tibia, 2.4; third, 1.8; fourth, 3.0. Total length of a specimen from Texas, 3.7. Carapace, 1.25 long, 1.08 wide. First femur, 1.92; patella and tibia, 1.60; metatarsus, 1.53; tarsus, 0.71. Second patella and tibia, 1.04; third, 0.83; fourth, 1.53.

Male: Cymbium of palpus rounded (figs. 61–63). Total length, 0.9–1.4 mm. (largest specimens from California). Total length of a specimen from Baños, Ecuador, 1.2 mm. Carapace, 0.55 long. 0.54 wide. First femur, 0.91; patella and tibia, 0.78; metatarsus, 0.60; tarsus, 0.41. Second patella and tibia, 0.53; third, 0.41; fourth 0.58. Total length of a specimen from Texas, 1.1. Carapace, 0.52 long, 0.39 wide. First femur, 0.69; patella and tibia, 0.65; metatarsus, 0.49; tarsus, 0.37. Second patella and tibia, 0.46; third, 0.34; fourth, 0.52.

Although the difference in size of males is small, females from Mexico and the United States measured between 2.4 and 4.5 mm. those of Central and South America 4.5 to 7.0 mm. The ratio of length of carapace to first patella and tibia is 10: 13 in the United States, 10: 15 in southern Mexico, 10: 19 in some specimens of northern Central America, 10:17 in more southern specimens. Hardly two specimens have the epigynum or internal genitalia similar.

Type locility: Female types of *Theridion fordum* from Santa Fé de Bogotá, Columbia. Female holotype of *T. elevatum* from Brazos County, Texas, and female holotype of *Theridion fordulum* Banks from Chiral Paraíso, Costa Rica in the Museum of Comparative Zoology. Female holotype of *T. minor* from Tallahassee, Leon County, Florida, Aug. 1933 (W. Ivie) in the collection of the University of Utah.

Records: florida: (Chamberlin and Ivie, 1934); (Fox, 1940); Lee Co. alabama: (Archer, 1946); Baldwin Co. mississippi: (Archer, 1946). texas: Liberty Co.; Hidalgo Co. arizona: Huachuca Mts. california (Chamberlin and Ivie, 1934); San Diego Co. tamaulipas: Tampico. san luis potosí: Tamazunchale. Nayarit: (Banks, 1898). Guerrero: km. 100 road to

Taxco; Acapulco. OAXACA: San Gerónimo. CHIAPAS: Mapastepec. YUCATÁN: Dry Cenote, Chichén-Itzá. QUINTANA ROO: Esmeralda, 45 km. S. of Peto, Yucatán. GUATEMALA: Chichicastenango. EL SALVADOR: (Kraus, 1955); San Salvador. COSTA RICA: (Reimoser, 1939); San José. PANAMA: Summit; France Field; Forest Reserve; Boca Toro; Balboa; Experimental Gardens; Barro Colorado Island. ECUADOR: I. de Puná; nr. Arenillas. Prov. Tungurahua: Puñapi. Baños. PERU: Dept. Junín; Huacapistana. Dept. Loreto: Río Topo. Quillabamba, Valle Urubamba, 1100 m. BRAZIL: numer. coll. nr. Rio de Janeiro, São Paulo, Teresópolis. PARANÁ: (Mello-Leitão, 1947). Rio Grande do Sul (Mello-Leitão, 1943). URUGUAY: (Mello-Leitão, 1943). ARGENTINA: Corrientes: (Mello-Leitão, 1945). Provincia de Buenos Aires (Mello-Leitão, 1948).

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BRANCH, J. H. 1942. A spider which amputates one of its palpi. Bull. South. California Acad. Sci. **41**: 139–140.

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(*Continued from page 58*)

MEETING OF FEBRUARY 3, 1953

A regular meeting of the Society was held at the American Museum of Natural History; President Clausen in the chair. There were nine members and seven guests present. The minutes of the preceding meeting were accepted as read. The Secretary announced the death of Mr. Nathan Banks, one of America's oldest and most distinguished entomologists, and a long time honorary member of the New York Entomological Society. It was announced that descriptive circulars and membership blanks for the Society were available from the Secretary. The President announced the illness of Dr. Hagan to the Society. The President appointed a program committee to consist of Drs. Vishniac and Pohl.

Dr. Vishniac introduced the speakers on the topic of the evening—"The Breeding of Lepidoptera". He said our speakers represented the experience of old age—Mr. Fred Naumann—and the enthusiasm of the younger generation—Mrs. Hopf.

Mrs. Hopf spoke of her breeding work on the Monarch Butterfly and showed an inexpensive breeding case of new design. Mr. Naumann had six double-pinned boxes of butterflies and moths, exotic and domestic, which he used to illustrate his experiences.

The meeting adjourned at 9:30 P.M.

LOUIS S. MARKS, *Secretary*

(*Continued on page 82*)

(JOUR. N. Y. ENT. SOC.), VOL. LXIII (PLATE V)

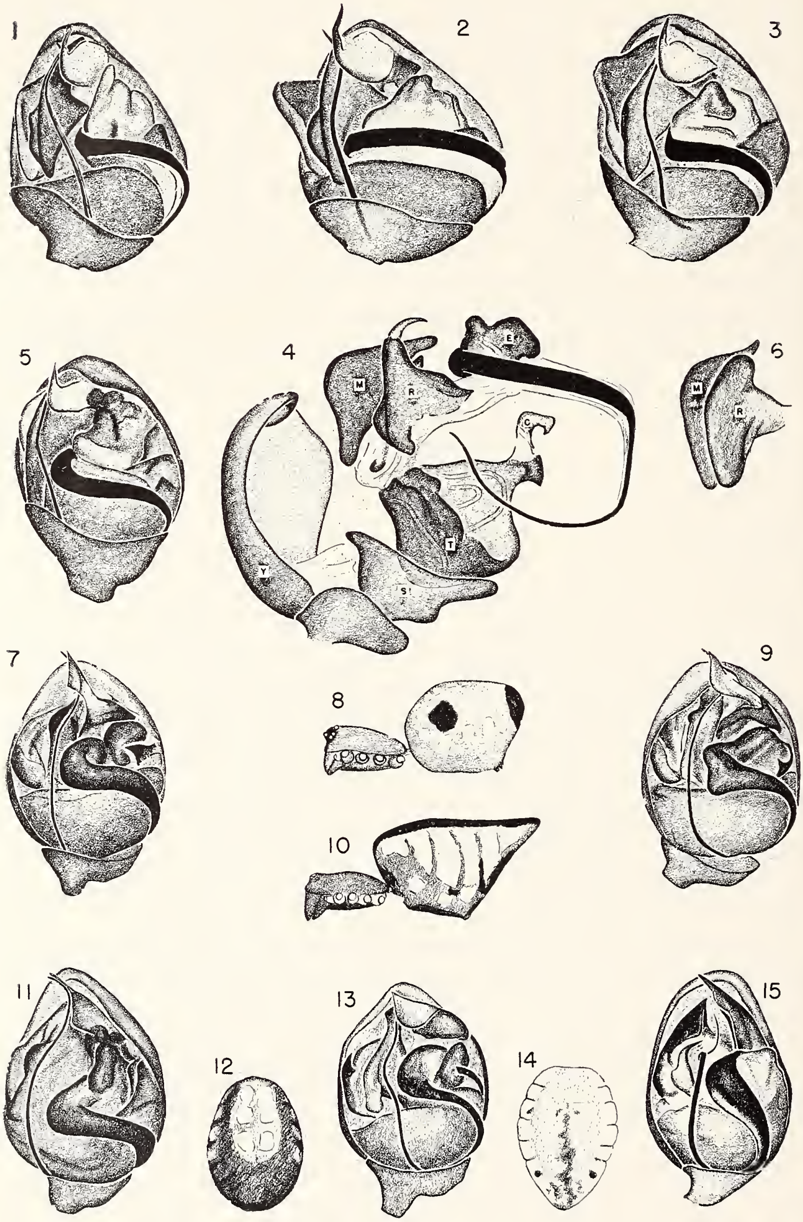


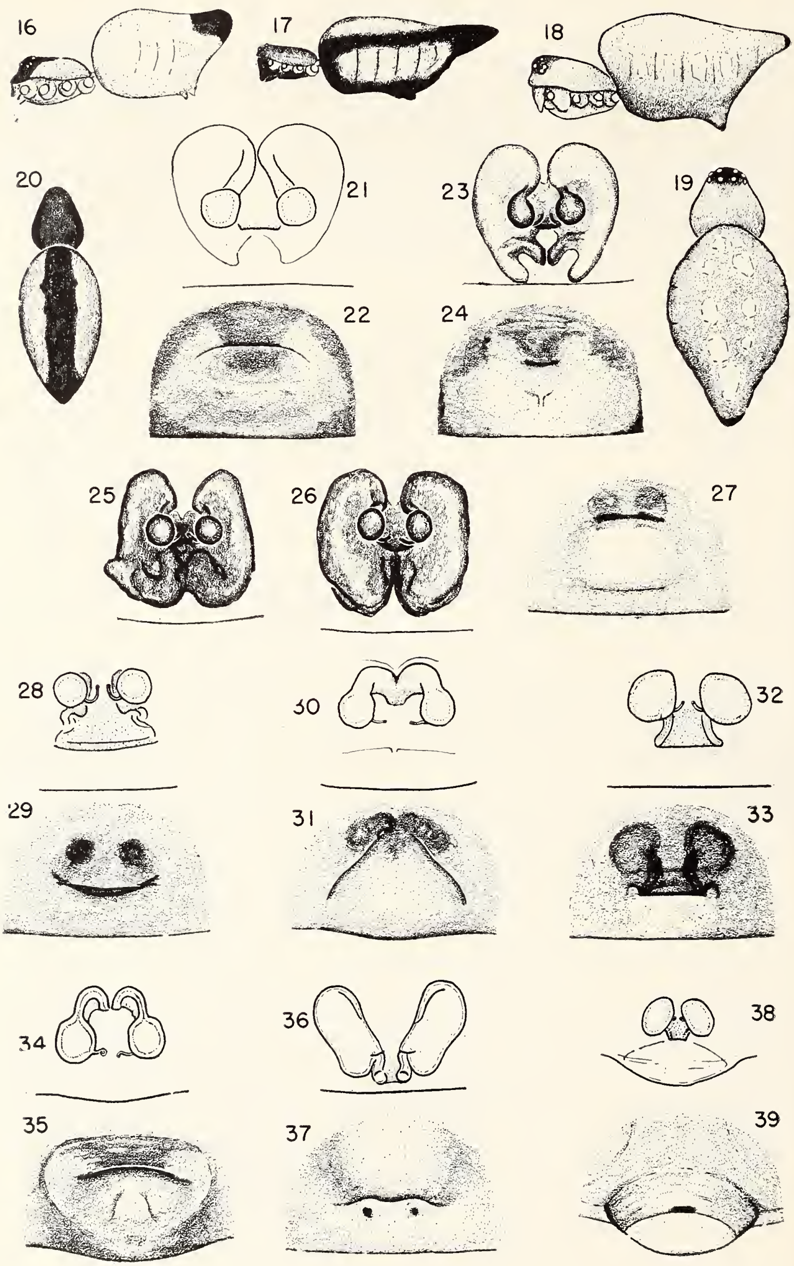
PLATE V

Figs. 1–4. *Chrysso albomaculata* O. P.—Cambridge, left palpus. 1–3. Ventral view, showing variation. 4. Subventral view, expanded.
Figs. 5–6. *C. vexabilis* Keyserling, palpus. 5. Ventral view. 6. Radix and median apophysis.
Figs. 7–8. *C. vallensis,* new species. 7. Palpus. 8. Female. Fig. 9. *C. diplosticha* Chamberlin and Ivie, palpus.
Fig. 10. *C. ecuadorensis,* new species, female.
Figs. 11–12. *C. indicifer* Chamberlin and Ivie. 11. Palpus. 12. Abdomen of male, dorsal view.
Fig. 13. *C. sulcata* (Keyserling), palpus.
Fig. 14. *C. sicki,* new species, abdomen of female, dorsal view.
Fig. 15. *C. mariæ,* new species, palpus.
Abbreviations: C, conductor; E, embolus; M, median apophysis; R, radix; S, subtegulum; T, tegulum; Y, cymbium.

PLATE VI

Fig. 16. *Chrysso nigriceps* Keyserling, female.
Fig. 17. *C. indicifer* Chamberlin and Ivie, female.
Figs. 18–19. *C. albomaculata* O. P.—Cambridge, female.
Figs. 20–22. *C. huanuco,* new species. 20. Female. 21. Female genitalia, dorsal view. 22. Epigynum.
Figs. 23–24. *C. vexabilis* Keyserling. 23. Female genitalia, dorsal view. 24. Epigynum.
Figs. 25–27. *C. albomaculata* O. P.—Cambridge. 25–26. Female genitalia, dorsal view. 27. Epigynum.
Figs. 28–29. *C. vallensis,* new species. 28. Female genitalia, dorsal view. 29. Epigynum.
Figs. 30–31. *C. diplosticha* Chamberlin and Ivie. 30. genitalia, dorsal view. 31. Epigynum.
Figs. 32–33. *C. nigriceps* Keyserling. 32. Female genitalia, dorsal view, 33. Epigynum.
Figs. 34–35. *C. indicifer* Chamberlin and Ivie. 34. Female genitalia, dorsal view. 35. Epigynum.
Figs. 36–37. *C. sicki,* new species. 36. Female genitalia, dorsal view. 37. Epigynum.
Figs. 38–39. *C. ecuadorensis,* new species. 38. Female genitalia, dorsal view. 39. Epigynum.

(JOUR. N. Y. ENT. SOC.), VOL. LXIII (PLATE VI)



(JOUR. N. Y. ENT. SOC.) VOL. LXIII   (PLATE VII)

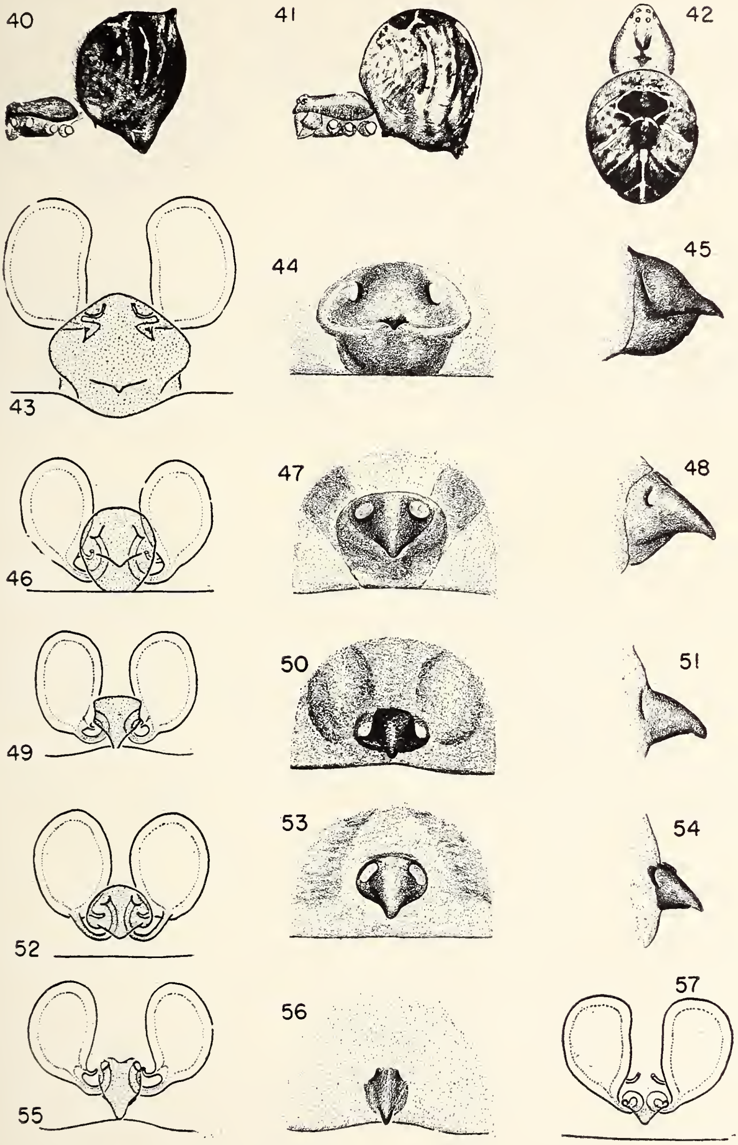


PLATE VII

Fig. 40. *Tidarren mixtum* (O. P.—Cambridge), female.

Figs. 41–45. *T. sisyphoides* (Walckenaer). 41–42. Female. 43–45. Epigynum. 43. Cleared. 44. Ventral view. 45. Lateral view.

Figs. 46–48. *T. mixtum* (O. P.—Cambridge), epigynum. 46. Cleared. 47. Ventral view. 48. Lateral view.

Figs. 49–57. *T. fordum* (Keyserling), epigynum. 49, 52, 55, 60. Cleared. 50, 53, 56. Ventral view. 51, 54. Lateral view.

PLATE VIII

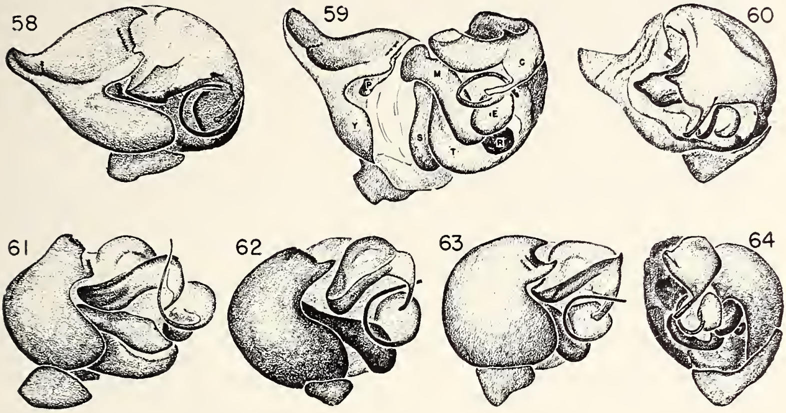
Figs. 58–60. *Tidarren sisyphoides* (Walckenaer), left palpus. 58. Ventral view. 59. Expanded, ventral view. 60. Ectal view.

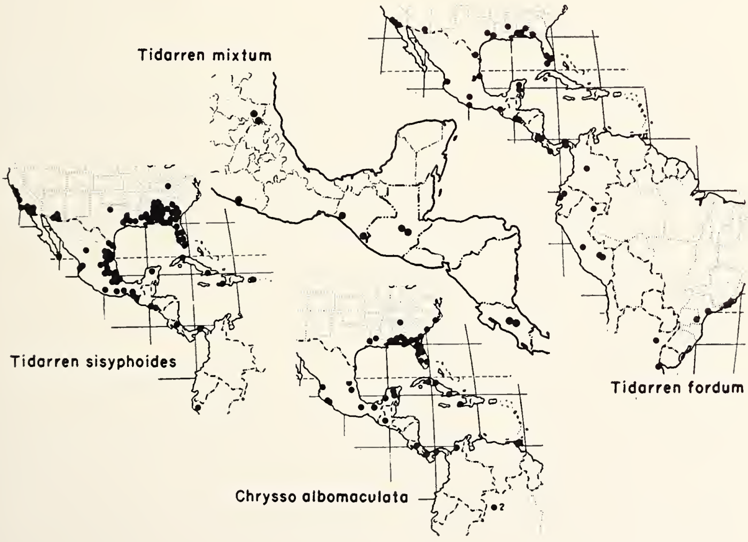
Figs. 61–64. *T. fordum* (Keyserling), palpus. 61–63. Ventral view. 61. Ecuador. 62. Panama. 63. Texas. 64. Ectal view, Texas.

Abbreviations: C, conductor; E, embolus; M, median apophysis; P, paracymbial hook; R, radix; S, subtegulum; T, tegulum; Y, cymbium.

Map showing the distributions of *Chrysso albomaculata, Tidarren sisyphoides, T. mixtum* and *T. fordum.*

(JOUR. N. Y. ENT. SOC.) VOL. LXIII (PLATE VIII)





(*Continued from page 75*)

MEETING OF FEBRUARY 17, 1953

A regular meeting of the Society was held at the American Museum of Natural History. President Clausen was in the chair. There were eight members and four guests present. The minutes of the previous meeting were read and approved.

The Secretary called attention of the members to "Insect Physiology" a new book edited by Dr. K. Roeder and "An Introduction to Arthropod Anatomy" by Dr. R. F. Snodgrass.

Dr. Vishniac introduced Dr. Nash of the John Powell Co. who spoke to the members on "Pyrethrum". Dr. Nash detailed the history of pyrethrum from its discovery and use in the early 1800s, its first introduction into the United States in 1858, and its continued use here until the present time.

Pyrethrum is an extract from the flower head of a member of the composite family which plant is grown commercially in Japan, Kenya and certain parts of the United States. Most of the work of collecting and extracting is done by hand. Dr. Nash outlined the active principle of the pyrethrum extract and the role of synergistic agents, such as oil of sesame, with pyrethrum. The addition of such activators increases the potency of the extract to many times its original strength. He concluded his talk with a discussion of the relationship of pyrethrum with other insecticides.

An interesting side light of Dr. Nash's remarks was the discussion on the method of breeding house flies for use in the Peet-Grady testing chamber.

The meeting adjourned at 10:00 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF MARCH 3, 1953

A regular meeting of the Society was held at the American Museum of Natural History. Vice-President Vishniac was in the chair. There were 11 members and six guests present. The minutes of the previous meeting were read and approved.

Mrs. Celia Smith Lowing, 370 Columbus Ave., N.Y.C. was proposed for membership in the Society on the written motion of Mr. John Pallister. Dr. Forbes moved that the By-Laws be suspended and the Mrs. Lowing be elected at this meeting. Mrs. Lowing was duly elected.

Attention of the members was called to the book "The Wonderful World of Insects" by our former President Mr. Albro T. Gaul. It was briefly reviewed and praised by Mr. Soraci.

Dr. Vishniac then introduced the speaker of the evening, a former President of the New York Entomological Society, Mr. George Becker of the U. S. Dept. of Agriculture Inspection House at Hoboken, N. J. Mr. Becker spoke on "The Troubles of a Quarantine Inspector". He traced the history of plant quarantine in this country, and pointed out interestingly enough that the Botanical Gardens were among the earlier opponents to the idea of plant quarantining. Many incidents, amusing in retrospect, happen to a plant quarantine inspector. Many of these were passed on by Mr.

(*Continued on page 93*)

SEROLOGICAL RELATIONSHIPS AMONG ORTHOPTEROID INSECTS AS DETERMINED BY THEIR WHOLE "BLOOD"[1]

By Ludwig K. Pauly
Zoology Department, University of Wisconsin in Milwaukee

Although precipitins were discovered in 1897 and various techniques have been employed for determining the strength of precipitin reactions, relatively few taxonomists have used this serological reaction in the study of animal relationships. This approach to the study of animal relationships showed great promise for clarifying disputed or undetermined relationships as early as 1904 when Nuttall published a book summarizing the results of some 16,000 tests in which some thirty different antisera were used on 900 species of animal blood. These results, in general, paralleled the existing classification of these animals as based on morphological and embryological characteristics. The solution of taxonomic problems has been carried out by means of the precipitin reaction (Graham-Smith on the king crab, Eisenbrandt on worms, and Wilhelmi on the phylogeny of the Chordates) but, all in all, there has been a general lack of use of precipitins for settling relationship disputes.

The class Insecta, being the largest class of animals in the animal kingdom, naturally has its share of members with uncertain taxonomic position. There is a general agreement in the gross picture of insect classification, but, when it comes to the relationship of orders to each other and families in each order, each author seems to have his own idea of classification. There is, perhaps, no better example of this variation in classification than among the orthopteroid insects. Comstock (1933), for instance, includes the families Tettigoniidæ, Gryllidæ, Locustidæ, Phasmidæ, Mantidæ and Blattidæ in the order Orthoptera and differentiates between the jumping forms (Saltatorial Orthop-

[1] Supported in part by the Research Committee of the University of Wisconsin Graduate School from funds supplied by the Wisconsin Alumni Research Foundation. Project under supervision of Professor H. R. Wolfe, Department of Zoology, Madison.

tera) and the walking forms. Ross (1948), on the other hand, divides the order Orthoptera into four suborders, Blattaria, Mantodea, Phasmida, and Saltatoria. Essig (1942) has still a different classification for the orthopteroid insects. He places the saltatorial forms in the order Orthoptera and each of the walking forms in separate orders: Blattaria, Phasmida, and Mantodea. Finally Blatchley (1920) has still a different classification. He divides the Orthoptera into four suborders: Dermaptoria, containing the family Forficulidæ, the earwigs; Cursoria (runners) including the family Blattidæ; Gressoria (walkers), including the families Mantidæ and Phasmidæ; and Saltatoria (jumpers), including the families Tetrigidæ (pygmy locusts), Acrididæ, Tettigoniidæ and Gryllidæ.

All of these authors base their classification on certain morphological features and each author expresses his own opinion by his classification. Thus we have variations in classification. These discrepancies in classification could be avoided with a more objective basis for classification.

No one can deny that the basic nature of any organism is found in its biochemical constitution. The best known means of measuring the biochemical relationship of different organisms is the precipitin testing technique. As Wells (1930) so aptly puts it, "The serologic reactions are essentially delicate methods for differentiation of proteins (either alone or as the complexes existing in protoplasm), and since the evolution of different species is essentially the evolution of different combinations of amino-acids to form the proteins characteristic of each species, . . ., evidently the serological reactions afford a means for the analysis of the evolutionary relationship of species."

Several serological studies on insects have been carried out in the past. Brown and Heffron (1928) and Martin and Cotner (1934) on certain Leidoptera, Cumley (1940) on Diptera and Leone (1947) on Orthoptera have all carried out successful studies in this respect. Brown and Heffron and Martin and Cotner used the ring test technique, Cumley used the ring test technique and complement-fixation, and Leone used the ring test technique and the Libby photronreflectometer (1938). All of these authors obtained their insect antigens by saline extractions from ground-up insect bodies. This is a questionable practice since Canning (1929) showed that different organs in the same species showed some differences in serological reactions.

In serological studies with larger animals it is customary to use the blood serum as the antigen. In this paper the author has made an attempt to continue this practice with insects. Naturally, only insects of relatively large size can be used.

MATERIALS AND PROCEDURE

Whole "blood" was obtained from each of the following species:

Order ORTHOPTERA

Family	*Scientific Name*	*Common Name*
Blattidæ	*Periplaneta americanum*	American cockroach
	Blatta orientalis	Oriental cockroach
	Leucophea maderiæ	Tropical roach
Acrididæ	*Romalea microptera*	Florida lubber grasshopper
	Melanoplus femur-rubrum	Red-legged grasshopper
Mantidæ	*Paratenodera sinensis*	Chinese praying mantis
Phasmidæ	*Anisomorpha* sp.	Walking stick

Order COLEOPTERA

Scarabæidæ	*Phyllophaga* sp.	May beetle

Some of the insects used in the tests were either raised or collected by the authors, while others were obtained through various biological supply houses.

Special "syringes" were made for bleeding the insects. Glass tubing seven millimeters in diameter and approximately twenty centimeters long was heated through the middle and drawn into long slender, tapering tubes. When these tapering tubes were broken at the narrowest point and a rubber bulb from an eye dropper attached to the blunt end, an excellent instrument for bleeding insects was obtained.

The insects were starved for at least twenty-four hours and were then anaesthetized for bleeding. The slender tapered end of the syringe was inserted through the softer tissue between the first and second tergum into the dorsal vessel of the insect. By careful manipulation of the rubber bulb a small amount of "blood" was obtained from each insect. Great care was necessary in inserting the syringe because of the delicate nature of the dorsal vessel. The tropical roach (*Leucophea maderiæ*) was found to yield the largest amount of blood per individual. Fifty of these insects would yield an average of 3.5 to 5 ml. of blood.

The blood of the various species of insects bled varied in color from a watery, colorless liquid as found in some of the cockroaches to a beautiful blue-green liquid as found in the Chinese mantids. The color of blood varied not only from species to species but also varied considerably from individual to individual in the same species.

The blood obtained from any one series of bleedings was pooled and allowed to stand for several hours—usually over night in a refrigerator. Several of the bloods formed a sort of clot while others did not. All of them, however, did have a fatty residue after standing for a time. The blood of the Florida lubber grasshopper (*Romalea microptera*) and the walking stick (*Anisomorpha* sp.) turned a dark almost black color after a few hours.

The blood was then centrifuged and the serum was stored in sterile vials in a freezer for future use. No attempt was made to determine protein content of the sera at this time.

Both chickens and rabbits were used for the production of antisera. For the ring test chicken antisera were used exclusively. Each chicken was given a single intravenous injection of 1 ml. of 2% dilution of the insect serum used as antigen. Wolfe (1942) found that this injection procedure usually yielded specific antiserum of high titer. Seven days after the injection the chickens were starved for 24 hours and bled completely by cardiac puncture. This blood was allowed to clot at room temperature. The clot was broken up and the blood was centrifuged. The antiserum was poured off and stored in cotton stoppered containers in the refrigerator for at least eight days. It was shown (Wolfe and Dilks, 1946) that the rise in titer of chicken antiserum occurred on standing and this was usually at a maximum after this length of time. Then the antiserum was used immediately or filtered and stored in sterile, rubber-stoppered vials in the refrigerator.

The ring test technique was performed similar to that of Boyden (1926) except that the original antigen dilution was a 2% solution of the insect's serum. Readings were taken at 5, 10, 20, 30 and 60 minute intervals, but only the 60 minute readings are recorded in this paper. Proper care was taken in layering the antiserum under the antigen and handling the tubes in order to maintain a clear interface.

A photoelectric instrument which has never been used in any serological study of taxonomy is the microdensitometer of Baier (1943). This instrument measures the amount of light transmitted by a turbid medium. It can cover an extremely wide range of turbidity concentration without readjustment but is less sensitive than certain other photoelectric instruments and consequently requires a much stronger antiserum for taxonomic studies.

In order to build up a strong enough antiserum for testing with the microdensitometer, a multiple series injection technique was employed. A rabbit was given a multiple series of injections of undiluted serum of the tropical roach (*L. maderiæ*). The first series consisted of injections of 0.5 ml., 1.0 ml., and 1.5 ml. of the roach serum into the lateral ear vein on alternate days. Thirty days after the last injection this series was repeated. Seven days after the last injection of the second series the rabbit was starved for 24 hours, anaesthetized, and bled completely by cardiac puncture. The blood was allowed to clot at room temperature. The clot was broken up, the blood was centrifuged, and the antiserum was filtered and stored in sterile, rubber-stoppered serum vials for future use.

The microdensitometer tests were conducted according to the procedure as outlined by Baier (1947). The tubes used in these tests were standardized according to diameter and transmittancy of light beams. This means that each tube in any one set of tubes would, when filled with distilled water, transmit the same amount of light in the instrument as any other tube in that set.

The microdensitometer readings should be made with antigen dilutions so chosen that the final readings for the highest and lowest dilutions (antibody excess and antigen excess) should equal the control reading at those two points. This was not possible at the antigen excess level because of the small amount of antigen and the relatively low protein content of the insect's sera. Protein N determinations were made when sufficient antigen was available and 2% standard solutions containing 0.16 gms. N or protein per 100 ml. were prepared.

These 2% standard dilutions were used in the initial tube in the microdensitometer readings. As will be noted (Figure 1)

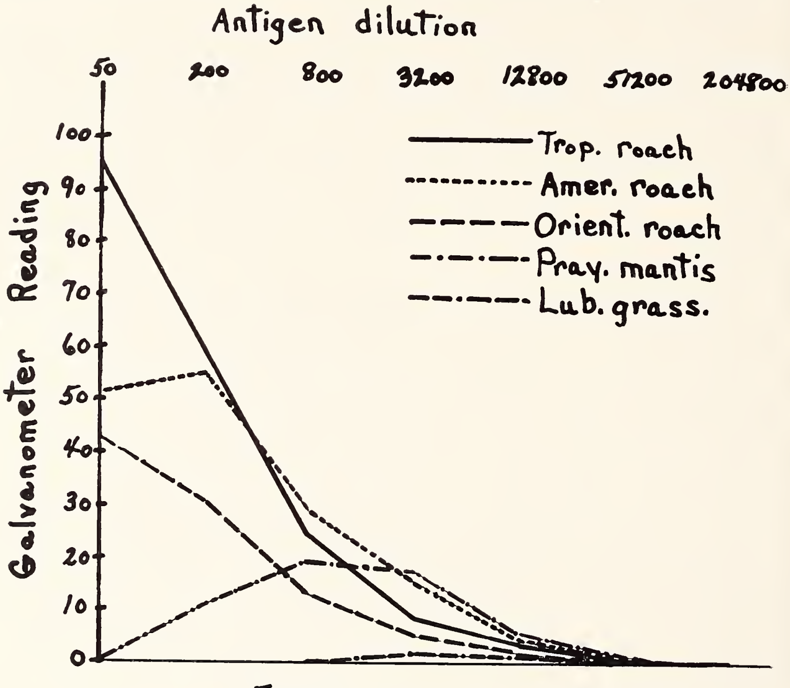


Figure 1

this procedure failed to produce readings in the prozone of the antigen-antibody reaction curve in some cases. In order to conserve antiserum only alternate tubes were used in the tests. No duplicate tests were run.

EXPERIMENTAL RESULTS

Successful antisera were produced against the tropical roach (*Leucophea maderiæ*), the lubber grasshopper (*Romalae microptera*), and the walking stick (*Anisomorpha* sp.). The limited amount of antigen prevented attempts to produce others.

Table I presents a summary of the results obtained with various antisera using the ring test technique and the microdensitometer. The first two anti-tropical roach sera were the same pooled immune serum obtained by combining the serum from several chickens. This combined serum was filtered and stored in sterile

TABLE I

RING TEST AND MICRODENSITOMETER RESULTS

Antisera	Homologous titer in hundreds	Antigens (Relationship values in per cent)							
		Tropical roach	Oriental roach	American roach	Walking stick	Chinese mantis	Lubber grass-hopper	Red-legged grass-hopper	May beetle
Tropical roach P.C.1—1949	128	100	25		12.5		3.1	0	
Tropical roach P.C.1—1950	64	100	12.5		1.6		0	0	
Tropical roach 41	256	100	12.5	.4	25	0	1.6	3.1	0
Lubber grass. (pool.) P.C.2	128	0	1.6	0	0	0	100	12.5	0
Lubber grass. 2876	128	25	1.6		0		100	50	
Walking stick (pool.) P.C.3	64	0	0	1.6	100	0	1.6	1.6	0
Tropical roach JD—diluted 1 + 2	128	100	50	100	0	100	.4		
JD—microdens		100	44.1	82.3	.3	27.7	1.3		

Note: First six tests run with non-standardized antigens. Last two run with 2% standard antigens.

vials in the refrigerator for a year. It is interesting to note in this pooled antiserum that the interfacial titer remained constant but the specificity seemed to increase during the first year. On the basis of these tests the tropical roach shows a closer relationship to the oriental roach than to any other insect tested. A relatively strong cross-reaction was obtained between the antitropical roach serum (1949) and the walking stick serum and a slight reaction was obtained with the lubber grasshopper serum.

Serum 41 against the tropical roach gave results that were similar to those obtained from the pooled tropical roach sera. It is interesting to note that again there is a weak reaction with the sera of the two jumping forms of Orthoptera tested.

For reciprocal tests three different antisera were used, two against the lubber grasshopper and one against the walking stick. Of the two antisera against the lubber grasshopper the pooled antiserum was again more specific. In testing this pooled antiserum only two heterologous reactions were obtained, a relatively strong one against the red-legged grasshopper and a very faint one against the oriental roach.

Antiserum 2876 against the lubber grasshopper showed a strong heterologous reaction against the red-legged grasshopper and the tropical roach and a very faint one against the oriental roach. This antiserum was definitely less specific than the pooled antiserum which probably accounts for the strong cross-reaction with the tropical roach.

The walking stick antiserum was a pooled antiserum of a very specific nature. Weak heterologous reactions were obtained with the American roach, the lubber grasshopper and the red-legged grasshopper.

All of the above tests were run with non-standardized antigens. This combined with the fact that the protein contents of the various insect sera varied considerably might lead one to believe that these tests were not too trustworthy.

The last two tests in Table I were run with 2% standard antigens. The antiserum in both of these tests was from the same rabbit. The results of the microdensitometer test are shown in Table I—last line. With the microdensitometer heterologous reactions were obtained with all antigens tested. On the basis of this test the American roach showed a much closer relationship to the tropical roach than did the oriental roach. The Chinese mantis showed a surprisingly close relationship to the tropical roach although it is considerably more distant than any of the roaches are to each other. The lubber grasshopper and walking stick showed only a slight relationship to the tropical roach.

Using one part of this same antiserum diluted with two parts of buffered saline, ring tests were performed with the same antigens used in the previous test. The results paralleled those of the microdensitometer although no distinction could be made between the tropical roach, the American roach and the Chinese mantis. No cross reaction was obtained with the walking stick and only a very faint reaction was obtained with the lubber grasshopper.

DISCUSSION

The above results combined with those of Leone are at best only a crude beginning in the serological study of orthopteroid relationships. The insect species used in this study were chosen because of their large size and availability. This study was made with two purposes in mind: (1) to show the possibility of performing serological tests using the blood serum of insects rather than the extracts of whole insects or parts thereof; and (2) to attempt to give a serological basis for the taxonomic classification of the orthopteroid insects.

To the best of the authors' knowledge this is the first serological study of insects in which the whole blood sera of insects is used rather than saline extracts of the macerated bodies of insects. In the serological studies of all of the Chordata and many of the Invertebrata whole blood sera were used as the antigen. Only in cases where the animals studied were too small or where they lacked a well-defined circulatory system was it found necessary to use a saline solution to extract the body protein. The validity of the use of saline extracts of whole organisms in establishing relationships has been frequently discussed but never proven. Leone (1947) conducted serological studies of the Orthoptera using saline extracts for antigens. The results of this study are quite similar to those of Leone. More work should be done comparing results obtained by using whole blood sera with those obtained by using saline extractions. If these results are parallel at all times then—and only then—can the use of saline extracts of whole organisms in establishing relationships be considered valid.

As indicated previously each author seems to have his own classification for the orthopteroid insects. On the basis of the serological data obtained in this study indications are that all orthopteroid insects belong in the single order, Orthoptera. In no case was any cross reaction obtained when orthopteroid antisera were tested with serum from the May beetle, a member of the order Coleoptera. With the sera of each of the orthopteroid forms, however, at least a slight reaction was obtained in one or more of the tests carried out.

In order to determine whether the order Orthoptera should be further divided into four suborders (Ross) or whether this order should merely contain six families (Comstock), more tests especially of the reciprocal nature, would have to be carried out. This author hopes to collect more insect sera and carry out these tests in the not too distant future.

SUMMARY

Serological tests were carried out using the whole blood serum of seven orthopteroid insects and one coleopteran insect.

Comparisons were made between results obtained from the "ring" test and the Baier microdensitometer.

On the basis of the results obtained the roaches showed a closer relationship to the Chinese mantis and the walking stick than to the jumping forms tested.

The results suggested that the orthopteroid insects belong in a single order rather than three or four different orders.

The right to accept results obtained by using saline extractions for antigen was questioned and a solution was suggested.

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(*Continued from page 82*)

Becker. On the serious side he pointed out the importance of the airplane in the transportation of insect and other epidemic producing pests, among them the Golden Nematode. Mr. Becker concluded that the greatest difficulty and hazard of plant quarantine inspection work is not with insects but with *Homo sapiens*.

The meeting adjourned at 9:30 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF MARCH 17, 1953

The meeting of the Society was called to order at 8:00 P.M. by the President, Dr. Lucy Clausen. In the absence of the Secretary, Mr. Marks, the minutes of the previous meeting were not read and the President asked Dr. James Forbes to serve as Secretary for the evening. There were 15 members and 7 guests present. Dr. Clausen cordially welcomed the guests to our meetings. She also greeted two members, Dr. Harold Hagen and Mr. Edwin W. Teale, who have not been with us recently. This was Dr. Hagan's first meeting in several months since his recent illness. Mr. Teale had just returned from a 28,000 mile, six-month jaunt around the country.

Mr. Jay Fox of Seaford, New York, was proposed for membership.

(*Continued on page 94*)

(*Continued from page 93*)

This brought the order of business to the speaker of the evening. Dr. Vishniac introduced Dr. Louis Pyenson of the Long Island Agricultural and Technical Institute of Farmingdale, New York, who spoke on ''Methods of Escaping Detection in the Insect World.''

There are four main devices which nature uses to assist insects in escaping detection. These are fusion, confusion, concealment, and deception. Fusion implies the blending of the organism with its background to make the organism unrecognizable. This is accomplished by countershading to create a flatness, or the imitation of the background color on the insect, or the repetition of the background pattern on the insect. Confusion means that the insect can be seen but not recognized. This is accomplished by disruptive patterning which is the use of irregular patterns, and structural disruption or the use of projections and irregular surfaces and contours. Concealment is the hiding of the insect in the ground, or within the stems, leaves, or twigs of plants, or within the foam produced by the spittle-bug. Deception is the means used to make the insect look more important or less important than it is. This is accomplished by the use of colored spots, or colored hairs and projections, or by mimicry. Dr. Pyenson stressed the point that these four devices are usually not employed singly, but they are combined in practically any combination. He had a very fine series of Kodachrome slides to illustrate the devices and the combinations.

The talk was followed by a discussion of the devices, their meaning and importance, insect problems in general, and the equipment which Dr. Pyenson used for taking his very fine pictures.

The meeting adjourned at 9:30 P.M.

JAMES FORBES, *Sec.*, pro temp.

MEETING OF APRIL 7, 1953

A regular meeting of the Society was held at the American Museum of Natural History. President Clausen was in the chair. There were 8 members and 5 guests present.

Mr. Jay Fox, Seaford, Long Island, was elected to membership.

Miss Rosalie Talbot, 262 Bay 17th Street, Brooklyn, N. Y. was proposed for membership. On motion duly made and seconded the By-Laws were suspended and Miss Talbot was declared elected.

The Secretary called attention to Dr. Ernst Mayr's volume ''Principles and Methods of Systematic Zoology''.

Dr. Forbes noted that the speaker of the previous meeting, Dr. Pyenson, writing an article in the Long Island Press, called attention to the fact that this year (1953) a brood of the 17-year cicada will make its appearance on Long Island.

Dr. Hagan spoke in some detail on the new book ''Fresh Water Invertebrates''.

The speaker of the evening, Dr. Roger Williams, spoke on ''*Culicoides* in Alaska''. He illustrated his lecture with some beautiful kodachromes.

(*Continued on page 110*)

A NEW NAME FOR ARGYNNIS LAIS EDWARDS (LEPIDOPTERA, RHOPALOCERA)

By Cyril Franklin dos Passos[1] and Lionel Paul Grey[2]

Mr. Nicholas W. Gillham, of New York, has kindly called our attention to the fact that *Argynnis lais* Edwards, 1883, is a primary homonym of *Argynnis lais* Scudder, 1875, and has suggested that it would be appropriate to propose a new name for the former insect.

Argynnis lais was published by Scudder in the synonymy of "*Brenthis Triclaris* (Hübn.) Herr.-Schaeff.," with the statement that ". . . Many years ago I distributed specimens of this butterfly under the MS. name of *Arg. Lais.*"

Subsequent to the publication of these two homonyms the former was transferred to *Proclossiana* and is now considered a synonym of *P. eunomia triclaris* (Hübner), [1821], while the latter is classified as *Speyeria* (*Speyeria*) *atlantis lais* (Edwards).

Prior to the Fourteenth International Congress of Zoology at Copenhagen in 1953, the mere listing of a specific name in the synonymy without an independent description was considered publication thereof, in accordance with Opinion 4 of the International Commission on Zoological Nomenclature (1907; Hemming, 1944). That opinion was incorporated in the Règles by the Thirteenth International Congress of Zoology at Paris in 1948 (Hemming, 1950), but that action was reversed by the Fourteenth International Congress of Zoology (Hemming, 1953). Since the latter action is not retroactive, we propose for this insect the name

Speyeria (*Speyeria*) *atlantis helena,* new name.

The type of *helena* is the lectotype of *Argynnis lais,* a male in the Carnegie Museum.

It is a question, in a case like the present, whether a new name

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(*helena*) for an homonym (*lais*) should be proposed in the original genus (*Argynnis*) in which the homonym was described or in the genus (*Speyeria* [*Speyeria*]) to which the homonym has been transferred. The Règles are silent on this subject and there are precedents for both methods of procedure.

It would be well, for the sake of uniformity, to amend the Règles so that this problem is covered. Such an amendment should not be retroactive, because that could upset many names. Possibly it should not even be mandatory, but merely in the form of a recommendation.

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THE NEOTROPICAL SPECIES OF THE ANT GENUS STRUMIGENYS FR. SMITH: GROUP OF CULTRIGER MAYR AND S. TOCOCAE WHEELER

BY WILLIAM L. BROWN, JR.
MUSEUM OF COMPARATIVE ZOOLOGY, HARVARD UNIVERSITY

The present paper is a continuation of my series on the New World fauna of the dacetine ant genus *Strumigenys* Fr. Smith. Earlier parts, containing keys to the abbreviations for measurements and proportions, may be found in Jour. New York Ent. Soc. **61**: 53–59, 101–110 (1953). Other parts are in press.

Discussed here are *S. cultriger* Mayr, *S. deltisquama* new species, and *S. tococae* Wheeler, considered as members of the *mandibularis* series. *S. cultriger* and *S. deltisquama* seem to be related, and these two may be considered as members of group *cultriger*. They are characterized by having basic *mandibularis*-series mandibular dentition, with the addition, on the inner or masticatory borders of each of the shafts, of a straightedged, translucent lamella which ends in a right angle just short of the proximal preapical tooth. *S. cultriger* shows obvious close relationships to the *smithii* group of the *mandibularis* series; *S. deltisquama* is somewhat more aberrant.

S. tococae has *mandibularis*-series dentition, except that the apical fork has two, instead of only one, intercalary teeth. A rudimentary lamella is also present on the inner mandibular border, but this does not imply a close relationship to the *cultriger* group; in fact, the relationships of *tococae* are obscure, and its assignment to the *mandibularis* series is tentative.

Each of these three species remains known from a single collection at the present time, so little can be said concerning their probable distribution. *S. tococae* is known to inhabit plant cavities above the ground, and its very large eyes appear to represent an adaptation to arboreal foraging habits.

Strumigenys cultriger Mayr

Strumigenys cultriger Mayr, 1887, Verh. zool-bot. Ges. Wien, 37 : 571, worker. Type loc.: Santa Caterina, Brazil. Lectotype (so labelled) in Naturh. Mus. Wien., by present selection.

Worker (notes based on lectotype, loaned through the courtesy of Dr. M. Beier): TL 3.7, HL 0.85, ML 0.51, WL 0.90 mm.; CI 77, MI 60. Antennal scape L 0.63 mm.; antennal funiculus segments, I 0.14, II 0.07, III 0.10, IV 0.23, V 0.37 = total funiculus L 0.91 mm.

In general habitus and proportions very similar to *S. prospiciens* Emery, but slightly larger overall, and with a narrow but distinct translucent margin or lamella extending along the inner mandibular border to very slightly beyond the midlength of the exposed length of the mandible, where it ends abruptly in a rectangular corner a trifle proximad of the proximal preapical tooth. Dentition as in other *mandibularis*-series species; preapical teeth spiniform, widely spaced, the distal shorter than the dorsal apical tooth, but nearly twice as long as the proximal preapical tooth.

Propodeum with dorsal surface a bit shorter and more convex than in *prospiciens,* and the lamellae much different, vestigial, represented only by a minute subrectangular dorsal tooth trailing a fine bordering carina on each side of the declivity.

Petiole and postpetiole opaque, as in *prospiciens,* but with more strongly convex dorsonodal surfaces and less well developed spongiform appendages. Gaster smooth and shining, the basal costulae obsolete. Mesokatepisternum smooth and shining; body otherwise opaque.

Reclinate, linear-spatulate hairs of ground pilosity more numerous and conspicuous than in *prospiciens* or *smithii* Forel, found on cephalic dorsum, clypeus, scapes, legs, promesonotum, posterior propodeum, and both nodes. Gaster with no conspicuous erect hairs except a few very fine curved ones along anterodorsal margin and on venter; very fine, dilute, but fairly long reclinate pubescence-like pilosity over dorsal and posterior ventral surfaces. Specialized erect hairs limited to two linear-spatulate pairs, one on humeri and one straddling mesonotum. Mandibular and trigger-hairs much as in *prospiciens, smithii* and relatives. Color medium ferruginous; appendages, anterior and posterior extremities of gaster a trifle lighter and more yellowish.

This ant can be distinguished readily from other *mandibularis*-series species by means of its mandibular lamellae, ending near midlength of the shafts, and by the peculiar reduction of propodeal lamellae and gastric pilosity. See also under *S. deltisquama* below.

Strumigenys deltisquama new species

(Fig. 1, a, b.)

Holotype worker: TL 2.6, HL 0.63, ML 0.34, WL 0.60 mm.; CI 97, MI 54. Scape, exposed L 0.28 mm.; funiculus L 0.48 mm.; apical segment L 0.23 mm.

Form of head, mandibles and a scape shown in fig. 1, b, with pilosity omitted from all parts except anterior clypeal and scape borders. With all the pilosity in place, the head appears relatively shorter and broader and the mandibles shorter, a common type of illusion in heavily pilose dacetine ants. Each inner mandibular margin bears a straight border of translucent lamella extending to the apical quarter of the exposed length, where it ends abruptly and subrectangularly just basad of the proximal preapical tooth (see fig. 1, a). Apical fork with a single intercalary tooth. Dorsal surface of head gently and evenly convex. Compound eye circular, moderate in size, slightly prospicient and usually just barely visible in direct dorsal view of head, with about fifteen facets, four in greatest diameter (equal to 0.04–0.05 mm.). Lateral surfaces of head just in front of eyes broadly and rather deeply concave, the concavity not interrupting the preocular lamina, which arches above it to reach the eye behind; the concavities are not extended mesad ventrally to form any "postoral grooves."

Promesonotum broad, subcircular in dorsal view, without humeral angles, depressed, surface gently convex, feebly impressed at site of obsolete promesonotal suture. Posterior mesonotum much narrowed, metanotal groove feeble, scarcely interrupting uniconvex alitruncal profile. Propodeum short, narrow, with a pair of sturdy acute teeth slightly shorter than the distance between the centers of their bases and subtended by narrow, concave, cariniform infradental lamellae. Petiolar peduncle slender, arched, naked beneath, subequal in length to the node; node distinct, just about as long as it is broad behind; from side view with differentiated subequal anterior and dorsal profiles; spongiform appendages confined to a thick rim around posterior margin of node. Postpetiole transverse-oval, small, but wider than petiolar node, maximum width about 0.17 mm., convex, with narrow spongiform margins and moderate lobes beneath; sides partly naked.

Mandibular apices and under-surfaces, apical gastric segments and median posterior gastric venter more or less smooth, shining; body otherwise completely and densely punctulate and opaque. Base of gaster with feeble superimposed costulation extending about half the length of the first segment. Head, with clypeus and scapes, and promesonotum densely covered with thick, orbicular, opaque, yellowish, squamose or stud-like hairs, pseudoappressed, uniform in size, but those on the promesonotum slightly larger. A few other thick squamose hairs also along the sides of the propodeal dorsum, and one applied to the dorsal surface of each propodeal tooth, a few each on the petiolar node and around lateral and posterior borders of postpetiolar node. The squamose hairs of the anterior scape borders have their blades curved ventrad at the apices, and thus appear deltoid to dorsal view; the specific name is in reference to this. Legs with reclinate spoon-shaped hairs; nodes with a few posteriorly-curved, suberect, narrowly spatulate hairs. Gastric dorsum with about six transverse rows of six posteriorly inclined, erect, flattened-clavate hairs, all conspicuous. Inconspicuous fine pilosity on ventral surfaces of head and gaster. Each mandible with three or four dorsal rows of slender, oblique pointed hairs. No trace of specialized erect hairs on head or alitrunk. Feebly concave sides of alitrunk largely naked; only three or four squamose hairs along ventrolateral prothoracic margin on each side. Color uniform light ferruginous.

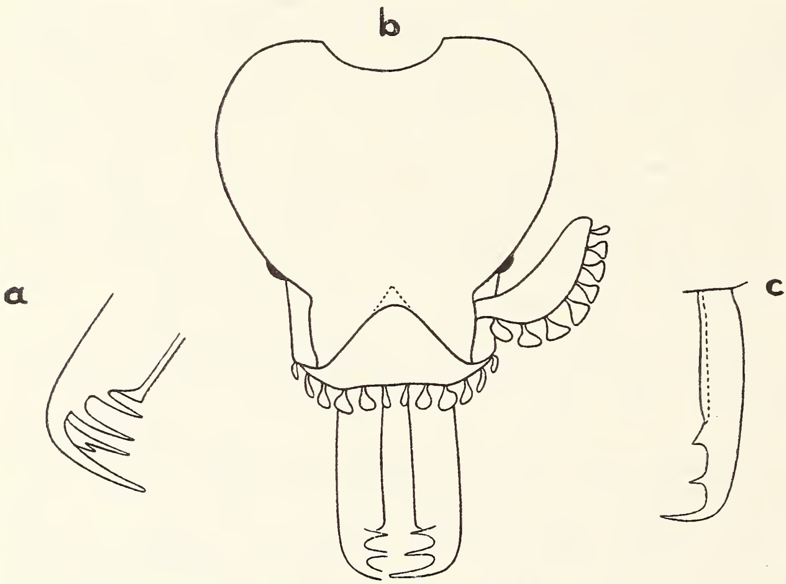

FIG. 1, a and b, *Strumigenys deltisquama* new species; a, apex of right mandible in detail, oblique dorsal view; b, head and mandibles, dorsal view, pilosity largely omitted (paratype worker); c, *Strumigenys tococae* Wheeler, left mandible, dorsal view (syntype worker).

Holotype selected from a series of workers taken by K. W. Cooper during January, 1941, on Barro Colorado Island, Panama Canal Zone. Holotype and paratypes in Museum of Comparative Zoology, Harvard University; paratypes in U.S. National Museum, Coll. K. W. Cooper, and elsewhere. Paratypes, all from type nest series, showed only very slight variation: TL 2.5–2.7, HL 0.62–0.67, ML 0.34, WL 0.60–0.63 mm.; CI 95–97, MI

51–55. Nothing is recorded concerning the biology of this ant, but the type locality is covered with rainforest.

S. deltisquama differs strongly from *S. cultriger* in the form of the head, which in the latter is similar to *S. prospiciens.* The mandibular teeth of *deltisquama* are also much closer to the apex of the mandible and to each other, and the lamella extends much farther along the shaft. There are also wide differences in size, sculpture and pilosity, as well as in the form of the propodeal lamellae or teeth.

Strumigenys tococae Wheeler
(Fig. 1, c.)

Strumigenys tococae Wheeler, in Wheeler and Bequaert, 1929, Zool. Anz., 82: 31, worker. Bequaert, *op. cit.,* p. 23, biology. Type loc.: Pará [Belém], Brazil. Syntypes in Mus. Comp. Zool., Harvard Univ., and elsewhere.

Worker (measurements from largest and smallest specimens of 8 in available syntype series): TL 3.3–3.6, HL 0.80–85, ML 0.44–0.47, WL 0.80–0.87 mm.; CI 75, MI 55. Max. diameter of compound eye 0.14–0.15 mm. This species is easily recognized by means of its very large, laterospicient eyes and by its distinctive mandibles.

In figure 1c, a mandible is shown in dorsal view, so as to display the preapical dentition and the narrowly lamellate internal margins. The apex of the mandible as seen end-on has two widely diverging teeth forming the apical fork, approximately equal in length, and between these, two shorter but acute intercalary teeth. The shafts lie close together and parallel at full closure. The head shape in general is that of many species of the *mandibularis* series and of the *emeryi-hindenburgi* groups. A very fine lamella or carina borders each antennal scrobe dorsally to mark the dorsolateral cephalic margin on each side.

Antennal scape slender; funiculus also slender, its second and third segments both longer than broad, the third much longer than the second. Promesonotum strongly convex, with well developed humeral angles, median longitudinal carinula and low, flange-like borders dorsolaterally. Impression in region of extreme posterior mesonotum and metanotum broad and deep; propodeal dorsum weakly convex, sloping ventrad posteriorly.

Propodeal teeth prominent, slender and acute, elevated, the upper tooth longest; upper and lower teeth on each side connected by a low, deeply concave lamella.

Petiole with a distinct, slender peduncle subequal in length to the node; node semiglobosely rounded, bicarinulate, its free portion seen from above nearly or quite as long as broad. Postpetiole broader than long and broader than the petiolar node, its free disc strongly convex, longitudinally costulate, opaque. Both nodes with voluminous lateral, posterolateral and ventral spongiform appendages. Gaster strongly longitudinally costulate at base for about ⅓ length of basal segment. Anteroventral spongiform pad of gaster prominent. Gaster otherwise smooth and shining, with scattered punctures.

Mandibles rather smooth, weakly shining; body and most of appendages otherwise finely punctate-reticulate, opaque. Head, with clypeus, promesonotum, posterolateral borders of propodeum, appendages, both nodes and gastric dorsum with abundant, rather evenly distributed, inverted lineocochlear ground pilosity, most hairs arched-reclinate, moderate-sized and fairly conspicuous. Vertex with a pair of erect remiform hairs; long flagellate hairs paired on humeri, others distributed sparsely over nodes and both surfaces of gaster. Mandibles with slender appressed hairs; inner margins each with about 9 slender, tapered, oblique sensory hairs; trigger hairs of labrum long, fine, curved. Color even light ferruginous yellow.

Dr. J. C. Bequaert took this species in some numbers in the peculiar foliac sacs of a species of the myrmecophyte *Tococa formicaria* Mart. group at Belém, in which circumstances he found it the commonest ant species. Several species of ants yet remain to be described in the arboreal *Strumigenys* fauna of South America, and one or more of these may prove to be closely related to *S. tococae*.

FLEAS ON RATS (RATTUS NORVEGICUS) IN NEW JERSEY[1]

By PAUL P. BURBUTIS[2] AND ELTON J. HANSENS[3]

In the spring of 1951 a survey of domestic rat parasites was started in New Jersey to determine ultimately the kinds of ectoparasites and their distribution in the state. These studies were supported in part by the New Jersey State Department of Agriculture. This paper briefly summarizes the data on fleas throughout New Jersey taken from rats (all *Rattus norvegicus*). Most of the animals were taken in garbage and refuse dumps but a portion of the animals were also taken in warehouses, stores, houses and other buildings. The place names used in the discussion do not necessarily denote that the dump is owned or operated by the municipality mentioned.

To obtain fleas and other ectoparasites, rats were captured on the dumps by driving them from their burrows with calcium cyanide or by running a bulldozer through the area and killing the rats as they emerged. As soon as killed, each animal was placed in a two quart jar containing a quart of water, and small quantities of lindane and a wetting agent. Each jar was set aside for at least 2 hours and then shaken vigorously 100 times to wash parasites from the animal. After washing the rat was removed, and the length and sex were recorded. Liquid remaining in the jar was passed through a sieve (60 meshes to the inch) to collect the parasites. Parasites and debris collected on the screen were washed from the screen and stored in 70% alcohol until mounted for study.

A preliminary report on the fleas infesting rats in New Jersey, by Hansens and Hadjinicolaou (1952), presented data on fleas taken from rats between June 1, 1951, and January 31, 1952. However, the study continued and this paper presents the data

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on fleas from rats collected between February 1, and September 30, 1952, and a summary of the entire study.

Data on the additional collections are summarized in Table 1.

At the following locations where rats were collected between February 1 and September 30, 1952, no fleas were taken (number of rats collected in parentheses): Atlantic County—Atlantic City (7), Somers Point (1); Bergen County—Englewood (18), Englewood Cliffs (1), Fairview (50), Lyndhurst (3), North Bergen (1), Rutherford (24), Woodcliff Lake (1), Wood Ridge

TABLE 1

FLEAS TAKEN FROM RATS COLLECTED FEBRUARY 1 TO SEPTEMBER 30, 1952

Location	Total Rates	Total fleas	Xenopsylla cheopis	Nosopsyllus fasciatus	Ctenocephalides felis
Secaucus	49	1	1		
Jersey City	72	30	26	4	
N. Arlington	41	6	3	3	
Union City	63	2	2		
Newark	71	5	1	4	
Rahway	39	1		1	
Perth Amboy	32	6	6		
Bernardsville	30	1			1
Bordentown	21	1			1
Flemington	34	14		14	
Camden	41	22	21	1	
Burlington	15	7		7	
Totals	508	96	60	34	2

(23); Burlington County—Pemberton (1), Palmyra (16), Riverside (29), Riverton (3), Roebling (3); Camden County—Audubon (14), Barrington (19), Pennsauken (10); Cape May County—Cape May (6), Wildwood (3), Woodbine (1); Cumberland County—Bridgeton (15), Deerfield (16), Port Norris (2), Vineland (10); Gloucester County—Gibstown (1), National Park (7), Westville (8), Woodbury (16); Hunterdon County—Highbridge (20), Lambertville (3); Mercer County—Hightstown (30), Trenton (3), White Horse (22); Middlesex County—Cranbury (31), North Brunswick (3), South Plainfield (1), South River (60); Monmouth County—Allentown (15), Freehold (20), Long Branch (15); Morris County—Dover (2), Pine Brook

(17); Ocean County—Toms River (1); Passaic County—Bloomingdale (45); Salem County—Centerton (3), Pedricktown (5), Penns Grove (11), Salem (10); Somerset County—Raritan (18); Sussex County—McAfee (3), Newton (25); Union County—Elizabeth (40); Warren County—Belvidere (10), Hackettstown (43), Phillipsburg (25), Washington (33).

Between February 1 and September 30, 1952, 96 fleas were collected from a total of 1,331 rats surveyed in 69 different locations in New Jersey. Thirty-eight of these fleas were taken from rats which were trapped in buildings, and the remainder were taken from rats inhabiting dumps. Of these 38 fleas taken from rats trapped inside buildings, 27 were *Xenopsylla cheopis,* the Oriental rat flea, and these were all collected from Jersey City and Camden, New Jersey. Eleven specimens of *Nosopsyllus fasciatus* were taken from rats collected in buildings in Jersey City, Newark, and Burlington, New Jersey.

A summary of the species of fleas taken from rats in New Jersey for the entire survey is set forth in table 2.

TABLE 2

FLEAS TAKEN FROM RATS FROM MAY 15, 1951, TO SEPTEMBER 30, 1952

Flea Species	Rats infested	No. of fleas	Fleas per infested rat
Xenopsylla cheopis	172	376	2.2
Nosopsyllus fasciatus	43	59	1.3
Ctenocephalides felis	17	19	1.1
Ceratophyllus gallinae	1	2	2.0
Totals	233	456	1.9

During the two summer-study periods, most of the fleas were collected from dumps in the northeastern part of New Jersey and in Camden. Of these fleas, 86.4 percent were *Xenopsylla cheopis,* the Oriental rat flea. *Nosopsyllus fasciatus* and *Ctenocephalides felis* make up the remaining 13.6 percent of the fleas collected from rats in dumps during the summer months. The flea index was very low; 0.24 fleas per rat during the first summer and 0.04 fleas per rat collected. *X. cheopis* was taken only in those areas close to port facilities.

Preliminary studies (Hansens and Hadjinicolaou, 1952) indicated that the peak of abundance of adult fleas was reached sometime in August. This was substantiated by further studies in that 32 of the 41 fleas collected during the second summer were taken in August.

In a study of the fleas on rats in buildings, a total of 142 rats were trapped at 24 different localities. These rats yielded a total of 103 fleas of which *X. cheopis* was again the predominant species, making up 76.9 percent of the total fleas. The flea index for rats trapped in buildings was 0.73 fleas per rat. This is 5 times that of the summer index for rats in dumps and 9 times that of the outdoor winter flea index. The winter flea index was 0.08 fleas per rat collected.

SUMMARY

In a study of fleas on rats in New Jersey from May 15, 1951, to September 30, 1952, 2,721 rats (*Rattus norvegicus*) and 456 fleas were collected, giving a flea index of 0.16 fleas per rat collected. Only 233 or 8.2 percent of the rats captured were infested with fleas. Although the flea index is only 0.16 fleas per rat collected, it is of interest to note that there were almost 2 fleas per infested rat.

In all, 4 species of fleas were found to parasitize rats in New Jersey, and these were: *Xenopsylla cheopis, Nosopsyllus fasciatus, Ctenocephalides felis,* and *Ceratophyllus gallinae. X. cheopis* represented 82.7 percent of the fleas collected, and it was found to be present mainly in the northeastern metropolitan and Camden areas. *N. fasciatus* represented 12.9 percent of the total fleas collected and it was the major flea parasitizing rats in rural areas. The cat flea, *Ctenocephalides felis,* was collected from 12 localities and it probably only occasionally attacks rats in New Jersey. The common chicken flea, *Ceratophyllus gallinae* collected from a rat in a poultry hatchery, does not normally attack rats, and, due to the situation in which it was found, it can be considered as only accidentally occurring on rats in New Jersey.

Reference

HANSENS, E. J. AND J. HADJINICOLAOU. 1952. Preliminary studies of fleas on rats (*Rattus norvegicus*) in New Jersey. Jour. N. Y. Ent. Soc. 60: 91–95.

DETERMINATION OF GLYCOGEN CONTENT DURING THE METAMORPHOSIS OF THE MEALWORM (TENEBRIO MOLITOR LINNÆUS)*

By Paul Gerald Rousell
Department of Biology, Fordham University

Many students of insect metamorphosis have reported a steady decrease in glycogen during the pupal period. Bataillon (1893), Vaney and Maigon (1905) and Kotake and Sera (1909) showed irregular but progressive decreases during the metamorphosis of the silkworm, *Bombyx mori.* Similar results were obtained by Weinland (1906) for the blowfly, *Calliphora vomitaria*; Strauss (1911) in the honeybee, *Apis mellifica*; Rudolfs (1926) for the tent caterpillar, *Malacosoma americana* and Courtois-Drilhon (1931) for three species of Lepidoptera (*Attacus pernyi, Sphinx liqustri,* and *Saturina pyri*). However, Ludwig and Rothstein (1949) found that in the Japanese beetle, *Popillia japonica* there was a decrease in the glycogen content during the early part of the pupal stage, followed by a significant increase between the fourth and fifth days of pupal life at 25° C. This increase was then followed by a steady decrease during the remainder of this stage.

Evans (1934) studied the changes in nitrogen, fat and total carbohydrate during the metamorphosis of the mealworm, *Tenebrio molitor* at 25° C. At this temperature, pupal life lasts 9.5 days. He assumed that all the carbohydrate was glucose and on the basis of experiments performed at intervals of 48 hours, he found that the total carbohydrate content fell steadily throughout metamorphosis. However, Evans failed to include determinations on glycogen and up to the present time, to the writer's knowledge, no studies on glycogen have been made using this insect.

The purpose of the present study was to determine the changes in glycogen content of *T. molitor* during metamorphosis, and also

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The author wishes to express his appreciation for the interest and assistance of Dr. Daniel Ludwig.

to ascertain whether these changes involve a progressive decrease as found by some workers or whether a synthesis occurs during part of the pupal stage as reported by Ludwig and Rothstein (1949).

OBSERVATIONS AND RESULTS

The results are given in Figure I. The values plotted in each

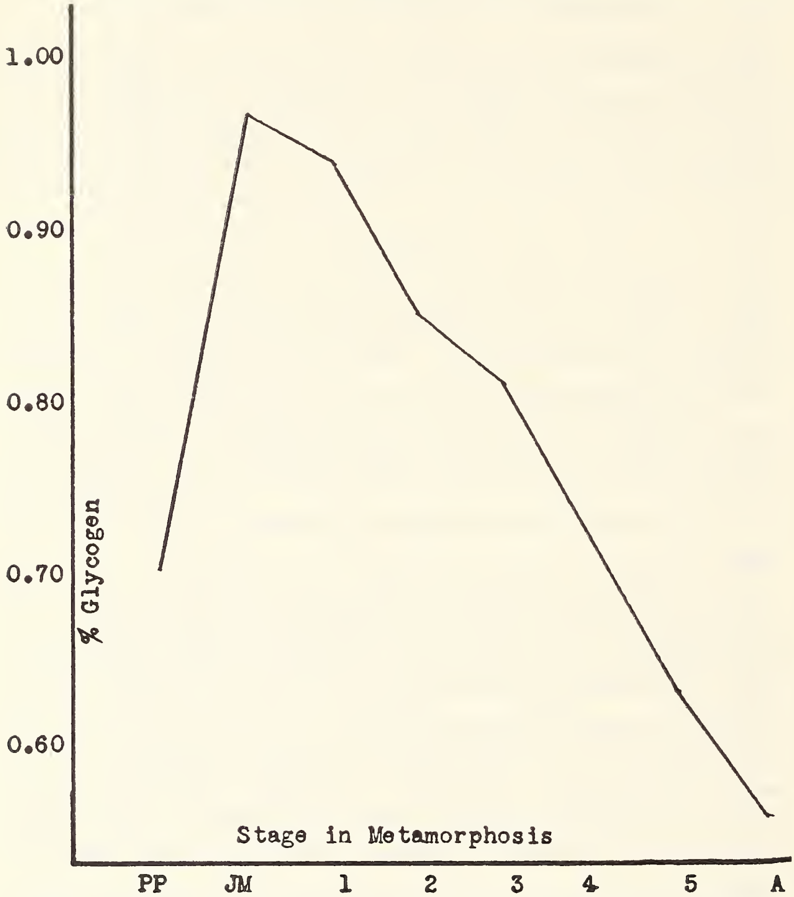

Fig. 1. Changes in glycogen during the metamorphosis of the mealworm. PP, prepupa; JM, just molted pupa; A, adult. Numbers indicate days of pupal stage.

case are averages of 10 individual tests. There was a considerable variation in the weights of different insects at the same stage of metamorphosis. Since the amount of glycogen is greater in larger insects, the average percentage values for each determination were plotted. The glycogen content increased from 0.71 in the prepupal stage to 0.97 percent in the newly-molted pupa. During the pupal stage there was a gradual and progressive decrease, the percentage values reaching 0.64 in 5-day pupa and 0.57 in newly-emerged adults.

A statistical analysis was made of these results. Two means are said to be statistically significant when their difference divided by the standard error of the difference is equal to 2 or more. Marked changes in the amount of glycogen occur where this value is attained. This statistical analysis showed that there were significant changes between successive days of the pupal period with the exception of the newly-molted to 1-day pupa and 2-day to 3-day pupa. A weight loss accompanies the emergence of the adult, but it is not sufficiently great to cause an increase in the percentage concentration of glycogen.

SUMMARY

Determinations were made on the glycogen content of the mealworm *Tenebrio molitor* at the following stages of metamorphosis: prepupa, newly molted, one, two, three, four and five day old pupæ, and newly emerged adults.

Glycogen content rises from 0.71 percent in the prepupa to 0.97 percent in the newly molted pupa. During the pupal period there is a steady decrease in the glycogen content, continuing through the emergence of the adult.

The increase in glycogen associated with pupation corresponds to the decrease in fat content reported by Evans (1934) and hence it appears probable that this glycogen is synthesized from fat.

These results indicate the utilization of glycogen for energy during the pupal stage.

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(*Continued from page 94*)

Dr. Williams found, in the course of his investigations, that *Culicoides* breeds in certain species of sedges. Control measures would include the use of "weed-killers" for killing off the sedges or bulldozing the sedges to bury them beneath the surface. It was brought out in subsequent discussion that *Culicoides* requires a blood meal before it can successfully oviposit.

The meeting adjourned at 9:25 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF APRIL 21, 1953

A regular meeting of the Society was held at the American Museum of Natural History, President Clausen in the chair. There were thirteen members and two guests present. The minutes of the preceding meeting were accepted as read.

The speaker of the evening was Mr. Chris Olsen who in two series of Kodachrome slides illustrated his method of plastic construction of a Lampyrid beetle and of a mosquito. Intriguing was the use of a green light, attached to an electric timer to simulate the flashing in the firefly. Mr. Olson's account was very well received.

Mrs. Alice Hopf then demonstrated models of a butterfly and a spider made by her entomologically-minded son for a puppet show. The spider is to be the villain.

The meeting adjourned at 9:30 P.M.

LOUIS S. MARKS, *Secretary*

(*Continued on page 134*)

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), XXIX

By Charles P. Alexander
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The present article continues the series of reports on tropical American crane-flies, the preceding part having been published in the Journal of the New York Entomological Society, 62: 139–152; 1954. At this time I am considering chiefly species from Peru, collected by Señor Luis E. Peña and by Felix Woytkowski, the latter assisted by his son George. A few further species from various sources are acknowledged in the text. I am greatly indebted to all these entomologists and friends who have so continued to enlarge our knowledge of the vast crane-fly fauna of the Neotropics. The types are preserved in my personal collection of these flies.

Genus *Limonia* Meigen

Limonia (Dicranomyia) altandina new species

General coloration gray, the præscutum with a broad median stripe; antennæ black, the basal flagellar segments subglobular; wings whitish hyaline, unpatterned; *Sc* relatively short, cell *1st* M_2 closed; male hypopygium with the ventromesal lobe of the basistyle large, dark-colored; ventral dististyle complex in structure.

MALE. Length about 6.5–7 mm.; wing 7.5–8.5 mm.

FEMALE. Length about 7–7.5 mm.; wing 7.5–8.5 mm.

Rostrum brownish black; palpi black. Antennæ black, scape weakly pruinose; basal flagellar segments subglobular to short-oval, the outer ones slightly longer, exceeding their verticils; terminal segment not or scarcely exceeding the penultimate in length. Head gray, the vertex with a more or less distinct Λ-shaped brown area; anterior vertex broad, nearly three times the diameter of the scape.

Pronotum infuscated above, gray on sides. Mesonotum gray, the præscutum with a broad median brown stripe that is weakly split behind, the lateral stripes ill-defined; scutal lobes weakly patterned with brown; scutellum somewhat lighter gray. Pleura and pleurotergite clear light gray; dorsopleural membrane dusky. Halteres with stem yellow, clearest at base, knob dark brown. Legs with the coxæ obscure yellow, sparsely pruinose; remainder of legs yellowish brown to brownish black, the outer segments darkest. Wings whitish hyaline, unpatterned; prearcular field more yellowed; veins brown. Venation: *Sc* relatively short, Sc_1 ending just before to opposite origin of *Rs*, Sc_1 alone approximately four-fifths *Rs*; cell *1st* M_2 closed, subequal to vein M_4; *m-cu* slightly variable in position, from shortly before to beyond the fork of *M*.

Abdomen dark brown, sparsely gray pruinose, in cases the lateral tergites bordered laterally by pale; hypopygium dark brown. Male hypopygium with the tergite transverse, the caudal margin with a small median notch and dorsal furrow, leaving two obtuse lobes; scattered elongate setæ on posterior two-thirds of tergite, concentrated on the lobes. Basistyle relatively small, its ventromesal lobe large, dark-colored, provided with unusually long and abundant setæ; on face of lobe at near midlength with a small accessory lobule. Dorsal dististyle a slender strongly curved sickle, very gradually narrowed to the tip. Ventral dististyle with the body relatively small; rostral prolongation a broadly flattened plate that is extended into two spines, the outer one from a larger basal tubercle, on lower face of prolongation with a small oval setiferous lobule; distad of base of prolongation with a conspicuous dark-colored lobe, occupying the notch between the prolongation and the main body of the style, provided with abundant short setæ; inner margin of style just cephalad of the rostral prolongation with a linear row of long strong setæ. Gonapophysis with the mesal-apical lobe slender, gently curved.

Holotype, ♂, La Raya, Cuzco, Peru, 4300 meters, February 21, 1950 (L. E. Peña). Allotopotype, ♀. Paratopotypes, several ♂ ♀.

From other generally similar regional forms that have the male hypopygium complicated by outgrowths, the present fly is most like *Limonia* (*Dicranomyia*) *andinalta* new species, and a few others, all well distinguished from one another by marked hypopygial characters. Other species, including *L.* (*D.*) *diura* Alexander, *L.* (*D.*) *humerosa* Alexander, and *L.* (*D.*) *muliercula* Alexander, have comparable yet entirely distinct male hypopygia.

Limonia (Dicranomyia) andinalta new species

General coloration light gray, the præscutum with indications of two intermediate brown stripes; antennæ black, the flagellar segments moniliform; anterior vertex broad; halteres pale; legs dark brown to brownish black; wings whitish subhyaline, without a stigmal darkening; male hypopygium very complex, especially the basistyle and ventral dististyle, which bear distinctive outgrowths and modifications; rostral spines two, powerful, more or less recurved.

Male. Length about 6–6.5 mm.; wing 7–7.5 mm.

Rostrum and palpi black. Antennae black throughout, moniliform; flagellar segments subglobular, the outer ones passing into short-oval; terminal segment oval, only a trifle longer than the penultimate; segments exceeding the longest verticils. Head light gray, the center of vertex more infuscated; anterior vertex relatively broad, nearly four times the diameter of the scape.

Thorax gray, the præscutum with indications of two intermediate brown stripes, the usual lateral pair obsolete. Halteres pale. Legs with the coxae light gray; trochanters obscure yellow; remainder of legs dark brown to brownish black, the femoral bases obscure yellow. Wings whitish subhyaline, more yellowed at base; stigma lacking; veins brown. Venation: *Sc* short, Sc_1 ending a little before origin of *Rs*, Sc_1 long, approximately two-thirds *Rs;* cell *1st* M_2 closed, open by atrophy of *m* in one wing of type; *m-cu* at fork of *M;* vein *2nd A* nearly straight.

Abdomen dark gray; hypopygium dark brown. Male hypopygium very complex in structure. Ninth tergite transverse, strongly narrowed outwardly, the caudal margin with two obtuse lobes that are separated by a V-shaped notch, the lobes with abundant long setæ. Basistyle relatively small, its ventromesal lobe unusually large, the area exceeding that of the remainder of style, appearing as an elongate appendage that widens outwardly, the apex pale, unequally bilobed; at near midlength of face of lobe with a low blackened lobule; mesal face of basistyle at apex with a further development of blackened lobes and points. Dorsal dististyle a moderately curved rod, the tip relatively short. Ventral dististyle large and complex, especially the rostral prolongation which is slightly dilated outwardly, the apex with a dense brush or comb of setæ; face of prolongation beyond the spines more or less protuberant, blackened; rostral spines two, strong and powerful, from small tubercles, slightly recurved; from the base of style, lying between it and the basistyle a further conspicuous lobe that terminates in a dense brush of long yellow setæ. Gonapophysis with the mesal-apical lobe slender, at apex curved to an acute point. Aedeagus relatively slender, glabrous.

Holotype, ♂, La Raya, Cuzco, Peru, 4300 meters, February 21, 1950 (L. E. Peña). Paratopotype, ♂, pinned with type.

The most similar species is *Limonia* (*Dicranomyia*) *altandina* new species, with which it was associated in nature. The two flies are most readily told by the different structure of the male hypopygium.

Limonia (Dicranomyia) clavistyla new species

General coloration dark brown, pruinose, more heavily so on the thoracic pleura; halteres elongate; wings with a strong dusky ground; basal section of vein R_{4+5} long, approximately four-fifths *Rs;* inner end of cell *1st* M_2 arcuated; male hypopygium with the main body of the ventral dististyle a long clavate lobe, constricted at near midlength, the outer half more darkened.

MALE. Length about 6.5 mm.; wing 6 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar segments short-oval; verticils short. Head gray; anterior vertex relatively broad, nearly three times the diameter of the scape.

Pronotum and mesonotum dark brown, sparsely pruinose; pleurotergite and pleura more heavily pruinose. Halteres long and slender, blackened.

Legs with the coxæ brownish testaceous; trochanters obscure yellow; remainder of legs blackened, the femoral bases restrictedly paler. Wings with a strong dusky tinge, the stigma scarcely indicated; prearcular and costal fields a very little more yellowed; veins brown. Venation: Sc_1 ending opposite origin of *Rs*, Sc_1 alone from two-thirds to three-fourths *Rs;* free tip of Sc_2 and R_2 in transverse alignment, both pale; basal section of R_{4+5} long, approximately four-fifths to five-sixths *Rs;* inner end of cell *1st* M_2 produced basad, arcuated; *m-cu* at fork of *M.*

Abdomen elongate, tergites black, their caudal borders very narrowly pale; basal sternites obscure brownish yellow, the outer segments and hypopygium blackened; ventral dististyle paler. Male hypopygium with the tergite generally transverse-oval in outline, with both the caudal and cephalic borders convex; several strong setae on posterior half of tergite. Basistyle darkened; ventromesal lobe complex, stout, bearing on its face near base an even longer but more slender darkened lobe, this with a linear series of about five very powerful fasciculate setæ. Dorsal dististyle a nearly straight slender rod, the apex very suddenly narrowed, extended at a right angle into a straight spine. Ventral dististyle very deeply divided, the main body a long clavate lobe, constricted at near midlength, the outer half more darkened; rostral portion of style complex, the basal half or more enlarged, the shorter slender apex beginning opposite the spines; in the notch at base of prolongation an oval lobe that bears numerous long scattered setæ; lower edge of enlarged part of rostrum bearing a small dark-colored lobe. Gonapophysis with mesal-apical lobe relatively slender, the tip acute, the margin back from tip coarsely roughened or erose.

Holotype, ♂, Chinchao, Huanuco, Peru, on wooded hills, 2500 meters, September 22, 1947 (George Woytkowski).

The present fly is related to species such as *Limonia* (*Dicranomyia*) *apposita* Alexander, *L.* (*D.*) *boliviana* Alexander, *L.* (*D.*) *malitiosa* Alexander, *L.* (*D.*) *muliercula* Alexander, and some others, differing especially in the distinctive male hypopygium, particularly the clavate lobe of the ventral dististyle.

Limonia (Dicranomyia) peñana new species

General coloration gray, the praescutum gibbous; antennæ black; halteres black, the base of stem vaguely paler; wings narrow, subhyaline, unpatterned; *Sc* relatively long, Sc_1 ending a short distance beyond origin of *Rs*, Sc_1 long; cell M_2 open by the atrophy of *m; m-cu* at or close to fork of *M;* male hypopygium moderately complex in structure; a single rostral spine.

MALE. Length about 6 mm.; wing 7 mm.

FEMALE. Length about 6.5 mm.; wing 7.5 mm.

Rostrum dark brown on dorsal surface, paling to light yellow beneath; palpi black. Antennæ black, scape pruinose; basal flagellar segments short-oval, the outer ones more elongate, the terminal one only slightly exceeding the penultimate; verticils shorter than the segments. Head brownish gray, clearer gray behind, with indications of a still darker median vitta; anterior vertex of male narrow, of female broader, approximately three times the diameter of the scape.

Pronotum above brownish gray, clearer on sides. Mesonotal præscutum high and gibbous, dark gray, the usual stripes more infuscated to produce a vaguely patterned appearance; posterior sclerites of notum brown, the central area of the scutum and scutellum light gray, the latter very flat; mediotergite gray, conspicuously patterned with darker. Pleura chiefly light gray, the ventral sternopleurite slightly darker. Halteres black, the base of stem narrowly and vaguely paler. Legs with the coxæ dark brown, especially the fore pair, pruinose; trochanters obscure yellow; femora light brown, tibiæ somewhat darker, especially at tips; tarsi brownish black. Wings narrow, whitish subhyaline, unpatterned, the base and costal margin slightly more yellowed; veins brown, those in the yellowed parts, together with *M*, paler. Venation: *Sc* relatively long, Sc_1 ending a short distance beyond origin of *Rs*, at near one-fifth the length of the vein, Sc_1 long; cell M_2 open by atrophy of *m*; cell M_3 subequal in length to its petiole; *m-cu* at or close to fork of *M*; vein *2nd A* evenly and gently convex, the cell of moderate width.

Abdomen dark brown, sternites a trifle paler. Ovipositor with cerci very weak and slender, decurved (possibly a deformity of the type); hypovalvæ strong, straight. Male hypopygium with the ninth tergite transverse, the caudal margin convexly rounded, with a narrow median incision, the lobes blackened, provided with numerous long yellow setæ. Basistyle with the ventromesal lobe long and conspicuous, nearly as large as the body of style, bearing a small setiferous lobule on outer face near midlength. Dorsal dististyle a strongly curved pale sickle, the tip acute. Ventral dististyle with the body relatively small, only about two-thirds that of the comparable part of the basistyle, dark-colored; rostral prolongation large and powerful, bearing a strong spine on outer margin at near midlength, arising from a strong basal tubercle that exceeds one-third the length of the spine. Gonapophysis with mesal-apical lobe pale, gently curved to the acute tip.

Holotype, ♂, El Cuzco, Cuzco, Peru, February 28, 1950 (L. E. Peña). Allotype, ♀, La Raya, Cuzco, 4300 meters, February 21, 1950 (L. E. Peña).

Limonia (*Dicranomyia*) *peñana* is named in honor of the collector, Señor Luis E. Peña, to whom I am indebted for very many Tipulidæ from Bolivia, Peru and Chile. The allotype was associated in nature with *L.* (*D.*) *altandina* new species, *L.* (*D.*) *andinalta* new species, and *L.* (*D.*) *anax* Alexander. In the wing shape and venation, the fly suggests the wide-spread Holarctic *L.* (*D.*) *longipennis* (Schummel) but there evidently is no close affinity, the male hypopygium being entirely different and more suggestive of the associated species above mentioned.

Limonia (Geranomyia) macrauchenia new species

Mesonotal præscutum gray with five dark brown stripes; femora obscure yellow with a dark brown subterminal ring; wings whitish subhyaline with a relatively heavy brown pattern; Sc_1 ending about opposite one-third the length of *Rs;* male hypopygium with the ventral dististyle large and fleshy, its area exceeding three times that of the basistyle; rostral prolongation slender, with a conspicuous basal or necklike portion before the spines; the latter long and slender, arising from the summit and side of a sclerotized caplike plate.

MALE. Length, excluding rostrum, about 7 mm.; wing 8 mm.; rostrum about 3.3 mm.

Rostrum and palpi black, the former long, nearly one-half the remainder of body. Antennæ with scape and pedicel black, flagellum dark brown; flagellar segments suboval to subcylindrical, longer than the verticils; terminal segment about one-third longer than the penultimate. Head light gray, the posterior vertex with two blackened lines delimiting a median vitta, the latter subequal in width to the anterior vertex.

Pronotum buffy, patterned with dark brown, scutellum more brightened. Mesonotal præscutum light gray with five dark brown stripes, the central three narrow, a trifle wider than the gray interspaces; sublateral dark stripes beginning behind the obscure yellow humeral triangles, the extreme lateral borders blue-gray; posterior sclerites of notum dark gray, each scutal lobe with a semicircular dark border; posterior part of mediotergite with a pair of more brownish areas. Pleura and pleurotergite dark gray, dorsal sternopleurite light brown; dorsopleural membrane buffy. Halteres with stem pale yellow, knob dark brown. Legs with coxæ dark brown, paler at tips; trochanters yellow; femora obscure yellow with a dark brown subterminal ring, this a little broader than the yellow apex; tibiæ yellowish brown, tarsi passing into black; claws long and slender, a single well-developed tooth nearly basal in position. Wings whitish subhyaline, the costal interspaces more yellowed; a relatively heavy brown pattern, as follows: A series of five darker costal areas, the third a major common one over origin of *Rs* and fork *Sc;* fourth area stigmal, not confluent with a spot over fork of *Rs;* other dark brown seams over cord and outer end of cell *1st* M_2*;* paler brown marginal clouds at ends of veins, those on the anals large; wing apex and cell *M* vaguely suffused; veins yellow, darker in the patterned parts. Venation: Sc_1 ending about opposite one-third the length of *Rs*, Sc_2 at its tip; *Rs* nearly three times *m-cu*; *r-m* much reduced by the approximation of veins M_{1+2} and R_{4+5}; *m-cu* shortly before fork of *M*.

Abdomen, including hypopygium, dark brown, the incisures slightly paler. Male hypopygium with the ninth tergite transverse, narrowed posteriorly, the caudal margin with two rounded lobes that are separated by a narrower median notch; margins of lobes thickened or sclerotized, provided with numerous setæ that are virtually restricted to the thickened borders. Basistyle with its ventromesal lobe large, obtuse, unmodified. Dorsal dististyle a gently curved rod, its tip extended into a straight spine. Ventral dististyle large and fleshy, its area exceeding three times the total area of the basistyle; rostral prolongation slender, especially the neck portion; spines from a sclerotized plate or cap, long and slender, straight, subequal in length but with one arising from the summit, the other from the face of the cap and thus appearing unequal. Gonapophysis with the mesal-apical lobe appearing as a slender curved terete spine, its tip acute.

Holotype, ♂, Chinchao, Huanuco, Peru, on wooded hills at 2500 meters, September 13, 1947 (George Woytkowski).

The present fly is closest to *Limonia* (*Geranomyia*) *destricta* Alexander, differing in the coloration of the body and legs and in the structure of the male hypopygium, particularly the ventral dististyle.

Limonia (Geranomyia) oneris new species

Size medium (wing, male, over 7 mm.); præscutum gray, with three narrow dark brown stripes on disk, additional to the less evidently darkened lateral borders; femora infuscated, deepening to a broad black subterminal ring; wings grayish subhyaline, patterned with brown; male hypopygium with the basistyle small, its area about two-fifths that of the ventral dististyle; rostral prolongation short, the two long slender spines arising from a low common tubercle; mesal-apical lobe of gonapophysis long and slender, pale.

MALE. Length, excluding rostrum, about 7.5 mm.; wing 7.2 mm.; rostrum about 3.2 mm.

Rostrum elongate, about two-fifths the wing, black throughout. Antennæ black; flagellar segments oval, verticils inconspicuous. Head light gray; posterior vertex extensively blackened on either side of the median ground line.

Pronotum gray, with three darker areas. Mesonotal præscutum gray, the broad lateral borders more infuscated; disk with three narrow still darker stripes that are wider than the interspaces, the central one not quite reaching the suture; humeral region of præscutum restrictedly more yellowed; scutum dark gray, each lobe with a semicircular more blackened mark, the opening behind; scutellum testaceous brown, narrowly more infuscated medially; postnotum dark gray. Pleura chiefly brownish black, pruinose; dorsal sternopleurite somewhat paler; dorsopleural region more buffy; region of the wing base reddened. Halteres with stem light yellow, knob brownish black. Legs with the coxæ dark brown, sparsely pruinose, the tips pale; trochanters yellow; femora infuscated, deepening to a broad more blackened subterminal ring, this about three times the yellow tip; tibiæ and tarsi brown, the outer segments of the latter brownish black. Wings pale grayish subhyaline, restrictedly patterned with medium brown, as follows: Stigma; a virtually common spot at fork of *Sc* and origin of *Rs*; supernumerary crossvein in cell *Sc*; cord and outer end of cell *1st* M_2, and arculus; small paler marginal clouds at ends of certain of the longitudinal veins, largest and most evident on the Anal veins; veins brownish yellow, pale brown in the patterned areas. Venation: Sc_1 ending about opposite one-third the length of *Rs*, Sc_2 near its tip; distal section of R_{4+5} arcuated on basal third, slightly widening the cell; cell *1st* M_2 subequal in length to distal section of vein M_3; *m-cu* close to fork of *M*.

Abdomen dark brown. Male hypopygium with the tergite relatively long, narrowed outwardly, the posterior border with a U-shaped notch; lateral lobes with long setæ, some continued along the outer border to the base. Basistyle relatively small, its area about two-fifths that of the ventral dististyle, the ventromesal lobe simple, slightly narrowed or constricted at base. Dorsal dististyle a gently curved rod, the tip acute. Ventral dististyle with the rostral prolongation short, with two long slender spines from a low common tubercle, one of the spines from a small further enlargement. Gonapophysis with mesal-apical lobe long and slender, pale, gently curved to the narrow obtuse tip.

Holotype, ♂, Sariapampa, Huanuco, Peru, 3600 meters, May 12, 1946 (Felix Woytkowski).

Although it bears a resemblance to *Limonia* (*Geranomyia*) *amoenalis* Alexander, the present fly differs in all details of coloration and especially in the structure of the male hypopygium.

Limonia (Geranomyia) stenoleuca new species

Mesonotum and dorsal half of pleura black, the ventral pleurites abruptly yellow; rostrum elongate, nearly two-thirds the body or wing; femora yellow, the tips conspicuously blackened; fore and middle tarsi extensively whitish yellow, the posterior pair snowy white, not dilated; wings with a strong blackish tinge, the prearcular border and narrow costal field whitened, the color not involving the radial cells; *Sc* short, Sc_1 ending opposite one-third to nearly one-half *Rs*; abdominal tergites black, sternites abruptly yellow. FEMALE. Length, excluding rostrum, about 7.5–8 mm.; wing 7.5–8 mm.; rostrum about 5–5.2 mm.

Rostrum elongate, nearly two-thirds the body or wing, black, the tips of the labial palpi slightly paler. Antennæ black; flagellar segments long-cylindrical; verticils of the intermediate segments unilaterally distributed, exceeding the segments. Head with the front and anterior vertex pale, the color continued backward over the center of the posterior vertex as a capillary pale line, the remainder brownish black.

Pronotum brown. Mesonotum almost uniformly brownish black, the humeral region of the præscutum restrictedly more reddish; posterior sclerites, especially the posterior border of scutellum and suture of the postnotum paler. Dorsal region of pleura similarly polished black, the ventral pleura and sternum abruptly yellow. Halteres with stem brown, paler at base, knob blackened. Legs with all coxæ and trochanters light yellow; femora yellow, the tips conspicuously blackened, the amount subequal on all legs; tibiæ brown, the tips narrowly more darkened; fore and middle tarsi pale yellow or whitish yellow, the terminal segment blackened, posterior tarsi snowy white but not dilated as in some other more or less similar regional species; outer tarsal segments of posterior legs broken. Wings with a strong blackish tinge, the prearcular field and narrow costal border white, the latter including cells *C* and *Sc*, together with Sc_1, the pale color not crossing vein *R*; stigma oval, darker brown; vague to scarcely evident darker seams at origin of *Rs* and over the cord; veins brown, not conspicuously paler in the whitened parts. Venation: *Sc* short, Sc_1 ending about opposite one-third to nearly one-half *Rs*, Sc_2 near its tip; supernumerary crossvein in cell *Sc* at near one-third the distance between *h* and the origin of *Rs*; free tip of Sc_2 and R_2 in approximate transverse alignment; cell *1st* M_2 long, subequal to vein M_{1+2} beyond it; *m-cu* at or shortly beyond the fork of *M*.

Abdominal tergites brownish black to black, sternites abruptly yellow; genital shield blackened; both cerci and hypovalvæ yellow, the bases of the latter extensively blackened.

Holotype, ♀, Fundo Sinchono, Huanuco, 1600 meters, August 5, 1947 (J. M. Schunke). Paratopotype, ♀, on pin beneath the holotype.

From the other regional species having whitened posterior tarsi, including *Limonia* (*Geranomyia*) *lacteitarsis* Alexander, *L.* (*G.*) *luteimana* Alexander, and *L.* (*G.*) *pallidapex* Alexander, the present fly differs very evidently in the wing pattern, especially the marked reduction of the pale costal border. The tarsi are slender, not more or less dilated as in the species above listed.

Limonia (Geranomyia) yunquensis new species

Size small (wing of male 4.5 mm.); rostrum about one-third the length of wing; mesonotal præscutum olive yellow with three poorly indicated more blackish stripes that are narrower than the interspaces; pleura obscure yellow; knobs of halteres blackened; legs medium brown, the outer tarsal segments darker; wings subhyaline, very restrictedly patterned with darker, including two costal areas additional to the stigma, including a common mark over the fork of *Sc* and origin of *Rs*; Sc_1 ending just beyond origin of *Rs*; male hypopygium with the dorsal dististyle extended into a long straight apical spine; rostral prolongation of ventral dististyle obtuse at tip, the two rostral spines subequal, straight, from very low contiguous basal tubercles; mesal-apical lobe of gonapophysis heavily blackened, broad at tip, the outer angle pointed.

MALE. Length, excluding rostrum, about 4 mm.; wing 4.5 mm.; rostrum about 1.5 mm.

Rostrum relatively short, less than one-half the remainder of body, black throughout; palpi black. Antennæ black; flagellar segments oval, terminal one pointed. Head black, with a continuous silvery median vitta from the narrow anterior vertex to the occiput.

Pronotum infuscated. Mesonotum obscure olive yellow, with three poorly indicated more blackish stripes that are narrower than the interspaces; median stripe broader and more clearly delimited than the laterals; scutal lobes weakly infuscated; scutellum obscure yellow, parascutella darker; postnotum darkened medially, paling to obscure brownish yellow on sides, pleurotergite concolorous. Pleura obscure yellow, propleura slightly darker. Halteres with stem weakly darkened, knob blackened. Legs with the coxæ and trochanters yellow; remainder of legs medium brown, the outer tarsal segments darker, tibiæ not darkened at tips. Wings subhyaline, very restrictedly patterned with darker, including the subcircular brown stigma and two small spots over the supernumerary crossvein in cell *Sc* and a common area over the origin of *Rs* and fork of *Sc*, the two latter very faint and indicated chiefly by a darkening of the veins; anterior cord even less distinctly seamed with brown; veins brown. Venation: *Sc* short, Sc_1 ending just beyond origin of *Rs*, Sc_2 opposite or immediately before this origin; *Rs* long, about two and one-half times the basal section of R_{4+5}; cell *1st* M_2 subequal in length to vein M_{1+2} beyond it; *m-cu* immediately before fork of *M*, subequal in length to the distal section of Cu_1; cell *2nd A* narrow, its outer end pointed.

Abdominal tergites dark brown, sternites paler; hypopygium infuscated. Male hypopygium with the tergite transverse, the caudal margin shallowly emarginate, lateral lobes low, provided with numerous long coarse setæ. Basistyle with ventromesal lobe oval, with coarse setæ, at its junction with the main body of the style with a small lobule that is provided with about six strong setæ. Dorsal dististyle strong, the apex drawn out into a long straight spine. Ventral dististyle relatively large, its total area nearly three times that of the basistyle; rostral prolongation relatively stout, the tip obtuse; two rostral spines that are a little longer than the prolongation beyond their bases; spines arising from very low tubercles that are placed close together and virtually contiguous. Gonapophysis with the mesal-apical lobe heavily blackened, the broad tip with the outer angle pointed. Aedeagus with the outer lateral angles terminating in an acute pale spinous point.

Holotype, ♂, El Yunque, Puerto Rico, in Sierra Palm forest, November 27, 1943 (Harry D. Pratt and Jenaro Maldonado Capriles).

This small fly is most similar to *Limonia* (*Geranomyia*) *subrecisa* Alexander, differing therefrom in the coloration of the body and wings and in the details of structure of the male hypopygium, especially the dististyles and gonapophysis.

Genus *Sigmatomera* Osten Sacken

Sigmatomera (Sigmatomera) felix new species

General coloration of entire body fulvous yellow, the thorax polished, unpatterned; antennal flagellum very strongly binodose; knobs of halteres dark brown; femora obscure yellow, the tips brownish black; wings yellow, very restrictedly patterned with brown, including a narrow darker band at cord and the axillary region; R_{2+3+4} and R_{3+4} subequal; veins R_3 and R_4

diverging at outer ends; cell M_2 open by atrophy of basal section of M_3. MALE. Length about 8 mm.; wing 9 mm.; antenna about 5.9 mm.

Rostrum brownish yellow; first segment of palpi obscure yellow, the outer segments brown. Antennae with scape short, brownish yellow, darker outwardly; remainder of antennæ black; basal flagellar segments of the normal *Sigmatomera* type, very strongly sinuously binodose, less accentuated on the outer segments. Head polished fulvous, with a narrow black transverse band across the cephalic part of the posterior vertex, extending from behind the eyes, completely crossing the vertex; anterior vertex narrowed, about two-thirds the diameter of the scape.

Thorax uniformly fulvous yellow, polished, without pattern. Halteres with stem yellow, knob dark brown. Legs with all coxæ and trochanters yellow; femora obscure yellow, the tips conspicuously brownish black, more intense immediately back from apex; tibiæ brownish yellow, the tips narrowly infuscated; tarsi brownish black to black. Wings yellow, the prearcular and costal regions more saturated; a restricted brown pattern, including a narrow darker band at cord, at its cephalic end involving the tips of *Sc* and R_{1+2} in a Y-shaped fork, the posterior end of the band a little expanded and paler; axillary region extensively darkened; small and vague clouds at fork of M_{1+2} and at tips of outer medial veins; a scarcely apparent clouding in outer radial field; veins yellow, darker in the patterned areas. Venation: *Rs* relatively short, straight; R_{2+3+4} subequal to R_{3+4}, R_2 thus far before the fork; cell R_3 not as deep as in *amazonica*, veins R_3 and R_4 more divergent at outer ends, cell R_2 at margins being only about one-half more extensive than cell R_3; cell M_2 open, cell *2nd* M_2 about as long as its petiole.

Abdomen opaque yellow, the posterior borders of the tergites narrowly infuscated; hypopygium relatively large, brown.

Holotype, ♂, Santa Isabel, Cuzco, Peru, 1700 meters, December 5, 1951 (Felix Woytkowski).

This distinct fly is named in honor of the collector, Mr. Felix Woytkowski, outstanding student of the flora and fauna of Peru. The only other described species of the genus having cell M_2 of the wings open is *Sigmatomera* (*Sigmatomera*) *amazonica* Westwood, of Amazonian Brazil, which differs conspicuously in the black thorax, heavily patterned wings, and distinct venational details.

Genus *Erioptera* Meigen

Erioptera (Mesocyphona) celestior new species

Belongs to the *dulcis* group; size relatively large (wing of female 5.4 mm.); general coloration of præscutum light gray with four very distinct brownish black stripes; scutellum obscure yellow; pleura black with a broad whitish longitudinal stripe; knobs of halteres weakly infuscated; femora yellow, with a broad black subterminal ring; wings dark brown, variegated with about a dozen large white spots, with relatively few small white dots in the medial and cubital fields.

FEMALE. Length about 4.6 mm.; wing 5.4 mm.

Rostrum and palpi black. Antennæ with the scape black, the succeeding segments obscure yellow, outer flagellar segments passing into black; flagellar segments oval. Head buffy above, more grayish beneath.

Pronotum variegated obscure yellow and black; pretergites narrowly whitened. Mesonotal præscutum with the ground light gray, with four very distinct brownish black stripes, the intermediate pair separated by a much narrower line, the outer pair lateral in position, humeral region more buffy; scutum variegated black and buffy; scutellum obscure yellow; postnotum black. Pleura and pleurotergite black with a broad whitish longitudinal stripe. Halteres with stem white, knob weakly infuscated. Legs with the coxæ infuscated; trochanters yellow; femora obscure yellow, with a broad black subterminal ring, preceded and followed by narrower clear yellow annuli; basal and central parts of femora slightly infuscated, this color produced by very abundant linear scales and fewer setæ; tibiæ and tarsi light yellow, the tips of the latter infuscated. Wings with the ground dark brown, variegated by about a dozen large white spots, arranged about as in members of the *dulcis* group, together with slightly more numerous smaller white dots in the medial and cubital fields; proximal half of the costal field more brownish yellow; central part of cell *2nd A* a little brightened; veins brown, white in the spotted areas. Venation: R_{2+3+4} rather strongly elevated, about twice the basal section of R_5; cell *2nd* M_2 nearly twice its petiole.

Abdomen dark brown; cerci elongate, dark brown basally, paling to horn-yellow outwardly.

Holotype, ♀, Cerro Punta, Chiriqui, Panama, 6000 feet, October 1953 (Noël L. H. Krauss).

This attractive fly is most similar to *Erioptera* (*Mesocyphona*) *venustipes* Alexander, differing conspicuously in the pattern of the legs and wings. The combination of spotted and dotted white markings on the wing give the fly a distinctive facies.

STUDIES ON THE EFFECT OF DECOMPRESSION ON CERTAIN INSECTS, WITH SPECIAL REFERENCE TO ANOPHELES QUADRIMACULATUS SAY AND AEDES SOLLICITANS WALKER[1]

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INTRODUCTION

Studies on the reaction of insects to varying reduced barometric pressures may lead to a better understanding of their tolerance to high altitudes. This may aid in the determination of the insects of medical importance that can be transported alive in non-pressurized portions of high flying aircraft.

Back and Cotton (1925) studied the effect of a vacuum varying from 26 to 29 inches of mercury on the immature and adult forms of insect pests of stored products at 60 to 70 degrees Fahrenheit. The majority of the adults were killed by an exposure of one day, one species required two days and another four. Stemler and Hiestand (1951) observed that a tolerance to anoxia is formed by insects following repeated, rapid ("explosive") decompression. Working with five orders of insects they found that all adult species showed some tolerance with the second decompression. Tolerance occurred if the interval between the first and second decompression was ten minutes or several hours. Wellington (1946) has studied the reaction of flies at low pressure and simulated storm pressures.

The purpose of the present study was to determine the mortality curve of mosquitoes exposed to decompression at various

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pressure altitudes, as well as observations on their reactions to such treatment.

MATERIALS

The strain of *Anopheles quadrimaculatus* used was obtained through the courtesy of the Orlando Florida Laboratory of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. The colony was reared through many generations before experiments were initiated. The eggs were placed on the surface of tap water containing brewers' yeast and brain heart infusion. Three days after the eggs hatched, the larvae were placed in 8 by 12 inch stainless steel pans, 200 per pan, and fed measured amounts of commercial dog food twice daily for the production of a uniform stock for test purposes. The colony was maintained in a constant temperature room at 85° F. with the humidity at 55 to 60 per cent. The adults were provided undiluted honey in screened Stender dishes, five per cent dextrose solution on cotton wicks, and beginning at the age of three to five days, daily blood meals from a guinea pig. The rearing technique was similar to that of Heal and Pergrin (1945). The ages of the test insects varied from day to day, but similar age groups were used in all tests. It was found that vitality was lost after 14 days and adults above this age were generally unsuitable for tests.

The *Aedes sollicitans* adults were collected in the field and utilized for tests.

PROCEDURE

The adult female mosquitoes were removed from screened cages with a suction tube and placed in an altitude chamber for observation at various simulated pressure altitudes. For observation of the reaction of insects to various altitude levels, the altitude chamber developed by Perry and Webster (1950) was utilized. For extensive mortality tests the equipment was enlarged and modified to provide five chambers which were evacuated by a vacuum pump running continuously. Varied amounts of vacuum were maintained by adjusting an air bleeder valve located between a calibrated gauge and the vacuum pump. By this system a given vacuum could be maintained without variation for eight or more hours.

Ten adult females picked at random from the rearing cage were placed in each of the five chambers and raised rapidly to the desired mercury level. Thirty tests, involving 300 insects, were made for each one-half inch rise of mercury from 19 to 28.5 inches. The tests were run for eight hours at a temperature of 80° + − 2°. After eight hours the mosquitoes were removed from the chambers by suction tube a few at a time to avoid injury. They were placed in groups of ten in 1,000 ml. beakers covered with 20 mesh copper screen, and fed five per cent dextrose solution in cotton wicks lying over the tops of the screens. The living insects were determined after 16 hours using a criterion of any visible movement of an appendage upon disturbance.

OBSERVATIONS OF REACTIONS OF INSECTS DURING ASCENTS AND DESCENTS

Aedes sollicitans

In order to observe the reactions of mosquitoes during the ascent to altitude and the subsequent descent, *Aedes sollicitans* was selected because of its relatively large size. Altitudes were measured as inches of Hg vacuum. Five vigorous field collected adult females were placed in the chamber for observation and raised an inch at a time at three-minute intervals to 28.5 inches of mercury. After three minutes at 28.5, they were returned to normal pressure at one-minute intervals. The results are given in Table 1.

Following recompression, the insects were removed from the chamber and placed in a beaker with five per cent dextrose as food. There was no mortality after 16 hours. During the decompression the mosquitoes were apparently normal up to 13 inches of mercury when they became quiet and a slight enlargement of the abdomen was noted. The abdominal distention gradually increased through the steps to 22 inches, at which level it was equal to that of a fully engorged female (Fig. 1). At the highest level, 28.5 inches, all were on their backs and quiet. On the return down to normal the insects began to walk at 21 inches of mercury and to fly at 18. They were apparently normal at the levels from six to zero.

Musca domestica

For comparison, ten six-day old laboratory reared house flies were treated in exactly the same manner as the *Aedes sollicitans* above (See Table 2).

The flies were apparently normal, flying in approximately the

TABLE 1

REACTIONS OF *Aedes sollicitans* FEMALES DURING ASCENT AND DESCENT

Inches Hg vacuum	Simulated altitude (feet)	Reaction
1–12	1,000–13,571	Normal
13	15,000	Quiet except when vigorously disturbed by tapping. Slight abdominal distention
14–19	16,500–25,400	Occasional flying
20	27,500	Walk when disturbed, no flying
21	29,900	One on feet, others inverted, no walking on disturbance
22–26	32,500–47,250	Quiet with greatly enlarged abdomens, slight leg movement when disturbed
26–28	47,250–62,200	Vigorous leg and wing movement during each change of level
28.5	68,500	All 5 inverted with abdomens greatly distended. Slight leg movement with vigorous tapping of chamber
28	62,200	Leg movements when disturbed
27	53,400	Vigorous movement of legs and wings when disturbed
26	47,250	Flying attempts when disturbed
25	42,500	Two on feet, wing movement on tapping
24	38,600	Five on feet, fly or jump ¼ inch in air when disturbed
23	35,400	Five on feet, moderate abdominal distention
22	32,500	Fly or jump ½ inch in air on disturbance
21–19	29,900–25,400	Walk without being disturbed, fly on disturbance
18	23,286	One flew to top of chamber, incoordinated flight in others when disturbed
17–11	21,473–12,143	Walking, attempted flights
10– 9	10,364– 9,455	Normal abdomen, 3 flew ½ inch on disturbance
8– 7	8,375– 7,222	Attempts at flight, one flew to top of chamber
6– 0	6,111– 0	All 5 apparently normal, abdomens normal

same ranges as the mosquitoes (0–21 inches in mercury). There was no visible distention of the abdomens. At 28.5 inches Hg there was no movement visible and this remained true on the way down to 26 inches when the first movement was observed. The insects began righting themselves at 24 inches and all were on their feet by 17 inches. All were apparently normal from 15 inches on down. Sixteen hours after exposure, one fly was dead while the controls remained normal.

It is evident from these tests that both *Aedes sollicitans* and *Musca domestica* females can withstand gradual decompression

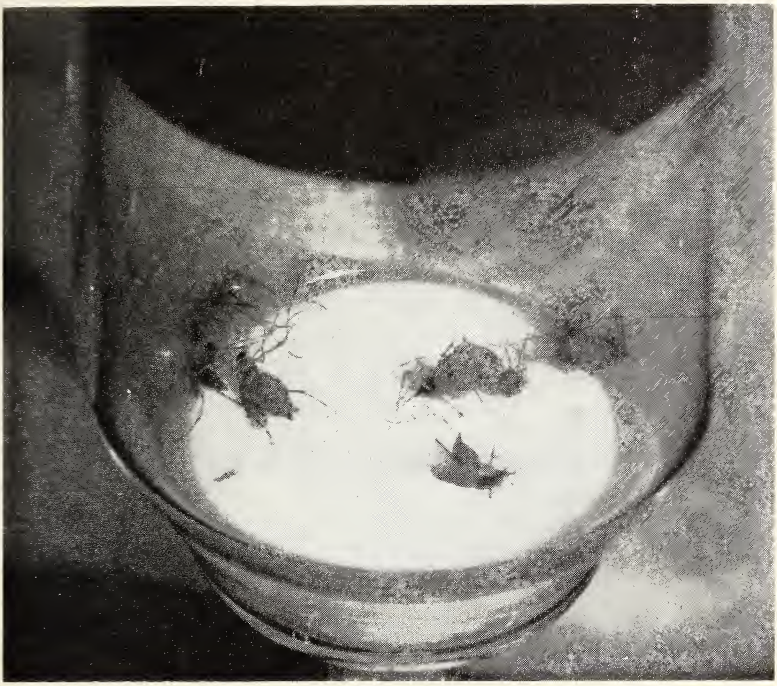

Fig. 1. Mosquitoes under decompression (note distended abdomens).

to 28.5 inches of mercury and return to normal pressure without ill effects, that they seem to be not adversely affected by the ascent to from 19 to 21 inches, are relatively quiet at higher levels, and that the mosquitoes acquire greatly distended abdomens at extremely low pressures. The two insects vary in ability to withstand a high vacuum sustained over a period of time. The flies were found to withstand 28.5 inches of mercury for one hour with no mortality 16 hours later. However, when ten field collected *Aedes sollicitans* were raised within 15 seconds to 28.5

inches of mercury for 30 minutes, then dropped suddenly to normal, 70 per cent were dead, 16 hours after exposure, while the controls remained normal. Within three minutes after decompression, all were quiet except for the slight movement of wings on one insect, and all abdomens were greatly distended. Upon

TABLE 2

Reactions of *Musca domestica* Adults During Ascent and Descent

Inches Hg vacuum	Simulated altitude (feet)	Reaction
1–15	1,000–18,000	Apparently normal, walking and flying
16–21	19,800–29,900	Quiet, preening wings, flying on disturbance
22	32,500	Quiet, 4 preening wings, do not fly on disturbance
23	35,400	Three lying flat on ventral portion of thorax, 1 flew when disturbed
24	38,600	One rubbing legs together, 2 attempting to fly, remainder, no noticeable movement on disturbance
25	42,500	One walking, 4 moving legs
26	47,250	Mouthparts moving in 1, no noticeable movement in remainder
27–28.5	53,400–68,500	No movement on disturbance
28–27	62,200–53,400	No movement
26–25	47,250–42,500	One wing moved, right and left rear legs moved on 1
24	38,600	One moving legs, one upright on feet
23–21	35,400–29,900	Two on feet rubbing legs together
20	27,500	Six on feet preening wings
18	23,286	Eight on feet
17	21,470	Ten on feet preening heads and wings
16	19,800	One flew to top of chamber
15– 0	18,000– 0	Normal

sudden recompression to normal after 30 minutes, movement was noted in two insects immediately, but it was 14 minutes before five moved and two attempted flights. During one-hour exposure under the same conditions, there was great activity during decompression, but all were quiet in one minute. No movement was noted for six minutes when slight leg and proboscis movements were seen. At 14 minutes convulsive movements were seen in one mosquito. There was no movement immediately upon return to normal. Leg motion was noted in two insects after two minutes. Sixteen hours later, all were dead.

ALTITUDE–MORTALITY DATA

Anopheles quadrimaculatus

Having studied the visible effect of decompression on mosquitoes and flies, the altitude-mortality curve was determined for *Anopheles quadrimaculatus*. This species was chosen because of its connection with disease transmission. A constant exposure time of eight hours was chosen because initial tests indicated that the insects could withstand considerable decompression over this period of time. The gauge on the altitude chamber was calibrated with a mercury manometer, and the estimated altitude computed from the Standard Atmosphere Tables of Diehl (1925). Exposures were made for each one-half inch rise in mercury level from 19 to 28.5 inches. The results were combined for each one-inch rise for the data shown in Table 3.

TABLE 3

TOLERANCE OF *Anopheles quadrimaculatus* TO DECOMPRESSION
3,014 FEMALES, 8 HOURS' EXPOSURE

Inches Hg vacuum	Simulated altitude (feet)	Per cent dead
19–19.5	25,400–26,440	17 ± 3
20–20.5	27,500–28,700	27 ± 4
21–21.5	29,900–31,200	37 ± 5
22–22.5	32,500–33,800	40 ± 5
23–23.5	35,400–36,900	46 ± 7
24–24.5	38,600–40,460	56 ± 8
25–25.5	42,500–44,700	71 ± 5
26–26.5	47,250–50,100	87 ± 5
27–27.5	53,400–57,400	96 ± 2
28–28.5	62,200–68,500	100
Controls	Sea Level	3 ± .1

Three hundred tests averaging ten insects each were conducted (30 for each combined one-inch mercury level) utilizing a total of 3,014 insects. The controls contained 73 units of ten insects each. Mortality based on the vast visible movement of an insect's appendage 16 hours after exposure, ranged from 17 per cent at 19–19.5 inches of mercury to 100 at 28–28.5 inches. From the smooth curve, the 50 per cent mortality point occurred at 36,800 feet corresponding to approximately 23.5 inches of vacuum. The altitude mortality curve is shown in Figure 2. On the basis of recovery over a period of 24 hours, however, 100 per cent mortality occurred at 26.5–27 inches of mercury with 98 per cent mortality occurring at 26 inches. It is therefore evident that very little ultimate survival occurs following eight hours' decompression above this level.

Since 26 inches of mercury appears to be the critical level for total mortality, ten *Anopheles quadrimaculatus* females, ten days old, were observed at this level for eight hours to determine their cumulative reactions. A summary of these observations is given in Table 4.

Sixteen hours after exposure all were dead. The ten controls were normal. Table 4 shows that the mosquitoes retained some

TABLE 4

REACTION OF *Anopheles quadrimaculatus* TO DECOMPRESSION (26 INCHES HG VACUUM)

Time (minutes)	Reaction
1	Very ataxic immediately following decompression
15– 75	Two active, opening and closing wings rapidly, ataxic, one flew across chamber
105	All quiet, one on back, all active when disturbed
135	Three on backs, remainder very ataxic but active
165–255	Five on backs, others quiet, unable to walk when disturbed
285–345	Six to nine on backs, one attempted walking and flying, ataxic
375–435	Nine to ten on backs, slight leg movement when disturbed
465–480	Ten on backs, no movement
480	Vacuum released, one righted itself immediately, one flew around chamber when disturbed, one moving legs, others immobile

movement for seven-and-a-quarter hours at 26 inches of mercury vacuum and two were apparently normal immediately after exposure. However, they were apparently sufficiently affected to cause death in 16 hours. Subsequent tests (30, involving 300 insects) at 26–26.5 inches of mercury indicated that this single test is not a true indication of mortality. The greater number of tests showed 87 per cent mortality in 16 hours increasing to 98 per cent in 24 hours.

Aedes sollicitans

An altitude mortality test was run on *Aedes sollicitans* adult females under the same conditions described above for *Anopheles quadrimaculatus* except one-inch mercury intervals were used. This test was for comparison only and did not involve as many individuals (370 insects, 37 chambers of ten each). The results are given in Table 5 and shown diagrammatically in Fig. 3.

TABLE 5

Tolerance of *Aedes sollicitans* to Decompression
370 Females, 8 Hours' Exposure

Inches Hg vacuum	Simulated altitude (feet)	Number females	Per cent dead
18.5	24,400	50	6 ± 6
21	29,900	50	62 ± 10
22	32,500	50	70 ± 7
23	35,400	50	80 ± 7
24	38,600	30	87 ± 6
25	42,500	50	92 ± 4
26	47,250	50	94 ± 3
26.5	50,100	40	100
Controls	Sea Level	82	9 ± 3

These data indicate that *Aedes sollicitans* reaches 100 per cent mortality at 26.5 inches of mercury 16 hours after exposure. *Anopheles quadrimaculatus* reached this point 24 hours after exposure to 26.5–27 inches of mercury. It is probable that there is very little difference in the tolerance of these two species. With reference to simulated altitudes, it will be necessary to expose the insects to the approximate temperatures inherent at the various levels. The extreme temperatures at the high altitudes may lower the tolerance level considerably. On the other hand, lowered metabolism may somewhat increase tolerance.

Culex restuans

Field collected *Culex restuans* were exposed to decompression at 26 inches of mercury for eight hours at 78° F. Ten chambers

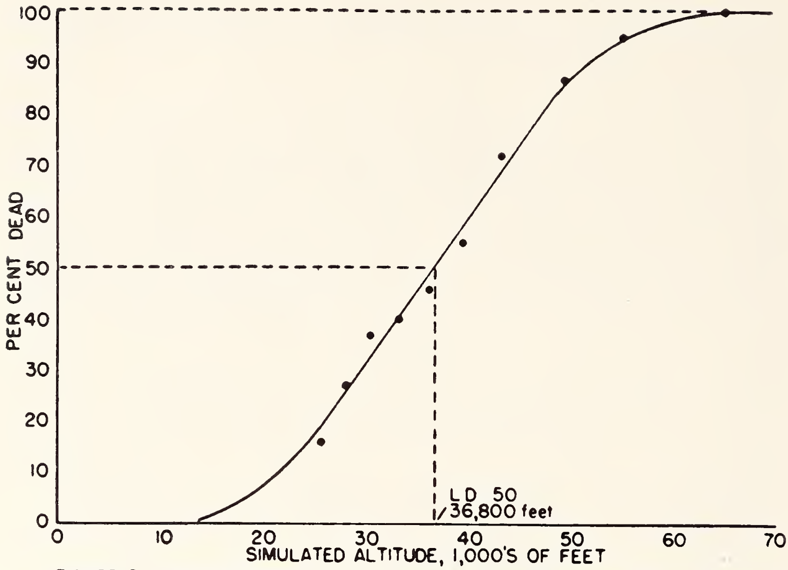

FIGURE 2 Altitude-Mortality Curve for Anopheles quadrimaculatus 8 hour exposure.

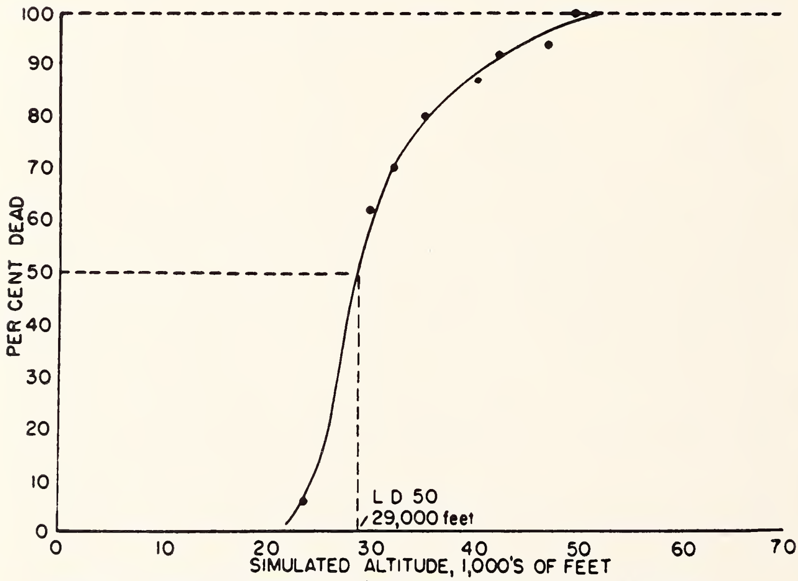

Figure 3 Altitude-Mortality Curve for Aedes sollicitans 8 hour exposure

were utilized averaging 11 females per chamber. One hundred per cent mortality was attained 16 hours after completion of the exposure with three per cent mortality in the controls. This indicates that *Culex restuans* probably does not withstand decompression greater than the critical level for *Anopheles quadrimaculatus* and *Aedes sollicitans*. Sufficient tests were not made to give more than an indication on the tolerance of this species and the critical mortality level could conceivably be much lower.

SUMMARY

Observation of *Aedes sollicitans* adult females at various ascending levels of decompression at room temperature showed gradual abdominal distention ultimately equaling that of a fully engorged female at 22 inches of mercury (32,500 feet). The insects were immobile at 28.5 inches (68,500 feet) and inverted. On descending to normal, they began to walk at 21 inches of mercury (29,900 feet), to fly at 18 (23,280 feet), and were apparently normal at levels from six inches (6,100 feet) to zero.

Houseflies acquired no abdominal distention at 28.5 inches of mercury (68,500 feet), were immobile from this level down to 26 inches (47,250 feet), were on their feet at 17 inches (21,470 feet), and were apparently normal from 15 inches (18,000 feet) down. Both the mosquitoes and flies withstood temporary decompression to the above level without apparent injury. The flies withstood 28.5 inches of mercury (68,500 feet) for one hour, while after 30 minutes exposure there was 78 per cent mortality in the mosquitoes.

Studies on the tolerance of *Anopheles quadrimaculatus* to eight hours' exposure at various mercury levels indicated that at room temperature 100 per cent mortality occurred at 28 inches (62,200 feet), based on the visible movements of appendages 16 hours after exposure, and based on recovery after 24 hours, at 26.5–27 inches (50,100–53,400). *Aedes sollicitans* reached 100 per cent mortality at 26.5 inches (50,100 feet) indicating that there is probably very little difference in the tolerance of the two species of mosquitoes. It is possible that decompression to various levels together with the extremely low temperatures found at high altitudes may lower the tolerance level. On the other hand the resulting low metabolism may have a tendency to increase tolerance.

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(*Continued from page 110*)

Minutes of meetings of May 5, 1953 and May 19, 1953 are not available.

MEETING OF OCTOBER 6, 1953

A regular meeting of the Society was held at the American Museum of Natural History. President Clausen was in the chair. There were seven members and four guests present.

Dr. Marion R. Smith of the Agricultural Research Service, Dept. of Agriculture, Washington 25, D.C. was proposed for membership. On motion duly made and seconded, the By-Laws were suspended and Dr. Smith was duly elected.

The meeting was devoted to the summer activities of the members.

Dr. Clausen mentioned that Dr. Klots had been to Europe during the past summer and that he would be a speaker at some future date. She also mentioned a visit to Mrs. Mutchler who was much impressed by the article on Mr. Mutchler in a recent issue of the Journal.

Dr. Vishniac called attention to the fact that his son, DeWolf Vishniac, had made some significant contributions to the mechanisms of photosynthesis. Dr. Vishniac then treated the Society to a description of his own activities both in the entomological and non-entomological fields of interest. With monotonous regularity it seems that Dr. Vishniac is called on to do the impossible. Among other things he was asked to photograph the facial expression of a dying mosquito. The high point of the evening was his description of the conflict between a reluctant sea bass and a squid frequently requiring artificial respiration. The sea bass ate the squid—the squid discharged its "ink"—the only victor, triumphant and unsullied was—Dr. Vishniac.

Dr. Pohl spoke about fine collections of Coleoptera he had seen exhibited in France. At an exhibition there, he had also seen an excellent display of Lepidoptera of Madagascar.

(*Continued on page 137*)

THE GENUS CRYPHULA STÅL, WITH THE DESCRIPTIONS OF TWO NEW SPECIES (HETEROPTERA: LYGÆIDÆ)

By HARRY G. BARBER
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AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

The genus *Cryphula* has a wide distribution in the Western Hemisphere. It was erected by Stål in 1874 to contain the single species *parallelogramma* from Texas. Distant in 1882, not recognizing Stål's genus, described three species under the generic name *Trapezus*. Only one species *abortiva* Barber has been added since, disregarding Distant's *affinis* which is a synonym of his *fasciata*. Two new species are herewith added to the genus.

Cryphula nitens, new species

= *apicatus* Barber (not Distant) Jour. N. Y. Ent. Soc. Vol. 26, 63, 1918.

Head, pronotum in part, scutellum and beneath, castaneous, highly polished; antennae testaceous; legs castaneous; pronotum with narrow anterior, posterior, lateral margins and humeral angles ochraceous.

Head one-third wider than long, impunctate. Antenna with the second and terminal segments subequal, third segment somewhat shorter than either the second or terminal segment, proportionate lengths of the segments: 12:27:20:25; each segment with several long semi-erect setae, which are over twice as long as diameter of the segment. Pronotum much wider than long (65 × 35), sparsely punctate anteriorly, along the margins and on the posterior one-third; lateral margins with a few long setae, often abraded. Scutellum equilateral, very sparsely punctate with a series of punctures along the margins, extreme apex pale. Veins of corium obscurely pale, surface sparsely punctate. Occurs in both macopterous and brachypterous forms.

Length 3.50 mm.

Type: Male. San Diego, California, Mch. 22, 1928. H. G. Barber, United States National Museum Cat. No. 63245. Paratypes, males and females; California: 4 with the same data as type, 12 Mch. 24, 1928, Barber; 5 Jan. 30, Hubbard; 5 Pasadena, Mch. and Apr. 1928 and 1 Los Angeles, Mch. 30, 1928, Barber; 1 Los Angeles Co. Coquillette.

Arizona: 17 Huachuca Mts., July 1905, under dead leaves, Barber; 1 Santa Rita Mts., July 20, 1932, Ball; 1 Sept. 20, 1936, Bryant; 1 May 20, Schwarz; 1 Chiricahua Mts., Sept. 5 and 1 Ft. Grant July 23, Hubbard; 1 Atascosa Mts. Oct. 27, 1937, Ball and 1 Oct. 24, 1937, Oman.

Utah: 9 Simpson Buttes, Dugway Co. Feb. 9, 1954, Gering; 6 Johnson's Pass, Tooele Co. June 2, 1954 and 5 Whiskey Spg. Can. Tooele Co., June 18, 1954, Ashlock.

Texas: 2 "Tex" Uhler collection.

Idaho: 2 Kendrick, Aug. 13, 1938, Harris.

C. nitens is most closely related to *apicatus* (Dist.) from which it differs in the coloration of the pronotum, less conspicuous veins of the corium and in having the antennæ provided with several long, semi-erect setæ. All of the specimens from Utah have the corium more fuscous than the California specimens.

Cryphula subunicolor, new species

Nearly uniformly colored, castaneous, surface duller than in the preceding species; narrow lateral margins of pronotum, corium, apex of scutellum, connexivum, antennæ and legs testaceous.

Head smooth, impunctate, one fourth wider than long, preocular part equal to remainder. Antennæ rather long and slender, second segment over twice as long as basal, and one-fourth longer than terminal, proportionate lengths of the segments, 15:40:25:30, each provided with a few long, semi-erect setæ. Pronotum about one-third wider than long, sparsely punctate anteriorly and on the posterior third. Scutellum but little longer than wide, very sparsely punctate. Corium with veins concolorous, rather evenly coarsely punctate between median and claval vein, more sparsely punctate elsewhere. Membrane dark brown. Macropterous and brachypterous.

Length 4 mm.

Type: Male, Tucson Mts., Ariz., Jan. 1, 1936, 3500 ft. el., O. Bryant, United States National Museum Cat. No. 63246. Paratypes, 2 with the same data as type, 1 "Ariz.", Casey collection.

Very easily distinguished from other members of the genus by reason of its nearly uniform, castaneous color.

KEY TO SPECIES OF CRYPHULA

1. Scutellum with three pale spots; antennæ with long semi-erect setæ ... 2
— Scutellum with only the apex pale; antennæ without or with long erect setæ ... 3
2. Corium with a distinct transverse castaneous fascia on a pale surface or otherwise colored. Posterior margin of pronotum conspicuously pale (= *affinis* (Dist.)) ... *trimaculata* (Distant)

— Corium without conspicuous transverse fascia; posterior margin of pronotum inconspicuously pale .... *parallelogramma* Stål
3. Corium with conspicuous transverse castaneous fascia; antennæ without long setæ .... *fasciata* (Distant)
— Corium without conspicuous transverse fascia 4
4. Dorsum pilose; antennæ without long setæ .... *abortiva* Barber
— Dorsum not pilose 5
5. Dorsum uniformly castaneous; antennæ with long semi-erect setæ .... *subunicolor* new species
— Dorsum, not uniformly colored, more or less fasciate with pale 6
6. Posterior margin of pronotum, with a spot on each side of the middle often connected with humeral angles, pale. Veins of corium conspicuously pale; antennæ without setæ .... *apicatus* (Dist.)
— Humeral angles of the pronotum pale; veins of corium rather inconspicuous. Antennæ with long, semi-erect setæ .... *nitens* new species

LIST OF SPECIES

1. *C. parallelogramma* Stål, Enum. Hem., Pt. 4, 165, 1874. Texas. Entire Eastern United States, south to Florida and west to Colorado and Texas.
2. *C. trimaculata* (Distant), B.C.A.Rhynch. 2, 217, 1882, Guatemala. Mex., C. Amer., Colombia, Brazil, Ecuador.
3. *C. fasciata* (Distant), B.C.A.Rhynch 2, 217. 1882, Guat. Panama =*affinis* (Distant), H.M.N.H. (7) 7, 500, 1901, Grenada, W.I.
4. *C. apicatus* (Distant), B.C.A.Rhynch. 2, 217, 1882, Mex. Guat. Mex., C. Amer., Venezuela.
5. *C. nitens* new species. So. Cal., Ariz., Tex., Utah, Idaho. =*apicatus* Barber (not Distant), Jl. N. Y. Ent. Soc. 26.63, 1918.
6. *C. abortiva* Barber, Jl. N. Y. Ent. Soc. 26, 63, 1918—Arizona.
7. *subunicolor* Barber, new species—Arizona.

(*Continued from page 134*)

Dr. Forbes called the Society's attention to Dr. Lepeg's theory on "The Struggle of the Bees". There was some discussion by the members on this subject.

Dr. Marks briefly mentioned his latest work on *Papilio* and reported progress in his studies.

Dr. Mullen then gave the report of the Field Committee and a resume of the recent Massapequa Park trip made by a number of the members of the Society. He showed some black and white pictures and Dr. Clausen showed kodachromes of the trip.

Dr. Clausen shocked the members with the announcement of the untimely death of esteemed member, Dr. Ralph B. Swain. It was voted that the Secretary send a letter of condolence to Mrs. Swain.

The meeting adjourned at 9:40 P.M.

LOUIS S. MARKS, *Secretary*

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(*Continued from page 137*)

Meeting of October 20, 1953

A regular meeting of the Society was held at the American Museum of Natural History. There were fourteen members and sixteen guests present.

There were three proposals for membership: Dr. Paul Ludwig, Boyce Thompson Institute, Yonkers, New York, who was proposed by Dr. Albert Hartzell, Mr. R. Cronin, S. J., Fordham University, New York 58, New York, proposed by Dr. L. S. Marks, and Mr. Pastor Alayo Dalman, Oriente, Cuba.

The program of the evening was a symposium on ''Ants as Biological Subjects''. Dr. James Forbes spoke on the anatomy and taxonomy of ants. He pointed out that because of Dr. Creighton's recent excellent work in taxonomy, he would confine his remarks to the anatomy of ants. Ants are poorly known anatomically. The pumping stomach has been known for many years, yet it is still not well understood. In the nervous system, the innervation of structures is unknown.

Dr. Smith and also Dr. Forbes have worked on characteristics of male genitalia, which can be used to segregate genera and perhaps subgenera.

Dr. Haskins spoke on three problems: sex determination, caste determination, and the phylogeny of colony formation. Polyploidy he pointed out is common in ants. Working on a very primitive Australian family of ants, he could work out its development from a solitary to a social ant.

Dr. Schneirla, after paying due homage to Wheeler's work on ants, discussed problems of orientation in ants and social behavior in Eciton.

After a discussion the meeting adjourned at 10:00 P.M.

Louis S. Marks, *Secretary*

Meeting of November 17, 1953

A regular meeting of the Society was held at the American Museum of Natural History. There were fifteen members and twenty guests present. The minutes of the preceding meeting were accepted as read.

The following persons proposed at the October 20 meeting were elected to membership: Dr. Paul Ludwig, Boyce Thompson Institute, Yonkers, New York; Mr. R. Cronin, S. J., Fordham University, New York 58, New York, and Mr. Pastor Alayo Dalman, Oriente, Cuba. The following persons were proposed for membership by Dr. Forbes: Mr. Peter H. Dix, 29 West 71 Street, New York 23, New York, and Mr. Wayne Boyle, Cornell University, Ithaca, New York.

The Secretary then read the following proposal to the Society:

> Whereas, the late Dr. Ralph B. Swain was an honored member of the New York Entomological Society and whereas, he was at the time of his death engaged in notable entomological service, and whereas, Su Zan N. Swain has long been the collaborator of the late Dr. Ralph B. Swain, and also a member of the New York Entomological Society, therefore, in honor and recognition of the services of the late Dr. Ralph B. Swain to entomology and to the Society, it is hereby proposed to confer honorary membership on Su Zan N. Swain.

(*Continued on page 152*)

NOTES ON SOME RARE OR LITTLE-KNOWN NEW YORK SIPHONAPTERA

BY ALLEN H. BENTON
DEPT. OF BIOLOGY, NEW YORK STATE COLLEGE FOR TEACHERS, ALBANY, NEW YORK

The collection of the Department of Biology, New York State College for Teachers, Albany, N. Y., contains several specimens of Siphonaptera which are of special interest. In view of our limited knowledge of distribution or taxonomy of these particular species, these notes may be of interest to students of fleas.

Ctenocephalides canis (Curtis)—Geary (1954) lists six records of this species from New York, one of which is based on an erroneous determination by the present author. The species is apparently much less common than its near relative, *C. f. felis*. We have one female *C. canis* from Albany, Albany county, taken from a red fox, *Vulpes fulva,* on December 4, 1954. The specimen was collected by Nancy Harrington.

Catallagia onaga Jordan—The taxonomic status of this species is uncertain. It is probable that it represents the male of *C. borealis* Ewing, (cf. Fuller, 1943), but until the synonymy is established it seems best to follow Jellison et. al. (1954) in retaining the two names.

A single male of this species, taken at Hardenburg Pond, Ulster county, from a red-backed mouse, *Clethrionomys gapperi,* on December 12, 1954, was collected by Daniel Smiley. Previous records from New York include only two collections from Essex county and one from Tompkins county.

Conorhinopsylla stanfordi Stewart—This species was described from specimens taken at Ithaca, N. Y., but has not been reported from elsewhere in the state. Our collection includes a female, taken at Mohonk Lake, Ulster county, from a gray squirrel, *Sciurus carolinensis leucotis,* on December 27, 1954. The specimen was collected by Daniel Smiley.

Orchopeas cædens durus (Jordan)—Some workers have expressed doubt as to the validity of this subspecies. Holland (1949), working with long series of specimens, has concluded that two valid subspecies exist, although males are not separable. Our collection includes six males and nine females taken at Raquette Lake, Hamilton county, from red squirrels, *Tamiasciurus hudsonicus*, on November 27, 1953. The collector was Custer Quick. All females in this series agree with Holland's diagnosis of the subspecies *O. c. durus*, and tend to support his contention that the subspecific designation should be retained.

Eptescopsylla chapini (Jordan)—Although it has long been expected that this species would eventually be found to have a wide distribution (cf. Geary, 1954), it has been reported only from Maryland, Ohio and Kentucky. We have four males and five females of this species, taken at Sprakers, Montgomery county, from *Eptesicus f. fuscus* and *Myotis subulatus leibii*, on January 27, 1955. The specimens were collected by Harold Schwager, who is carrying out a study of bats in a small cave. The occurrence of this species at this location in midwinter strengthens the probability that it will be found to occur throughout the northeastern states and southeastern Canada.

Literature Cited

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Holland, G. P. 1949. The Siphonaptera of Canada. Canad. Dept. of Agr. Bulletin 70: 1–306.

Jellison, W. L., Betty Locker and Roma Bacon. 1953. A Synopsis of North American fleas, north of Mexico, and notice of a supplementary index. Journ. of Parasit. **39** (6): 610–618.

CHANGES IN THE DISTRIBUTION OF NITROGEN DURING GROWTH AND METAMORPHOSIS OF THE HOUSEFLY, MUSCA DOMESTICA (LINNÆUS)*

By Robert J. DelVecchio
Department of Biology, Fordham University

Needham (1929), pointed out that when histolysis of larval structures occurs, their constituent proteins are presumably broken down resulting in a raised proportion of proteoses, peptones, and amino acids. As imaginal organs are constructed, this trend should be reversed, and the relative concentration of complete protein should increase. In addition, if some nitrogenous compounds are destroyed during metamorphosis, the fact that nothing, except gases, may leave the body during the pupal stage, should result in an increase in the concentration of end-products and in the proportion of non-protein nitrogen from this source.

Anderson (1948) working on the changes in the distribution of nitrogen in the Japanese beetle, *Popillia japonica,* showed that there was no significant loss of nitrogen during the course of metamorphosis. However, at pupation there was a sudden large decrease in the nitrogen of the water-insoluble fraction, followed by gradual increases during subsequent days of pupal life. An increase in amino acid nitrogen occurred at pupation followed by a decrease, which became more gradual during the remainder of pupal life. Soluble protein, proteose and peptone nitrogen decreased significantly between larval and early prepupal stages. They showed no change in the late prepupa but subsequently rose to a maximum percentage of the total nitrogen on the second to third day of the pupal period at 25° C. By the sixth to seventh day they had returned to the former level and maintained this concentration through emergence. These complimentary shifts may be interpreted as indicative of the destruction of mature larval tissues at pupation, followed by gradual

* Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Biology at Fordham University. The author wishes to express his sincere appreciation to Dr. Daniel Ludwig under whose direction and guidance this investigation was carried out.

construction, from the materials thus made available, of the definitive structures of the adult.

Most investigators confined their analyses to larvæ, pupæ or adults, without making a complete analytical study during these stages to determine exactly when the changes first occurred and when they are reversed. Therefore it was decided to investigate the changes in nitrogenous components in the housefly, *Musca domestica,* and to analyze insects during each day of the larval and pupal periods, and finally as young and old adults. These data should be of value in comparative studies of the developmental physiology of insects in general.

MATERIAL AND METHODS

Larvæ of the housefly were raised on whole milk. A fingerbowl containing cotton saturated with this food served as the feeding medium. Eggs were transferred daily to a humidifier regulated at approximately 30° C. and a humidity near saturation. The eggs hatched in approximately 24 hours under these conditions, and the time of hatching was recorded. In this manner carefully timed records, within 24 hours, were obtained for each group of experimental animals. The flies were tested in samples of approximately 100 mg. at the following stages: one-, two-, three-, four-, five-, and six-day larvæ; one-, two-, three-, and four-day pupæ; newly emerged adults, and old adults (seven to ten days after emergence).

Fractionation was accomplished by the techniques used by Ludwig and Rothstein (1952), Anderson (1948), and also by a modification of these techniques. By the first method, Fraction A (lipid nitrogen) was extracted with a solution of ether-alcohol. Fraction B was then extracted with hot water and separated from Fraction C by the addition of sodium tungstate and sulfuric acid. Fraction B probably contained amino acids, ammonia, urates, and urea, while Fraction C (water-soluble nitrogen precipitated by tungstic acid) probably consisted of soluble proteins, proteoses, peptones and polypeptides. Fraction D, the residue remaining after the previous extractions, contained complex proteins and chitin. With the technique used by Anderson (1948), cold water extraction was made but no lipid nitrogen was removed. Hence, this method gave Fractions B, C, and D. The third method consisted of cold water extraction prior to lipid removal with alcohol-ether. The remaining fractionations were

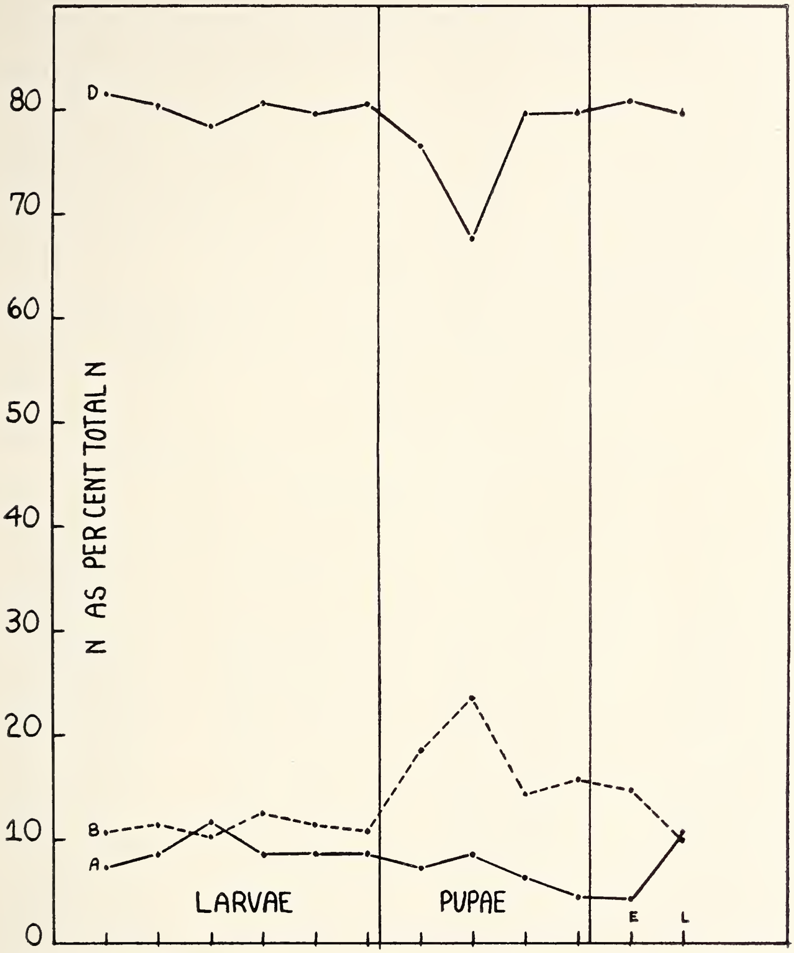

Fig. 1. Graph showing the per cent of total nitrogen of the various fractions at different stages of metamorphosis (technique used by Ludwig and Rothstein 1952).

performed according to the procedure of Ludwig and Rothstein (1952). This method yielded Fractions A, B, C, and D. The Kjeldahl procedure was employed to make the nitrogen determinations. A minimum of 10 determinations was made on each day of growth and metamorphosis tested.

OBSERVATIONS

No loss of nitrogen occurred during the process of metamorphosis from the larva to pupa. However, there was an increase in the total nitrogen content per 100 mg. The average nitrogen of all three series of experiments increased from 1.35 per cent in the six-day larva to 2.27 in the one-day pupa, and 2.55 per cent in the young adult. This increase in total nitrogen is thought to be associated with the decrease in the amount of water, since pupae and adults contain less water than larvæ.

The changes in the distribution of nitrogen for each day of metamorphosis as derived by the technique used by Ludwig and Rothstein (1952), are shown in Table 1, and in Figure 1. Each

TABLE 1

CHANGES IN THE DISTRIBUTION OF NITROGEN DURING THE METAMORPHOSIS OF THE HOUSEFLY. NITROGEN AS PER CENT TOTAL NITROGEN AND STANDARD ERRORS.

	FRACTION A	FRACTION B	FRACTION D
1-day larva	7.22 ± .0217	10.96 ± .0107	81.81 ± .0107
2-day larva	8.78 ± .0176	11.16 ± .0220	80.04 ± .0117
3-day larva	11.30 ± .0206	10.27 ± .0135	78.44 ± .0067
4-day larva	8.79 ± .0107	12.39 ± .0220	80.71 ± .0075
5-day larva	8.89 ± .0075	11.18 ± .0082	79.92 ± .0118
6-day larva	8.92 ± .0119	10.62 ± .0119	80.45 ± .0142
1-day pupa	7.26 ± .0144	18.96 ± .0066	76.04 ± .0083
2-day pupa	8.78 ± .0120	23.92 ± .0085	67.62 ± .0119
3-day pupa	6.25 ± .0082	14.09 ± .0065	79.68 ± .0118
4-day pupa	4.30 ± .0116	16.06 ± .0118	79.51 ± .0114
Early adult	4.15 ± .0142	14.86 ± .0169	80.97 ± .0247
Late adult	10.53 ± .0219	9.67 ± .0085	79.93 ± .0221

fraction is expressed as per cent total nitrogen. Fraction A, increased during the larval period from 7.22 in the one-day, to 8.92 per cent in the six-day larvæ. During the latter part of the pupal period it decreased to a value of 4.30 per cent. No change occurred on emergence, but this fraction increased to 10.53 per cent in the old adult. Fraction B remained constant during the larval period at approximately 11 per cent of total nitrogen. However, it increased to 23.92 per cent in the two-day pupa and then decreased to 16.06 per cent in the four-day pupa. During the adult stage, this fraction showed a further

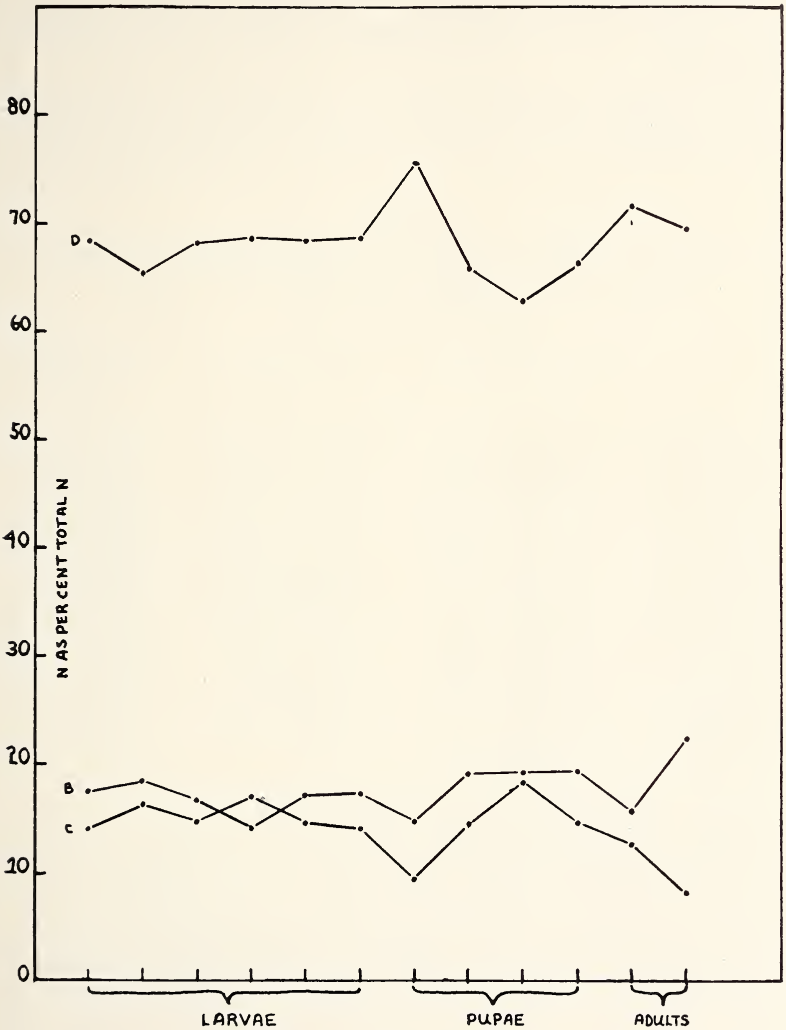

Fig. 2. Graph showing the per cent of total nitrogen of the various fractions at different stages of metamorphosis (technique used by Anderson 1948).

decrease to 9.67 per cent in the old adult. No Fraction C appeared with this procedure. Fraction D remained constant at approximately 80 per cent of the total nitrogen during the larval stage. It decreased to 67.62 per cent in the two-day pupa and returned to the larval value of approximately 80 per cent in the three- and four-day pupæ, retaining this value in the young and old adults.

The changes in the distribution of nitrogen for each day of metamorphosis as derived by the technique of Anderson (1948), are expressed in Table 2, and in Figure 2. No fraction A was

TABLE 2

CHANGES IN THE DISTRIBUTION OF NITROGEN DURING THE METAMORPHOSIS OF THE HOUSEFLY. NITROGEN AS PER CENT TOTAL NITROGEN AND STANDARD ERRORS.

	FRACTION B	FRACTION C	FRACTION D
1-day larva	17.68 ± .0141	14.01 ± .0103	68.49 ± .0107
2-day larva	18.43 ± .0179	16.37 ± .0115	65.22 ± .0115
3-day larva	16.95 ± .0117	14.89 ± .0119	68.17 ± .0141
4-day larva	14.05 ± .0115	17.17 ± .0179	68.77 ± .0177
5-day larva	17.01 ± .0063	14.77 ± .0107	68.21 ± .0177
6-day larva	17.24 ± .0107	14.14 ± .0117	68.62 ± .0083
1-day pupa	14.95 ± .0067	9.56 ± .0332	75.48 ± .0176
2-day pupa	19.08 ± .0070	14.63 ± .0035	65.92 ± .0176
3-day pupa	19.05 ± .0089	18.41 ± .0017	62.67 ± .0108
4-day pupa	19.34 ± .0067	14.59 ± .0075	66.06 ± .0108
Early adult	15.85 ± .0019	12.72 ± .0216	71.39 ± .0107
Late adult	22.38 ± .0019	8.14 ± .0107	69.48 ± .0102

obtained with this procedure. Fraction B remained relatively constant at approximately 17 per cent of total nitrogen during the larval period. Increased to 19 per cent in the two-day pupæ and retained this value until the end of the pupal stage, decreasing to 15.85 on emergence. During the adult stage it increased to 22.38 per cent. Fraction C remained relatively constant at about 14 per cent of total nitrogen during the larval stage. It increased to 18.41 per cent in the three-day pupa. This fraction then decreased steadily during the remainder of the life cycle to

14.59 in the four-day pupa, 12.72 in the young adult, and finally to 8.14 per cent in the old adult. Fraction D remained constant at 68 per cent throughout the larval period. It decreased to 62.67 per cent in the three-day pupa. This decrease was then

Fig. 3. Graph showing the per cent of total nitrogen of the various fractions at different stages of metamorphosis (water extraction prior to lipid extraction).

followed by an increase to 66.06 in the four-day pupa and to 71.39 per cent in the young adults.

The results obtained when the water-soluble materials were extracted prior to lipid extraction are shown in Table 3, and in Figure 3. Fraction A remained constant at approximately 2 per cent of the total nitrogen throughout the life cycle. Fraction B remained constant at 17 per cent during the first three days of the larval period, and then decreased to 13.39 per cent in the four-day larva. This decrease was followed by an increase to 16 per cent where it remained up to and including the one-day

TABLE 3

CHANGES IN THE DISTRIBUTION OF NITROGEN DURING THE METAMORPHOSIS OF THE HOUSEFLY. NITROGEN AS PER CENT TOTAL NITROGEN AND STANDARD ERRORS.

	FRACTION A	FRACTION B	FRACTION C	FRACTION D
1-day larva	2.076 ± .0117	17.19 ± .0141	13.63 ± .0103	67.09 ± .0289
2-day larva	1.848 ± .0119	17.38 ± .0179	15.44 ± .0115	65.32 ± .0219
3-day larva	2.159 ± .0107	16.51 ± .0117	14.53 ± .0119	66.81 ± .0102
4-day larva	2.364 ± .0084	13.39 ± .0115	16.37 ± .0179	67.88 ± .0142
5-day larva	2.252 ± .0102	15.84 ± .0063	13.75 ± .0107	68.16 ± .0135
6-day larva	2.187 ± .0102	16.06 ± .0107	13.17 ± .0117	68.58 ± .0287
1-day pupa	2.434 ± .0177	16.50 ± .0067	10.55 ± .0332	70.52 ± .0083
2-day pupa	2.411 ± .0177	20.37 ± .0070	16.01 ± .0035	61.21 ± .0083
3-day pupa	2.346 ± .0076	19.73 ± .0089	18.91 ± .0017	59.03 ± .0107
4-day pupa	2.563 ± .0102	15.31 ± .0067	11.55 ± .0075	70.58 ± .0126
Early adult	2.257 ± .0176	15.33 ± .0019	12.25 ± .0216	70.03 ± .0107
Late adult	1.987 ± .0107	22.49 ± .0019	8.18 ± .0107	67.35 ± .0107

pupa. It then increased to 20 in the two-and three-day and then decreased to 15 per cent in the four-day pupæ and young adults. Finally it increased to 22.49 per cent in the old adults. Fraction C increased from 13.63 per cent in the one-day and to 16.37 in the four-day larvæ. This increase was followed by a decrease to 13 in the five- and six-day larvæ and to 10.55 per cent in the one-day pupa. It then increased to 18.91 per cent in the three-day pupa and decreased to 12 in the four-day pupa and young adult, and finally to 8.18 per cent in the old adult. Fraction D remained constant at about 68 per cent throughout the larval period. It decreased to 59.03 in the three-day pupa, returning to its former level of about 70 per cent in the four-day pupa and young adult.

DISCUSSION

Many authors have reported that the process of metamorphosis in holometabolous insects is accompanied by no significant loss of nitrogen (Kellner, Sako, and Sawano 1884; and Inouye 1912, for the silkworm *Bombyx mori;* Heller 1924, for the moth *Deilephila euphorbiæ;* Frew 1929, for the blowfly *Calliphora;* Evans 1932, for the blowfly *Lucilia sericata;* Anderson 1948, for the Japanese beetle *Popillia japonica;* and others). No loss of nitrogen was evident in the present study, during the metamorphosis of *Musca domestica,* although at pupation the larval skin is shed, and upon emergence of the adult, the pupal skin is also shed. Both these exuviæ may be shown to contain nitrogen.

An examination of the data presented in Figures 2 and 3, reveals that Fraction D remains at a high value while Fraction C remains low throughout the larval period. During the pupal period Fraction D decreased and Fractions B and C increased during the second and third days. This shift in nitrogen indicates a breakdown of larval protein and an increase in the decomposition products. At the end of the pupal stage, this change is reversed indicating a utilization of these products for the synthesis of tissue. Evans (1932), for the metamorphosis of *Lucilia sericata,* also found that when the highest value for insoluble protein was obtained there was a corresponding low value of soluble protein nitrogen. In 1934, he obtained similar changes in the mealworm, *Tenebrio molitor.* Anderson (1948), found that during the metamorphosis of the Japanese beetle, pupation is accompanied by a relatively tremendous change in nitrogen distribution, water-insoluble nitrogen undergoing a marked decrease, while the water-soluble fractions show significant increases.

A possible explanation for the disappearance of Fraction C, containing the water-soluble compounds precipitated by tungstic acid, with the technique used by Ludwig and Rothstein (1952), is that when the lipid fraction is removed prior to water extraction, some of the proteins which are water-soluble and which would ordinarily be precipitated by tungstic acid are also removed. The possible removal of water-soluble protein with the lipids would also explain the larger lipid fraction with this technique than that obtained when water extraction is made prior to lipid extraction. Furthermore, alcohol is a protein precipitating agent. Hence it precipitates some of the proteins which would also appear in Fraction C. These proteins then appear as insoluble proteins in Fraction D. A comparison of values in Table 1 with those in Tables 2 and 3 shows a greater amount of nitrogen in Fraction D with this procedure. On the other hand, when the water-soluble compounds are removed first, some of the lipid fraction may also be removed, therefore accounting for the larger percentages of these fractions, when compared with the technique of Ludwig and Rothstein (1952).

The results obtained with the three methods of fractionation indicate that little change occurs in the various fractions during the entire larval period. However, during the pupal period each method of fractionation indicated an increase in the water-soluble nitrogen during the second and third days of the pupal stage which was then followed by a steady decrease during the remainder of metamorphosis. The insoluble nitrogen decreased at the time when water-soluble nitrogen increased.

The difference in timing of metamorphosis is of utmost importance when correlating these results with the work of other investigators. Anderson (1948) reported changes which occur at or after pupation. This description suffices for the Japanese beetle, for in this insect the shedding of the last larval skin is visible. However, in the housefly, the molt which results in the formation of the pupa cannot be seen due to the presence of a puparium. Consequently, the results tabulated are timed from puparium formation and not from pupation. The latter process probably occurs within a 24 hour period after puparium formation at the temperature employed. If this 24 hour interval is subtracted from the time values given in this work for the pupal stage, the increase in water-soluble and the decrease in water-insoluble nitrogen occur at approximately the same time with respect to pupation, as that reported in the Japanese beetle by Anderson (1948).

SUMMARY

One hundred milligram samples of houseflies, *Musca domestica,* collected at 24 hour intervals during growth and metamorphosis,

at 30° C. were analyzed for nitrogen by different fractionation methods. The determinations were made of the following fractions: Fraction A (lipid nitrogen), Fraction B (water-soluble nitrogen not precipitated by tungstic acid), Fraction C (water-soluble nitrogen precipitated by tungstic acid), and Fraction D (water-insoluble nitrogen).

No changes occurred in the distribution of nitrogen among these fractions during the larval period.

No loss of nitrogen was evident in the present study. There was an increase in the percentage of total nitrogen during metamorphosis from larva to pupa due to a loss of water.

During the pupal stage, a decrease in water-insoluble nitrogen and a corresponding increase in water-soluble nitrogen occurred in the second and third days following puparium formation. The reverse shifts occurred during the latter part of the pupal stage.

These complimentary shifts between the nitrogenous fractions may be interpreted as indicative of the destruction of mature larval tissues in the early pupæ, followed by gradual construction from the materials thus made available of the definitive structures of the adult.

When lipid extraction was done prior to water extraction, some of the water-soluble proteins which would ordinarily be precipitated by tungstic acid are also removed, therefore giving a greater percentage of total nitrogen in this fraction. Also, alcohol precipitates proteins which would ordinarily be present in Fraction C, but consequently appear as insoluble proteins in Fraction D.

When water extraction was done prior to lipid extraction, some of the lipids, not tightly bound, were also removed, therefore adding to a larger value for the water-soluble fractions.

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(*Contiued from page 138*)

Dr. Vishniac seconded the motion and it was carried without dissent.

Dr. Clausen appointed a nominating committee of Mrs. Vaurie, Dr. James A. Mullen and Mr. Sam Harriott.

Dr. Vishniac introduced the speaker of the evening, Dr. Louis S. Marks of Fordham University, who spoke on ''Notes on the Genus Papilio''. Dr. Marks traced the generic concepts within the genus from the time of Linnaeus, and presented new evidence for the creation of three genera—*Battus* Scopoli, *Papilio* Linnaeus, and *Graphium* Scopoli. He then outlined briefly our present concept of populations within the various species. His talk was illustrated by Kodachromes and an exhibit. The exhibit consisted of five boxes of *Papilio* (sensu lato). At least one specimen from each of the minor groups into which the genera are subdivided was exhibited. Noteworthy and rare swallowtails included *Papilio aristor, Papilio aristodemus ponceana,* the female of *Papilio alexandrae,* and a dwarfed *Papilio glaucus.*

LOUIS S. MARKS, *Secretary*

Minutes of meeting of December 8, 1953 are not available.

MEETING OF DECEMBER 15, 1953

A regular meeting of the Society was held at the American Museum of Natural History. There were nine members and six guests present.

Miss Eleanor Lappano of Fordham University was proposed for membership by Dr. Forbes.

The speakers of the evening were Dr. Roman Vishniac and Dr. Szybalski of Cold Spring Harbor Biological Labs on ''Resistance in Insects and Bacteria''.

Dr. Vishniac explained the phenomenon of resistance on a genetic basis. He pointed out that the resistant population has always been present, and

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NEW MISSOURI CHILOPOD RECORDS WITH REMARKS CONCERNING GEOGRAPHICAL AFFINITIES

BY RALPH E. CRABILL, JR.
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The following records are based upon a considerable mass of material most of which was collected by a local naturalist, Brother Charles Roe, F.S.C., a teacher at the Christian Brothers College. I should like to express my gratitude to Brother Charles and also to one of his students, Maurice Pickard, who contributed a number of the Saint Charles and Franklin county specimens. The centipedes from Crawford, Iron, Carter, and Oregon counties were captured by me.

In the ensuing discussion, collecting stations are identified by a formula following each species name. A capital letter refers to a county, and the associated number to a locality within the county from which the species is recorded. The following reference list of counties and localities is arranged such that the counties are presented as they occur from north to south. Audrain county, on the drier prairie, and Saint Charles county, at the edge of the somewhat wetter Ozark highland region to the south, both occur on the glacial drift plain north of the Missouri river; the remaining counties are south of the Missouri. Although the present site of the city of Saint Louis seems to have been covered by Illinoian ice, apparently Saint Louis county was never completely glaciated. The remaining counties, in the list E through J, occupy part of the driftless Ozark highlands, a region celebrated as a refuge for a number of ancient plant and animal types.

A. Audrain County
    1. Mexico
B. Saint Charles County
    1. Dardenne Slough (5 miles northeast of Saint Charles on the Mississippi river flood plain).
C. Saint Louis (An independent city, not included in any county).

1. Forest Park
2. Missouri Botanical Gardens

D. Saint Louis County
1. Brentwood
2. Rock Woods Reservation
3. Webster Groves
4. Clayton
5. Manchester
6. Ladue
7. Valley Park
8. Chesterfield
9. Glencoe
10. Creve Coeur
11. Ranken (23 miles southwest of Saint Louis on U. S. 66, 5 miles west of Valley Park; the Beaumont Boy Scout Reservation).

E. Franklin County
1. Sullivan
2. Stanton

F. Jefferson County
1. High Ridge
2. Big River
3. Vaugirard (8 miles southwest of House Springs).

G. Crawford County
1. Saint Louis University biological station (5 miles west of Berryman in Washington County).

H. Iron County
1. Taum Sauk mountain (1700′, 8 miles southwest of Ironton).
2. Graniteville

I. Carter County
1. Big Springs State Park (5 miles south of Van Buren).

J. Oregon County
1. Grand Gulf (at Thayer).

Information based upon chilopodous material from so few, geographically restricted localities makes it difficult to discuss the zoogeographical affinities of the fauna of the entire state. It may be significant too, that all but one county (Audrain, on the glaciated prairie) belong in only one of the state's four phytogeographic regions.[1] Yet the available records do tempt one to speculate upon the affinities at least of the areas investigated here, roughly east-central and parts of south-central Missouri. This fauna is essentially, though not exclusively, Carolinian,[2] an association perhaps best reflected by the Geophilomorpha, most of the Missouri representatives of the order being prevalent in Illinois, Indiana, Kentucky, the Carolinas, and Virginia. Similarly, the scolopendromorph genus *Theatops* enjoys a broad Austral distribution in eastern North America. This Carolinian habitus is equally true of a number of the Lithobiomorpha but with this probably significant distinction. A number of the eastern Missouri lithobiomorphs seem more representative of the midwestern than of the southeastern states, so that instead of ranging over the entire Carolinian Region, species such as *Pokabius bilabiatus* (Wood), *Sonibius politus* (McNeill), *Sigibius urbanus* Chamberlin, and *Neolithobius voracior* (Chamberlin) on the basis of existing records seem to be restricted to a sector of this vast area.

LITHOBIOMORPHA

Neolithobius voracior (Chamberlin). (C-1, D-2-3, E-1, F-1, H-1-2, I-1, J-1). This large lithobiid is now known from Florida, Mississippi, Missouri, and Illinois. Although common in the localities collected to the south of the Missouri river, *voracior* has not yet been encountered on the drift area north of the river. The admittedly fragmentary data on hand suggest it there to be replaced by the closely related *N. suprenans,* discussion of which follows. It may be of some interest to note that I have found active specimens of the former species beneath rocks on top of Taum Sauk mountain while the temperature was close to 50° F.

Neolithobius suprenans Chamberlin. (B-1). This form is known in Missouri presently only from Saint Charles county; it has also been recorded from New Mexico, Colorado, Texas, Oklahoma, Kansas, Nebraska, Iowa, and Arkansas. The specimens I

[1] Palmer and Steyermark (Ann. Mo. Bot. Gardens, XX, pp. 399–442, 1935) recognize four regions: glaciated prairie, unglaciated prairie, Ozark, and southwestern lowlands. All but Audrain county are included in the Ozark region.

[2] See the Carolinian Region as defined by L. R. Dice in ''The Biotic Provinces of North America'', pp. 16–18, 1943, University of Michigan Press.

have studied, from Nebraska and Kansas, agree favorably with the Missouri samples.

Nadabius iowensis (Meinert). (D-3-11, F-2, G-1, H-2). This species is very common throughout the present range where, to the south, it is rivalled only by *Neolithobius voracior.* I can detect no significant differences between local populations and those inhabiting other midwestern areas.

Lithobius forficatus (Linne). (C-2). As Chamberlin has noted previously, members of this genus appear to be replaced in the south by those of *Neolithobius.* The present species, extremely common in Europe and temperate America, is represented in this survey by a single specimen captured in the Missouri Botanical Gardens, where it may have been introduced in a floral shipment from some other part of the country.

Pokabius bilabiatus (Wood). (B-1). Apparently not common in this state, *bilabiatus* is typically midwestern and is not known to occur east of Ohio.

Sozibius providens (Bollman). (D-2). One specimen was collected.

Sonibius politus (McNeill). (B-1, D-6-8-10-11, E-2, G-1). Saint Charles and Saint Louis counties yielded numerous specimens. This form seems to prefer the more northern states and is not now known to occur south of Missouri and Kentucky. It has been reported from Minnesota, Wisconsin, Illinois, Missouri, Kentucky, Indiana, Ohio, Michigan, and Ontario.

Sigibius urbanus Chamberlin. (D-3). This interesting microlithobiid is known presently only from Missouri and the type locality, Chicago, Illinois. My specimen is a female like the holotype and agrees favorably with the original description. The following notes pertain to the Missouri specimen. Antennæ: left with thirty-one articles; right broken. Prosternum: with 2 + 2 teeth; diastema distinctly U-shaped. Female gonopods: claw tridentate; spurs 2 + 2, not markedly long and slender as in *Paitobius* (in some respects *urbanus* resembles certain species in the latter genus). Plectrotaxy: 1V(00001), 2V(00011), 14V(01331), 15V(01310); 14D(left = 00210/right = 00310), 15D(00200).

Bothropolys multidentatus (Newport). (B-1, C-1, D-6-7-8-9-10, E-2, F-1, G-1). Extremely common throughout the eastern

United States, *multidentatus* has been found to be prevalent in all but the south-central Missouri counties: it is known, however, from Arkansas, Louisiana, and Texas to the south. Apparently dependent upon high environmental moisture, it is almost always taken beneath loose bark and only occasionally upon the ground.

SCOLOPENDROMORPHA

Theatops spinicauda (Wood).[3] (B-1, C-1, D-2-8-9, E-1, F-1-3). The species seems relatively common in the state, where its familiar congener, *postica* Say, remains as yet unknown.

Scolopocryptops sexspinosa (Say). (D-2-11, F-3). Owing to the marked latitude of variation observed in what I take to be specimens of *rubiginosa* Koch, the present determinations can only be provisional. The Koch species is readily identifiable in Kansas and Nebraska by the presence of complete paramedian sutures on most of the tergites, and the Say form in the vast area east of the Mississippi by the absence of complete paramedian sutures on *any* tergite. Until the present time this had been the only good point of difference between them. Yet quite unexpectedly in eastern Missouri considerable variability in this character has been encountered in specimens still referable to *rubiginosa.* For example, although the sutures are complete (or rarely very minutely broken) on most of the tergites that show complete sutures in Kansan material, they are often at the same time thin and shallow to the point of being vague. And it is not uncommon to find widely, distinctly broken sutures on anterior and posterior tergites that in Kansan specimens have complete, unbroken sutures. The variation here is impressive. This sort of evidence suggests intergradation between geographical races, i.e. subspecies, a possibility that cannot be substantiated now because of a lack of adequate material. In a very few specimens no complete sutures were observed; these have been referred to *sexspinosa* hesitantly because of the possibility of their being extreme variants of a highly variable hybrid population existing in eastern Missouri between two subspecies, *rubiginosa* centering

[3] In the past there has been a great deal of vacillation between masculine and feminine renditions of trivial names following the cryptopid ''-*ops*'' genera. I propose for the sake of future stability that we follow the recommendation in the recent ''Copenhagen Decisions'' (p. 51) that all names terminating in -*ops* be considered feminine.

around the north-central states and *sexspinosa* in the east. But until the problem can be resolved, I feel it preferable to treat the two as distinct species.

Scolopocryptops rubiginosa Koch. (D-3-7-8-9, E-1, F-2). This form is quite common in its localities. See the discussion under *sexspinosa.*

GEOPHILOMORPHA

Geophilus mordax Meinert (sens. str.). (G-1, H-1, I-1). As do the other specimens that I have studied, from Kansas, Alabama, Florida, North Carolina, and Virginia, the Missouri forms display heavily sclerotized, consolidated paxilli and sacculi, and the ventral coxopleural pores of the present forms are concentrated under or adjacent to the last ventral sternite. Each coxopleuron possesses a distinctive closed pore. The series consists of three specimens: a female with 53 pairs of legs, two males with 53 and 55 pairs of legs.

Geophilus vittatus (Rafinesque). (formerly *rubens* Say, 1821). (B-1, C-1, D-8, F-3). The pedal counts fall within the usual dispersions, i.e., ♂ 49–51, ♀ 49–53.

Arenophilus bipuncticeps (Wood). (A-1, D-2-3-4-8-9-10, F-3). This is apparently the first record of this ubiquitous Austral species from the state, where previously the genus was known to be represented only by *watsingus* Chamberlin. The Wood form is by far the most common geophilomorph wherever it is found in the present localities. The following pedal dispersions have been observed in the Missouri specimens: ♂ 47–55, ♀ 55–63.

Pachymerium ferrugineum (C. L. Koch). (D-8, F-2). All of the Stanton specimens are females, four with 47 and two with 45 pairs of legs. The single Chesterfield female has only 39 pairs of legs, to my knowledge the lowest pedal count ever ascribed a female of this widespread Holarctic species.

Arctogeophilus fulvus (Wood). (B-1, D-2-8-9). All of the specimens are females, three of which have 57 and one 55 pairs of legs.

Strigamia bidens Wood. (D-8). A female with 73 and a male with 69 pairs of legs were collected.

Strigamia bothriopa Wood. (C-1, H-1). The Saint Louis county male has 47, the two Iron county males have 51 pairs of legs.

Tomotœnia urania Crabill. (D-3). This male with 55 pairs of legs is the second specimen of the species to be collected; the female holotype has 59 pairs of legs. Both were taken in Saint Louis county, and both agree in all essentials.

Garrina parapoda (Chamberlin). (F-1). This tiny form is known now only from its Texan type locality and from High Ridge in Missouri where a single male with 63 pairs of legs was taken.

SCUTIGEROMORPHA

Scutigera coleoptrata (Linne). (D-1-4-5-8-10). Contrary to its habits farther north, where its haunts seem restricted to human dwellings, in the Saint Louis area *coleoptrata* is found quite commonly out of doors as well as indoors. This might be explained on the basis of the milder climate of Missouri.

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it is merely a question of selection in a population. He pointed out that mutations are not necessary to provide resistant insects.

Dr. Szybalski, speaking about bacteria, approached the problem from a genetic and statistical point of view. He explained resistance not only on the basis of selection within a population but also on the evolution of bacterial populations. There are two types of resistance—multi-step and single-step resistance. These were both explained on the basis of a creation of a microenvironment by the population. Resistance in bacteria is chiefly due to mutation. For Hinshelwood's claim that resistance is due to adaptation, there is no experimental evidence.

In the discussion which followed, Dr. John Rehn pointed out that the phenomenon of insect resistance to poisons has been much overrated. Pseudo-resistance is often traced to disintegration of non-stable insecticide or poor application.

Dr. Marks pointed out how much of the published work on resistance implies a belief in the inheritance of acquired characteristics.

The meeting adjourned at 10:00 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF JANUARY 5, 1954

The annual meeting of the Society was held at the American Museum of Natural History. President Clausen was in the chair. There were 15 members and 6 guests present.

In opening the meeting, President Clausen extended the Society's greetings to Dr. and Mrs. Monros from Tucaman, Argentina, two of our honored guests.

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The minutes of the previous meeting were read and approved. The Secretary, in accord with the procedure laid down in the By-Laws verified that a quorum was present. There were no proxy ballots. The Secretary's annual report was read. A copy is appended to these minutes.

The Editor, Mr. Soraci, reported that the December 1953 issue of the Journal will be three months late in appearing. However he has now caught up with the backlog of papers submitted for publication. A decision has been reached to change the printer for future issues of the Journal and it was the Editor's hope that the forthcoming version of the magazine will be as satisfactory as have been the past issues. The numbers will still be held to 64 pages.

Dr. Mullen reported for the Field Committee. During the first week of June 1953 eight members of the Society went to Massapequa Long Island to study the emergence of the brood of 17-year cicadas there. Pictures were taken by various members and a report of the trip appeared in the New York Herald Tribune.

The Nominating Committee, consisting of Mrs. Patricia Vaurie (Chairman), Dr. J. A. Mullen and Mr. Sam Harnott proposed the following slate of officers for 1954:

President—Dr. Lucy Clausen

Vice President—Dr. Roman Vishniac

Secretary—Dr. Louis S. Marks

Asst. Secretary—Dr. Frederick Rindge

Treasurer—Mr. John Rehn

Asst. Treasurer—Mrs. Patricia Vaurie

Editor Emeritus—Dr. Harry B. Weiss

Editor—Mr. Frank Soraci

Asst. Editor—Mr. Herbert F. Schwarz

Trustees—Mr. E. W. Teale, Mr. E. I. Huntington, Dr. A. B. Klots, Dr. Mont A. Cazier

Publication Committee—Mr. Frank Soraci, Mr. Edwin W. Teale, Mr. Herbert F. Schwarz, Dr. James Mullen.

There were no other nominations. A motion to close the nominations was made and passed. The Secretary cast one ballot for the election of the above slate.

Dr. Forbes then moved that the Society send a vote of thanks to the outgoing Treasurer, Mr. Arthur Roensch. This was passed without dissent. President Clausen then thanked all officers and members of committees who had served with her during the past year.

The Secretary then spoke to the membership regarding the forthcoming sale of the Journal, numerous copies of which are now in storage.

Upon motion made and seconded, Miss Eleanor Lappano, Biological Laboratories, Fordham University, New York 58, N. Y. was elected to membership in the Society.

The Secretary then read a proposal, advanced by Dr. Mont Cazier and

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THE ACTIVITY OF SUCCINIC DEHYDROGENASE DURING DIAPAUSE AND METAMORPHOSIS OF THE JAPANESE BEETLE (POPILLIA JAPONICA NEWMAN)*

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Insect diapause may occur in any stage of the life cycle. However, the nature of this resting condition appears to be very different in the egg or pupal stages from that which occurs in the larval stage. Bodine (1934) showed that the respiration of diapause eggs of the grasshopper, *Melanoplus differentialis,* is cyanide insensitive, while that of the pre- and postdiapause egg is markedly inhibited by cyanide. Williams (1948) reported that the pupal diapause of the moth, *Platysamia cecropia,* is characterized by a disruption of the cytochrome system. In this insect, the respiration of the diapausing pupa is also resistant to cyanide. On the other hand, Levenbook (1951) found that the respiration of the diapause larva of the horse bot fly, *Gastrophilus intestinalis,* goes through a cyanide- and carbon monoxide-sensitive heavy metal protein, probably cytochrome oxidase. McDonald and Brown (1952) observed that the prepupal diapause of the larch sawfly, *Pristiphora erichsonii,* shows no decrease in cytochrome oxidase and no change in cyanide sensitivity. Ludwig (1953) obtained high values for the activity of cytochrome oxidase during the larval diapause of the Japanese beetle, *Popillia japonica.* He suggested that in forms with a larval diapause, this condition may be controlled by some mechanism other than the cytochrome system.

The present experiments were undertaken to determine whether the diapause of the Japanese beetle larva is associated with any change in the activity of succinic dehydrogenase. These experiments were extended to include a study of the activity of this enzyme throughout the period of metamorphosis.

* This work was supported in part by the Medical Research and Development Board, Office of the Surgeon General, Department of the Army, under Contract No DA-49-007-MD-444.

MATERIAL AND METHODS

The Japanese beetle larvae were obtained from eggs collected in the laboratory; and the metamorphosing individuals, from larvae collected in the field during the winter months. The larvae of both groups were kept individually in one ounce metal salve boxes containing moist soil to which several grains of wheat were added to serve as food, and kept at a temperature of 25°C. until used in the experiment. Each larva was examined every four or five days, and food or water added as needed. On the approach of a molt, the insect was examined daily until it had molted and the date of the molt recorded. In this manner, an accurate record of each individual was obtained.

Readings on the activity of succinic dehydrogenase were made on insects for each week of the larval stage beginning with the second instar and continuing through the third instar until the beginning of metamorphosis. Readings were made on early and late prepupae, on pupae for each day of this stage, and on newly-emerged adults.

The activity of succinic dehydrogenase was determined on individual insects by the method of Cooperstein and Lazarow (1950). All readings were made on homogenates in a final dilution of 1:1,000 in a Beckman DU spectrophotometer at a wave length of 550 mμ. Calculations of succinic dehydrogenase activity were made using the formula given by Cooperstein and Lazarow.

OBSERVATIONS

The changes in the activity of succinic dehydrogenase during diapause and metamorphosis are shown in Table 1. The values are expressed as Δ log [$CyFe^{+++}$] per minute. The enzyme activities obtained for prediapause third instar larvae are grouped, and those for larvae from the fifth to twelfth week after the second molt (diapause larvae), are also grouped. The figures show that diapause in the Japanese beetle larva is associated with a high activity of succinic dehydrogenase; the value for prediapause third instar larvae is 0.019, and for diapause larvae, 0.028.

Metamorphosis of the Japanese beetle is associated with a U-shaped change in the activity of succinic dehydrogenase. The activity values drop very rapidly on the transformation from larva to prepupa. This decrease in activity continues until two days after pupation when a low value of 0.005 was obtained. Enzyme activity increases throughout the remainder of the pupal stage reaching a value of 0.023 just before, and of 0.053, just after

TABLE 1

SUCCINIC DEHYDROGENASE DURING GROWTH, DIAPAUSE, AND METAMORPHOSIS OF THE JAPANESE BEETLE

Stage of development	No. of readings	Enzyme activity Δ log [$CyFe^{+++}$]/min.
Second instar larva	6	0.013
Third instar larva		
Prediapause	21	0.019
Diapause	45	0.028
Postdiapause	8	0.030
Prepupa		
Early	8	0.012
Late	4	0.010
Pupa		
Just molted	6	0.008
1 day after molt	4	0.007
2 days after molt	5	0.005
3 days after molt	5	0.006
4 days after molt	4	0.007
5 days after molt	5	0.008
6 days after molt	6	0.013
7 days after molt	6	0.011
8 days after molt	6	0.015
9 days after molt	6	0.023
Adult		
Just molted	7	0.053

adult emergence. No difference was noted in the enzyme activity of male and female insects.

DISCUSSION

These results closely parallel those obtained by Ludwig (1953) for the activity of cytochrome oxidase during the growth, diapause, and metamorphosis of the Japanese beetle, except that they are considerably lower. In general, the values for succinic dehydrogenase are approximately one-third of those previously reported for cytochrome oxidase. This ratio is the same as that found by Ludwig and Wugmeister (1955) for the activities of these enzymes during the first three and last two days of the embryonic development of the Japanese beetle at 30°C., and by Schneider (1946) for their activities in rat liver cells. The results indicate that diapause in the Japanese beetle is associated with relatively high activities for both succinic dehydrogenase and cytochrome oxidase.

Ludwig (1931) showed that the respiration of the Japanese beetle during metamorphosis follows the characteristic U-shaped curve with the lowest rate of oxygen consumption in insects two and three days after pupation. In 1953, he obtained a similar series of changes in the activity of cytochrome oxidase during metamorphosis, the low point also being present in 2-day and 3-day pupae. The present experiments indicate that the same series of changes occurs in the activity of succinic dehydrogenase. They are in agreement with those of Agrell (1949) who found that in the blow fly, *Calliphora erythrocephala*, malic, succinic, citric, and glutamic dehydrogenases all follow a U-shaped activity curve.

The principal difference in the activities of cytochrome oxidase and succinic dehydrogenase was noted in the adult stage. Ludwig (1953) reported much higher cytochrome oxidase activities in the male than in the female. In the present experiments, no sex differences were observed in the activities of succinic dehydrogenase.

SUMMARY

Determinations on the activity of succinic dehydrogenase were made during diapause and metamorphosis of the Japanese beetle.

The activity of this enzyme, expressed as Δ log [$CyFe^{+++}$] per minute, increases during the prediapause portion of the third instar for a low of 0.013 to 0.028, the former figure being characteristic of the second instar; and the latter, of the diapause third instar. It decreases during the prepupal stage and early part of the pupal stage, reaching a low value of 0.005 in insects two days after pupation. The remainder of the pupal period is characterized by a gradual increase in enzyme activity which reaches a value of 0.023 just before, and of 0.053, just after adult emergence. No sex difference was noted in the activity of succinic dehydrogenase.

Diapause in the Japanese beetle is associated with relatively

high activities for both cytochrome oxidase and succinic dehydrogenase, the former being approximately three times as active as the latter.

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ROBERT J. SIM, 1881–1955

Robert J. Sim, naturalist, antiquarian, one time contributor to the Journal of the New York Entomological Society and entomologist of the New Jersey Department of Agriculture died in the McKinley Memorial Hospital, Trenton, New Jersey, on November 26, 1955, after a brief illness. Mr. Sim was born at Geddes, a suburb of Syracuse, New York, August 16, 1881, his parents being Eli F. and Ruby Ayer Sim. About a year after his birth, the family moved to Jefferson, Ashtabula County, Ohio, and it was there that his interest in natural history was fostered by his mother who was a naturalist and a writer of articles on natural history. Along with his school work, the young man took private art lessons. For two years, Mr. Sim attended the Cleveland School of Design and later enrolled at Ohio State University, where he studied for the most part, only subjects in which he was interested. At that period he made the illustrations for a book on botany by Dr. E. N. Transeau. On November 28, 1919, he married Mary A. Bechtol of Ashtabula, Ohio, and the following summer was spent at Cranberry Lake in the Adirondacks, where he did illustrations for the New York State College of Forestry.

During a period of two years, 1921–1923, Mr. Sim was the artist for the Pennsylvania Department of Agriculture at Harrisburg, Pennsylvania. From January 1, 1924 to December 31, 1928 he was employed by the New Jersey Department of Agriculture on Japanese beetle work. From January 1, 1929 to July 1, 1934 he was employed as an agent by the Bureau of Entomology, United States Department of Agriculture, working as an artist, photographer and entomologist, at the Japanese Beetle Laboratory, Moorestown, New Jersey. From July 1, 1934 until his death he was employed by the Division of Plant Industry of the New Jersey State Department of Agriculture, where his knowledge of entomology, and his artistic and photographic abilities were used and appreciated.

Robert J. Sim was one of a small group of old-time naturalists, who have all but disappeared. He had a lively interest in plants, birds, mammals, reptiles and insects and his knowledge of the many common forms and their habits was extensive. As a result, he was an ideal companion in the field. He was also a skilled artist and photographer and his illustrations adorn many publications.

Of late years, Mr. Sim had expanded his interests to include what might be called rural antiquities. He was interested in early New Jersey pottery and in early New Jersey industries, particularly those connected with farming and rural life both inside and out of the home. During the course of these activities, he made many friends and acquaintances all over the State. The New Jersey Department of Agriculture published his work on old farm houses and vanishing phases of rural life, and the New Jersey Agricultural Society his "Pages From the Past of Rural New Jersey." Just before his death his last work appeared on charcoal burning, in collaboration with Harry B. Weiss. In addition Mr. Sim was an ardent collector of various kinds of early tools used on farms and in farm households.

As a collaborator with Mr. Sim, and as a recipient of his help in many ways over the years, I was in a position to become fully acquainted with his ability in various fields and to recognize and appreciate his varied talents. For the past year we worked closely on a history of early gristmills in New Jersey. Once actively interested in a subject, Mr. Sim pursued it enthusiastically and intensely to the exclusion of everything else. With his death I have lost an agreeable companion upon whom I depended for many things, and also a valued friend. Mr. Sim is survived by his wife, Mary B. Sim of Yardville Heights, New Jersey.—HARRY B. WEISS.

Papers by Robert J. Sim

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(*Continued from page 160*)

Mr. Irving Huntington, to make Mr. William P. Comstock an Honorary Member of the New York Entomological Society. The citation reads as follows:

"William P. Comstock has for many years been an excellent student of West Indian zoogeography, entomological bibliography, and an outstanding authority on the classification of the Lycaenidae and Heliconidae. He has also been for many years a Research Associate of the Department of Insects and Spiders of the American Museum of Natural History. He was Vice-President of the New York Entomological Society in 1942 and its President in 1943". The proposal was passed without dissent.

The paper of the evening was given by Dr. Lucy Clausen on "Insects and People". Dr. Clausen envisioned cave man with having to face two economic problems, first cockroaches in his cave and secondly, dermestid beetles in his spare loin cloth. In the course of history man has used his insect associates to his own advantage. Dr. Clausen enumerated several facets of this part of the story. Insects have been used, a) for therapeutic value, b) as a basis of commerce, c) as part of his religious belief and rites, d) as objects and contestants in sports, and e) as laboratory experimental animals. Dr. Clausen discussed the origin of insects from the point of view of the American Indian, whose belief was that the Great Spirit made pebbles of many colors and that the South Wind breathed life into these pebbles so that they became the first moths and butterflies. Dr. Clausen pointed out, among other things, that the intestinal tract of the silkworm is the source of the best surgical gut; that the silkworm disease, first worked on by Pasteur, laid the basis for the modern germ theory of disease, the egyptian scarab is not only a symbol of religion and resurrection, but also considered by many as a good luck talisman.

Elaborating on the study of scarabs, Dr. Clausen pointed out that in carvings, scarabs are usually made very accurately and copied from six genera. At death, in the ancient egyptain religion, the heart of the deceased was removed and replaced with a scarab carving, or an actual scarab was used in the wrappings, or the scarab was placed on the sarcophagus. Egyptians considered all scarabs as males and that each segment of the body had an involved symbolism.

Cricket fighting is the national sport of China. Dr. Clausen gave many points on the raising of these insects with the idea that in America there may be a time when fighting between crickets will become a home pastime replacing the current ''Scrabble'' rage.

Insects as a source of dyes served to highlight the interesting exhibit set up in the meeting room. The brilliant red coat of the British Army soldier worn during the Revolutionary War was dyed with cochineal derived from the scale insects of that name.

Dr. Clausen's concluding remarks on the use of insects in diet, whet the appetites of all members present, for many members have tasted ''goozanos'' as canapes. Thereupon Mrs. Monros and Dr. Pohl swapped recipes with Dr. Clausen in regard to their favorite insect dishes. In the discussion that followed Dr. Pohl told of his various entomophagus gastronomic delights.

Dr. Clausen's talk was illustrated with her excellent kodachrome slides and an interesting exhibit laid out in the meeting room.

The meeting adjourned at 9:34 P.M.

LOUIS S. MARKS, *Secretary*

NOTE—Minutes of meeting of January 19, 1954 are not available.

MEETING OF FEBRUARY 2, 1954

A regular meeting of the Society was held at the American Museum of Natural History. President Clausen was in the chair. On motion of Mr. Soraci, seconded by Dr. Vishniac, the reading of the minutes of the previous meeting was suspended. There were 14 members and three guests present.

Dr. Vishniac introduced the speaker of the evening, Dr. Hansens of The New Jersey Agricultural Experiment Station at Rutgers University. Dr. Hansens outlined the three year project upon which he is working, to wit, the mammalian ectoparasites found in the State of New Jersey. In the course of this survey 3000 rats, obtained principally from municipal dumps, were examined. Dr. Hansens had extensive cooperation from the N. J.

Department of Agriculture, the U. S. Public Health Service, the New Jersey Pest Control Operators and the New Jersey Fish and Game Commission. The work was started in 1951 at 20 stations in northern New Jersey, at which points collections were made about once a month. The survey was then extended to other parts of the State. The unique method of collecting the parasites was of some interest. Each captured rat was put in a 2-quart jar to which was added a washing solution of the insecticide, Lindane, and a detergent. The jar was then shaken about one hundred times. After a waiting period the wash water was drained off and taken to the laboratory where the free ectoparasites were sorted and placed in vials with 70% alcohol. The results of the study show that the flea index is 1.3 per rat; the louse index is 4.0 to 5.0 per rat. One rat had as many as 16,000 lice on its body. Many ticks were taken, about 5% of which will be described as new species. In general the bulk of the specimens taken were of the same species. Dr. Hansens announced that he will continue his work for some time in the future.

After some discussion on the paper of the evening, Dr. Clausen announced that she had heard from Dr. Hagan who seems to be enjoying life on his farm in Nebraska.

The meeting adjourned at 9:15 P.M.

LOUIS S. MARKS, *Secretary*

NOTE—Minutes are not available for the meeting of Feb. 16, Mar. 2, Mar. 16, Apr. 6, Apr. 20, May 4 and May 18, 1954.

MEETING OF OCTOBER 5, 1954

A regular meeting of the Society was held at the American Museum of Natural History. President Clausen was in the chair. There were eleven members and one visitor present.

On the motion of Dr. Forbes, the minutes of the preceding meeting were tabled.

The evening was devoted to a discussion of the summer experiences of the members.

Dr. Marks reported on his continued work in the genus *Papilio.* The *Papilio* portions of the Smith, Sperry, and Rindge collections have been incorporated into the collection. The material from the fourth Archbold Expedition to New Guinea is being worked upon. New Guinea, a very large island with extensive mountain ranges, is an area in which *Papilio* has undergone extensive subspeciation. Dr. Marks then displayed copies of "A Laboratory Guide for Students of Entomology" of which he is co-author with Dr. James A. Mullen.

Dr. Mullen has been working on the blood of the Milkweed Bug. He is particularly interested in the ion content.

Mr. Teale spent part of the summer on the Maine-Canadian border at Moose River. His most interesting entomological observation was the finding of a nymphal shell of a damsel fly—52 feet away from the water!

He also noted, ornithologically, the attraction of a ruby throated humming-bird for a red plaid jacket.

The first newspaper he saw on his return to civilization was serializing our President's new book.

Dr. Schneirla went even farther afield. He attended a conference at the University of Paris on ''Instinct in Animals''. While there he had the opportunity to observe many species of European ants. He also studied the indigenous ant fauna of Central Park in New York.

Dr. Forbes continued his efforts to correlate the male genitalia of ants with the taxonomy of the group. He also commented on the many fine reviews received by Dr. Clausen's volume. Mr. Dix and Mrs. Loewning collected at Monroe, New York. Mrs. Loewning exhibited a fly trap. Dr. Schneirla told of how Coati's learned to turn fly traps over in the Canal Zone. Mr. Teale commented on the great numbers of katydids this year.

Mr. Pallister gave an interesting account of the entomological year as seen from the desk of a museum curator. The year begins with Elm Leaf Beetles. This is followed by the wasps. The year ends as it begins with the Elm Leaf Beetle. He has written several papers on South American and Central American beetles.

It was called to the attention of the Society that Mr. Pallister had worked up the insect portion of ''The Animal Kingdom'' (Greystone Press).

Mr. Hubermann called Dr. Mullen's attention to an 84 foot high termite colony—termites in a wooden ball atop a flagpole.

Dr. Vishniac reported that he had worked on insect vision and insect flight during the past summer months.

The meeting adjourned at 9:30 P.M.

Louis S. Marks, *Secretary*

Note—Minutes not available for meetings of October 19 and November 16, 1954.

Meeting of December 7, 1954

The meeting of the New York Entomological Society, held at the American Museum of Natural History, was called to order at 8:05 by the President, Dr. Lucy Clausen. In the absence of the Secretary, a motion was passed to suspend the reading of the minutes of the previous meeting, and the President asked Dr. James Forbes to serve as Secretary for the meeting.

Dr. Clausen welcomed the 23 members and 7 guests present and extended an invitation to our coming meetings. Two persons were proposed for membership; Mr. Edward J. Feeley of 208 East 123rd Street, New York 35, N. Y. and Mr. Carl D. Prota of 221 County Street, New Haven 11, Conn. These proposals will be held over to be voted upon at the next meeting.

Dr. Vishniac introduced the speaker of the evening, Dr. E. S. Hodgson of the Department of Zoology of Barnard College and Columbia University whose topic for discussion was ''Recent Studies on Insect Chemoreception.''

The speaker's opening remarks were that the literature on chemoreceptors and chemoreception in insects is voluminous and overwhelming because of the diversity of observations and interpretations of the investigators. In briefly tracing the history of these investigations, he pointed out that the earlier workers spent considerable time in delving into the anatomy and histology of these structures and then trying to explain their functioning on the basis of what is known about chemoreceptors in mammals and humans. This has continued up to rather recent times. In some previous work on chemoreceptors in water beetles, Dr. Hodgson located sensilla on the tips of the antennae and on the tips of the maxillary and the labial palps. These were determined to be chemoreceptors by covering other sensilla and various parts of the head with lacquers and paraffin.

Within the past few years, Dethier, in his work on the sensilla in flies, has described bristles on the labellar lobes of the fly proboscis. These are chemoreceptive, because the proboscis is extended and reacts when they are touched with sugar solutions. At the base of each bristle there are three fairly large cells, which are probably nerve cells because of their position, their morphology, and their staining reactions. Two of these nerve cells send processes to the tip of the bristle where they are combined in a specialized ending. All three cells are connected by processes to the central nervous system.

The speaker then explained the work he has been doing in Dr. Roeder's laboratory in studying the electric potentials and in making oscillographic recordings of the functioning of these chemoreceptors on the fly labellum. He explained the apparatus he uses, and the techniques he employs. He showed the results he has obtained, so far. The difficulties in both technique and interpretation were discussed.

In summary Dr. Hodgson made the following points. Insects apparently do not have chemoreceptors similar to mammals and humans, which respond to various kinds of substances (sweet, sour, salty, and bitter). The response in the insect is one of either acceptance or non-acceptance. The anatomy and histology of these receptors is important, but structure alone will not reveal all the story. Lastly, the state of the central nervous system, as a whole, is important, and not only the reception and the response of the end organ. A discussion of the techniques used and the interpretations made followed the presentation of the paper.

The President appointed a Nominating Committee, consisting of Dr. Herbert Ruckes, Mr. Edwin W. Teale, and Dr. James Forbes as Chairman, to arrange for a slate of candidates for the various offices to be presented at the annual meeting in January. Dr. Clausen mentioned that the second meeting in December, which should be the next regularly scheduled meeting of the Society, has been postponed by the Executive Committee because this year it falls too close to Christmas.

The meeting adjourned at 9:40 P.M.

JAMES FORBES, *Secretary,* pro tem.

MEETING OF JANUARY 4, 1955

The annual meeting of the Society was held at the American Museum of Natural History. There were 14 members and 6 guests present. President

Dr. Clausen in the chair. The minutes of the previous meeting were accepted as read. It was announced that the annual reports of the Secretary and Treasurer would be given at a later date. Mr. Edward J. Feeley of 208 East 123rd St., New York City and Mr. Carl D. Prota of 221 County Street, New Haven 11, Connecticut, were elected to membership.

Dr. Clausen reported on the health of two members. Dr. Pohl is recovering in a very satisfactory fashion from surgery. Mr. Chris Olsen has been in the hospital for three months and is recuperating nicely.

Dr. Forbes then reported for the Nominating Committee of which he was chairman.

The following officers were nominated:

President—Dr. Roman Vishniac
Vice-President—Dr. Asher Treat
Secretary—Dr. Louis S. Marks
Assistant Secretary—Dr. Frederick Rindge
Treasurer—Mr. Jacob Huberman
Assistant Treasurer—Mrs. Patricia Vaurie
Editor emeritus—Dr. Harry B. Weiss
Editor—Mr. Frank A. Soraci
Trustees—Drs. L. Clausen, M. Cazier and H. Ruckes, and Mr. E. L. Huntington

Mr. Teale seconded the nominations. The Secretary was empowered to cast one ballot for the nominated slate. The retiring President, Dr. Clausen, then thanked the members and officers who had cooperated with her and turned the chair over to the new President, Dr. Vishniac.

Dr. Vishniac thanked Dr. Clausen and asked for the continuing help of the membership. He then introduced for the speaker of the evening—Dr. Clausen—who spoke on ''Some Thoughts of a Retiring President.'' After commenting that the title may not have been particularly appropriate, Dr. Clausen recalled the early and middle history of the Society. The Society started in 1892 and originally met at the home of the members. In 1900 this cozy group found a meeting place in the American Museum of Natural History. The Society is now sixty three years old. She recalled the days of Lutz, Mutchler, W. P. Comstock, and W. T. Davis.

Dr. Clausen recalled that on her first meeting with W. T. Davis, he discussed two major topics: first, his ulcers, and secondly, he informed her ''The graveyards of Staten Island are full of Clausens.''

She then paid a glowing tribute to Andrew J. Mutchler who had a gruff countenance but a heart of gold. Mr. Mutchler had a phenomonal memory, especially on library materials. In Mr. Mutchler's later years, Dr. Clausen became his ''eyes'', i.e., she sat at the microscope while he read the keys and descriptions.

The meetings of the Society at this time were very well attended. Groups of ten to twelve members gathered for dinner before the meetings. The conversation at the dinner table was often better than at the meetings.

The most famous—or infamous—meeting in recent times was arranged by Dr. Curran. The topic was the use of maggots in the treatment of osteomyelitis. The accompanying movies were excellent. Everything went well until a couple of dull ''thuds'' made it necessary to put the lights back on. Some of the members had fainted.

Dr. Clausen was the Society's thirty-fifth President. During her presidency, three problems have faced the Society.

1. Meetings.—During Dr. Clausen's presidency, a new meeting policy was followed. A reading of a scientific paper was alternated with a symposium. Symposia were held on Orthoptera, Coleoptera, Hymenoptera, spiders, ants and Lepidoptera. This seemed to work out fairly well. An unresolved question is that of a token payment to out-of-town speakers.
2. Publications.—The movement to change printers started during the Presidency of Dr. Hagen, was brought to successful fruition. The Editor, Mr. Soraci, worked very hard on making this change a success. Due to the delay—the March Journal came out in October. The June, September and December, 1954 Journals are in the process of being edited.
3. Membership.—The membership is divided into two groups, the older group and the younger group. This is really not a chronological division, but one based on knowledge of the field of entomology. We welcome newcomers.

Dr. Vishniac thanked Dr. Clausen.

Dr. Janvrin called the attention of the Society to his own 1901 election. He recalled the old meetings in the Tower Room. The Secretary showed copies of the 1894 By-laws and membership list.

The January 18 meeting will be a discussion of ''Insect Flight'' by Dr. Vishniac—the new president.

Mr. Huberman made a motion that the Secretary notify the newspapers. Mr. Teale made a motion that notices be sent to members at frequent intervals. These motions carried. Dr. Treat suggested the possibility of student membership. This will be referred to the executive Committee. The meeting adjourned at 9:05 P.M.

L. S. MARKS, *Secretary*

NOTE—Minutes of the meeting of January 18, 1955 are not available.

MEETING OF FEBRUARY 1, 1955

This regular meeting of the Society, at the American Museum of Natural History, was called to order at 8:00 p.m. by the President, Dr. Roman Vishniac. In the absence of the Secretary, the minutes of the previous meeting were not available for reading, and Dr. James Forbes was asked to serve as temporary secretary. Ten members and six guests were present.

Two notices of coming events were brought to the attention of the members by the President. First, Mr. Hubert J. Thelen of the Brooklyn Entomological Society is to present a color slide show, ''Fragments of Nature,'' at their February 9th meeting. Second, an American Chemical Society meeting on February 11th to be held in the Carbon & Carbide Cafeteria, 30 E. 42nd St., at 7:30 p.m. will have as its topic, ''Basic Considerations in Development of Agricultural Chemicals.''

Two persons were proposed for membership; Mr. Robert Pioselli of 651 East 220th St., N. Y. 67, N. Y., proposed by E. Irving Huntington and Mr. Isaiah Cleeve Gordon Cooper of 280 Bidwell Ave., Staten Island 14, N. Y., proposed by R. Vishniac. The members will vote on these proposals at the next meeting.

Dr. Vishniac commented on some moving pictures which had been presented at the recent annual meeting of the New York Zoological Society. Dr. William Beebe's picture about the metamorphosis of the euchromid moth, *Aethria carnicaude*, was excellent. The larva plucks out some of its body hairs and arranges them in whorls at either end of its body around the twig upon which it is going to pupate. These hairs serve as barricades to protect the larva while it is spinning its cocoon. The other picture, which was about the sexes of butterflies being attracted to models of the opposite sex, he thought was not too conclusive.

Dr. Forbes passed around some preserved mealworm larvae, which had the imaginal wing pads everted. These specimens had been found by Dr. Ludwig of Fordham University in his culture. This phenomenon, prothetely, is due apparently to an hormonal imbalance at the time of molting.

The meeting was then turned over to Dr. Forbes who acted as chairman of the evening's program, which was entitled ''Insects Alive'', a discussion of the rearing techniques, material needed, and problems encountered in the culturing of some common insects. Mr. Albert Kasper, a graduate student in the Biology Department of Fordham University, opened the program by explaining and illustrating how he rears cockroaches. He was followed by another Fordham graduate student, Mr. P. V. Joseph, who discussed his rearing techniques for the housefly. The food used for both these insects is dog-food pellets which supply a balanced diet. In the case of the houseflies, when the larvae are ready to pupate, sawdust is poured onto the top of the culture to supply a drier environment for pupation. Both speakers had small cultures of the insects they discussed.

Dr. Vishniac added that apparently all roaches are not as easily reared in the laboratory. The wood-feeding roach, *Cryptocercus*, has given Dr. Cleveland and his workers considerable difficulty. The molting of this insect, which occurs about the end of May each year, is correlated with the sexual reproduction cycle of its intestinal protozoa. For some inexplicable reason this is a hazardous time for the insects.

Mr. Huberman had a small roach in a bottle, which he had picked up from one of his exterminating jobs. This he said was the brown-banded roach, a relatively new import, which seems to be becoming more numerous about New York City.

Dr. Ruckes mentioned that in the insectary at Cornell University, where they are rearing flies in large quantities for insecticide testing, the culture medium used is cow manure moistened every other day or so with evaporated milk.

Miss Alice Gray of the Department of Insects and Spiders of the American Museum of Natural History, the next panel member, pointed out that cultures of insects were maintained in their department to provide food for living displays. Cultures of the giant tropical roach and mealworms are maintained practically constantly and fruitflies and other forms as they are needed. The roaches and mealworms are used to feed tarantulas, scorpions, and the black-widow spider. Miss Gray had these arachnids and insects on display.

A small culture of the milkweed bug, *Oncopeltus fasciatus,* which had been arranged by Dr. James A. Mullen from a larger culture in his laboratory, was displayed and commented upon by Dr. Forbes in Dr. Mullen's absence.

Dr. Vishniac had some black field crickets which he had collected near Carmel, N. Y. He was hoping to hear them chirp during the winter months. Miss Gray remarked that he would probably need a fairly large cage or container for them to keep happy and chirping.

The meeting was adjourned at 9:20 p.m. so that those present could get a chance to see the displays and to continue the discussions and questions informally.

JAMES FORBES, *Secretary,* pro tem.

MEETING OF FEBRUARY 15, 1955

The meeting at the American Museum of Natural History, was called to order at 8:10 P.M., President Vishniac in the chair. There were twenty-one members and guests present. Dr. Ruckes was appointed secretary pro tempore in the absence of Dr. Marks.

Dr. Forbes read the minutes of the previous meeting (February 1, 1955) which were approved as read.

Dr. Vishniac remarked upon the fact that the present period of the year represents the height of insect inactivity. Over the weekend no evidence of insect life was observed, merely evidence of life to come was found in the form of egg clusters (tent caterpillar), and these were passed around for inspection. Dr. Vishniac also drew attention to an article by Lindauer in the German journal ''Die Unschau'' on the cooling and warming systems used by insects.

Dr. Treat reported for the program committee and stated that the program for the remainder of the year has virtually been completed. The committee also discussed the possibility of procuring, from time to time, paid outside speakers. No action of this proposal was taken, however.

The Society elected two new members: Robert Pioselli, 651 East 220th Street, and Mr. Cooper, 280 Bidwell Avenue, Staten Island. Dr. Vishniac introduced Mr. Cooper, now Curator of the William T. Davis collection at the Staten Island Museum. Mr. Cooper invited all members of the New York Society to visit at St. George, Staten Island, at any time.

Dr. William S. Creighton, speaker of the evening, chose for his topic ''Some Notes on the Habits of Desert Ants''. He called particular attention to the species *Veromessor pergandei* (Mayr), one of the harvester ants of the southwest. With the showing of a number of very beautiful Kodachrome slides, Dr. Creighton set the stage for his talk which covered the area of the Chihuahuan, Sonoran and Mojave deserts. In these areas precipitation varies from five inches (Mojave) to twenty inches (Chihuahuan) of rainfall a year, and daily temperatures range from 40 degrees F. in early morning to more than 130 degrees F. during midday. It becomes soon patent that all life is geared at least to these two climatic conditions. Harvester ants are vegetarians, so their activities are tied in with the cyclic development of the vegetation which in turn is dependent on rainfall and temperature. While grain seeds (the food of these ants) are present in small quantities all year round, most grasses produce their seeds in large quantity during only limited periods. Therefore harvester ants can forage either—a) all year round, or—b) during that annual period when seed production is at its maximum, i.e., during the mid and late summer after sufficient earlier rainfall. *Veromessor pergandei* appears to follow the later procedure. After seeds are harvested they are carried to the nests for storage and soon thereafter are shucked of their hulls which are then disposed of outside of the nest on the slopes of the ''crater''. There seems to be a definite periodicity in the activity of these ants and a specific behavior pattern followed. Dr. Creighton was interested in trying to explain this behavior. The activity is somewhat as follows: In early morning (about 5:30 A.M.) the ants emerge from the nests, begin foraging when temperatures are near 40 degrees F. and light of day still rather dilute; foraging continues until about 10:30 A.M. when all foraging seems to cease and the ants return to their nests. At this time the temperatures may be as high as 115 degrees or may be much lower (90 degrees) but there is full sunlight present. No further foraging activity is evident until about 5:30 P.M. when the activity recommences. In the interim the ants have been actively engaged in shucking the seeds previously gathered and disposing of the hulls outside the nest. During the mid-day period the ground temperatures reach as high as 145 degrees F. and even more; if at this time ants are removed from the nest they immediately scurry back if close by, but if placed too far from the entrance of the nest (travelling time 20 seconds to 1½ minutes) they die. Temperature seems to play some role but is not the sole factor controlling the activity. Dr. Creighton tried modifying light intensities by using various shading devices but no definite conclusions could be reached since most ants were somewhat uncooperative.

In summation Dr. Creighton pointed out that there is apparently an interaction of several factors involved in interpreting this behavior: 1) temperature, 2) light intensity, 3) time of day, and 4) the quantity of seed collected during the foraging period (foraging does not recommence in the afternoon until all seeds collected during the morning period have been shucked). General discussion followed the presentation of this fine paper. Emphasis was laid on the possibility of another factor, i.e., color intensity, being involved. The measuring, both quantitatively and qualitatively of color intensity might be very important and add considerable to a better understanding of this phenomenon.

The meeting adjourned at 9:45 P.M.

HERBERT RUCKES, *Secretary*, pro. tem.

NOTE—Minutes of the meeting of March 1, 1955 are not available.

MEETING OF MARCH 15, 1955

A regular meeting of the Society was held at the American Museum of Natural History, President Vishniac in the chair. There were 25 members and 14 guests present. The minutes of the preceding meeting were accepted as read. The Program Committee chairman, Dr. Treat, read the program for the next four meetings.

Mr. Robert Bloch, 781 Ocean Avenue, Brooklyn, sponsored by Mr. Huberman, was elected to membership. The following were proposed for membership: Mr. John G. Lloyd, R. D. #2, Farmingdale, New Jersey, proposed by Dr. James Forbes, and Mr. Roger M. Gable, Ridgefield Road, North Salem, New York, proposed by Mr. Lucien L. Pohl.

Dr. Vishniac introduced Mr. Baumhoner who had worked with him in Orlando, Florida. Mr. Baumhoner spoke on his work with screwflies in Curacao. The release of sterile males cuts down the reproductive potential of the entire screwfly population. He used 400 sterile males per square mile. Within two weeks success had been achieved. This procedure has virtually eliminated the screwworm in the area.

Dr. Vishniac then introduced the speaker of the evening, the Osborn Professor of Zoology at Yale, Dr. Charles Remington, who spoke on mimicry.

Dr. Remington traced the concept of mimicry in historical fashion starting with the work of Henry Walter Bates on the Amazon in 1862 in which he discovered this phenomenon in Heliconids, Ithomiids, and Pierids.

Bates noticed the resemblance between the forms and formulated the theory today called in his honor Batesian mimicry.

In Batesian mimicry the insect is conspicuous to serve as a warning to predators. A conspicuous pattern means nonedibility. The models which are poisonous are common. The mimics which are non-poisonous are very rare. The predator learns to reject the model and thus the mimic is protected.

Dr. Remington discussed Carpenter's feeding experiments and some done in his own laboratory that illustrated the education of predators or their innate refusal to take certain forms. He also showed evidence of beak marks and lizard mouth outlines on butterfly wings.

An interesting conclusion presented by Dr. Remington was that one cannot generalize about the feeding habits of predators in relation to mimicry phenomena.

Dr. Remington very briefly discussed the genetics of mimicry. He then also briefly discussed Mullerian mimicry in which there are two or more distasteful models which are almost identical. In Mullerian mimicry abundance is no criterion.

The talk was illustrated by Kodachromes of specimens and plates from various books.

The meeting adjourned at 10:00 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF APRIL 5, 1955

A regular meeting of the Society was held at the American Museum of Natural History (Room 129), President Vishniac in the chair. There were fifteen members and eight guests present. The minutes of the preceding meeting were accepted as read. Mr. John G. Lloyd, R. D. #2, Farmingdale, New Jersey, and Mr. Roger M. Gable, Ridgefield Road, North Salem, New York, were elected to membership. Dr. William J. Wall, New York State College for Teachers, Albany, New York, was proposed by Dr. Minnie B. Scotland (per notification of the Secretary).

The President called attention to the death of Judge Parker of Woods Hole. He also called attention to Edgerton's work on undersea photography with electronic flash which appeared in the last issue of National Geographic magazine.

The Secretary displayed the Fordham University copy of the 1862 paper of Henry Walter Bates and the 1879 paper of Fritz Muller. These two papers are the starting points for any discussion of Batesian and Mullerian mimicry.

Dr. Vishniac then introduced the speaker of the evening, Dr. Louis S. Marks of Fordham University, the Secretary of the Society, who spoke on ''Insects and Stamps''.

Dr. Marks briefly traced the history of stamp collecting from its infancy in the 1850's until the present day. He divided it into three parts. The early period in which the entire philatelic output of the world was collected. The period came to a close because the rarity of certain items made their collection impossible and the rise of forgeries of some of these items—the classics, as they are called—discouraged the average collector. Of this period, Dr. Marks displayed some of the early newspaper stamps of Austria, including forgeries and reprints.

The second period was the age of specialization in one country, or period, or even in one issue or one stamp. This still remains a favorite means of collecting.

The third and most recent period involves the collecting of stamps on one topic or theme. Of this period Dr. Marks displayed seven frames of stamps.

A successful, complete collection of insects on stamps (including the entomologists) would contain 205 stamps from 41 countries. Only the more spectacular stamps were on display.

Dr. Marks explained why insects appear on stamps. They may be decorative as corner fillers; the Netherlands Indies are of this type. They may be used on Charity issues to make them attractive. The Swiss ''Pro Juventute'' issues are of this type. Or as in the case of the famous Mozambique butterflies and Portuguese Guinea beetles, the collectors eye and alas! his pocketbook, may be the ultimate objective. The acquisition, arrangement and display of a collection of this type was discussed.

The literature of Insects on Stamps was reviewed. The Kodachrome slides of the stamps shown were from the collection of Dr. Lucy Clausen.

For the Lepidoptera, Dr. Marks showed slides of the various Papilio which have appeared on stamps from his own slide collection.

Mr. Sidney Hessel showed a page of early United States ''Bee'' cancellations and graciously distributed copies of a reprint on ''Philatelic Lepidoptera'' by Smith which had appeared in the Lepidopterists News.

The meeting adjourned at 9:45 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF APRIL 19, 1955

A regular meeting of the Society was held at the American Museum of Natural History. In the absence of Dr. Vishniac, Vice-President Treat was in the chair. There were fourteen members and one guest present. The minutes of the preceding meeting were accepted as read. The program committee announced that Dr. Cazier will speak on the new Southwest desert laboratory early in the Fall. Dr. A. B. Klots will speak in December.

Dr. William J. Wall, New York State College for Teachers, Albany, New York, was elected to membership.

The Secretary called the attention of the Society to the illness of Mr. Arthur Roensch, a former treasurer of the Society. Dr. Ruckes made a motion to send a get-well card to Mr. Roensch. This was enthusiastically seconded.

Dr. Treat called attention to all of the past presidents present—Dr. Ruckes, Dr. Forbes, Mr. Teale, Dr. Clausen.

Dr. Treat then introduced Dr. Forbes who conducted the symposium on live insects. The members and their guests gathered about the table in a mode and mood reminiscent of the early days of the Society.

Dr. Clausen exhibited Ptinid or spider beetles feeding on Pablum and some cicadas. Mr. Dix exhibited the German roach. The Carolina mantes from Louisiana was shown by Miss Alice Gray.

Dr. Treat showed an ant nest designed by Dr. Creighton and exhibited moths of the genus *Zate* which contained a new mite. The mite nests in both ''ears''—but later leaves the ear. This confirms certain theories of Dr. Treat. Dr. Treat also discussed his experiences with ''black light'' collecting. He uses a 15 watt GE tube with a maximum emission at a wave length of 3,000 Angstroms.

Dr. Mullen exhibited a thriving colony of termites which he has kept going for four years. He furthermore described a colony he has kept going for ten years without any alate forms. Dr. Mullen described many strange habits of termites which he has reported in the literature, i.e. their wine imbibing propensities and the most interesting fact that they will bore through lead.

Mr. Teale discussed the first signs of Spring. Spring moves north at the rate of fifteen miles per day. Mr. Teale showed photographs of a neuropteran which was identified by Dr. Rehn as a member of the Ascalaphidae. He mentioned two interesting examples of nest building—one in which a house wren used part of a tent caterpillar nest as material and another where a Polistes used clothesline.

Mr. Teale, Miss Gray and Dr. Rehn engaged in a discussion of the habits of mantids. There was also a discussion of Ants and Aphids including an instance in which an Ant removed a woolly aphid. The members decided this was an example of culling the herd.

The meeting adjourned at 9:30 P.M.

LOUIS S. MARKS, *Secretary*

NOTE—Minutes of the meetings of May 3 and May 17, 1955 are not available.

BOOK NOTICES

Insects in their World. By Su Zan N. Swain. Garden City Books. Garden City, New York. 1955. $8\frac{1}{2} \times 11\frac{1}{4}$ inches. vi + 53 pp. Illustrated. $2.50.

If further proof is needed of the ability of Su Zan Swain, honorary member of the New York Entomological Society, to teach and enthuse children and adults in the fields of entomology and art, it is contained in this fine book.

Starting her message with the sentence, "This book was written to encourage you to explore the world of insects.", Mrs. Swain proceeds to tell and show how, where, when and why. With uncluttered language, she introduces her readers to the world of insects. Her careful, beautiful and profuse illustrations lead the neophyte by the hand through the field of insect study and the pleasures and benefits that might be derived.

Interesting insects and insect habits are selected, outlined, illustrated and discussed to whet the appetite of youngsters and laymen.

To serve its purpose, this book should be made available to children in grade and high schools. The budding entomologist or naturalist might easily use this work as a first step before taking the second step to the much used and very helpful, "The Insect Guide," earlier publication by Ralph B. Swain. It is suggested that you keep Mrs. Swain's book in mind when trying to select a gift for the youngster who is a little tired of modern living and needs a breath of good, fresh air.—F.A.S.

Dragonflies of North America. By James G. Needham and Minter J. Westfall, Jr. 1955. University of California Press. Berkeley 4, California. 6½ × 9½ inches. xii + 615 pp. 341 figs. $12.50.

To the many entomologists, who are interested in the Dragonflies, this book must become the Bible. Through its pages the suborder Anisoptera is fully covered. The book is divided into two parts; the first of which deals with the dragonflies in general, providing an excellent introduction to the Odonata and its suborder, collection, rearing and preservation of specimens and suggestions on use of the taxonomic information, which comprises the second part of the book. A list of genera and species completes the first part.

Part two of the book is taken up with Systematic Classification. In the descriptions, keys and tables the language used is as simple as is consistent with clarity. Diagrams and photographic illustrations are well utilized throughout, to give every possible help to the beginner. A glossary is also presented as an important aid. And finally there is a helpful list of synonyms.

The authors took cognizance of the need for information on the nymphal stages of the dragonflies. Characters by which these stages might be recognized are treated in separate keys and tables. Illustrations of nymphs of each of the 66 genera are provided.

An authoritative manual on the dragonflies has been needed for many years. Entomologists, experts and beginners, will find it indispensable.—F.A.S.

Mosquitoes of North America. By Stanley J. Carpenter and Walter J. La Casse. 1955. University of California Press. Berkeley 4, California. 9 × 11¼ inches. vi + 360 pp. + 127 full page plates. $10.00.

This book provides an excellent reference and a much needed single manual on the mosquitoes of North America. The 127 full plates of adult mosquitoes, contributed by Japanese artists Saburo Shibata and Kakuzo Yamazaki are outstanding.

Good general information on mosquito life history, collecting, preparation of specimens and anatomy of all stages is given in the first 24 pages of the book. The remainder is devoted to descriptions and keys of the 143 species and subspecies treated. Keys are provided for genera and species, adults and larvae. The descriptions cover adult females, males and male terminalia, and larvae. There is included an impressive bibliography and a systematic index, which add further to the usefulness of the book.

It is very likely that Mosquitoes of North America will become the standard encyclopedia on this subject. The arrangement of genera and species follows closely that of Edwards. Figures, largely from standard references capably illustrate the larval characteristics.

Entomologists, engineers and all others engaged in the study and control of mosquitoes are indebted to the authors for the production of this excellent manual.—F.A.S.

INDEX TO NAMES OF INSECTS AND PLANTS IN VOLUME LXIII

Generic names begin with capital letters. New genera, subgenera, species, varieties and new names are printed in italics.

The

New York Entomological Society

Organized June 29, 1892—Incorporated February 25, 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 24, N. Y.

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Devoted to Entomology in General

Editor Emeritus HARRY B. WEISS

Edited by FRANK A. SORACI

Publication Committee

FRANK A. SORACI — HERBERT F. SCHWARZ
E. W. TEALE — JAMES MULLEN

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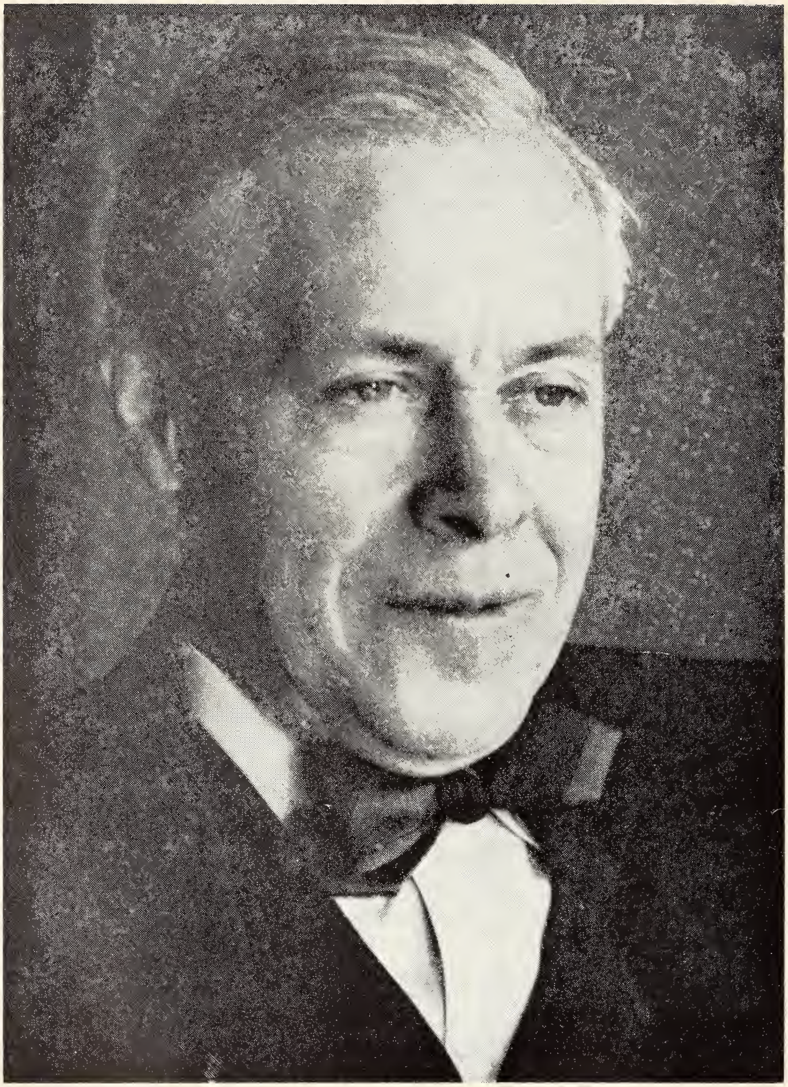

WILLIAM PHILLIPS COMSTOCK

Journal of the New York Entomological Society

Vol. LXIV 1956

WILLIAM PHILLIPS COMSTOCK, 1880–1956

William Phillips Comstock was born at New York City, New York on 1 March 1880. He was the only child of William Tompkins Comstock, formerly of Redding, Connecticut, and Mary Ida Phillips of Nashua, New Hampshire. Although an only child, he was brought up, fortunately, with two orphaned cousins, Elizabeth and Ida Comstock, daughters of his uncle, Dr. David Close Comstock, who were like sisters to him.

Will, as he was familiarly known to his friends, was educated at the Horace Mann School in New York City, and in 1903 graduated from Columbia University from which he received his B.A. degree, and also earned his athletic "C" by serving as coxswain of the varsity crew.

After graduation Will entered his father's publishing house in New York City, The William T. Comstock Company, which specialized in architectural books and published a magazine entitled "Architecture and Building." This was not entirely to Will's liking, but because of his father's poor health he stayed there until his father's death in 1910. He then turned to construction work, which was more to his taste, and during the First World War, being ineligible for military service, he worked on a large army supply base that was being erected in New Orleans. After the war he worked in Baltimore on another substantial construction job undertaken by the American Sugar Refining Company. When that job was completed, Will became consulting engineer for the Roanoke Water Company and was located at times in Virginia and at other times on Long Island, New York.

With the coming of the depression in 1932 most construction and engineering jobs ceased, and Will turned to his life interest, entomology, which thus far had been a side line or hobby.

At an early age Will became interested in entomology and by good fortune made the acquaintance of Frank Edward Watson (1877–1947), with whom he formed a close friendship that lasted as long as they lived. Together they collected, mostly Rhopalocera, in the vicinity of New York City, and especially in Van Cortlandt Park. It must be remembered that in the Nineteenth Century upper New York City was open country, and there were many good collecting grounds which have long since disappeared.

Living at 117 Lincoln Avenue, Newark, New Jersey, where he had moved with his family in 1907, residing there until 1953, he went with the Newark Museum as a Research Assistant in November of 1934 and worked in their Science Department on the entomological collection. This connection continued until 1937 when he came to the American Museum of Natural History where, in 1944, he became a Research Associate in the Department of Insects and Spiders.

Will's main interest in Lepidoptera was in the Lycaenidae, and most of his papers deal with that family. However, during the last years of his life and until 1950 when he retired due to ill health, he was engaged with the late Frank Johnson in writing a Monograph of the genus *Anaea,* which was completed but has not yet been published. This is a beautiful work, excellently illustrated by many colored figures.

Will was interested also in philately and formed a nice collection of United States and foreign stamps, which was disposed of some years before his death. This collection showed his usual care and close attention to details.

Will was a mild-mannered, friendly man who had scores of friends and no enemies. During our friendship, which began in 1935 through Watson, who was then a Scientific Assistant in the Department of Insects and Spiders of the American Museum of Natural History, he and his wife often visited me. At the Museum, where we met frequently, he usually wore a blue smock and invariably a blue bow tie and a striped shirt. Blue was his favorite color. With hair that was grey, he looked more like an artist than an entomologist. The accompanying photograph, taken about 1950, is an excellent likeness.

No one had greater aptitude than Will for inventing and making things. He was, what has been termed, a "jack of all trades." With Watson they planned and made several hundreds of what became known as the Watson-Comstock insect box. It is quite an ingenious, light and inexpensive affair with top and bottom of heavy cardboard and sides of wood. The bottom is lined with pressed cork. During the Second World War, Will and his sons organized a small machine shop in the cellar of their home, where parts for munitions, etc., were turned out. Anything or any job that had to be done about the home, Will was qualified and able to handle.

A member of the New York Entomological Society, President for the year 1943, and Delegate to the New York Academy of Sciences from 1945 to 1950, Will was a member also of the Brooklyn Entomological Society, Newark Entomological Society and The Lepidopterists' Society.

Will was first married in 1907 to Eleanor Robinson of Newark, New Jersey, but became a widower two months later. On 16 April 1914 he was married to Mary Rait Robinson of Chelsea-on-Hudson, New York and later Newark, New Jersey, who survives him. They have three sons, also surviving, Richard Underhill, William Phillips, Jr., and Theodore Robinson, as well as thirteen grandchildren. One snapshot that has been seen recently shows Will beaming in the midst of three daughters-in-law, five young grandchildren as well as Mrs. Comstock and a friend with her small child. While the Comstock boys were in service, their families lived with Will and his wife, and during that time Will's disposition, as usual, was perfect.

After a long illness Will passed away at his home in Shark River Hills, Neptune, New Jersey on 23 September 1956. Departed friends can never be replaced. They live on in their works and in our memories.

John Adams Comstock of Del Mar, San Diego County, California, has published a sumptuous book, "A history and genealogy of the Comstock family in America," (1949), to which the reader is referred for other family details.

I. Papers by William Phillips Comstock

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1911. On the identity of *Thecla muiri,* Henry Edwards. Jour. New York Ent. Soc. **19**: 86–87.

1912. *Erebus odora. Ibid.* **20**: 68.

1913. A new North American butterfly in the family Lycaenidae. Bull. Brooklyn Ent. Soc. **8**: 33–36, pl. 2.

1913. On the recurrence of *Thecla wittfeldii* Edw. (Lep.). Ent. News. **24**: 261–263.

1914. Lycaenidae of California described by Boisduval. Jour. New York Ent. Soc. **22**: 33–37.

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CYRIL F. DOS PASSOS
Mendham, New Jersey

A NEW RECORD OF THE ANDROMEDA LACE BUG (STEPHANITIS GLOBULIFERA (MATSUMURA)) FROM NEW JERSEY

BY ROSE ELLA WARNER

ENTOMOLOGY RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

While recently visiting in South Orange, New Jersey, I was asked to examine Andromeda shrubs in the front yard. The shrubs were planted about 1922 and were of considerable size. Those in the backyard were already dead and the others were very severely damaged. From all indications this was the work of an insect. The foliage was much mottled with grayish-yellow blotches. Some leaves were completely blanched, others brown and ready to drop off. On the lower surface of the infested leaves were numerous, flattened, black, shiny, sticky spots of excrement. The owner of the property had observed the work of the insect for some time but it was not until September that adults were noticed. At the time I looked at the plants (October 24, 1954) the adults were destructively abundant and very active on the lower surface of the leaves. A number of the lace bugs were collected and brought back to Dr. Reece I. Sailer for determination. They proved to be the lace bug currently known as *Stephanitis globulifera* when compared with specimens in the National Museum.

Apparently a recent introduction from Japan, *S. globulifera* is a major pest of Andromeda (*Pieris* spp.). Report of the presence of this pest was first made in North America from Connecticut in 1946 on a specimen of *Pieris japonica* (Bailey, N. S., Entomologica Americana (N.S.) 31, 53–56, 1951). Reports have also come from Rhode Island, parts of New York State and Long Island (Schread, John C., Conn. Agri. Expt. Station Bull. 568, March 1953).

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF OCTOBER 4, 1955

A regular meeting of the Society was held at the American Museum of Natural History. President Vishniac was in the chair. There were eleven

(*Continued on page 84*)

A REVISION OF THE GENUS EPHUTA (MUTILLIDAE) IN AMERICA NORTH OF MEXICO

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PART II. SPECIES GROUP GRISEA[1]

A considerable delay in the publication of this second section of the paper is partially due to difficulties experienced in the study of the Floridian populations of some species. Long series of several species, without adequate labels, were submitted in February, 1951 by a Floridian collector; these were all returned early in July, 1951, with a request that females, labelled as allotypes, be inserted in the collection of the U. S. National Museum, or another public museum. To date, these have not been so inserted, and data from them are not available for publication, thus imposing certain limitations on the description of these females, and in the matter of giving exact locality data of the allotypes.

References to figures in this section (and the forthcoming final section) refer to the figures in Plates I–V, pp. 35–43, in Part I of this publication. In addition to the help acknowledged in Part I of this paper, I would like to especially acknowledge the aid and encouragement received from my friend and colleague, Karl V. Krombein, in the completion of the final revision of the present text.

Since the publication of Part I of this Revision (Schuster, 1951), a very considerable additional body of material has become available for study, almost all collected during the last five years, in large part by Karl V. Krombein. The astute collecting of the latter has led to the association of several other females (*E. battlei battlei, E. sabaliana sabaliana*) with their respective males, necessitating an emended key to the *E. scrupea-pauxilla* complex of females, i.e., to those females without an evident microvestiture of the head, and without any trace of discal maculae of the second tergite of the abdomen. These are the females, of

[1] The first part of this revision appeared in this journal (Volume LIX, March 1951, pages 1–43).

course, which had been lumped in preceding treatments as "*E. puteola.*" This emended key to the *E. puteola*-type females follows at the close of the final part of this Revision.

In addition to the undescribed females previously mentioned, a third undescribed taxon has been found, in the male sex, which is so wholly deviant in the structure of the head that it cannot be placed within the genus *Ephuta* s. str. as diagnosed and discussed in the preceding section of this revision. For this wholly anomalous species, it is necessary to erect a new subgenus, which may prove worthy of generic segregation if the as yet unknown female should possess sufficiently striking characters. A key separating the two subgenera recognizable in the North American fauna follows:

KEY TO SUBGENERA (MALES)[2]

1. Mandibles simply falcate, their tips not strongly deflexed, ventrally with the contours smooth, not emarginate nor dentate; dorsal margins of mandibles not produced as a lamellate prominent tooth; clypeus convex, with two usually divergent carinae running down from a common origin below and between the antennal tubercles (rarely fused to form a common median carina), diverging below to delimit an obtrapezoidal "clypeal basin"; lateral faces of pronotum not armed with a tooth below. Subgenus *Ephuta*[3]

1. Mandibles contorted, their distal halves sharply deflexed, the ventral margins interrupted and with a small subtending tooth; dorsal margins of mandibles expanded, before the middle, into a prominent lamellate expansion; clypeus strongly depressed, forming a basin with the closed mandibles, without carinae, but with a sharp finger-like process at its juncture with frons; lateral faces of pronotum armed with a small tooth near base of coxae. Subgenus **Xenochile** subg. n.

Subgenus **Xenochile** subg. n.

MALE. Wholly black, with aspect of subgenus *Ephuta,* the petiole narrow and subparallel, hardly longer than broad; terga 3–6 of gaster longitudinally carinate along midline. Head transversely rectangulate, almost subquadrate, in dorsal aspect, rather full in temples, with close to contiguous, but rather fine puncturation. Genae evenly rounded into postgenal regions, neither region armed. Ocelli very small, their length *ca.* 0.2 the ocellocular distance. Clypeus strongly depressed, forming a distinct basin with the monstrous, contorted mandibles, nearly flat, without carinae but with a sharp, finger-like median process at juncture with frons, which is produced down over the clypeal basin as a prominent, finger-like tooth. Mandibles

[2] The female sex of Xenochile is unknown.
[3] See key to species on p. 24 of Part I of this revision.

strongly dilated, the distal halves strongly and sharply, angularly deflexed, obliquely bidentate apically, the ventral contours highly irregular, the ventral margin with a small but sharp, angular tooth beyond the middle, situated proximal of a slight but distinct notch; dilated dorsal margins of mandibles produced as a prominent, erect, lamellate and rounded tooth or expansion, situated well before the middle of the mandibles.

Alitrunk as in typical *Ephuta,* except for the flat lateral faces of the pronotum, which are produced at their lower corners as a distinct tooth. Gaster wholly identical in form with that of typical *Ephuta.*

Genotype:—*Ephuta* (*Xenochile*) *krombeini* sp. n.; the subgenus is monotypic.

Ephuta (*Xenochile*) *krombeini* represents a wholly deviant type in the genus *Ephuta.* It differs at once from all the nearctic and neotropical species of the genus known to me in the extraordinary, wholly anomalous mandibles, whose proximal and distal halves lie at a distinct angle to each other, and whose ventral and dorsal margins are both armed with teeth or angulations. Equally distinctive is the flat clypeus, wholly lacking the "usual" divergent carinae, but provided instead with a ligulate prominent process, projecting down over the depressed clypeal disk, originating just below the juncture of clypeus and frons. In spite of the distinctive and very large mandibles, and associated expansion of the head capsule and malar space, the single known species of *Xenochile* agrees very closely with the subgenus *Ephuta* in the form of the alitrunk and gaster. Only the slight armature of the lower angles of the pronotum represents a valid differentiating feature from *Ephuta* s. str. Should the female sex show major features differentiating it from the normal *Ephuta* "type", it will probably prove desirable to elevate *Xenochile* to the rank of a full genus.

Ephuta (Xenochile) krombeini sp. n.[4]

MALE. Length 7–9 mm. Integument wholly black, the rather sparse vestiture almost wholly silvery, except the upper part of front, the mesoscutum, and in part abdominal terga 4–7 with fuscous to black hairs and setae. Puncturation relatively fine (compared to other nearctic species of *Ephuta*), the head with front, vertex and genae nearly equally, closely to contiguously, but moderately punctured, bearing scattered, erect, long setae and a thin, decumbent vestiture of silvery hairs (except, in part, on upper front, where the vestiture is blackish).

Head transversely subquadrate, subparallel for some distance behind the

[4] Named for my friend and colleague, Karl V. Krombein, through whose generosity I owe the opportunity to study this anomalous species.

rather weakly protuberant eyes and rather strongly and abruptly narrowed into the posterior face, 1.58 mm. wide. Eyes moderately convex, only slightly laterally projecting beyond head capsule, 0.68 mm. long; malar space long, 0.30 mm. to the posterior mandibular condyle; narrowest interocular frontal distance 0.76 mm. long. Ocellar triangle small, and ocelli small: ocellar length 0.13 mm.; ocellocular distance 0.45 mm.; interocellar distance 0.20 mm.; distance between posterior and anterior ocelli 0.16 mm. Clypeus and mandibles as in description of subgenus. Antennae with scape sharply bicarinate; pedicel elongate 0.15 × 0.11 mm. wide; first flagellar segment elongate, 0.21 mm. × 0.14 mm. wide distally; second and third flagellar segments equal, 0.17 × 0.14 mm. wide.

Alitrunk rather moderately sculptured. Pronotum dorsally with contiguo-confluent, setigerous punctures, partly obscured by rather thin vestiture of sericeous. decumbent silvery hairs; lateral faces of pronotum nearly flat, the anterodorsal angles hardly angulate, not produced (width at shoulders 1.24 mm.); lateral pronotal faces coarsely but obscurely punctate both above and below the obscure and low oblique carina that traverses each lateral pronotal face.

Tegulae rather translucent, convex but not tectate even at base, smooth and polished but with scattered, rather fine setigerous punctures except laterally. Mesoscutum with more or less shallow, irregularly spaced but largely close, rather coarser, setigerous punctures that are not obscured by vestiture. Mesopleura convex, almost uniformly and almost throughout with close to contiguous, rather small, setigerous punctures, partly obscured by a rather thin vestiture of decumbent, sericeous, silvery hairs, only the posterior margin of mesopleura narrowly impunctate and virtually glabrous. Metapleura smooth and impunctate, except for the area above the coxae, which bears rather few but contiguous, shallow, coarse setigerous punctures verging on close-meshed areolations. Propodeum with dorsal and posterior faces evenly and gradually declivous into each other, with moderately coarse, rather shallow polygonal areolations, which become narrower and smaller anteriorly and along the slope into the lateral propodeal faces; without any distinct transverse ridge marking the boundary between dorsal and posterior propodeal faces; lateral propodeal faces smooth and nitid anteriorly, posteriorly with coarse and shallow punctures grading into areolations, which stop abruptly along a crenulate line anteriorly. Legs black, the posterior coxae unarmed; anterior coxae nearly glabrous, highly polished.

Gaster without distinctive features, except for petiole, wholly black. Petiole unusually elongate for the North American species of the genus: 0.58 mm. long × 0.44 mm. wide at anterior shoulders, 0.51 mm. wide at posterior margin, with the usual apical band of sericeous, silvery hairs; ventral carina sharp throughout, hardly produced anteriorly (but slightly higher both anteriorly and posteriorly than at middle). Tergum two on disk with relatively fine and well-separated setigerous punctures, bearing rather short, fuscous to black setae; lateral margins of tergum with even finer, but closer, yet not contiguo-confluent puncturation. Terga 3–7 with median longitudinal carinules. Hypopygium buff-colored.

Type:—Ramsey Canyon, Huachuca Mts., Arizona, July 12, 1955 (G. Butler and F. Werner), on *Melilotus alba;* in collection of United States National Museum.

Ephuta (*Xenochile*) *krombeini* is the most strongly isolated of the North American species of the genus. It differs not only in the wholly deviant form of the mandibles and clypeus, but also has much more elongated flagellar segments, and a more elongate pedicel. The head is also much more strongly developed behind the eyes, and is almost subquadrate, as compared with the strongly transverse head shape of our other species of the genus. The subquadrate head shape is undoubtedly associated with the extremely heavy and cumbersome mandibles, which surely entail a heavier cephalic musculature. It is strongly reminiscent of a series of species of western Photopsidine (Sphaeropthalmine) Mutillidae.

Subgenus *Ephuta* Say

The discussion dealing with *Ephuta* Say in Part I of this Revision pertains wholly to the present subgenus, as does the diagnosis given therein. Of the three species groups known in the male sex (Groups *Grisea, Copano* and *Eurygnathus*), the first is dealt with in the remainder of this section.

Species Group GRISEA

Species in the males of which the subantennal carinae are dentiform produced about a half or more than a half their distance down to the anterior clypeal margin; the subantennal basin thus set off is higher than wide, often more like a gutter than a basin, and is about as high as the clypeal basin, or higher; a transverse carina between the dentiform processes is most often present, separating the two basins (Figs. 2–4, 6, 10, 14–23). The genae are moderately sculptured and rounded into the postgenal region. The sculpture is weak, rarely moderate; the vestiture is generally denser than in the group Pauxilla; the ridges running up from the antennal tubercles and out obliquely toward the eyes are entirely absent, and the frons is punctured right down to the scrobal carinae (Fig. 10); the transverse carina separating the propodeum into a dorsal and posterior face is absent, or weakly developed, rarely moderate; sometimes it is reduced to a median tooth; the body is always black in color, with no tendency towards erythrization (with the exception of *E. floridana* and *rufisquamis*); the humeri are weak (except in *tegulicia*); and the mandibles are slender, evenly but strongly curved, acuminate, unidentate within (Fig. 10).

The relationship within the group of the various segregates is very difficult to ascertain at this point. Until the females have been correlated with the males, no opinion as to the interrelationships of the species, or of their status, can have more than a tentative validity.

Ephuta grisea Bradley

1899 *Mutilla scrupea* Fox, Trans. Amer. Ent. Soc., **25**: 272, male (in part).

1916 *Ephuta grisea* Bradley, Trans. Amer. Ent. Soc., **42**: 194 male (Montana, Colorado).

Holotype: Colorado, no other data, in collection of the American Entomological Society.

Distribution: Colorado (typical subspecies), and Alberta, Canada, Montana, Utah and North Dakota (subspecies *fusco-sericea*).

This species, in its typical form, has the smallest ocelli of any of our North American species (see Table I). The type from Colorado is particularly notable in this regard. Other material seen from Montana, referred here, has the ocelli slightly larger. I believe that this material should probably be separated subspecifically from *grisea* proper, as typified by the holotype. A series of specimens, from North Dakota, and several specimens from Alberta, have been seen that agree with a series of individuals studied from Utah in having decidedly larger ocelli than the Colorado typical material of *grisea*. These specimens also differ in that there is a strong tendency for the subantennal carina to become obsolete dorsad of the median augulations (Figs. 14–15), thus leaving a subantennal platform, rather than a basin. Since these specimens have the ocelli so much larger, they are provisionally separated from typical *grisea* as the subspecies *fusco-sericea*.

The species, as thus broadly defined, may be defined briefly as follows: tegulae lacking coarse punctures, polished; humeri weakly produced, with the oblique extension of the humeral carinae that traverses the lateral faces of the pronotum obsolete, weak and rounded; ocelli small, the ocellocular distance 3.00–4.82 the ocellar length (see Table I); hypopygium fuscous to black; dorsum of head, mesonotum, and distal segment of gaster with inconspicuous fuscous hairs, as well as silvery hairs; transverse propodeal ridge virtually absent; subantennal carinae acutely diverging in straight lines, dentiform produced half way down towards the clypeal margin (Figs. 14–15, 21); wings distinctly subfuscous throughout; head never conically produced in the ocellar region.

As thus defined, the species is very closely related indeed to *Ephuta conchate* Mickel, which differs from it in the more strongly produced humeri of the prothorax, which have the carinae that obliquely cut the lateral prothoracic faces very sharp and acute.

The species as a whole is redescribed more fully under the description of *E. grisea* subspecies *fuscosericea* subsp. nova, below. Those characteristics and tendencies found in *fuscosericea,* but not in typical *grisea* are enclosed in parentheses.

The female sex is possibly *E. coloradella.*

Ephuta grisea subsp. *grisea* Bradley (Figs. 21, 42).

Ephuta grisea Bradley, Trans. Amer. Ent. Soc., 42: 194, male (in part, Colorado material only).

The typical subspecies of *grisea* has the ocelli smaller than in any other nearctic species of *Ephuta* (Table I). The present subspecies appears to represent a southern, perhaps montane race, of decidedly more limited distribution than the subspecies *fuscosericea.* It differs from the latter in that the ocellocular distance is nearly or quite five times as great as the ocellar length, and the interocellar distance is nearly or quite three times the ocellar length. Furthermore, the configuration of the subantennal ridges is different, with the subantennal ridges only slightly dentiform produced half-way from the base to apex (Fig. 21). The Montana material, cited as paratypic of *grisea,* I doubtfully place in the subspecies *fuscosericea.* In the size of its ocelli, as well as form of subantennal ridges, it appears to connect the southern race (typical *grisea*) with the northern race (*fuscosericea*). Study of more complete series, especially from the area from Colorado north to Montana is necessary for a final differentiation between these two forms.

No material, other than the types, has been seen of typical *grisea.*

Ephuta grisea subsp. **fuscosericea** subsp. n. (Figs. 14–15, 42).

Male. Length 15.5 mm. Similar to *grisea,* but the ocelli somewhat larger, their relative distance from the eye-margins less; (the subantennal carinae obsolete or weak above, strongly triangularly dentate about half way to the anterior clypeal margin, and there connected by a strong transverse carina), thus separating the subantennal basin, whose sides are subparallel below, from the clypeal basin that is delimited on the sides above by strongly diverging carinae that become obsolete before reaching the anterior clypeal margin (Figs. 14–15). Pubescence quite dense for *Ephuta,* that of the vertex, mesonotum and scutellum and apical tergite and sternite more or less strongly infuscated.

Head transversely oval-obtrapezoidal, the punctures moderate, but close to contiguous, foveate or nearly so; those of the genae somewhat larger, but scarcely obscured by the sericeous appressed silvery hairs; lower frons above antennal tubercules with dense decumbent tuft of silvery hairs; rest of frons chiefly with sparse erect silvery hairs; vertex with similar pubescence, but largely a deep fuscous. Ocelli small, but larger than in typical *grisea,* their maximum diameter 0.14 mm.; their distance apart 0.29 mm. (twice their diameter); their distance from the front ocellus 0.17 mm. (1.2 their diameter); their distance from the nearest eye-margins 0.51 mm. (3.6 their diameter); ocellar region slightly elevated. Pedicel equal in length to the first flagellar segment; second flagellar about one-fourth longer, scarcely longer than wide. Subantennal carinae as above; diverging at first, then subparallel (setting off a subantennal basin that is nearly twice as high as wide, and that is more or less obsolete above, because of the obsolescence of the carinae), produced as strong triangular teeth half-way to anterior clypeal margin, connected by a strong transverse carina, then diverging strongly, soon becoming obsolete, before reaching the rather moderately reflexed anterior clypeal margin.

Alitrunk entirely, moderately densely silvery pubescent, except for the mesonotum and scutellum, which are largely or entirely fuscous pubescent. Prothorax with the humeri weak, scarcely produced (0.82 as wide at humeri as head), evenly widened to tegulae (there 2.18 mm. wide; the width at humeri 0.71 the width at tegulae); dorsal face of pronotum rather evenly rounded into the cephalic face and into the lateral faces; the latter and the pronotum with rather coarse, close, at times contiguous punctures, the lateral faces with the punctures at times less close; the latter lacking any backward extension of the humeral carinae; the intervals between the punctures of the lateral faces micropunctate, bearing fine silvery appressed hairs; the dorsal face with rather dense erect and decumbent silvery pubescence. Mesonotum with moderately small, scattered punctures, some contiguous, a few confluent, others well-separated, bearing sparse, decumbent and erect fuscous pubescence, except the lateral edges of the apical margin, which bear dense tufts of silvery fine hairs. Scutellum similarly punctured, nearly flat, weakly longitudinally sulcate medially in back; the pubescence long erect, fuscous and silvery mixed. Tegulae smooth, shining, except for a few coarse and some finer punctures bearing decumbent and erect silvery light fuscous pubescence; the basal half rather strongly folded, otherwise evenly convex. Mesopleura evenly convex, rather coarsely punctured, slightly more so than pronotum, closely so, moderately obscured by the decumbent and erect silvery pubescence. Metanotum raised medially, nearly evenly continuous with the scutellum, the raised portion coarsely punctate; the whole metanotum with fine, rather dense silvery hairs. Propodeum nearly glabrous, except at base, hexagonally to irregularly reticulate-areolate, the ridges sharp, high, medially delimiting an elongate large areole reaching back to the apex of the dorsal face; the less coarsely sculptured, mainly moderately punctured to smooth posterior face separated from the anterior by a rather weak, crenulate ridge; lateral propodeal faces rather coarsely punctured. Legs black, silvery pubescent. Wings evenly, moderately infuscated, the veins more so, the base of wing slightly less so.

Abdomen rather densely, closely punctured, with rather dense, shaggy pubescence. Petiole transverse, coarsely foveate above, with apical band of silvery hairs very weak; ventrally with median keel obsolete except anteriorly, where it is produced into a weak rounded tooth. Second tergite with the punctures close to contiguous, moderate, laterally less close; the intervals of the lateral areas with rather dense micropunctures bearing fine decumbent hairs (simulating the felt lines of other mutillids); apically with a dense band of curly, sericeous silvery pubescence; disk with sparse erect and decumbent silvery hairs. Apical tergites simularly pubescent, tergites three–five with (little), progressively less, sericeous pubescence similar to that of apex of second tergite. The sixth and seventh tergite with the long erect pubescence more or less strongly infuscated. Second sternite sparsely pubescent, with coarse punctures, less close but coarser than those of second tergite; apical sternites closely punctured apically, with sparse silvery pubescence, except for the more coarsely punctured hypopygium, whose apex is deep brown instead of black and bears all over strongly infuscated, long pubescence.

Holotype: Amalga, Utah, June 30, 1943 (C. J. Sorenson), from Sweet Clover (*Melilotus*) in collection of United States National Museum.

Paratopotypes: Five, some data, also in collection of United States Museum.

Paratypes: Beach, North Dakota, August 22, 1921, on flowers of *Solidago* (C. N. Ainslie), ten males; Williston, North Dakota, July 24, 1920 (A. L. Olson), one male; Lethbridge, Alberta, Canada, June 28, 1914 (F. W. Sladen), two males, one lacking the abdomen; Manyberries, Alberta, August 11, 1939 (E. H. Strickland), one male.[5]

This subspecies is very closely related to subsp. *grisea,* but differs from it in the larger size of the ocelli (compare Table I), in the less amply developed vestiture (especially of the curly, sericeous hairs of abdominal tergites three and four), and in the fact that the dorsal portions of the subantennal ridges are more or less obsolete, while the dentiform produced median tooth of each ridge is very well-developed. The rather noticeably developed fuscous vestiture of the type and paratopotypes gives the subspecies its name.

The paratype material of *grisea* from Montana perhaps should be included here, since all of the specimens of this material I have seen, as well as two other specimens measured (see Table I), from Montana, have the ocelli nearly approaching *fuscosericea* in size rather than typical *grisea.* Study of more adequate series, from more localities, must precede final decision on this matter.

In the larger ocelli, the more strongly developed infuscation of portions of the vestiture, *fuscosericea* is more or less intermediate between *argenticeps* and typical *grisea.* The much more strongly developed fuscous vestiture of that species, and its very large eyes and ocelli certainly warrant specific separation of *argenticeps.*

Ephuta argenticeps sp. n. (Fig. 42)

MALE. Length 8–8.5 mm. Integument totally black, except for the pale buff to pale castaneous hypopygium, which is paler (nearly ivory white) on basal half. Vestiture quite sparse, the pronotum, mesopleura and dorsum of propodeum with only very thin, relatively inconspicuous decumbent, griseous vestiture; the abdominal tergites 3–5 totally devoid of such griseous vestiture. Erect vestiture largely silvery, but vertex, second tergite (except apex), anterior part of scutellum and tergites 3–7, as well as hypopygium virtually or entirely fuscous pubescent. Mandibles normal, slender, appearing bidentate (middle tooth suppressed). Ocelli rather large. Subantennal carina forming a tall, very narrowly triangular (virtually subparallel) basin, about 1.25 as high as the narrowly obtrapezoidal clypeal basin (which is separated from subantennal by a strong

[5] Two other males, labelled simply "Montana" have been seen; these are apparently from the same lot as the two paratypes of *grisea* listed by Bradley. These specimens, as noted below, are somewhat intermediate between typical *grisea* and *fuscosericea.*

transverse ridge). Sculpture quite coarse (much coarser and more rugose than in *grisea*). Tegulae rather evenly convex, ridged obtusely on basal fourth, the disk (except for the hyaline flange) with ill-defined, rather coarse and shallow, scattered to locally close punctures (not smooth and polished throughout, as in *grisea*). Wings subhyaline basally, weakly fuscous distally.

Head transversely oval, rounded behind eyes, 1.78 mm. wide. Sculpture quite coarse, confluent to rugosely sculptured on front and vertex, and virtually equally coarsely sculptured on the genae; the latter scarcely separated, rather evenly rounded into postgenae. Clypeal region with very sparse, erect silvery vestiture; upper front and vertex with similar, but deeply fuscous vestiture (except just above the antennal tubercles, and at upper boundary of scrobes, where it is erect and decumbent, sparse and silvery); genae with sparse, sericeous, decumbent vestiture arising from scattered punctulations. Ocelli rather large, length 0.175 mm.; ocellocular distance 0.38 mm. (2.17 times the ocellar length); the interocellar distance 0.22 mm. (1.26 times the ocellar length); distance from median ocellus 0.15 mm. (0.86 the ocellar length). Eyes large, impinging notably on front and narrowing it perceptibly; eye-length 0.80 mm.; minimum frontal distance apart of eyes 0.69 mm. (0.86 times the eye-length); malar distance (to apex of ventral mandibular condyle) 0.23 mm. (0.29 times the eye-length). Between and below the antennal tubercles the head is strongly produced outward and elevated, the elevation on each side sharply defined by subantennal carinae, which diverge shortly, then run virtually parallel to the subantennal angulations (which occur distinctly more than half way down to the clypeal border), thus delimiting a subantennal basin of narrow boat-shaped, longitudinal form, three times as high as wide; at the angulation of the subantennal carina there is a transverse, carinate elevation, separating the gutter-like subantennal basin from the narrowly trapezoidal clypeal basin (which is about three times as wide as subantennal at its lower border); the subantennal carinae from the subantennal angulations on diverge at about a 50–55 degree angle, and soon become obsolete, before reaching the anterior clypeal margin (which is rounded and produced medially, and rather strongly reflexed). The oblique, suprascrobal ridges are vestigial and do not extend far above the antennal tubercles; the scrobal oblique ridges are strong, and separated from the coarse sculpture of the vertex by a depressed, transverse narrow, smooth region at their upper edges. Antennae with scape normally, very strongly bicarinate; pedicel small, subglobose, 0.14 mm. long; first flagellar slightly transverse, shortly, truncately obconic, 0.15 mm. long, 0.16 mm. wide: second flagellar slightly shorter, if anything, equal in length to third flagellar.

Alitrunk black, the legs piceous black. Sculpture rather coarse; vestiture sparse, silvery, except for that of mesonotum and anterior part of scutellum, where it is fuscous; decumbent-sericeous hairs of pronotum and mesopleura and dorsal propodeal face very sparse, inconspicuous, not obscuring sculpture. Prothorax a short trapezoid, in dorsal profile, broadly rounded-emarginate posteriorly, the humeral angles very weakly developed, obtusely angulate (width at humeri 1.37 mm.; width at tegulae 1.91 mm.); humeral carinae obscure, the posterior fork normally obliquely traversing the lateral pronotal faces virtually absent (the lateral pronotal faces thus nearly plane, except for the median shallow depression); lateral faces shallowly, very obscurely, weakly sculptured, nearly flat and bearing sparse, setigerous punctulations; dorsal pronotal face rather coarsely, contiguo-confluently punctured. Tegulae as described above, moderately hirsute, the hairs pale or partly weakly infuscated, 0.88 mm. long (0.94 the length of the pronotum from humeral angles to lateral apices, which is 0.94 mm.). Mesonotum with coarse, rather poorly defined, foveate punctures separated by variable, moderate to slight intervals; the posterior portion with obscure parapsidal furrows indicated by weak, shallow depressions; vestiture entirely fuscous, except for a little on postero-lateral corners. Mesopleura evenly convex, less coarsely, more regularly punctured than mesonotum, with round, separated contiguous punctures. Scutellum flatly swollen, hardly gibbous, coarsely, contiguously punctured (much more coarsely punctate than in *grisea*). Propodeum very coarsely areolate dorsally, the areoles sharply defined, few in number (coarser than in *grisea*), separated by a median arrow-head shaped, longitudinal glabrous area extending back to posterior margin of dorsal face, where it ends in an erect, rather moderate tuberculiform tooth (which, on each side, extends obliquely backward and lateral to form a gradually disappearing weak transverse ridge, obscurely separating the propodeum into a dorsal and posterior face); lateral propodeal faces with ill-defined, very coarse reticulations, separated by rounded, glabrous intervals (the reticulation much coarser than in *grisea*); lower part of metapleura with a few, similar but smaller reticules, separated by a glabrous, shallow, oblique gutter (running along the anterior propodeal margin), from the propodeal reticulation. Legs piceous black. Wings subhyaline basally, weakly infuscated distally (the veins darker, but scarcely contrastingly so).

Abdomen piceous to black. Petiole coarsely, deeply punctured dorsally, with narrow lamellate intervals; with the distal sericeous, white band of hairs quite thin; ventrally with a low carina that is weakly produced anteriorly. Second tergite rather coarsely, closely to contiguously punctured (considerably more so than in *grisea*), fuscous pubescent, except for lateral and distal narrow borders; the lateral edges with sparse erect, and some sparse, curled, sericeous hairs (the latter arising from scattered punctulations occurring on the narrow intervals); the distal margin with a moderate, rather narrow and thin sericeous band of similar, curled hairs. Second sternite more coarsely, less sharply punctured, with rounded, narrow intervals, each puncture bearing a single white hair; distal band of hairs very thin. Apical tergites with separated, distinct, moderately small punctures, each bearing an erect to sub-erect fuscous hair (no pale vestiture beyond apex of second tergite), the intervals obscurely longitudinally striolate; median carinules distinct on tergite 3–7, rather sharp on the pygidium, on which the puncturation and vestiture become denser. Sternites three to six with rather distinct punctures, rather coarser than on tergites, each bearing a single, short hair (thus with very thin sternal pale fringes); hypopygium closely, contiguously, distinctly punctured, with shorter, stiff, suberect, fuscous hairs; distal half of hypopygium buff to castaneous, basal half a dirty yellow-white.

FEMALE. Length 5 mm. Totally ferruginous, the last four abdominal segments somewhat castaneous distally, darker in appearance. Head with front, vertex and genae very densely, conspicuously silvery white, erect and decumbent and appressed pubescent, the vestiture obscuring the sculpture. Alitrunk with fine, close, sharply defined punctures, with sparse, erect and setaceous, and decumbent, finer vestiture, mostly fuscous pigmented (except on pleura and propodeum, where it is white); propodeum lacking median and dorsolateral lines of pale sericeous hairs. Second tergite with regular, fine, sharp puncturation, as on head and alitrunk; disk with almost absent, vestigial indication of pale maculae (consisting of a few isolated sericeous hairs); distal tergites fuscous pubescent, with a median line of sparse, silvery, sericeous, decumbent hairs.

Head broadly transversely oval, inflated appearing; the vertex with close, deep, round, distinct punctures situated subcontiguously (as on alitrunk), with narrow intervals punctulate, bearing dense, brilliant silvery, decumbent and appressed, curled, short sericeous vestiture; front and genae similarly punctured, with similar, rather sparser vestiture; the sparse erect hairs (issuing from the coarser punctures) also white. Parahypostomal ridges sharp, elevated, oblique, ending in a distinct, moderate, scarcely spiniform tooth; length of ridges 0.26 mm.; distance between dentiform-spiniform tubercles 0.47 mm.; beyond the dentiform angulation, the genal-postgenal ridges become very swiftly obsolete and do not extend for any distance beyond the teeth. Supraclypeal ridge weakly arcuate, transverse, broad, not strongly elevated and downward produced, 6-dentate (the lateral teeth of the four normal teeth again slightly bidentate). Eyes silvery, strongly facetted, irregularly ovate, weakly convex (not protruding from head), 0.47 mm. long, 0.38 mm. wide; interocular frontal minimum distance apart 0.66 mm.; head width 1.11 mm. Pedicel 0.09 mm., subglobose; first flagellar truncated obconic, 0.10 mm. long and 0.11 mm. wide; second flagellar short-cylindrical, 0.09 mm. long, 0.14 mm. wide.

Alitrunk elliptical-obovoid, a little more narrowed posteriorly than anteriorly, 0.95 mm. wide, 1.37 mm. long; at the prothoracic spiracles 0.95 mm. wide, at propodeal spiracles 0.88 mm. wide (the latter situated on conical projections); distance between anterior and posterior spiracles 0.47 mm. Puncturation close, sharp, distinct, contiguous and subcontiguous, rounded-hexagonal, very regular; each puncture with either a long, setose, erect, stiff, fuscous hair, or a decumbent, fine, shorter, paler or white hair; pleura similarly punctured and pubescent, but vestiture all pale; propodeum similarly punctured, with vestiture also all pale; propleural region with sericeous, decumbent vestiture quite thin and sparse.

Abdomen with petiole very short, transverse, parallel-sided. Second tergite closely, uniformly, hexagonally-circularly punctured, if anything, slightly more coarsely punctuated than on alitrunk (decidedly more coarsely so than in *baboquivari*); the disk with decumbent, rather short, fuscous vestiture (suberect and much longer in *baboquivari*); maculae of basal half of tergite virtually absent (represented by a few inconspicuous, sericeous, curled, pale hairs); distal sericeous, pale band well-developed, undulate, unequally wide, medially interrupted. Segments 3–6 erect fuscous pubescent dorsally (except along narrow lateral edges, where silvery pubescent), but along the midline segments 3–5 bear distinct, though sparse, decumbent, silvery, curly hairs. Pygidium with area distinctly defined by anteriorly diverging carinules that extend about one-third length of tergite, U-shaped, 0.10 mm. wide (0.15 the interocular distance); lateral portions of pygidial tergite with shallow, rather close punctures, irregularly scattered. Hypopygium with basal tubercles connected by sharp carina, distally entire, not quadridentate.

Holotype: Male, Poway, San Diego County, California, in collection of University of Minnesota.

Paratypes: Claremont, California (Baker), in collection of Cornell University; Stanford University, Stanford, California, Sept. 12, 1909, in collection of United States National Museum.

Allotype: Female, Santa Clara County, California (Harkins), in collection of Stanford University.

The above male and female are associated by elimination; since no other male, and no other female of the genus *Ephuta* are known to occur on the west coast, it is presumed that the above male and female represent the two sexes of one species. The fairly extensive collections that have been built up from California during the last forty years would probably have revealed the existence of other species, if these exist on the west coast.

This species, in the male sex, is very closely related to *grisea*, and especially to the subspecies *fuscosericea* of the latter complex. Since the genus appears to be largely an eastern and midcontinental group, it may be presumed that *argenticeps* is a far-western derivative of the *grisea* complex.

The much more extensive infuscation of the vestiture of the body, and the development of much larger ocelli and eyes (with corresponding decrease in ratio of the length of these organs to their distance from ocelli, and frontal distance apart, respectively) at once distinguish this species from other males of the *grisea* complex (see Table I). The completely fuscous vestiture of tergites 3–7, indeed, will separate the species from all other black nearctic forms.

Other characteristics that separate the male from related species are the narrow, gutter-like subantennal basin, the much coarser sculpture of the head, mesonotum, scutellum, propodeum, and second tergite (compared with *grisea*), the less conspicuous pale vestiture. In the extremely poorly developed posterior, oblique fork of the humeral pronotal carina the present species closely resembles *grisea*.

In the female sex, the brilliant silvery, conspicuous vestiture of the head is absolutely characteristic. The only other species approaching *argenticeps* in this regard is *albiceps,* from Texas. The relatively vestigial maculae of tergite two; the silvery (not ivory-white) vestiture of the head; the hypopygium not quadridentate; the smaller eyes (distance apart on front 1.4 the eye-length, instead of 1.0–1.2 the eye-length) will separate *argenticeps* at once from *albiceps.* Structurally, the presence of a sharp transverse basal ridge of the hypopygium in *argenticeps* at once separates that species from *albiceps,* which has the hypopygium unarmed.

The obsolescence of the hypostomal-postgenal ridges, shortly beyond the dentiform angulation, and the vestigial maculae of tergite two, as well as the rather fine, close puncturation of the dorsum are also characteristic (although the puncturation is distinctly coarser than in the allied *baboquivari*).

E. conchate female differs from that of *argenticeps* in the less dense and less shaggy, dull golden, instead of gleaming, silvery vestiture of the head (as well as in the presence of basal tubercles of the hypopygium instead of a transverse carina).

Ephuta conchate Mickel (Figs. 16, 46).

1923 *Ephuta conchate* Mickel, 19th Rept. State Ent. Minn.: 111, male.

Holotype: Fort Snelling, Minnesota, July 27, 1922 (A. A. Nichol), in Collection of University of Minnesota, Type No. 131.

Distribution: Previously known only from the type. Reported herein from Nebraska, Minnesota, Iowa, Illinois, Michigan, and New York westward to South Dakota and Kansas (Fig. 46).

Specimens examined:

KANSAS: Riley Co., June (Marlatt), one male.

ILLINOIS: Four males, numbered 17077 (two), 19569, 17424, no other data.

NEBRASKA: Malcolm, June 1909 (C. R. Oertel), one male.

SOUTH DAKOTA: Brookings, July 30, 1928 (M. Fredericksen), two males.

IOWA: COUNTY No. 4, July 17, 1934 (H. E. Jaques), one male.

MICHIGAN: Muskegon County, August 2, 1944 (R. R. Dreisbach), one male.

NEW YORK: Breesport, Chemung County, July 5, 1937 (Harvey I. Scudder), feeding on honey-dew of *Myzus ribis* on currant, one male; Ithaca (no other data), on male.

This rare species appears to have a distribution limited largely to the Transition, with a slight extension into the Upper Austral and Canadian Zone. Its distribution is analogous to that of *Dasymutilla gibbosa* (*cariniceps*).

As is at once evident from the key, this species is very closely related to *E. grisea* (especially to the subspecies *fuscosericea*), and the ocelli are of nearly the same size in *conchate* as in *grisea*. In *conchate* the humeri of the prothorax are more strongly produced (humeral width 0.85–0.90 the width of head, contrasted to 0.80–0.86 for *grisea*). Perhaps the most striking characteristic in which this species differs from the *grisea* complex is in the development of the humeral prothoracic carinae. In *conchate* the posterior fork of the humeral carinae (obliquely traversing the lateral pronotal faces, from the humeral upper corners, to the lower, posterior corners) is very sharp and high, dividing the lateral prothoracic faces into distinct anteroventral and posterodorsal faces. The anteroventral portion of the lateral prothoracic faces are strongly declivous into the propleura. In *grisea* (and related species, such as *cephalotes, argenticeps, ecarinata,* etc.) the posterior fork of the humeral carinae is weak, and the posterodorsal and anteroventral portions defined are virtually on one plane.

The single atypical individual from Ithaca, New York (See Table I) may be found to represent an extreme, heterogonic individual, in which the specific characters of *conchate* are not developed to a recognizable degree.

The female sex of this species, judging from distribution and similarity to the female of the related species *argenticeps,* is almost certainly the following undescribed female. This female has a distribution in the Upper Austral and Transition Zones, from New York to Illinois. No other male (that is not correlated with a female) has a distribution approaching this circumscribed range. The presumptive female sex of *conchate* may be described as follows:

FEMALE. Length 5.2 mm. Ferruginous throughout, except for the slightly darker vertex and the brownish-testaceous legs. Head with a very sparse and conspicuous yellowish to golden sericeous vestiture dorsally (in addition to the suberect, sparse, fuscous hairs); hypostomal-postgenal carinules not complete. Disk of second tergite with minute sericeous maculae; pygidium defined, distinctly, finely granulose-punctate or granulose; hypopygium with basal tubercles obsolete, not connected by a discrete transverse ridge.

Head 1.32 mm. wide, seen from above rather full in temples, nearly transversely oval-rectangular, not suddenly narrowed behind eyes; eyes 0.53 mm. long and 0.41 mm. wide; front 0.79 mm. wide (1.49 the eye-length); malar distance 0.29 mm. (the eye-length 1.83 the malar distance). Integument ferruginous, the vertex deeper and somewhat piceous-red. Punctures of front, deep, rather coarse and close but not confluent, those of vertex oval, much less close, the intervals mostly nearly as great as punctures; intervals not nitid, but roughened and punctulate, bearing a sparse vestiture of decumbent to appressed sericeous, chiefly golden tinted pubescence; the gross punctures bearing decumbent and erect golden tinted to fuscous stiff vestiture; genae with moderate vestiture of sericeous appressed and erect silvery hairs. Hypostomal-postgenal carinules not complete, disappearing gradually above the low, triangular hypostomal teeth, and then reappearing near the margin of the occipital ridge; the genal sculpture and vestiture slightly extending on to the area mesad of the ridges, the rest of the postgenal area transversely striolate. Antennae dull rufo-testaceous, uniformly colored and not darker than head, with the flagellar segment short and transverse (as in *coloradella*).

Alitrunk obovate-elongate in shape, considerably more narrowed in back than in front, the length 1.65 mm.; width at prothoracic spiracular plates 1.04 mm.; width at apices of propodeal spiracles 1.00 mm.; distance between front and posterior spiracles 0.58 mm. Puncturation deep, rather foveate, contiguous; vestiture sparse, the lateral pronotal faces with sparse, off-white sericeous vestiture (lacking prominent silvery sericeous vestiture); propodeum sparsely whitish, sericeous pubescent. Legs concolorous with alitrunk, slightly more testaceous, unicolorous.

Abdomen with petiolar ventral carina high and sharp throughout, slightly higher anteriorly. Second tergite with disk with rather coarse, not very sharply defined and rather shallow, slightly separated punctures; basal half of disk with two faint, obsolete spots of golden sericeous hairs; apical band equally wide, of brilliant silvery sericeous hairs, interrupted by fuscous hairs medially; disk of tergite two and tergites 3–5 with fuscous, suberect to somewhat decumbent hairs; pygidial tergite silvery pubescent. Pygidial area distinct, laterally defined by two discrete carinules, rather wide (frontal width 4.5 the pygidial width), the apical half somewhat obscurely roughened, finely granulose, the basal part gradually becoming smooth. Hypopygium coarsely rugose-punctate on apical half, near base of coarsely sculptured region with a pair of obscure lateral tubercles; the coarsely sculptured area of hypopygial disk separated by faint lateral ridges from the impunctate lateral areas; these ridges running backward and not distinctly dentiform produced near apex; hypopygium thus appearing nondentate and truncate apically.

Allotype: Palos, Illinois (R. Gregg), September 6, 1936, in collection of author (to be deposited in collection of Cornell University).

Parallotype: Poughkeepsie, New York, August 30, 1936 (H. K. Townes), in collection of Karl V. Krombein.

This female will be confused superficially with the *puteola* complex. The head bears a thin vestiture of fine, sericeous, deep, golden to burnt golden or somewhat fuscous decumbent hairs on the front and vertex, arising from punctulations interspersed amidst the normal punctures; this vestiture is so thin, however, as to be easily overlooked. Unlike the *puteola* complex the disk of the second tergite bears a pair of small, quite inconspicuous maculae of sericeous yellowish or whitish hairs. Both of these characteristics can be easily overlooked, and lead to confusion with the distantly related members of the *puteola* complex.

The related members of the *albiceps* and *baboquivari* complexes are sometimes difficult to distinguish. Both *albiceps* and *auricapitis* differ at once in the dense sericeous pubescence of the head and the large, conspicuous maculae of the second tergite. The weak development of the hypopygial basal tubercles in *E. conchate* and in *coloradella*, and the absence of a transverse, strong ridge connecting them is diagnostic, and will serve to separate *conchate* and *coloradella* females from all other members of the *baboquivari* complex. (See Key, p. 71)

E. conchate and *coloradella* appear to find their closest relatives in the superficially similar *E. baboquivari* and *E. floridana dietrichi*. The distinctly larger eyes and finer sculpture of *baboquivari* at once eliminate that species from confusion with *conchate* and *coloradella;* it furthermore has the head brilliant golden-yellow pubescent. Confusion is therefore most likely with *E. floridana dietrichi*. *E. conchate* and *floridana dietrichi* and *coloradella* have the eyes similar in size; with the interocular distance from about 1.3–1.5 the eye length; all three have the sericeous vestiture of the head quite thin, and not golden yellow. *E. floridana dietrichi,* however, can be separated from the other two by the total absence of maculae of tergite two and by the sharply transversely ridged basal portion of the hypopygium; the apex of the hypopygium is also sharply quadridentate, while it is very weakly quadridentate (and appears entire) in *chonchate* and *coloradella.*

The hypostomal-postgenal carinules are rather distinctly oblique, dorsad of the hypostomal teeth, and gradually disappear dorsad and mesad of the hypostomal teeth. The upper parts of these carinules are distinct at their juncture with the occipital ridge; they are produced downward and slightly outward, and are margined externally by a shallow obscure groove, becoming gradually obsolete at a point near, but somewhat laterad of the oblique ridges going up from the hypostomal teeth. The upper and lower portions of the carinules margining the postgenae thus are slightly indicated, and are obsolete medially only, not completely meeting. This condition prevails also in *E. coloradella.* In *E. floridana* and its subspecies *dietrichi,* on the other hand, the carinules bounding the postgenae disappear very swiftly above the hypostomal teeth and the genae and postgenae are very broadly continuous. Although these two types differ among themselves, both of these groups do not have the carinules bounding the postgenae developed nearly as strongly as in *baboquivari* and *argenticeps.* In *conchate* and *coloradella* the postgenal area is largely striolate; in *E. floridana* and its subspecies *dietrichi* it is smooth throughout almost all its area. All three of these species agree in the nearly concolorous pigmentation of the legs and of abdominal segments 3–6, the entire body being uniform in color; all three species, furthermore, have a coarse sculpture recalling that of *argenticeps,* much coarser than that of *baboquivari.*

The differentiation between the female of *conchate* and *coloradella* is based on very slight grounds that may not justify the erection of species. *E. conchate* has the vestiture of front and vertex burnt golden or subfuscous pigmented; in *E. coloradella* it is pale and white throughout. Since *E. conchate* female (with its distribution from New York to Illinois) suggests *E. conchate* male as regards distribution, and since *E. coloradella* is reported from a state from which only one other species, *E. grisea grisea* is reported, certain interesting possibilities suggest themselves. It has been stressed that *conchate* is only doubtfully specifically distinct from *grisea;* the females belonging to these two forms would be expected to be exceedingly similar. The morphological similarity of the females of *conchate* and *coloradella* suggests they may not be specifically distinct; their analogous distribution suggests that *coloradella* is the female of *grisea.* If this should prove true, it may therefore be found wise to separate *conchate* as a subspecies only.

Ephuta scrupea Say (Figs. 2–4, 26–30, 42)

1836 *Ephuta scrupea* Say, Journ. Boston Soc. Nat. Hist., **1**: 297, male.

1871 *Mutilla scrupea* Blake, Trans. Amer. Ent. Soc., **3**: 230, male (in part.)

1899 *Mutilla scrupea* Fox, Trans. Amer. Ent. Soc., **25**: 272, male (not Say).

1899 *Ephuta scrupea* Ashmead, Journ. N. Y. Ent. Soc., **7**: 57, male.

1903 *Mutilla scrupea* Melander, Trans. Amer. Ent. Soc., **29**: 324, male. (not Say).

1903 *Rhoptromutilla scrupea* André, Gen. Ins. Fasc. **11**: 45, male.

1909 *Ephuta scrupea* Say, Viereck, in Insects of New Jersey p. 665?

1916 *Ephuta scrupea* Rohwer, Hymenoptera Conn. p. 625, male. (not Say, entirely or in part *E. pauxilla* Bradley).

1916 *Ephuta scrupea* Bradley, Trans. Amer. Ent. Soc., **42**: 196, male.

1938 *Ephuta scrupea* Bradley, Insects of North Carolina p. 438.

1943 *Ephuta scrupea* Fattig, Emory Univ. Bull., **1**: 13.

Type: Indiana (lost).

Plesiotype: Male, Washington, D. C., Aug. 6, 1948 (D. Shappirio), taken at same time and place as allotype female (in USNM).

Distribution: New Jersey, Pennsylvania, Maryland, Virginia, North Carolina, Georgia, Alabama, westward to Ohio, Michigan and Arkansas, and presumably Indiana.

This, next to *pauxilla,* is the most frequent species in collections. Since it occurs over such a widespread area, and is so fully represented, it was felt certain that the female was confused with that of *pauxilla* in collections. This suspicion has proved to be founded in fact.

It is quite uncertain, in the writer's opinion, whether the name *scrupea* Say should apply to this species or to *E. pauxilla* Bradley, or possibly to *E. conchate* Mkl. Bradley (1916, p. 196) states: "In deciding to which of these two species (i.e., *pauxilla* Bradley and *scrupea* Say of the present treatment) Say's name should apply, I was guided by his description of the propodeum, which would not seem to fit *pauxilla* so well as the other. The remainder of the description might apply to either." I have not been able to gather from Say's description of the propodeum of his *scrupea* whether *scrupea* sensu Bradley or *pauxilla* Bradley or *conchate* Mkl. was involved, and believe that a decision of which species to call *scrupea* cannot be derived from the geographical distribution of these three species. The range of *scrupea* includes the southernmost tip of Ohio, west to Arkansas, and the entire region eastward of that line. A single specimen from Michigan indicates that *scrupea* will probably be found in Indiana (the type state of the species), although no material is known from there. *E. pauxilla* Bradley has been found in the entire region from Maine to Minnesota, and Florida to Texas. It occurs in the neighboring states of Ohio and Illinois and Michigan. It is certain to be found to occur throughout all or most of Indiana. I therefore believe that *scrupea* Bradley (and *scrupea* in this paper) may have to be given a new name, and that *pauxilla* Bradley may prove the same as *scrupea* Say. I feel that a change in names at this point is unnecessary, unless definite proof is at hand, and therefore follow Bradley (1916) as regards the names of these two species.

The male of *E. scrupea*, in the pale hypopygium, coarsely sculptured tegulae, simple hind coxae, absence of dense vestiture of the dorsum of the propodeum, and moderate, dense sculpture of abdominal tergite two, closely resembles *pauxilla* Bradley. That similarity, however, appears to be entirely superficial. The form of the subantennal ridges, the absence of a distinct transverse propodeal carina, the much finer puncturation (especially of the disk of abdominal tergum two), and the lack of distinct genal ridges, at once separate *scrupea* from *pauxilla.*

E. floridana sp. n., however, appears to be closely related to *scrupea,* differing chiefly (in the male sex) in the totally ferruginous color of the integument (except only the yellowish-white hypopygium). The tegulae, ocelli, sculpture and form of subantennal carinae appear identical in both species.

This is the only male of the genus occurring in North America that tends to have the pygidium, as well as the hypopygium of the male largely yellowish; this character, unfortunately, is not absolute. All individuals have at least a faint trace of infuscation of some of the hairs of the vertex and mesoscutum; in some individuals the degree of infuscation of the vestiture recalls *grisea* and *conchate.* The form of the tegulae and pale color of the hypopygium will separate the species from these two forms, which bear at best a distant relationship to *scrupea.*

The male of *E. scrupea* can always be easily separated from other black species, by the shape of the subantennal carinae, and the basins they delimit, the moderate size of the ocelli, the weak humeri, lack of a strong transverse propodeal carina, lack of a median tooth between the two faces of the propodeum, coarsely punctured and hirsute tegulae, and yellow hypopygium.

There is considerable variation in the shape of the subantennal carinae and the basins they delimit, as can be seen on referring to the figures on Plate I; the carinae may run down parallel to each other to the upper margin of the clypeal basin, or they may diverge at first and then converge to varying degrees, at times becoming approximate at the dorsal margin of the clypeal basin, thus setting off an oval subantennal basin; at times the dentiform processes at the end of the subantennal basin may be connected by a weak transverse ridge, at times by a strong carina, and often there may be no separation, the two basins being evenly declivous into another; there is also considerable variation in comparative heights of the two basins; the slightly dentiform processes may occur less than, more than, or exactly half way down to the anterior clypeal margin.

The female sex of this species has been universally confused with *E. puteola* (Blake). The species is identical in nearly all respects with *puteola,* and agrees with it in the essential measurements of head, alitrunk, and gaster (see Table IV). It may be briefly described as follows:

FEMALE. Nearly entirely ferruginous, but becoming castaneous to piceous on last 4 abdominal segments, and the legs and antennae usually castaneous to fuscous. Head with vertex with sparse erect and suberect dusky hairs only, not hiding the punctures, the very narrow intervals between the punctures devoid of punctulations; eyes relatively small, the front 1.33–1.49 the eye-length; head width 1.68–1.71 the frontal distance between eyes; malar distance 0.58–0.64 the eye-length (measured from lower corners of eye to apex of the ventral mandibular condylar region). Genal-postgenal carinules running up from the hypostomal teeth complete, but delicate, the genae and postgenae not continuous at any point.

Alitrunk as in *puteola;* closely, contiguously punctured, the propodeum not at all trilineate.

Gaster with disk of tergum two very regularly, contiguously punctured with fine, nearly circular punctures. Second segment light to deep ferruginous, nearly or quite concolorous with alitrunk; segments 3–6 more deeply pigmented, tinged with castaneous or piceous. Pygidial area bare, nitid, laterally defined; hypopygium distinctly tuberculate near base on each side, the tubercles more or less connected by a transverse, welt-like ridge; apex of hypopygium varying from entire and subtruncate to slightly but distinctly quadridentate.

Allotype: Washington, D. C., August 6, 1948 (D. Shappirio), taken at the same time and place as the plesiotype male; in collection of U. S. National Museum.

The female of this species differs from the female of *puteola* essentially as follows: the genal-postgenal carinules are complete (incomplete in *puteola*); disk of abdominal tergum two with fine, regular, very close and contiguous punctures throughout; gaster with second segment usually ferruginous and concolorous with alitrunk, contrasted to the more deeply pigmented distal abdominal terga. The relatively fine and regular puncturation, otherwise, is much as in *puteola:* it is subequal on vertex, notum of alitrunk, and disk of tergum two (with that of vertex slightly less coarse).

Occasional females can be separated from *puteola* only with great difficulty, since the two species have the eye-size and head measurements the same, and have a very similar facies (leading to uniform confusion in the literature under the name "*puteola*"). In some individuals of *puteola* the genal-postgenal carinules are obsoletely indicated throughout, at best by an obscure, delicate groove bordering the postgenae rather than by a distinct ridge. Such individuals may give rise to confusion, and the writer at one time felt that the disposition of such females was virtually impossible. However, there are rather obvious differences in puncturation between the two species: in *scrupea,* the second abdominal tergum has the punctures extremely regular and contiguous, relatively fine and almost circular; in *puteola,* the tergum has the discal puncturation much coarser, the individual punctures more discretely separated from each other, and more or less elongate; furthermore, *scrupea* females generally have the deeper pigmented distal abdominal segments contrasted to the paler ferruginous second segment, which is always concolorous with the alitrunk (in *puteola* there is a well developed, though scarcely universal tendency for the posterior and lateral edges, and often disk as well, of the second tergum to be tinged with piceous, and the entire gaster is very often uniformly piceous-tinged, contrasted to the dull ferruginous alitrunk). The pigmentation in these two females often varies in the same manner and shows approximately the same type of variation. In the individual from Sea Cliff, for instance, the head and gaster are mahogany reddish to reddish-piceous, and the alitrunk and second abdominal segment are ferruginous, and somewhat contrasted to the darker apical abdominal tergites. As in *puteola* such regional differences in intensity of pigmentation cannot be correlated with other characters, and hence there is no indication that taxonomically sufficiently distinct genotypes are before me to warrant separate names. The development of the basal hypopygial tubercles also varies; they are weak and scarcely connected in the individual from Chatsworth, New Jersey; they are well-developed but scarcely connected in the individual from Washington County, Pennsylvania; they are well-developed and connected by a distinct transverse welt or ridge in the individual labelled "Penna."

The female differs from other *puteola*-like forms (except *tentativa* and *minuta*) in the complete genal-postgenal carinules. The nitid, relatively broad pygidial area, as well as the much finer puncturation separate the species at once from *minuta,* and the much smaller eyes separate the species from *tentativa.*

The female is divisible into two groups, occurring largely through the same range, on the basis of the form of the apex of the hypopygium: in one group of individuals (form a) its apex is retuse (thus slightly bidentate), and the lateral margins, just before the apex, bear a small tooth on each side (the hypopygium thus appears slightly quadridentate in outline apically); in the other form (b) the hypopygial apex is truncate and there are no discrete lateral tubercles. It may be possible that these two forms represent discrete genotypes, but possibly the forms may be due to age differences (the tubercles, conceivably, can wear away with age). Until more is known about this extremely difficultly perceptible character it seems unwise to assign names to these forms, especially since intermediate individuals appear to occur.

SPECIMENS EXAMINED:[6]

NEW YORK: Sea Cliff, one female (form b); Derby, Aug. 18, 1951 (K. V. Krombein), one female, slightly atypical). NEW JERSEY: Chatsworth, Burlington County, June 15, 1923 (J. C. Bradley), one female (form a); Freehold, August 23, 1947 (D. Shappirio), one male. (Also reported from "Camden Co. [Fox]; Clementon, VIII, 27 [Fk]," *fide* Viereck, in Smith, 1909, p. 665; these reports may also refer to either *spinifera* or *pauxilla*). PENNSYLVANIA: Washington Co. (G. A. Ehrmann), one female (form a); "Penna.," no other data, one female (form a); Enola, reared from cocoons of *Pseudagenia bombycina* (Kirk & Champlain), one male; Mt. Holly Springs, Sept. 1, 1918 (R. M. Fouts), one male. MARYLAND: Cabin John, Sept. 9, 1916 and Aug. 21, 1917 (R. M. Fouts), two males; Beltsville, Aug. 30, 1947 (D. Shappirio), two males; Cabin John, Sept. 10, 1947 (D. Shappirio), one male; Potomac, Sept. 19, 1947 (D. Shappirio), one male; Patuxent Refuge, Bowie, Sept. 3, 1947 (D. Shappirio), one male. DISTRICT OF COLUMBIA: Washington, two females; Washington, Aug. 16–Sept. 11, 1943 (M. Vogel), three females (form b); Washington, July 25, 1947 (D. Shappirio), one male; Washington, July 30, 1948 (D. Shappirio, a), one male; Washington, July 3, 1948 (D. Shappirio, b), one male; Washington, July 23, 1947 (D. Shappirio), two males; Washington, August 29, 1947 (D. Shappirio), two males; Washington, Aug. 30, 1947 (D. Shappirio), two females, one male; Washington, Sept. 5, 1947, one female, two males; Washington, **Aug. 6, 1948** (D.

[6] Most of the females examined have been labelled "Parallotype" in order that a series of widely distributed specimens of the female sex shall be available in various institutions.

Shappirio), two males; Washington, Sept. 1, 1947 (D. Shappirio), two males, one female; Washington, Sept. 3, 1947 (D.S.), one male; Washington, Oct. 25, 1944, one male; Washington, July 31, 1947 (D.S.) two males; Washington, July 24, 1947 (R. Boetticher), one male; July 26, 1948 (D.S.), one male; Aug. 2, 1948 (R. Boetticher), one male; July 18, 1947 (R. Boetticher), one male; Aug. 1, 1947 (R. Boetticher), one male; July 17, 1948 (R. Boetticher), one male, one female; Washington, Aug. 30, 1947, two females, one male; Washington, July 17, 1948 (R. Boetticher), one male, one female; Washington, July 15, 1947 (D.S.), one female; Washington, Sept. 4, 1947 (D.S.), one male, one female; Washington, Aug. 5, 1948 (D.S., c), one female; Washington, July 10, 1947 (R. Boetticher), one female; Washington, June 7, 1947 (D.S.), one female; Washington, Sept. 11, 1948 (D.S., a), one female; Washington, Sept. 12, 1948 (D.S., a), one female. VIRGINIA: Dyke, Sept. 2, 1948 (D. Shappirio) one female; Great Falls, July 22 (N. Banks), one female (labelled "*puteola*" Bradley); Falls Church, Aug. 22 (N. Banks), two females (labelled "*puteola*" by Bradley; taken on Tulip Tree honey-dew); Great Falls, Sept. 24 (N. Banks), one female; Falls Church, Aug. 11 (N. Banks), one female; Falls Church, Sept. 16 (N. Banks), two females, on Tulip Tree honey-dew (labelled "*puteola*" Bradley); Falls Church, Sept. 6 (Banks), one female (labelled "*puteola*" Bradley); Falls Church, April 24 (N. Banks), one female (labeled "*puteola*" Bradley); Great Falls, June 16 (N. Banks), one female; Falls Church, Sept. 5 (N. Banks), one female (labelled "*puteola*" Bradley); Great Falls, June 25 (N. Banks), one female (labelled "*puteola*" Bradley); Falls Church, Apr. 26 (N. Banks), one female; Falls Church, Sept. 15 (N. Banks), one female; Vienna, July 4, 1935 (K. V. Krombein), one female; Glencarlyn, May 10 (N. Banks), one female; Falls Church, Sept. 10 (N. Banks), one female; Rosslyn, Sept. 1, 1912 (H. L. Viereck), one male; Falls Church, July 2, 1913 (W. Middleton), one male; Falls Church, Sept. 11–14, 1915 (G. M. Greene), two males; Falls Church, August 2 and Sept. 13 (J. Bequaert), two males; Falls Church, August 24 (on honey-dew on *Liriodendron tulipifera*) (N. Banks), one male; Glencarlyn, July 26, one male; East Falls Church, July 8 and July 17, 1912 (W. Middleton), two males; Great Falls, Aug. 13 (N. Banks), two males; Falls Church (various times, N. Banks), fifteen males; Short Hill, Hillsboro, Aug. 26, 1944 (J. C. Bridwell) one male; Dunn Loring, Aug. 28, 1949, on *Liriodendron tulipifera* (K. V. Krombein), one female; Dunn Loring, July 13 1947, July 4, 1950, July 16, 1950, Sept. 11, 1948, July 29, 1951, July 18, 1948, Aug. 4, 1951, Aug. 5, 1951, Aug. 28, 1949, Aug. 7, 1949, Aug. 6, 1949, July 30, 1949, July 24, 1949, Aug. 21, 1949, Aug. 11, 1951, Sept. 9, 1951, July 31, 1948 (K. V. Krombein), 19 males; Arlington, Aug. 22, 1951 (K. V. Krombein), one male; Great Falls, Sept. 15, 1948 (K. V. Krombein), one male. WEST VIRGINIA: Cheat Mountain, August 23, two males; Cacapon State Park, Aug. 11, 1953 (K. V. Krombein), two males; Lost R. State Park, Hardy Co., July 5, 1953 (K. V. Krombein), one female cited erroneously as *E. conchate* in Krombein, 1954. NORTH CAROLINA: Valley of the Black Mountains, August 5, 1906 (W. Beutenmueller), eight males; Kill Devil Hills, July 10, 13, 18, 1950 (K. V. Krombein), three females; Kill Devil Hills, July 1, 4, 16, 1950 (K. V. Krombein), three males; Raleigh, July 19, 1933, October 4, 1935, August 13, 1929, September 27, 1929 (C. S. Brimley), four males; Raleigh, September 14, 1943 (D. L. Wray), one male. SOUTH CAROLINA: Venus, Greenville Co., 1100 ft., September 22, 1934 (H. K. Townes), one male. GEORGIA: "Two males, collected at Atlanta, July 8, 1942, and July 28, 1942" (Fattig, 1941, p. 13); Clayton Co. (2000–3000 ft.), June 1909 (W. T. Davis), one female. ALABAMA: Coleta (H. H. Smith), four males. OHIO: Hocking County, August (C. H. Kennedy), one male. ARKANSAS: Summit of Rich Mountain, 2600 ft., August 1, 1905 (A. P. Morse), one male. MICHIGAN: Muskeegan County, August 7, 1944 (R. R. Dreisbach), one male.

The species has been bred from the bee, *Pseudagenia bombycina.* The males are found frequently on honey-dew.

Females assigned to *scrupea* (Say) are placed here on the basis of: a. collection of males and females at the same time and place, b. correspondence in distribution, and subequal local frequency of male and female, c. elimination of all other species that could be involved.[7] The above correlation has been possible

[7] The three species found around Washington, D. C. can also be easily correlated with the respective male sex on the basis of similarities in sculpture between the sexes. The male *E. scrupea* has the disk of tergum two finely punctured; the female here associated with it is also characterized by the very fine puncturation of the disk of tergum two. In contrast, both male and female sex of *E. spinifera* and *pauxilla* have relatively coarse puncturation of the disk of abdominal tergum two.

largely because of the mass collections made around Falls Church, Va., by Mr. Nathan Banks, and in Washington, D. C., by Mr. D. Shappirio. In addition to the allotype and plesiotype, males and females have been collected together several other times (with no other male or female of *Ephuta* collected at the same time and place); Washington, D. C., July 17, 1948 (R. Boetticher), one male, one female; Washington, D. C., August 30, 1947 (D. Shappirio), one male, two females; Washington, D. C., September 4, 1947 (D. Shappirio) one male, one female. The male and female or also both quite frequent in the region around Falls Church, Virginia.

Ephuta floridana sp. n.

The present species, as here circumscribed, differs essentially from the very closely related *E. scrupea* by (a) the ferruginous color of the male, with the sculpture coarser; (b) the presence of a much more discrete microscopic tomentum or vestiture of the head, arising from minute punctulations scattered among the sparser, coarser punctures, in the female; (c) the obviously incomplete genal-postgenal carinules in the female.

The female sex appears to be composed of genotypically different forms, which may even be found to represent the female sex of distinct species of males. For the present the following more conservative course is followed, since the relationships with *E. scrupea* are so close that further "splitting" will probably not be warranted.

Ephuta floridana subsp. **floridana** sp. et subsp. n. (Fig. 42)

MALE. Length 5.5–6.0 mm. Totally ferruginous red, except for the legs, antennae, basal portions of mandibles, and distal portions of tergites 3–7, which are a castaneous red to piceous-red, and the hypopygium, which is off-white. Subantennal ridges sharp, pyramidally dentiform produced about half-way their length down to anterior clypeal margin, moderately diverging from between and below the antennal tubercles; connected at points of angulation by a transverse, sharp, erect ridge (thus delimiting a rather small ovate, deep, pit-like subantennal basin, distinct from the obtrapezoidal clypeal basin). Ocelli moderately small. Sculpture rather coarse (considerably more so than in *scrupea*), locally punctate reticulate. Tegulae non-carinate, but very coarsely, closely to contiguously punctured throughout, with sparse short hairs. Propodeum coarsely recticulate-areolate, with no sharp separation into dorsal and posterior faces (the transverse ridge virtually imperceptible, the dorsal and posterior faces rounded into each other angularly.)

Head ferruginous, the clypeal region lighter, the basal portions of mandibles and antennae darker, castaneous-red to piceous. Front and vertex with rather coarse, well-defined, contiguous to rugose puncturations; genae similarly, much more coarsely, more sharply and deeply sculptured, posteriorly the intervals forming a slight, irregular ridge separating the genae from postgenal regions. Vestiture very sparse, inconspicuous, virtually erect and suberect (no sericeous vestiture), on clypeus, lower front and genae silvery, on upper front and vertex fuscous. Eyes moderate in size, 0.57 mm. long, 0.44 mm. wide; minimum frontal distance apart 0.57 mm. (equal to eye-length; this ratio about equal to that occurring in *scrupea*). Ocelli 0.12 mm. long; ocellocular distance 0.34 mm. long (2.83 ocellar length): interocellar distance 0.16 mm. (1.33 times the ocellar length); distance from anterior ocellus 0.10 mm. (0.83 times the ocellar length). Subantennal carinae as described above, the subantennal basin ovate, rather short and nearly pit-like, deep, hemispherical-ovate; subantennal ridges gradually becoming obsolete below the angulations. Antennal tubercules with very slight, short, swiftly obsolete ridges indicated above; scape normally bicarinate; pedicel subglobose, 0.11 mm. long; the first flagellar segment 0.12 mm. long, 0.15 mm. wide; second flagellar segment 0.10 mm. long, 0.15 mm. wide. Head 1.28 mm. wide.

Alitrunk ferruginous, quite coarsely sculptured. Pronotum coarsely sculptured on disk, the punctures deep, contiguous, angular; dorsal face rounded into cephalic face; width at the moderately strongly produced humeri 1.10 mm. 1.39 mm. at tegulae, trapezoidal in dorsal outline, with the base of the trapezoid deeply, obtusely, angularly emarginated by the mesoscutum (the pronotal face strongly abbreviated medially); humeri moderately acute, the strong humeral carina with the oblique fork of the lateral faces dividing it into two obsoletely, shallowly, distally punctured areas bearing a thin sericeous, fine pile, arising from minute punctulations. Mesoscutum similarly sculptured as dorsal propodeal face (more coarsely so that vertex), with no trace of parapsidal furrows: vestiture ferruginous-fuscous; scutellum somewhat swollen, but not approaching gibbous, with close, but less coarse punctures. Mesopleura evenly convex, with regular, rounded, rather deep, punctures considerably more moderate in size than those of pronotum; vestiture very sparse, thin, mostly erect, white, neither obscuring punctulation nor color of integument. Central, elevated area of metanotum nearly continuous with scutellum, with one or two coarse punctures; lateral regions depressed, obscurely punctulate and with a thin, pale pile; metapleura polished and glabrous, except for a few coarse, rounded punctures below. Tegulae as described above; very coarsely punctured, more than normal for *scrupea*. Propodeum dorsally very coarsely areolate, the areoles devoid of all vestiture; basal areole ending in a median ridge that ends in the vestigial, obscure transverse propodeal ridge; dorsal and posterior propodeal faces not distinguished, rounded into each other, the obscure transverse ridge not medially dentiform produced (as in *scrupea*); lateral propodeal faces with posterior half with a row of moderately coarse, sharply defined areoles, the anterior half polished, forming a smooth gutter adjoining the metapleura. Legs piceous-red, with pale calcars, coxae not dentate. Wings subhyaline, distally not notably infuscated, the veins darker, brown.

Gaster ferruginous, except distal portions of tergites 3–6, pygidium and median carinules piceous or castaneous. Petiole short, transverse, rectangular in outline; first tergite coarsely, contiguously, sharply, polygonally punctate into about three transverse rows, at apex with a thin fringe of sericeous, curly hairs; first sternite with a low median carina, slightly more amply produced anteriorly. Second tergite with central portion of disk with rather coarse, rounded-hexagonal, deep, contiguous punctures, each bearing a single, short, subdecumbent fuscous hair; distal part of tergite with rather smaller, close, punctures, at apex with a rather thin band of white, sericeous, curled hairs (as in *scrupea*). Second sternite very coarsely punctured, the punctures contiguous, the narrow intervals rounded at apex, very sparsely silvery pubescent. Tergites 3–6 with rather distant, small punctures, with erect and subdecumbent fuscous, sparse vestiture (no sericeous decumbent vestiture); pygidium with similar, slightly coarser, contiguous punctures and erect and decumbent sericeous, curled, moderately dense, pale vestiture. Hypopygium whitish, at the very apex slightly brownish or buff, with obscurely defined, rather close, moderately coarse punctures.

FEMALE: Appearing intermediate in form between *E. scrupea* and *E. floridana* subsp. *dietrichi* (see below). The head with a discrete delicate, microscopic tomentum of fine fuscous hairs (so inconspicuous that the species has the facies of *E. puteola*); disk of tergum two of abdomen not bimaculate, the distal band subequally wide, except for the median interruption; genal-postgenal carinules incomplete, extending only a slight distance up from the teeth peripheral to the hypostomal area, the genae and postgenae thus broadly confluent, evenly continuous; hypopygial basal tubercules connected by a rather discrete transverse, welt-like ridge.

Holotype: Male, Pasco Co., Nov. 13, 1929 (O. C. Tigner), in collection of U. S. National Museum. Paratype: ''Florida'' in collection of Univ. of Minnesota (the measurements in diagnosis from paratype); the paratype is unfortunately in poor condition of preservation; the right eye, the distal portions of antennae and parts of the legs having been eaten away by dermestids, and the apical portions of the wings missing. A third male, Gainesville, Florida (F. W. Mead), taken on *Medicago sativa,* is in the U. S. National Museum.

Allotype: Florida, no other data supplied by the collector (D. Downes); to be deposited in collections of United States National Museum (fide Downes).[8]

[8] The above brief description is totally unsatisfactory. A better one cannot be given because the collector, who submitted a large series of specimens of both sexes, without locality data, which the author returned after verification, with the request that the material be labelled with labels other than meaningless code-tags. The material has not been made available again, and the above brief diagnosis is the only one made before the return of the allotype specimens. The long series of males and females present in the Downes collection made correlation of the male and female readily possible.

This species is the Florida analog of the *scrupea-argenticeps* complex, and is obviously related to *E. scrupea*. In the male sex it shares with the latter species all of its main species characteristics: whitish hypopygium, ocelli of moderate size, form of subantennal ridges and the basins they delimit, eye-form and size, and the relative length of eye to the frontal distance apart; moderate degree of development of humeral ridges; form of propodeum (with lack of a sharp differentiation into an areolate dorsal and smooth posterior face). Aside from the obvious color differences between the two species, one may mention the following structural differences: the head, dorsum of pronotum, and propodeum, as well as second tergite, are much more coarsely sculptured; the lateral pronotal faces are much more weakly and shallowly punctured, indeed, virtually impunctate (in *scrupea* rather deeply and distinctly punctured virtually throughout); the scutellum is rather more distinctly swollen; the disk of the second tergite is contiguously punctured (rather than moderately closely so). These structural characters indicate that *floridana* is certainly specifically distinct from *scrupea*.

The female sex (which is correlated almost certainly with the right male), is nearly transitional between the *Grisea* and *Puteola* complex of females. It shares, with these two complexes, the obviously incomplete carinules that lie between the genae and postgenae (above the hypostomal teeth), resulting in broadly confluent genae and postgenae. This characteristic at once will separate the female from that of *E. scrupea* (in which the carinules are complete). However, in other characters, the female closely approaches that of *E. scrupea*, notably in the lack of discal maculae, in the very slight development of the microsetigerous punctulations and vestiture of the dorsum of the head, and especially in the relatively small, very close to contiguo-confluent punctures of the disk of tergum two of the abdomen. If the correlation of these females to *E. floridana* and *scrupea*, respectively, will be substantiated (as is expected), the differences between the females will indicate beyond any doubt, that there are two distinct species, even though the males differ in largely pigmentational characters.

The extremely slightly developed microsetigerous hairs of the front and vertex of this subspecies will make its identification difficult. In ''rubbed'' specimens, the presence of these hairs can be seen largely because the intervals between the coarser punctures are not highly polished, but somewhat roughened and dull, marking the points of origin of the microvestiture. Occasional females of *E. scrupea* almost approach the "baldest" individuals seen of *E. floridana floridana.*

The female sex of this subspecies looks superficially like "*E. puteola,*" e.g., the disk of tergum two is immaculate, and the head is superficially devoid of sericeous vestiture. Under the higher powers of the wide field binocular microscope, however, the head shows a distinct (if thin) microsetigerous vestiture, and obscure micropunctulations, arising in part from the narrow intervals between the coarser macrosetigerous punctures. The decumbent microsetigerous, more or less sericeous hairs are griseous-fuscous to fuscous (and therefore extremely inconspicuous, since they almost blend with the integumentary color of the head). In this respect, the subspecies looks very much like *E. conchate* and *E. coloradella* females. It differs from these immediately in the uniform absence of the small maculae of the disk of abdominal tergite two, in the fact that the hypopygial tubercles are more or less connected by a transverse welt-like ridge, in the largely pale pubescence of abdominal tergites 4–5, and in minor differences in puncturation. A further difference may lie in the head shape: in *floridana* it is apparently uniformly strongly convergent behind the eyes, hence the head (behind the eyes) looks almost broadly triangular, or narrowly obtrapezoidal; in the few individuals seen of *E. conchate* females, the head is slightly convergent behind the eyes and more gradually rounded into the broadly truncate posterior aspect: hence, the head behind the eyes is more obtrapezoidal-rectangulate. This difference, although real, can be appreciated only when individuals of both species can be compared side-by-side.

Although the males of *E. floridana* and *scrupea* appear to be closely similar, the females exhibit a relatively distant relationship. The female of *E. floridana* differs from that of *scrupea* as follows: 1) the head is provided with a decumbent sericeous vestiture, 2) the head has the genal-postgenal carinules quite obsolete above the hypostomal ridges and teeth.

The female *E. floridana floridana* is almost identical with that of *E. floridana dietrichi,* from Alabama and Mississippi, differing from the latter in that the microsetigerous, sericeous vestiture of the head is less obvious, very fine, and more or less fuscous (never golden yellow). Whether these differences will prove to be subspecific is problematical. The more brilliant vestiture of the head of *E. dietrichi* gives it a facies (under even relatively low powers) unlike that of the old "*E. puteola.*" On the other hand, the very obscure sericeous vestiture (together with the fact that it is so dark that it blends with the pigmentation of the head capsule), gives *E. floridana* females a facies very similar to that of *E. puteola* (in its classical sense).

In Florida, *E. floridana* and *slossonae* appear to occur together very frequently (see notes under *E. slossonae*), and are not easily separated at times; both share the incomplete genal-postgenal carinules, a *puteola*-like facies, and similar pigmentation. *E. floridana* differs from the latter (and from *E. tentativa*) in that the head has a sparse, easily overlooked sericeous vestiture on the front, vertex and occiput. The females of the species known from Georgia and Florida (except for *E. marqueritae,* which lacks a pygidial area) can best be contrasted in the subjoined key:

1. Genal-postgenal carinules complete; head totally devoid of sericeous vestiture of the upper front and vertex (with sparse, erect hairs only). .... *E. tentativa*
1. Genal-postgenal carinules obsolete, the genae and postgenae confluent without trace of interruption, continuous .... 2.
2. Head with very sparse, inconspicuous, but distinct sericeous vestiture (in addition to sparse longer erect hairs) on the front and vertex, the macropuncture intervals dull, not smooth; disk of tergum two with round-hexagonal, regular, contiguo-confluent, smaller, very regular and close puncturation .... *E. floridana*
2. Head without any sericeous vestiture, the puncture-intervals of front and vertex polished; disk of abdominal tergum two with coarser, shallower, ill-defined punctures, mostly with obvious intervals (except at base) .... 3.
3. Eyes large: the front between the eyes 1.17–1.21 the eye-length; eye length 1.9–2.1 the malar distance; head obtrapezoidal, strongly and swiftly narrowed behind the protuberant eyes; abdominal tergites 4–5 silvery pubescent; front and vertex with round punctures, widely separated, the flat intervals polished, the head thus nitid. *E. slossonae* and *battlei*[9]
3. Eyes smaller: the front between the eyes 1.22–1.65 the eye-length: eye-length 1.3–1.9 the malar distance; head not obtrapezoidal, gradually

[9] As will be brought out under *E. battlei,* the female sex is hardly separable with any certainty from that of *E. slossonae.*

narrowed behind the eyes, which appear less protuberant; front and vertex with close, contiguous to contiguo-confluent, angular punctures, the intervals narrow to obsolete. .... 4.

4. Antennae reddish on scape, blackish only distally; legs concolorous with alitrunk proximad of apices of femora, fuscous to blackish distally only; terga 3–6 of abdomen with integument castaneous to fuscous and tergite 2 more or less castaneous to fuscous (at least laterally and distally); head often piceous; front 1.30–1.65 the eye-length. .... *E. puteola*[10]

4. Antennae uniformly blackish, including scape, strongly contrasted to the always ferruginous head; legs wholly blackish, except for coxae and trochanters; terga 2–6 of abdomen with integument wholly ferruginous, like that of alitrunk and head; front 1.22–1.37 the eye-length. *E. sabaliana*

Ephuta floridana dietrichi sp. et subsp. n.

FEMALE. Length. 5.2 mm. Similar in general appearance to *puteola*, but with the entire body ferruginous, the head with the vertex concolorous, the legs and distal abdominal segments all uniformly pigmented, and with the head with a distinct, decumbent to appressed sericeous yellowish tinged vestiture that slightly obscures the sculpture; hypostomal-postgenal carinules disappearing shortly above the hypostomal teeth. Disk of tergite two not maculate; pygidium defined, smooth and nitid; hypopygium with the basal tubercules distinct, connected by a discrete transverse ridge, the apical part of the hypopygium distinctly quadridentate.

Head transversely oval, not conspicuously narrowed behind eyes (hence not obtrapezoidal in outline), 1.26 mm. wide; eyes moderately large, silvery, 0.54 mm. long and 0.40 mm. wide; front 0.72 mm. wide (1.32 the eye-length); malar distance 0.31 mm. (eye-length 1.74 the malar distance). Integument ferruginous, concolorous with rest of body; sculpture moderate, the punctures of the front slightly but distinctly separated, scarcely contiguous, those of vertex even more distinctly separated, the intervals roughened and punctulate; coarse punctures setigerous, giving rise to burnt golden, suberect, stiff, moderately long hairs, the interspersed punctulations giving rise to a moderately dense, sericeous vestiture, pale yellowish on lower front and posterior part of vertex, but somewhat fuscous-tinged on lower vertex; occiput and genae similarly, slightly more deeply punctured and with a rather distinct whitish sericeous vestiture. Hypostomal-subgenal carinules very incomplete; high and lamelliform in the lower, oral portions, from the condylar region to the spines, but obsolete very shortly above the teeth, thus with the genal and postgenal regions evenly continuous for the greater part of their length; the postgenal region largely smooth and nitid, except anteriorly along midline, where the integument is weakly, transversely striolate. Antennae concolorous at base, somewhat fuscous on distal halves; pedicel transversely obconic, 0.10 mm. long and 0.12 mm. wide; first flagellar segment 0.13 mm. long and 0.16 mm. wide; second flagellar segment 0.11 mm. long and 0.18 mm. wide.

[10] The putative female of *E. pauxilla*.

Alitrunk ovate-elliptical, slightly wider anteriorly than posteriorly, 1.72 mm. long, 0.92 mm. wide at prothoracic spiracular plates, 0.93 mm. wide at apices of propodeal spiracles, the distance between the front and posterior spiracles. 0.56 mm. Integument concolorous with head and gaster, ferruginous; sculpture moderately coarse (considerably more so than on head, the punctures more elongate and close to contiguo-confluent), more shallow and not as sharply defined. Vestiture of meso– and metanotum dusky, sparse, elsewhere silvery white; the pronotum, especially on the lateral faces, with rather dense and obvious off-white sericeous vestiture; propodeum silvery pubescent; lacking all trace of lines of sericeous hairs. Legs uniformly yellowish-ferruginous, nearly concolorous with body.

Gaster ferruginous throughout, the apical segments scarcely castaneous tinged, virtually concolorous. Petiole with carina high, scarcely higher anteriorly. Second tergite rather coarsely and contiguo-confluently punctured on disk (like notum of alitrunk), the punctures contiguo-confluent even laterally; disk with stiff, fuscous, sparse, setose pubescence and at apex with a dense, subequally wide band, of ivory-white sericeous decumbent to appressed hairs, distinctly interrupted medially by fuscous hairs; disk lacks all trace of sericeous discal maculae. Second sternite coarsely confluently to rugose-confluently punctured, with sparse whitish vestiture. Tergite three, except laterally, with burnt golden to fuscous vestiture; tergites 4–6 and sternites 3–6 with virtually entirely silvery-white vestiture. Pygidium with distinct lateral carinules defining a smooth and nitid area 0.16 mm. wide; area laterad of pygidial area with rather distinct contiguo-confluent setigerous puncturation. Hypopygium with basal tubercles distinct, connected by a discrete but low, rounded transverse ridge; region distad of basal ridge rather coarsely and closely setigerously punctured; apex distinctly quadridentate.

Holotype: Lucedale, Mississippi, April 13, 1932 (Henry Dietrich), in collection of Cornell University.

This subspecies (and the variant of it described below) agree in most respects with *E. baboquivari* in the relatively dense, slightly yellowish sericeous vestiture of the head, obscuring the sculpture; the absence of all trace of maculae of tergite two; the connected hypopygial teeth; the nitid, defined pygidial area. *E. floridana dietrichi,* however, differs from *baboquivari,* in the somewhat smaller eyes and wider front, the incomplete hypostomal-postgenal carinae, the much coarser, less sharply defined punctures (on disk of the second tergite the punctures are about 0.07 mm. wide in *dietrichi;* in *baboquivari* only about 0.04 mm.).

Structurally, the species agrees more with *E. conchate* and *coloradella,* from which it differs in the more completely continuous genal-postgenal region (with the hypostomal-postgenal carinules much less developed above the hypostomal teeth), the smoother postgenal region, and the more completely developed basal hypopygial tubercles (and connecting ridge). *E. f. dietrichi* also has the sericeous vestiture of the head better developed, while it lacks the maculae of the second tergite (which are present in *E. conchate* and *coloradella*).

Related very closely to *E. floridana dietrichi* is the following form. Since I cannot demonstrate that the differences between the two are constant, I prefer to treat it, tentatively, as a minor variant to which no taxonomic rank is accorded:

Similar to typical *dietrichi*, but differing as follows: tergites 3–5 of abdomen largely fuscous pubescent, except for a median longitudinal line, obscurely defined, formed by decumbent to appressed, silvery, sericeous hairs; head more densely and uniformly pubescent, the sericeous hairs all ivory white to very pale yellowish, the erect hairs all uniformly golden in color; hypostomal-subgenal ridges quite suddenly obsolete dorsad of the hypostomal teeth.

From Mobile, Alabama, August (Creighton), in collection of University of Minnesota.

This variant differs chiefly in the presence of a line of silvery sericeous hairs on the distal abdominal tergites. More material may bridge the gap between this and typical *dietrichi* and indicate nomenclatorial recognition of this extreme as unnecessary. The chief dimensions are in about the same ratio as in typical *dietrichi* (compare Table IV).

It needs to be pointed out that *E. floridana floridana* is at present known only from Central and Southern Florida. No male closely allied to that of *E. floridana floridana* is known from the Gulf Coast region of Mississippi and Alabama. As a consequence, the real possibility exists that the individuals here described as a subspecies of *E. floridana* (subsp. *dietrichi*) may represent a wholly discrete species.

Ephuta tentativa sp. n.

FEMALE.— Length 6 mm. Integument nearly uniformly ferruginous, except the flagellum of the antennae and the apical four segments of the abdomen slightly darker (the head and disk of second tergite light ferruginous). Entirely similar to *E. puteola*, but the eyes larger, more prominent, the front only 1.17–1.25 the eye-length.

Head 1.46 mm. wide, in dorsal profile transversely oval-rectangular, gradually narrowed behind eyes and not distinctly obtrapezoidal, punctured and pubescent as in *scrupea* and *puteola.* Eyes 0.66 mm. long and 0.49 mm. wide; front 0.79 mm. wide between eyes (1.17 the eye-length); space between eyes and apex of posterior mandibular condyles (base of hypostomal carinules) 0.30 mm. (the eye-length 2.2 the malar space). Genal-postgenal carinules running up from the hypostomal carinules complete, sharp and even, but delicate, the smooth, nitid, impunctate postgenal region sharply separated from the contiguously punctured genae. Antennae as in *scrupea* and *puteola* as regards ratios between segments.

Alitrunk as in *scrupea* and *puteola,* with puncturation of dorsum slightly coarser than that of vertex, 1.19 mm. wide at anterior spiracles, 1.09 mm. wide at apices of the tubercle-like propodeal spiracles (the distance between the anterior and posterior spiracles 0.64 mm.); length of alitrunk 1.83 mm. Legs concolorous with alitrunk.

Gaster with distinct anterior petiolar tooth: second tergite with punctures no coarser than on alitrunk, contiguous to nearly confluent on central part of disk; apical pubescent band equally wide, dense, interrupted by darker vestiture medially. Tergites 3–5 more or less completely fuscous pubescent; tergite 6 whitish pubescent, 0.76 mm. wide at base; pygidial area discreet, small, smooth and nitid, 0.16 mm. wide (the last tergite about 4.8 as wide as pygidial area; the front also about 4.8 as wide). Hypopygium with prominent basal tubercles, not distinctly connected by any transverse ridge; apex very obscurely 4-dentate, the lateral teeth minute, the apex scarcely retuse.

Holotype: Atlanta, Georgia, June 2, 1935 (P. W. Fattig), in collection of University of Minnesota.

Paratype: Ochlochnee, Georgia, May 8, 1940 (P. W. Fattig), in collection of P. W. Fattig.

This new species is possibly the female sex of *E. psephenophila,* since it differs from *puteola* and *scrupea* in the larger eyes and correspondingly narrower front. The larger eyes of *E. psephenophila* and narrower front, it will be remembered, represent one of the significant characters separating that species from *scrupea.* Associated with larger eyes, there has been a corresponding decrease in size of the malar space (which for convenience is measured, in all the females) from the base of the hypostomal carinules, i.e., near the posterior mandibular condyles, to the lower eye-margin. The relatively sharply developed, complete carinules separating the genae from the postgenae also separate the species from *E. puteola* and *E. slossonae.* Confusion with either of these species is easily avoided, since *E. slossonae,* which has larger eyes as in *tentativa,* has virtually no indication of the genal and postgenal carinules and therefore has very broadly confluent genae and postgenae. In *puteola,* where there may be slightly indicated obscure ridges, the eyes are much smaller than in *tentativa.* Confusion, therefore, is possible only with *scrupea,* from which *tentativa* differs only in the larger eyes. It is therefore possible that the latter should be considered merely a subspecies of the former, but the occurrence in the same general area of both forms suggests this is impossible.

This species agrees with *scrupea* (and *minuta*) in possessing very distinct, if low, complete postgenal carinules that extend up to the occipital transverse ridge. It differs from both of these species in the relatively large, silvery, prominent eyes (the front between them narrow, only 1.17–1.21 the eye-length; the malar distance, to apex of ventral mandibular condyle, narrow, only 0.4–0.45 the eye-length; the head 1.85 the width of the front).

The species is extremely close to *scrupea,* with which it agrees in sculpture, size, and pigmentation.

Ephuta psephenophila sp. n. (Fig. 18).[11]

Male. Length 6.2 mm. Entirely black, with moderately abundant silvery pubescence; ocelli extraordinarily large; subantennal pit elongate, narrow, higher than the clypeal; humeral angles weakly developed; tegulae smooth, except for micropunctures; transverse propodeal carina distinct, but rather weak; sculpture moderate.

Head oval-obtrapezoidal, rather shallowly, not at all coarsely punctured with well-separated punctures that are somewhat obscured by the rather dense, silvery, erect and appressed pubescence (especially on the lower front); punctures coarser, but well-separated, on the occiput, genae and postgenal region; the latter not subreticulate and carinate; width of the head 1.56 mm. (1.26 the width of the prothorax at the humeri). Width between the eyes, below their emargination 0.62 mm. Ocelli exceedingly large (larger than in any other North American species); the maximum diameter of the posterior 0.21 mm.; distance between them 0.20 mm. (0.95 their diameter); distance from nearest eye-margin 0.36 mm. (1.71 their maximum diameter); diameter of anterior ocellus 0.18 mm. Ocellar area imperceptibly elevated. Length of eye 0.76 mm. Distance between eyes and head process at posterior mandibular articulation 0.21 mm. (0.28 the length of the eyes). Antennal tubercles approximate, with a strong tuft of erect silvery hairs between and above them; lacking a strong oblique carina running up them and the frons; a short dentiform, oblique carina between them and the eye margins above the antennal scrobes. Below the insertion of the scapes arise two carinae (connected in a loop dorsad) that run down, nearly parallel, to the dorsal margins of clypeal basin (Fig. 18); they delimit a narrow, elongate, rather shallow basin, less than 0.06 mm.

[11] Through an oversight Fig. 18 (Part I, p. 36) is labelled as "**Ephuta ocellaria** sp. n." This latter is an earlier species name that was dropped because of nomenclatorial reasons.

wide and about 0.25 mm. long (i.e., over four times as high as wide); at their anterior lateral ends they connect to the widely flaring clypeal carinae that run down to the reflexed margin of the clypeus, thus setting off a wide, truncated triangle, with the long side (anterior margin) about 0.24 mm. wide (0.39 the distance between the eyes below their emargination), which is about four times as wide as the subantennal basin; the declivent clypeal basin, measured to the reflexed anterior margin, is considerably lower than the subantennal; the two are separated by a low carina. Laterad of the subantennal carinae there is considerable long, but fine, brush-like pubescence. Mandibles normal, not truncate apically, their apex acuminate, unidentate apically, with a subapical tooth within; lacking a molar surface; punctate and pubescent on basal halves. Antennae with bicarinate scape and subglobose pedicel with some long silvery hairs; the latter as wide as long, subequal in length to the first and second flagellar segments; these slightly shorter than the third which is still wider than long.

Alitrunk moderately to somewhat coarsely sculptured, entirely black. Pronotum moderately narrowed anteriorly (0.75 as wide at the humeri as at the tegulae), the humeral angles very feebly developed; 1.24 mm. wide at humeri (0.79 the width of the head); 1.65 mm. wide at tegulae; its dorsal face rounded into the cephalic plane gradually, the latter punctate above and smooth and glabrous below. Dorsal surface of pronotum rather coarsely, closely punctured, but the punctures distinctly separated; the lateral pieces similarly sculptured dorsad, but smooth, except for abundant setigerous micropunctures, below; the smooth area obliquely traversed by the moderately developed backward extension of the humeral carinae; dorsally with rather dense appressed and sparser erect pubescence. Mesonotum with punctures scattered and shallow, much less closely punctured than pronotum and much less appressed-pubescent. Scutellum with unusually large, shallow punctures, as large as those of mesonotum, and considerable long, erect pubescence; flatly inflated, scarcely gibbous. Mesopleura very densely pubescent, obscuring the puncturation; chiefly of short, appressed, but also of long erect hairs. Metanotum with moderate punctures, nearly obscured by abundant, fine, silvery pubescence. Tegulae smooth, except for small setigerous punctures, not carinate, conchiform; 0.71 mm. long (0.89 as long as lateral length of pronotum). Dorsal face of propodeum irregularly areolate-reticulate; a large, elongate, irregular, smooth areole extending from the anterior margin of the propodeum to the rather weak, transverse propodeal carina, which is rather strongly dentate medially; dorsal face with only moderate, appressed, fine pubescence, that does not obscure the areolation; posterior face shallowly, obscurely areolate dorsally; lateral faces coarsely, deeply foveate-reticulate dorsally, more shallowly sculptured below. Legs black, rather densely silvery pubescent; the femora and tibiae, on their outer faces with many small setigerous micropunctures; middle tibiae slightly longer than the first and second tarsal segments combined; the longer calcar subequal in length to the first tarsal segment. Wings rather weakly infuscated, at base even more weakly so. Free part of M_4 scarcely four-fifths as long as either m–cu, free part of M_{3+4}, or the sector of M between m–cu and the origin of M_{1+2} and

M_{3+4}. R–m only a little longer than the sector of M between m–cu and r–m; nearly twice as long as sector of Rs between r–m and the origin of R_5. Sector of R_{3+4} between origin of R_5 and origin of R_3 and R_4 less than twice as long as sector of Rs between r–m and origin of R_5. Cell R_5 short, only twice as long as high.

Abdomen black, the pubescence silvery, moderately sparse, long and erect, except for the apical bands of dense, curly, appressed pubescence on the first and second tergites. Petiole coarsely punctured above and laterally, the apical half with punctures obscured by the pubescent band; ventrally with a high carina, produced anteriorly as a strong tooth; not bidentate. Second tergite with sparse, widely separated, deep, coarse punctures; those on the sides much closer; lateral margins finely, setigerously micro-punctate. Second sternite very coarsely, deeply, closely, setigerously punctured, much more so than the tergite; the punctures slightly less coarse laterally; apically with a thin band of slightly denser pubescence, and a row of long hairs. Apical tergites finely punctured and pubescent, except for the somewhat more coarsely and shallowly punctured pygidium. Apical sternites sparingly punctured and pubescent, the largely yellow-white hypopygium more coarsely so.

Holotype: Stone Mountain, Georgia, August 6, 1931 (Bradley and Knorr), in the collection of Cornell University.

This very distinct new species differs from most other members of the genus in the possession of very large ocelli (Table 1).

It differs from *E. battlei* in which the ocelli, though large, are still appreciably smaller, in having the subantennal pit very high and narrow, higher than the clypeus, instead of minute, subquadrate and very low. It also is entirely black, while typical *battlei* has a red second abdominal segment. The tegulae are also smoother, lacking coarse punctures, and the humeral angles are not nearly as strongly produced; furthermore, there is no trace of the carinae running up from the antennal tubercles. The relatively weakly sculptured genae, that are not carinate behind will separate the species immediately from any form of *battlei.*

It is more closely related to *E. marguerita, rufisquamis,* and *ecarinata,* than to *battlei,* for the configuration of the subantennal and clypeal basins is more nearly similar and the transverse propodeal carina is similarly dentiform medially.

From *scrupea* it differs in the smooth tegulae and the possession of a transverse propodeal carina, as well as in the large ocelli. However, the subtennal pit of *scrupea* is not so very different.

Ephuta tegulicia Bradley (Fig. 23).

?1894–96 *Mutilla idiasta* Cameron, Biol. Centr.-Amer., Hymen. 2: 312.

1916 *Ephuta tegulicia* Bradley, Trans. Amer. Ent. Soc. 42: 193, male.

Holotype: Male, Fedor, Lee County, Texas, June 1–7, 1909 (Birkman), in the collection of Nathan Banks (Museum of Comparative Zoology, Type No. 13733; examined June 1951).

Distribution: Apparently very local; as far as known limited to southern Texas, south of the 31st degree of latitude, and southern Arizona. Probably occurring in Mexico.[12]

Records: TEXAS: Victoria, August 3, 1910 (J. D. Mitchell), one male; Fedor, Lee County, September 1900, one male; Lee County, May 1907 (G. Birkman), one male; Lee County, August 1910 (Birkman), two males; Dallas (Boll), one male; Fedor, Lee County, June 21, 1909, one male. ARIZONA: West Slope, Patagonia Mts., Santa Cruz Co., August 9, 1955 (Butler and Werner), one male (USNM).

This species differs from all other nearctic species in the form of the tegulae, which are strongly arched and roof-like, with a strong longitudinal median ridge throughout their length. The dense sericeous, silvery vestiture obscuring the dorsum of the propodeum, and the rather elongate, boat-like subantennal basin (narrowed on both ends), as well as the black hypopygium are characteristic. The humeri in this species are rather strongly produced and acute; the ocelli are moderately large (Table I). The species appears most closely related to the other forms with a dense vestiture of the dorsum of the propodeum, such as *E. psephenophila* and *margueritae*. These both have the hypopygium pale, the tegulae evenly convex, and the propodeal carina strongly dentiform produced medially; they furthermore have the humeri of the thorax very little produced.

Ephuta ecarinata, occurring in the same general region as *tegulicia* very closely resembles the latter; it has the thoracic humeri strongly produced, the ocelli of identical size, and the

[12] It is very probable that *E. tegulicia* will prove a synonym or subspecies of the Mexican *E. idiasta* (Cam.). The latter shares with *tegulicia* roof-like, tectate tegulae, a dorsally densely silvery sericeous-pubescent propodeum, and a quadrate to transverse petiole. Until material of *tegulicia* can be compared with the type of *idiasta* it appears wisest to retain the name *tegulicia* for the Texan material.

propodeum of similar form, and similarly densely pubescent dorsally. The white hypopygium of *ecarinata,* and the non-carinate tegulae (hence the name) certainly warrant specific separation of the latter.

Brimley (1938, p. 438) records *E. tegulicia* from North Carolina. I have examined the specimen upon which this record is based, and find it to represent *Ephuta margueritae* ssp. *xanthocephala* ssp. n.

Ephuta ecarinata sp. n. (Fig. 22)

This species, with a known distribution from southeastern and south central Texas to Arizona and Mexico, is apparently the western member of the *margueritae-psephenophila* complex.

The decidedly smaller ocelli, as well as the much broader, not gutter-like subantennal basin are the chief characteristics that serve to differentiate it from *psephenophila. Ecarinata* (except in very small individuals in which the heterogonically-developed species characteristics are very poorly emphasized) has the humeri much more strongly developed than in *psephenophila.*

The much larger ocelli, more strongly developed humeral angles, and entirely differently shaped subantennal basin serve to separate *ecarinata* from the eastern *margueritae.*

Superficially *ecarinata* is almost a duplicate of the relatively distantly allied *tegulicia.* The vestiture, degree of development of the sculpture, size of ocelli, development of the subantennal ridges and the basins they delimit (Fig. 22), are identical in both species. The noncarinate tegulae and yellow-white hypopygium of *ecarinata* at once distinguish that species from *tegulicia.*

The relationship between *ecarinata* and *neomexicana* requires further study. The decidedly smaller ocelli of the latter form, the less obvious development of sericeous vestiture, and the more weakly developed humeri of the latter strongly indicate that *neomexicana* probably does not belong to the *margueritae* complex. The relationships of that subspecies may be more with *cephalotes,* sp. n., described on a following page.

Critical study of available material indicates that *ecarinata* is to be divided into two distinct races, a Texan-eastern Mexican subspecies with smaller ocelli and denser vestiture, and an Arizonan subspecies with the ocelli larger, the vestiture sparser, and the median propodeal tooth only weakly developed. Until opportunity is available again to study the type of *neomexicana* it is tentatively left as a third subspecies of *ecarinata.*

Ephuta ecarinata subsp. **ecarinata** sp. et subsp. n.

MALE, length 7–8 mm. Totally black, except for the yellow-white hypopygium; rather densely silvery pubescent, the head, pronotum, mesopleurae, and dorsum of propodeum with a rather conspicuous vestiture of decumbent, sericeous, silvery hairs. Subantennal carinae triangularly dentiform produced about half-way down to anterior clypeal margin, the teeth connected by a transverse ridge (thus delimiting an elliptical-ovate, boat-shaped subantennal basin, about twice as high as wide). Tegulae on basal sixth slightly ridged, but not carinate, more or less evenly convex, with fine and moderately small, rather close punctures on limited central portion, the wide flange with minute setigerous punctulation. Propodeum distinctly divided into a densely sericeous pubescent, areolate, dorsal portion, and a nearly vertical posterior face, by a low transverse ridge that is distinctly produced medially into a moderate erect tooth.

Head transversely oval, 1.8 mm. wide. Sculpture on front and vertex moderate as regards coarseness, but close to contiguous, rather irregular, not deep; genae more coarsely, sharply punctate-reticulate, evenly rounded behind into the postgenae. Eye-length subequal (1.0–1.08) to the minimum frontal distance apart of eyes. Ocelli moderately large, length 0.18 mm.; ocellocular distance 0.38 mm. (2.11 times the ocellar length); interocellar distance 0.27 mm. (1.50 times the ocellar length); distance from anterior ocellus 0.14 mm. (0.78 the ocellar length). Antennal tubercles lacking distinct suprascrobal ridges; scape bicarinate, the lower edge with the carina sharper; pedicel obconic-subglobose, ratio of its length to first, second and third flagellar segments respectively 1.7; 1.8; 1.7; 2.1. Vestiture totally pale, silvery, erect and decumbent, the front, vertex and genae with a thin, sericeous, curly vestiture in addition to the erect, sparser hairs.

Alitrunk black, moderately weakly sculptured. Pronotum with rather strongly produced humeral angles, subdentiform projecting, the pronotum in dorsal view trapezoidal, with the mesoscutum cutting into the base of the trapezoid at an obtuse angle, almost to the cephalic declivence of the anterior pronotal margin; puncturation of pronotum moderate in size, but close, angular, contiguous; vestiture pale, erect and with a rather thin pile of decumbent silvery, curled, hairs; lateral pronotal faces with the oblique posterior fork of the humeral carinae moderate, distinct, but not acutely, sharply developed; dorsal part of lateral pronotal faces concave, along upper border with the notal sculpture obsoletely extended into them, otherwise smooth (except for the minute punctulations, which give rise to a thin vestiture of microscopic hairs); width of pronotum at humeri 1.62 mm. (0.90 the width of head); width of pronotum at tegulae 2.01 mm. (width at humeri 0.8 the tegular width). Mesoscutum much more coarsely, irregularly punctured, the rounded intervals narrow to obsolete; with erect, sparse, off-white vestiture; scutellum not swollen, nearly flat, with close, regular, rounded-polygonal punctures, much inferior in size to those of mesoscutum. Tegulae as described above, rather thin and hyaline except medially, with a distinct, moderate fine vestiture. Mesopleura evenly swollen, contiguo-confluently punctured, the punctures subequal in size to those of dorsum of pronotum, the vestiture of moderately dense, sericeous, decumbent, curled hairs, and sparse, suberect hairs (somewhat obscuring sculpture). Metanotum with 2–3 coarse punctures on the central, slightly elevated portion, laterally depressed, smooth, with a thin silvery pile. Metapleura smooth and polished, except for a few coarse punctures ventrally, and for a few sparse minute punctulations, bearing fine, microscopic hairs. Propodeum coarsely areolate dorsally, with the areolation deep, obscured by the rather thick mat of decumbent silvery, pilose-sericeous hairs; lateral faces with posterior halves deeply, closely punctate-reticulate, foveate, glabrous, the anterior halves glabrous and smooth, impunctate, forming a smooth wide gutter bordering the metapleura. Legs piceous-black, with pale white calcars and thin silvery vestiture. Wings virtually hyaline basally, the distal halves slightly fumose, the veins a moderately deep brown.

Abdomen black, except for the hypopygium; petiole extremely short, transverse, with very little dorsal face, with several transverse rows of contiguous coarse punctures, obscured except along posterior margin by the dense, sericeous silvery border of hairs; ventrally with a low, median keel, rather angularly produced anteriorly. Second tergite with rather small, very regular, rounded, subcontiguous puncturation (laterally the narrow intervals with some punctulations giving rise to thin vestiture of microscopic decumbent hairs); distal border of sericeous, silvery hairs rather dense and broad. Second sternite with moderately coarse, moderately close punctures, with rounded intervals. Disk of second segment and distal segments entirely white pubescent. Distal tergites with sparse, entirely erect, thin fringes of hairs, arising from moderately distinct to close, rather small punctures. Pygidium contiguo-confluently, slightly more coarsely punctured, with a little sericeous, decumbent vestiture, in addition to the erect hairs. Hypopygium yellow-white, similarly punctured as pygidium, with subdecumbent white hairs.

Holotype: Lee County, Texas, August 1906 (G. Birkmann) in collection of Museum of Comparative Zoology.

Paratypes: Fedor, Lee County, Texas, October 1909 (G. Birkmann); Texas (Belfrage); Texas, no other data; Edinburgh, Texas, July 1935 (S. Mulaik) one male; Brownsville, Texas (J. C. Bridwell); Mexico, no other data, one male; Texas, no other data, one male.[13]

This species, with its subspecies, differs from related forms bearing a considerable vestiture of the dorsum of the propodeum by the following combination of characters: tegulae smooth, with at most a few scattered coarser punctures; ocelli moderately large; humeri rather strongly produced (width at humeral angles about 0.9 the width of the head); hypopygium yellowish-white; transverse propodeal ridge not very strongly dentiform produced

[13] An additional specimen, from Brownsville, May 15, 1935, has been seen.

medially; subantennal ridges with the configuration essentially similar to that of *E. tegulicia.*

This species is rather similar, in most ways, to *E. tegulicia,* but differs from it in the simple, ecarinate form of the tegulae, and in the yellow-white hypopygium. Except for these two characters the two species are virtually identical. The lack of a median strong tooth of the propodeum separates the species from both *psephenophila* (which has weaker humeri and much larger ocelli) and *margueritae* (which has weaker humeri and smaller ocelli). Both of these species also differ from *ecarinata* in the form of the subantennal carinae.

The individual from Brownsville, Texas (J. C. Bridwell), deposited in the United States National Museum, should perhaps be separated from *ecarinata* proper. In the more weakly developed humeral angles (compare Table I) it approaches *grisea,* while in the weaker vestiture of the dorsum of the propodeum and in several other characteristics it is similar to *ecarinata pima* ssp. n., treated below.

This subspecies represents the eastern population of *ecarinata*; it is limited to Texas and Mexico, as far as material examined is concerned. The female sex is unknown, but *E. auricapitis* or *sudatrix* may represent the female sex.

The chief differentiating characteristics between the typical subspecies and the subspecies *pima* (briefly diagnosed below) are given in the key. *E. e. ecarinata* has smaller ocelli, with the ocellocular distance distinctly greater than twice the ocellar length (in *pima* not to scarcely more than twice the ocellar length); the transverse propodeal carina is better developed in *ecarinata,* with the median tooth much more amply developed; the dorsal propodeal face is also more distinctly and densely silvery pubescent.

Ephuta ecarinata subsp. **pima** sp. et subsp. n.

Identical with typical *ecarinata,* but the ocelli somewhat larger (ocellocular distance 1.8–2.1 the ocellar length), the sericeous decumbent vestiture more weakly developed (the dorsal portion of the propodeum with the areolation not at all obscured by pubescence), and the median propodeal tooth obsolete or weakly developed.

Holotype: Tucson, Arizona (Snow), in collection of University of Minnesota.

Paratypes: Phoenix, October 10, 1934 (R. H. Crandall), one paratype.

The head measurements and prothoracic measurements of this subspecies are contrasted with those of typical *ecarinata* in Table I. It should be stressed that in typical *ecarinata* occasional individuals (like the one from Brownsville cited in the Table), have the humeral angles less strongly developed, and have the vestiture less dense and the propodeal tooth less obvious. Such individuals may easily be mistaken for the present subspecies, but will not be confused if the difference in ocellar size is kept in mind.

Since the completion of the manuscript several specimens referable to this taxon have been seen, including: West slope Patagonia Mts., Santa Cruz Co., Arizona, Aug. 9, 1955 (Butler and Werner) (USNM). This individual is more robust and better developed and shows several differences from the nominate subspecies that suggest a wholly distinct species may be at hand: (1) the tegulae are somewhat sharply tectate on their basal halves and very smooth, with only scattered, minute punctures; (2) the oblique carinae transversing the lateral pronotal faces are quite obsolete, rather than moderately sharp; (3) the legs are black, rather than castaneous. However, this extreme individual appears to be closely related to a more "typical" specimen of *E. ecarinata pima*, from Casa Grande, Arizona, Sept. 28, 1955 (Butler) (USNM). In this last individual the tegulae are less dark, bear coarser punctures centrally, and are less tectate basally. However, the legs are virtually black and the lateral oblique pronotal carinae are equally obsolete. Connecting the two extremes is a third individual, from Z. Marana, Arizona, July 6, 1955 (Butler and Werner) (UA), in which the tegulae are nontectate, but are very slightly punctured and highly polished. while the legs are virtually black.

Ephuta ecarinata subsp. **neomexicana** sp. et subsp. n.

Male. Length 7.7–8.0 mm. Closely resembles *cephalotes,* but lacks the strongly conical elevation of the ocellar region, has the punctures of both frons and vertex much coarser, contiguous to subconfluent; the punctures of the mesonotum are also coarser; cell R_4 is distinctly hexagonal (free part of vein M_2 arises considerably before R_4 joins $R_{5+}M_1$), and the wings are distinctly, if not strongly, infuscated; in *cephalotes* M_2 arises just before R_4 joins $R_{5+}M_1$ (cell R_4 is thus pentagonal), and the wings are much less noticeably infuscated (subhyaline); the humeri are more acute than in *cephalotes* (width at humeri 1.51 mm., 0.85 the width of the head; 0.75 the width of the prothorax at tegulae), although the thorax at humeri is scarcely wider than in *cephalotes;* the pronotum is not evenly rounded into the cephalic surface in *neomexicana,* and the cephalic surface is glabrous and impunctate (in *cephalotes* the dorsal surface is evenly rounded into the anterior face, and the puncturation is continued down, gradually becoming sparser and less coarse).

The ocelli are small, differing somewhat in size from those of *cephalotes;* the length of the posterior is 0.13 mm.; their distance apart 0.30 mm. (2.31 times their length; in *cephalotes* 2.58); their distance from the anterior is 0.18 mm. (1.38 their length; in *cephalotes* 1.67); their distance from the eyes is 0.45 mm. (3.46 their length; in *cephalotes* 2.80 their length).

Holotype: Sandoval Co., New Mexico, 6000 ft. altitude, August 21, 1939 (Rehn and Rehn), in the collection of the Academy of Natural Sciences, Philadelphia.

This form is related to *ecarinata* and *cephalotes.* It resembles the latter in the shape of the tegulae (convex, but not ridged basally, with a wide, less convex, translucent flange; disk with some scattered, moderate punctures, otherwise polished), which are somewhat hirsute in the present form, however. In both forms the upper carinae of the scapes are much weaker than the lower (nearly obsolete at times); both have dense, appressed silvery pubescence above the antennal tubercles; both have the punctulate, lateral, microsetose areas of the second tergite very well developed; in both forms the propodeum is similarly sculptured and its pubescence is equally sparse; the shape and sculpture of the scutellum is identical; the well-developed, rather dense vestiture of the head, pronotum, mesopleura, and of the body in general is equally developed in both forms; the punctures of the dorsal surface of the pronotum are extended down to the upper half of the side pieces in both; the disk of the second tergite is equally sparsely, weakly punctured towards its apex in both forms.

The subspecies differs from both other forms of *ecarinata* at once in the much smaller size of the ocelli. The spatial arrangement of the ocelli (i.e., relation between interocellar and ocellocular distances) approximates that of *ecarinata* more closely than that of *cephalotes,* while the unproduced ocellar region also would allay the species more with *ecarinata.* However, *ecarinata* and the subspecies *pima,* as regards size of ocelli, may be the extremes of a cline, with the member with smaller ocelli in the east. The occurrence of *neomexicana* in the region between *ecarinata* and *pima,* and its much smaller ocelli, therefore, are quite inexplicable. It therefore seems that *neomexicana* may eventually be found to represent a discrete species. Upon the basis of the single available specimen a more conservative course appears warranted at present.

Ephuta sudatrix (Melander) (Figs. 33, 34)

1903 *Mutilla sudatrix* Melander, Trans. Amer. Ent. Soc. 29: female.

Type: Fedor, Texas, May 16, 1899 (Birkmann) [14]

Plesiotype: Fedor, Lee Co., Texas, May 12, 1902 (Birkmann), in collection of Museum of Comparative Zoology.

Records: Brownsville, Texas, May 8, 1935 (D. J. and J. N. Knull), one female; Brownsville, Texas, May 7, 1904 (H. S. Barber), one female; Los Borregos, Brownsville, Texas, May 21 and June 6, 1904 (H. S. Barber), two females.

This species is still known only from a limited area in southern Texas. The type was not available for examination, but the topotypic plesiotype listed above agreed with its description in every detail. From it the following description, not given in the original diagnosis, has been drawn.

Last tergite evenly convex, lacking a clearly defined pygidial area; laterally it is rather finely, evenly punctured, the punctures rather well separated, medially it is glabrous; its pubescence is golden-brown to rather strongly infuscated. Last sternum acuminate apically, with the tubercles of the base of the coarsely sculptured apical area distinct, well-developed, connected by a slight, obscure smooth ridge; at apex distinctly acuminate, not broadly truncate or emarginate at apex; the whole coarsely sculptured area is distinctly longer than wide at base, and bears very coarse punctures whose intervals are irregular and rounded into the punctures, the whole rather unevenly coarsely sculptured; bearing long pilose silvery hairs. Antennae with the tubelcles prominent; the pedicel two-thirds as long as

[14] According to a letter from Dr. Melander, the type is supposed to be in the collection of the Washington State College, at Pullman, Washington. A letter to that institution resulted in a statement to the effect that the type material deposited there by Melander had been placed in the general collection, available for student use, and that some of the material had disappeared; the rest had been sent on to Dr. C. E. Mickel, at the University of Minnesota. The type of *sudatrix* could not be located among the Melander material sent to Minnesota, so it appears probable that it is no longer in existence. For that reason, I have declared a specimen, conforming in every detail to Melander's satisfactorily detailed description, and topotypical with the supposedly lost type, as the plesiotype.

the first flagellar segment, which is about a fourth wider than long and but little longer than the second flagellar segment. Supraclypeal flange quadridentate, the teeth prominent, narrowly separated from each other, not strongly downward produced over the clypeus. The hypostomal-postgenal carinules are complete and distinct throughout, attaining the occipital ridge.

This distinctive species, overlooked by Bradley in his revision of the nearctic species of the genus (1916) has remained unrecognized, though Melander's description was quite satisfactory. The species is one of two North American forms that have only a slight, vestigial indication of a pygidial area. The entire apex of the gaster is more slender and elongate, with the last tergite and sternite more pointed and narrow. The hypopygium on superficial examination appears entire (Fig. 33), but under a magnification of 100 × or more (especially when the last sternite is pried away from the sting, or removed and placed on a slide), the very tip is slightly tridentate. This feature is shared with *E. marguerita*e, but is not found in other species of the genus. The median, terminal tooth is about as wide as long, and corresponds with the strongly transverse, retuse, truncate or emarginate apical portion of the hypopygium in the forms with quadridentate hypopygia. This tridentate form of the apex of the hypopygium thus is to be interpreted as a modification of the more frequent quadridentate form, correlated with a narrowing of the sternite, and corresponding reduction of the usually bidentate apex into a single tooth. In addition to the undefined pygidial region, the large, silvery eyes, the golden yellow pubescent head, and the bimaculate disk of the second tergite are distinctive: these characters, as well as the form of the last tergite and sternite are shared with *E. margueritae,* though the sericeous vestiture and maculae in the latter species are much less conspicuously developed. The two species also share the presence of complete, well-developed carinules (flanked externally by slight grooves) that connect the hypostomal spinous teeth with the occipital ridge (which forms a nearly complete circle in all our species).

This species is very difficultly separable from the female of *E. margueritae*. In the present form the sericeous vestiture of the head is denser, thus more conspicuous, and the maculae of the second tergite are slightly larger, more conspicuous. These differences are very slight, yet the male sex of *margueritae* does not extend west to Texas, hence *sudatrix* must be the female of a species of male distinct from *margueritae.* Therefore the slight differences between the two species in the pigmentation of the vestiture (*see E. margueritae*) appear to indicate two species are at hand.

E. margueritae sp. n.[15]

This species belongs to the *ecarinata-psephenophila* complex of males, agreeing with these two species in the yellow hypopygium, the presence of a distinct median tooth at the juncture of the dorsal and posterior propodeal faces, and the moderate to dense sericeous white vestiture of the dorsal propodeal face. The species differs from *psephenophila* in the much smaller ocelli and broader subantennal basin, that is not sharply separated from the clypeal basin. It differs from the very closely related *ecarinata* in the somewhat smaller ocelli, the much less strongly produced humeri, the subequally wide subantennal and clypeal basins (Fig. 17) that are not separated by a discrete transverse carina, and by the possession of a very strongly developed median propodeal tooth.

The species includes two racial types, with the typical form occurring in Florida (subspecies *margueritae*), while the other subspecies (subspecies *xanthocephala*) appears limited in occurrence to the Piedmont and Appalachian Plateau region of the Upper and Lower Austral. Both subspecies are known from both sexes.

E. margueritae subsp. **margueritae** sp. et subsp. n. (Fig. 17)

MALE. Length 8.5–9 mm. Entirely coal-black except for the abundant silvery pubescence (which is unusually dense for *Ephuta*); humeri weakly carinate, feebly produced. Sculpture moderately coarse. Propodeum with a comparatively feebly developed transverse carina. Tegulae ecarinate, impunctate except for a few fovea at base; with fine, setigerous punctures only.

Head transversely oval-obtrapezoidal, closely but not coarsely punctured (much less coarsely so than *E. sabaliana*) the punctures never confluent; those of the genae much larger, but never forming rows of areolae, not carinate behind; entire head densely, silvery pubescent, the pubescence chiefly fine and appressed, obscuring the sculpture; also with erect, long hairs, especially on the frons above the antennae. Maximum width of head 2.21 mm. (1.20 times the width of the thorax at the humeri). Ocelli rather

[15] This species is named for my wife, *Olga Marguerite Schuster,* in appreciation for the constant help given during the twelve years during which this genus has been studied.

small (similar in size to those of *E. sabaliana*); the maximum diameter of the posterior ocelli 0.16 mm.; their distance apart 0.32 mm. (2.0 times their maximum diameter); their distance from the front ocellus 0.17 mm. (*1.06 times their maximum* diameter); their distance from the nearest eye margins 0.54 mm. (3.0 times their maximum diameter). Ocellar area nearly imperceptibly elevated. Length of eye 0.98 mm. (3.08 times the length of the distance between the lower eye-margin and the posterior mandibular articulation). The approximate antennal tubercles flattened above, densely pubescent and punctured above, carinate transversely towards their apices, entirely lacking the carinae that run up them and obliquely traverse the front in *E. stenognatha* and *sabaliana*. Antennal scrobes with a short, dentiform, high carina running into the base of the antennal tubercles. From below the antennae arise two carinae that delimit an oval subantennal basin, subequal in height to the clypeal basin, and very deeply and coarsely, setigerously punctured within. The two carinae that delimit the basin very high dorsad, suddenly diminishing in height half way down to the clypeal basin. Clypeal basin narrowly trapezoidal, smooth except for some setigerous punctures; the carinae that delimit it laterally suddenly diminishing in height and becoming obsolete before reaching the margin of the clypeus (thus the subantennal carinae are each biundulate). Clypeus as high as wide; width 0.31 mm. (0.31 as wide as the distance between the eyes, measured at the level of the antennal tubercles; in *E. sabaliana*, half as wide as the distance between the eyes); an area on each side of clypeus with long, brushlike, silvery, erect pubescence. Mandibles normal in size and shape, their width below the clypeus much less than the height of the clypeal basin, largely ferruginous, gently arched, acuminate, unidentate apically, with a smaller subapical tooth within; with some long, erect, silvery hairs. Subgenae smooth, strongly depressed below genae and sharply separated from them. Antennae blackish, the bicarinate scape with erect, silvery hairs; its carinae sharper and delimiting a deeper channel than in *E. sabaliana;* pedicel elongate, subconical, considerably longer than wide, with some erect, silvery hairs; slightly longer than first flagellar segment, which is subequal in length to the second flagellar and only slightly more than two-thirds as long as the third flagellar.

Alitrunk moderately punctured, entirely black. Pronotum rather strongly narrowed anteriorly (0.74 as wide at the humeri as at the tegulae), the humeral angles very weakly produced; 1.84 mm. wide at humeri (0.83 as wide as head); 2.49 mm. wide at tegulae; pronotal cephalic plane flat, smooth, shining. Length of pronotum from humeral angles to tegulae 1.21 mm. (0.66 times the width at the humeri). Sculpture of pronotum moderate dorsally, nearly entirely obscured by the appressed, dense, pilose silvery pubescence, the punctures round, distinctly separated; laterally the margins are similarly sculptured, but the lower parts of the lateral pieces are smooth, except for micropunctures that bear many fine, appressed pilose hairs. The obsolete backward extension of the humeral carinae traverses the side-pieces obliquely cutting them into two triangular sectors. Mesonotum more sparsely pubescent than pronotum, the punctures larger, subreticulate-areolate, frequently confluent, rather shallow, more or less arranged in longitudinal rows. Mesopleura inflated, very densely, silvery pubescent, the more abundant appressed hairs nearly obscuring the moderately large punctures. Scutellum closely, confluently punctate, the punctures deep, but only about half the size of those of the mesonotum; somewhat inflated, but nearly flat on top. Tegulae folded, but not carinate, nearly smooth except for the setigerous micropunctures, 1.10 mm. long (0.91 times as long as the pronotum laterally). Metanotum with some punctures; entirely obscured by the dense, silvery pile. Transverse carina of propodeum weak, consisting of a strong median tooth and a vague, poorly defined transverse ridge on each side that becomes obsolete laterally; the areolae of the dorsal face entirely obscured by the conspicuously dense silvery, appressed, pilose pubescence; lateral faces subreticulate dorsally; posterior face shallowly, coarsely, longitudinally areolate. Legs blackish, with silvery, erect pubescence; middle tibiae considerably shorter than first two tarsal segments; the calcaria strongly unequal in length, the longer subequal in length to the first tarsal segment. Wings moderately infuscated throughout, somewhat less so at base. Free part of M_4 slightly shorter than m–cu, ⅕ shorter than M_{3+4}. R–m at least ½ longer than the sector of Rs between r–m and the origin of Rs. Free part of R_5 equal in length to r–m and half again as long as the sector of Rs between r–m and the origin of R_5 (differing thus from *E. scrupea,* where R_5 is considerably longer than r–m). Sector of R_{3+4} between origin of R_5 and origin of R_3 and R_4 twice as long as the sector of Rs between r–m and R_5 (agrees with *E. scrupea;* but in *E. sabaliana* the two are subequal). Cell R_5 is nearly three times as long as high (in *E. scrupea* it varies from 2.1 to 1.8 times as long as high).

Abdomen moderately sculptured, black except for the dense bands of appressed silvery pubescence at the apices of the first and second tergite, and for the rather abundant, long, erect, silvery pubescence scattered all over the abdomen; the last ventral segment whitish. Petiole subquadrate in outline from above, its anterior face concave, with the ventral, anterior angles produced; rather coarsely sculptured dorsally, but the punctures obscured on apical half by the dense vestiture; ventrally with a strong median carina that is not hollowed out medially (i.e., carina not bidentate); anteriorly the carina is produced as a very strong dentiform process; lateral areas of sternite with a tuft of erect pilose pubescence each. Second tergite with moderate, well-separated punctures, those of the lateral margins more dense, however; the smooth lateral margins and a broader area dorsally on each side with numerous fine, setigerous micropunctures bearing pilose silvery pubescence, forming a rather conspicuous lateral border. Erect pubescence of tergites 2–7 rather abundant, conspicuous (somewhat more so than in *E. scrupea*). Second sternum with coarse, but well-separated punctures (much coarser than second tergite), with considerable erect silvery pubescence, that of the apex forming a weak band. Apical sternites similarly pubescent, black, except for the whitish hypopygium.

FEMALE. Length 7–9 mm. Integument deep ferruginous, locally piceous tinged; legs a piceous red. Vestiture largely fuscous tinged; sericeous vestiture of head fuscous or burnt golden, except adjacent to antennal tubercles, and on clypeus, where pale to golden; maculae of tergum two of abdomen golden; abdominal terga 3–5 with obscure, pale, decumbent to appressed patches on each side of midline, the midline and broad lateral areas entirely with decumbent and erect blackish hairs; pygidial segment largely (or partly) with dense ''beard'' of silvery hairs, largely obscuring the impunctate, nitid, median strip of the tergum; setigerously punctured lateral areas with punctures small but contiguous.

Head transversely oval, with large, somewhat silvery eyes; lowermost edge of front with erect and finer decumbent, sericeous golden hairs; rest of front, vertex and occipital region, and upper genae with erect, fuscous to blackish, and decumbent, burnt-golden to fuscous vestiture; the erect hairs arising from subcontiguous macropunctures, the decumbent, finer, more sericeous hairs arising from scattered micropunctures situated on the narrow puncture-intervals (at least in largest part); lower genae with pale to silvery, sparse, erect, and scarcely denser, decumbent, sericeous hairs; carinules bordering the hypostomal region (and ending in small, sharp teeth), obvious, sublamellate, high; carinules running up from the sharp teeth of the hypostomal carinules (i.e., the carinules bordering the subgenal region, running up to join the occipital carina) somewhat undulate, discrete throughout, sharply separating the genae from the glabrous and highly polished postgenae.

Alitrunk deep ferruginous, with contiguous-confluent puncturation, that of the pleurae merely contiguous; dorsal vestiture fuscous, except on propodeum, which bears a dorsolateral, short, ill-defined stripe of silvery, sericeous hairs on each side.

Gaster with tergum two with very close, nearly circular, contiguo-confluent, moderately coarse punctures, with suberect, fuscous vestiture (except on lateral, basal and distal narrow margins); disk with a small, obscure pair of widely separated golden maculae formed of decumbent, fine, sericeous hairs, anterior to midline of tergite; apex of tergum with subequally wide, dense, silvery, sericeous band, narrowly interrupted in middle. Distal terga with vestiture as above. Abdominal sterna entirely with sparse, silvery hairs; hypopygium with the silvery hairs forming an obscure, lateral brush near apex, on each side. Pygidium scarcely distinct, a narrow, cuneiform, nitid median strip free of punctures, almost hidden by the densely setigerously punctured lateral portions of the segment (whose hairs arch across and hide the narrow pygidial region); pygidial region undefined, except very obscurely on distal $\frac{1}{12}$ or less of segment (forming a vestigial pygidium less than $\frac{1}{16}$ the width of front between eyes).

Holotype: Male, Larkins (South Miami), Florida, April; in Museum of Comparative Zoology.

Paratopotype: Same data, retained in writer's collection (to be deposited in collection of Cornell University).

Allotype: Female, Tampa P. Scrub, Hillsborough County, Florida, July 22, 1949 (D. J. Downes), to be deposited in collection of United States National Museum.[16]

[16] A more complete description of the female is impossible at present, the allotype, supposedly in the United States National Museum (according to a letter received from the collector in 1951) not being in that collection at the time of writing (1956). The diagnosis given is a tentative one, made during the short period when the specimen was available to the writer in April–June 1951. In addition to the allotype, a second female was seen, consideraly smaller in size. The collector had, unfortunately, failed to provide locality data.

This species differs abundantly from our other nearctic species of *Ephuta*. The weakly sculptured, evenly convex tegulae of the male and the dense vestiture of the dorsum of the propodeum at once place the species in the same group with *E. rufisquamis* André, *E. psephenophila* sp. n., *E. ecarinata* sp. n., and *E. tegulicia* Bdly. The white hypopygium separates the species at once from both *rufisquamis* and *tegulicia,* which furthermore have the subantennal carinae of a different configuration. The form of the subantennal carinae and the larger ocelli, as well as absence of a strong propodeal median tooth at once eliminate *ecarinata* from consideration. *E. psephenophila,* the other species that appears to exhibit some relationships to *margueritae,* has relatively enormous ocelli, has the configuration of the clypeal basins and subantennal basins quite different (with the subantennal a narrow, gutter-like basin) and has less dense, less sericeous vestiture of the head.

Perhaps most characteristic, in the male sex, are the configuration of the subantennal ridges and the resulting subantennal and clypeal basins (Fig. 17). The subantennal basin is a shallow, ovate-elliptical depression, separated from the clypeal basin by a weak, transverse convexity; the subantennal basin is but little narrower than the clypeal, and the sharp carinae that delimit the two basins are biundulate, but are not dentiform or angulate at the corners where the two basins join. The antennal tubercles also bear a convex, curved, obscure ridge towards their apices, dorsally, on each side; these obscure ridges set off more or less U-shaped, flat, closely punctured, pubescent areas immediately above the antennal tubercles.

In the male sex the underside of the head of this species is very characteristically modified, as follows: the narrow area around the hypostomal ridges, and the postgenae are strongly depressed, smooth and nitid, and separated from the genae by a distinct ridge on each side, running from near the lower mandibular condyles (where it is sharpest, and where the resulting depression of the underside of the head is strongest) up to and joining the occipital ridges. The consequent ridges resulting, however, are quite different from the genal carinae that occur in groups *Pauxilla* and *Eurygnathus* (which never run into the occipital ridge, and never start at the mandibular condyles). The depressed parastomal and subgenal regions at once separate this distinctive species from *E. ecarinata* and *tegulicia.*

The female sex of *E. margueritae* is very closely related to *E. sudatrix,* agreeing in the obsolete pygidial area, and in the dense, sericeous vestiture of the front and vertex, as well as in the presence of maculae of the second tergum.

Comparison of the allotype female of subsp. *margueritae* with that of the allotype of the subspecies *xanthocephala* reveals a number of differences which seem to be suggestive. The hypostomal-postgenal ridges which are equally slightly arched in both subspecies (e.g., with the hypostomal not at an angle with the postgenal) are much more strongly developed in subspecies *marguerituae,* than in subspecies *xanthocephala.* The vestiture of the dorsum of the head in typical *marguerituae* is strongly fuscous tinged (both the erect and decumbent sericeous hairs); in subsp. *xanthocephala* the head appears whitish, because of the glittering, nearly white, slightly yellowish tinged, erect and decumbent pubescence. The dorsum of the alitrunk in typical *marguerituae* has the punctures scarcely more than half the diameter of the very coarse pleural punctures; in subspecies *xanthocephala* the dorsal punctures are more clearly contiguo-confluent and are considerably finer; they are only moderately smaller than the pleural punctures which are also uniformly contiguo-confluent. The disk of the second abdominal segment bears coarser, slightly more separated, rounder punctures in subspecies *marguerituae* while the maculae are quite small and inconspicuous; in subspecies *xanthocephala* the punctures are contiguo-confluent throughout, with the intervals vestigial everywhere, and the distal maculae are somewhat larger and paler. The erect pubescence of abdominal terga 3–5, and portions of 6 are quite fuscous to blackish in typical *marguerituae,* while they are nearly uniformly glittering and whitish in subspecies *xanthocephala.* Whether all of these differences will prove to be constant on examination of longer series must yet be determined. Perhaps most significant are the differences in development of the hypostomal teeth, and the rather distinct differences in puncturation (which are, however, conceivably heterogonically controlled).

The Floridan subspecies has the female darker ferruginous throughout, with the vestiture more deeply pigmented nearly throughout, compared with the northern subspecies (*xanthocephala*). The most obvious immediate difference lies in the much deeper pigmentation of the vestiture of the head, which gives the Florida race a considerably different facies (suggestive of the *puteola* complex).

The allotype female is unusually large, approaching *E. tumacacori* in size; the second female seen is considerably smaller. Except for this, the two individuals are virtually identical, though the brush-like development of the suberect hairs of the pygidial tergum is much more luxurious in the allotype, and consists very largely of silvery hairs (in the other female, more sparse, with all but the terminal group of hairs more or less fuscous). The allotype also has the second abdominal sternum with a conspicuous vestiture of decumbent, fine silvery-white hairs; this is quite absent in the other female.

This female is extremely similar to *E. sudatrix;* if it were not for the fact that *E. margueritae* males are quite discrete from *E. ecarinata* males (the possible male of *sudatrix*), I would not consider the two females specifically distinct. The female of *E. margueritae* subsp. *margueritae* is a uniformly deeper pigmented insect, with much of the vestiture that is silvery in *E. margueritae* subsp. *xanthocephala* replaced by fuscous hairs. Except for these differences in pigmentation and pubescence, no others appear to occur (though the limited number of females seen fall into two sharply discrete categories as regards the pigmentation and vestiture). The differences between the females, therefore, appear to be clearly racial, e.g., subspecific—analogous to the racial differences between the males.[17]

The female of this subspecies looks superficially more like *E.*

[17] The most important of these pigmentational differences are those cited in the key:

1. The distinctly fuscous (hence less conspicuous, against the deep ferruginous integument) vestiture of the vertex and occipital region of the head (*vs.* a more conspicuous, silvery to ivory-white vestiture in the subsp. *xanthocephala*).
2. The very deep ferruginous pigmentation of the body and appendages (*vs.* pale ferrugino-testaceous in the subsp. *xanthocephala*).
3. The somewhat less shaggy, shorter-clipped vestiture.
4. The largely or entirely blackish erect hairs of abdominal terga 3–5 (very largely silvery in subsp. *xanthocephala*).

These differences are slight, and based on study of only a limited number of specimens (five in all), hence the relationship between these two types of females should be studied more fully, with especial reference to the ocular micrometer. (The female of subsp. *margueritae* was discovered only in 1951, some four years subsequent to study of the other materials, and when an accurate ocular micrometer was unavailable. Therefore the cephalic indices of the typical subspecies should be studied, in order to determine whether there are any constant separating features in this regard).

sudatrix in the deeper pigmentation, more slightly developed patches of silvery hairs on each side of the midline of terga 3–5, than it looks like the *E. marguerilae* subsp. *xanthocephala* female. Both this and the next subspecies of *E. margueritae* differ from *E. sudatrix* in the less dense, less obviously golden vestiture of the head, and in the presence of at least slightly developed submedian patches of pale, silvery hairs of terga 3–5. The fuscous to subfuscous vestiture of the head of *E. margueritae* subsp. *margueritae* stands in direct contrast to the very pale vestiture of the head in the subsp. *xanthocephala;* both subspecies have in common the fact that the vestiture of the head is much less brilliant than in *E. sudatrix.*

The correlation of the female of this subspecies with the male is based on purely circumstantial evidence. *E. margueritae* subsp. *margueritae* is the only male of the *ecarinata-margueritae-psephenophila* complex known from Florida; the present female is the only female of that complex known from Florida. Furthermore, the female assigned here is certainly only racially distinct from the female of *E. margueritae* subsp. *xanthocephala* (whose correlation with the male can be regarded as certain).

Closely related to typical *margueritae* is the following race or subspecies, that appears to replace the typical species in the region from North Carolina to Pennsylvania.

Ephuta margueritae xanthocephala sp. and subsp. n. (Fig. 25)

MALE. Length 6–7 mm. Closely related to the species, but has the propodeum much less densely pubescent; has cell R_5 not more than two and one-half times as long as high; has sector of vein M between m–cu and r–m subequal in length to r–m (five-sevenths that length in the typical species); the wings are less heavily infuscated (subhyaline).

FEMALE. Length 6.3 mm. Frons, vertex, and upper part of genae with rather dense, fine, appressed golden-yellow pubescence, in addition to the infuscated erect coarser hairs; disk of second tergite with two distinct, but small spots of similar hairs. Pygidium not distinctly defined by carinae, the median glabrous area narrow, evenly rounded into the lateral punctured areas; hypopygium appearing entire, not at all four-lobed or four dentate apically.

Head rather full in the temples, not suddenly and evenly narrowed behind the eyes, a rounded transverse rectangular in outline from above. Frons vertex and genae closely and deeply to contiguously punctured, the punctures of the frons and genae slightly less close; punctures each bearing a long, erect, setose hair, not or scarcely infuscated (except on lower frons and genae, where they are silvery). The intervals between the punctures closely punctulate, each micropuncture bearing an appressed golden-yellow to ivory-white, fine hair (except on genae, where they are silvery). Clypeal area dorsally bounded by the usual quadridentate flange, but the teeth rounded, obtusely triangular, the two median ones separated by a deeper, yet obtuse incision. Genal-postgenal carinules running up to occipital ridge complete, sharp.

Alitrunk a longitudinal oval in outline, deeply contiguously and rather coarsely punctured dorsally, bearing long, erect, fuscous hairs, except on the anterior margin of the pronotum, where they are silvery. Pleura similarly sculptured, below rather more sparsely punctured; propleurae anteriorly with moderate vestiture of silvery, sericeous, appressed, hairs; with similar pubescence on dorsolateral margins of propodeum; pleurae otherwise with some sparse erect silvery hairs. Legs unicolorous with body, silvery pubescent, some of the pubescence slightly yellowish-tinged.

Petiole dorsally densely yellowish-white appressed pubescent, with some long, erect, silvery hairs. Second tergite with rather coarse contiguous to confluent punctures, each bearing an erect setose hair (those of disk infuscated, those of base, lateral margins, and apical margin silvery); anterior half of disk in addition with a pair of sericeous golden-yellow, rather small pubescent maculae. Apical margin with a dense, silvery to yellowish tinged band of dense, appressed, sericeous pubescence, interrupted medially by some dark pubescence. Apical tergites less coarsely punctured, towards the apex nearly impunctate, glabrous, shining; bearing erect infuscated pubescence (laterally, and on pygidium, silvery), on tergites 3–4, and less so on tergite 5 with some golden appressed, sericeous pubescence medially. Pygidium acuminate, no distinct pygidial area defined by lateral carinae, the median longitudinal area glabrous and shining, however. Longitudinal carina of petiole acutely dentiform produced anteriorly; laterad with considerable erect, fine, silvery pubescence. Second sternite more coarsely, less closely punctured, than second tergite, with sparse, erect and short, appressed, silvery pubescence. Apical sternites with the pubescence somewhat infuscated, that of the hypopygium quite dusky. Hypopygium on apical half with coarse, irregular sculpture, and, near its base, with a pair of distinct tubercles, connected by a more or less discrete transverse welt, the apex acuminate, not quadridentate.

Holotype, allotype, and two male paratopotypes: Rockville, Dauphin County, Pennsylvania (H.B. Kirk); the specimens were bred from cocoons of Hymenoptera found under stones, and emerged May 1, 1910–May 23, 1910. In the collection of Cornell University and the author's collection.

Paratypes: Raleigh, North Carolina, June 23, 1933, one male; Raleigh, North Carolina, Aug. 27, 1935, one female; Bluff Mountain, Chilhowee Mountains, Tennessee, June 22, 1941 (A. C. Cole, Jr.), one female.

This is one of few species of which we know both male and female with certainty. From the similarity of the males to *tegulicia* Bradley, and *ecarinata* sp. n. and of the females to *sudatrix* (Melander), I feel reasonably certain that *sudatrix* will turn out to be the female of either *tegulicia* or *ecarinata.*

The female is quite closely related to *sudatrix,* which it resembles in lacking a distinct pygidial area, possessing sericeous, appressed, very pale golden-yellow pubescence on the head (hence the name *xanthocephala*), and similar maculae on the second tergite. It differs from *sudatrix* in the difference of pubescence color and pattern of the apical abdominal segments, in having the maculae of the second tergite weaker and the appressed vestiture of the head weaker (thus resulting in a general facies more like that of *puteola* than like *sudatrix*).

The distribution of these two forms is puzzling. The species is southern coastal plain (Sabalian), while the subspecies is restricted to the Transition and Austral, and is limited to the region above and west of the fall line. It appears evident that this is among our rarest of North American species of this genus.

The male paratype from North Carolina was reported by Brimley (1938) as *E. tegulicia* Bradley.

Ephuta rufisquamis André (Fig. 19).

1905. *Rhoptromutilla rufisquamis* André, Zeitsch. f. Hymn., 5: 366, male (Arizona).

MALE: Length 7.25 mm. Coal black, except for the legs, tegulae, antennal scape, pedicel, mandibles, and eyes, which are ferruginous; the pubescence is silvery-white. Humeral angles weakly carinate, not at all prominent. Sculpture of body rather weak for *Ephuta.* Propodeum lacking a strong transverse carina. Tegulae smooth.

Head transversely oval-obtrapezoidal, moderately sculptured, with the setigerous larger punctures rather shallow, not sharply defined, well-separated, interspersed with minute micropunctures; punctures of genae and post-genae somewhat larger, obscured by the relatively dense, decumbent pubescence; genae thus not coarsely foveate and not carinate behind. Pubescence very sparse, except on the lower frons and genae. Maximum width of head 1.63 mm. (1.27 times the width of the thorax at the humeri). Ocelli large for the genus; maximum diameter of the posterior pair 0.21 mm.; their distance from each other .22 mm. (1.05 their maximum diameter); their distance from the front ocellus 0.13 mm. (0.62 their diameter); their distance from the eye-margin 0.35 mm. (1.66 times their diameter). Ocellar triangle quite strongly elevated. Distance between eyes above their emargination 1.00 mm. (4.76 times the maximum diameter of the posterior ocelli; 1.35 times the length of the eye). Distance between eye and posterior mandibular articulation 0.21 mm.; length of eye 0.75 mm.

(3.57 times the distance between the eye and the mandibular articulation). Antennal tubercles flat above, approximate, irregularly, rather coarsely rugose above, entirely lacking any trace of the irregular carinae that runs up them in the *pauxilla* group and obliquely traverses the frons. High, sharp, dentiform, carinae occur between the eyes and the antennal tubercles, one on each side. Beneath the insertion of the antennae, two high, sharp carinae arising from a common base beneath and between the antennal tubercles, and diverging noticeably at first, and soon running subparallel to each other (diverging but slightly), delimit a high, narrow subantennal basin, higher than the clypeal basin beneath. Extensions of these carinae diverge widely and run down towards the anterior margin of the clypeus, but become obsolete considerably before reaching it, thus setting off a small, rather low clypeal basin whose width is 2.6 times the width of the subantennal basin and only 0.32 the width of the distance between the eyes below their emargination (which is 0.82 mm.). Clypeal margin somewhat reflexed apically. Mandibles normal in size and shape, quite slender, somewhat falcate, their width apically less than the height of the clypeal basin; unidentate apically, with a small subapical tooth within. Antennae with the bicarinate scape and the pedicel ferruginous; the flagellum dark mahogany in color; pedicel slightly longer than the first flagellar segment; the latter subequal to the second flagellar segment; the third 1.75 as long as the second. On each side of the face, laterad of the clypeal and subantennal basins occurs an area of long, erect, silvery, brush-like pubescence.

Alitrunk moderately sculptured, black, except for the ferruginous tegulae and legs. Pronotum strongly narrowed anteriorly (0.66 as wide at humeri as at tegulae), the humeri very weakly, yet distinctly produced (width at humeri 1.28 mm.; 0.79 as wide as head); width at tegulae 1.94 mm. The lateral length of the pronotum 0.95 mm. (0.74 as long as the width of the pronotum at humeri). Pronotum dorsally with rather close, large punctures; the side pieces similarly sculptured near their dorsal borders, but nearly smooth below, excepting the dense, setigerous micropunctures that bear abundant decumbent silver pile. The backward extension of the humeral carinae obsolete, running vaguely, obliquely downward. Mesonotum more sparsely punctured, the punctures more shallow; the inflated mesopleura more closely and densely punctured, but lacking the conspicuously denser pubescence found in *E. scrupea.* Tegulae strongly angulate-carinate basally, but becoming simply convex mesally, with a few coarse punctures on center of the disk, surrounded by a wide, smooth border bearing micropunctures only; sparsely pubescent. Scutellum inflated, scarcely gibbous, rather less closely punctured than in *E. pauxilla,* with erect, long pubescence. Propodeum with the dorsal face nearly evenly rounded into the posterior face, separated medially by a slight, crenulate transverse ridge. The dorsal face with the shallow areolation obscured by rather dense, fine, appressed silvery pubescence, and some long erect hairs; posterior face with some round large punctures, similar to those of the lateral faces. Tibial calcaria of the middle legs strongly dissimilar in length, the longer subequal in length to the first tarsal segment. Wings entirely hyaline, the veins conspicuously dark brown. Free part of M_4 0.75 the length of the free part of M_{3+4}. The latter 1.6 times the length of the sector of M between r–m and the origin of M_{1+2} and M_{3+4}; equal in length to the sector of M between m–cu and the origin of M_{1+2} and M_{3+4}; equal in length to 1.1 the length of m–cu. M_4 equal to 0.84 the length of m–cu. R–m 0.4 the length of the cell 2nd $R_{1+}R_2$, equal in length to the sector of M between r–m and m–cu.

Abdomen with the petiole densely punctured dorsally, the sculpture obscured on apical half by the very dense border of appressed and decumbent silvery pubescence; ventrally with a median carina, dentate anteriorly and concavely hollowed behind the anterior tooth but not bidentate; with considerable erect, fine, silvery pubescence on the postero-lateral area of the sternite. Second tergite with rather deep, elongate, but well-separated, setigerous punctures, somewhat denser laterally and basally, very sparsely pubescent, except for the very dense apical band of silvery, appressed, curly pubescence. The lateral borders of the tergite with some sparse, setigerous punctures, bearing pubescence similar to that of the apical border. Apical segments with sparse, erect pubescence chiefly, inconspicuous, not in bands; punctures small, scattered. Second sternite with but a very few scattered punctures, except laterally and apically, where they are more abundant; pubescence almost none, except for a sparse border of hairs apically. Apical sternites with very sparse erect pubescence. Hypopygium lighter than other segments, but not whitish, with well-separated, moderate punctures.

Holotype: Arizona, in Museum Nationale d'Histoire Naturelle, Paris.

I have not seen the type of this species. The above description is based on an individual from Hot Springs, Arizona. André's type specimen came from Arizona, without further locality data. I have seen only the following specimens:

ARIZONA: Hot Springs, June 25 (Barber and Schwarz), one male; Empire Mountains, May 20, 1926 (Alt. 5000 feet), (A. A. Nichol), one male. CALIFORNIA: Antelope Springs, Inyo Co., July 17, 1953 (J. W. MacSwain), two males.

This abundantly distinct species differs at once from any other nearctic species in the possession of red legs and tegulae, and a red flagellum, contrasted with the entirely black body. In the pigmentation this species is identical with *E. carinata* Schuster, from Central America, but differs from that species in that the subantennal carinae are distinct above, and not fused to form a single median carina.

This species is apparently related to *tegulicia* Bradley, which also has a dark hypopygium and to *psephenophila* sp. n. with large ocelli like *rufisquamis,* as well as to *margueritae.* These four species all agree in having the dorsum of the propodeum densely silvery pubescent. *E. psephenophila* and *margueritae* differ from *E. rufisquamis* in the pale hypopygium and distinctly dentiform-produced transverse propodeal carina, as well as the more fuscous wings and weaker contrast between veins and wing-membrane. The isolated *tegulicia,* in its carinate tegulae and black hypopygium, as well as smaller ocelli and strongly developed humeri, can scarcely be confused with the present species, which has a much narrower, more elongate subantennal basin (quite similar to that of the more closely allied *E. psephenophila*).

The female sex is conceivably represented by *E. tumacacori* sp. n.

Ephuta cephalotes sp. n. (Figs. 10, 20, 46)

Male. Length 8–9 mm. Entirely coal-black; moderately sculptured, with moderately dense, silvery vestiture. Head prominently, conically produced in the ocellar region, there glabrous and shining. Tegulae smooth, weakly convex, punctulate moderately, thin, translucent, except medially, shining. Propodeum with a moderately distinct, crenulate transverse carina. Wings nearly completely hyaline, the veins only infuscated.

Head moderately, distinctly punctured, the setigerous punctures well-separated; rather prominently pubescent with long, erect, silvery hairs, except for those on the lower frons, above the scrobal carinae, and on the genae, which are chiefly decumbent or appressed, finer, and much denser. Puncturation of genae much coarser, but not alveolate-reticulate, and not carinate behind, but evenly rounded into the occipital and postgenal areas; punctures of occiput and vertex also somewhat coarser than those of frons. Head with the ocellar area strongly elevated, conic, nearly smooth and impunctate at apex, the ocelli inserted on the sides of the cone. Ocelli moderately small; the posterior 0.12 mm. in diameter; their distance apart 0.31 mm. (2.58 their maximum diameter); their distance from the front ocellus 0.20 mm. (1.67 their maximum diameter); their distance from the nearest eye-margins 0.39 mm. (2.80 their maximum diameter). Oblique ridges running up the antennal tubercles and traversing the frons towards the eyes (thus forming suprascrobal ridges) entirely absent, the punctuation continuing down to the scrobal carinae, which are punctate and pubescent on their dorsal faces. Beneath the insertion of the scapes a pair of carinae, at first divergent and obscure, run down nearly parallel to within about one half the distance towards the anterior clypeal margin; there they are each produced into a strong triangular tooth (and are connected by a low transverse ridge); they then diverge abruptly, suddenly greatly diminish in height, and become obsolete and disappear long before reaching the reflexed margin of the clypeus. Thus a relatively narrow subantennal basin, not very deep, and poorly delimited dorsally, about twice as high as wide, is set off; the clypeal basin, which is of about the same height, is a poorly defined, truncated, wide triangle, whose sides are defined only on top. Pedicel bead-like, scarcely shorter than first flagellar; the latter about a fourth shorter than second flagellar; third flagellar a third longer than second, scarcely one-fourth longer than wide. Mandibles normal, bi-dentate, lacking a molar area; their width at apex less than height of clypeal basin.

Alitrunk moderately to weakly punctured, for *Ephuta*, with moderate silvery pubescence. Pronotum 1.40 mm. wide at humeri (0.84 as wide as head), strongly, evenly widened to apex (width at tegulae 1.93 mm.); humeral width 0.74 that of the tegulae; humeral angles rather moderate, feebly dentiform; the dorsal face of pronotum rather evenly rounded into the cephalic; punctures of dorsal face moderate, rather close, less so near tegulae and near sides; the pubescence rather dense, silvery, somewhat obscuring the sculpture; side pieces of pronotum sparsely punctured, less coarsely than dorsal face, traversed obliquely by the inferior extension of the humeral carinae, bearing numerous micropunctures on the intervals between punctures that bear short, fine, silvery appressed hair. Mesonotum evenly, noticeably convex, with sparse, evenly scattered moderate punctures bearing erect silvery hairs. Scutellum flatly inflated, closely foveately punctured, the size of the punctures similar to those of mesonotum or larger; towards apex medially longitudinally sulcate; with moderate, erect silvery pubescence. Mesopleura strongly, evenly convex, with rather coarse, but well-separated punctures, with fine appressed and coarser erect silvery pubescence that moderately obscures the sculpture. Tegulae very smooth, polished and shining, except for very sparse moderate punctures bearing a few hairs; the sides and apical half very thin, transparent; the disk rather moderately convex, thicker than the more nearly flat edges; conchiform in shape. Propodeum with the reticulate-areolate dorsal face nearly glabrous, except the base and lateral margins with some sparse silvery pubescence; separated from posterior face almost at right angles, but nearly rounded into it narrowly, separated only by a weak transverse crenulate ridge; the posterior face reticulate-punctate dorsally, punctate to glabrous below; lateral faces with several rows of coarse punctures, nearly glabrous. Wings hyaline, the veins brown; vein m–cu nearly one-fourth longer than free part of M_{3+4}, fully one-fourth longer than free part of M_4; M from m–cu to origin of M_{1+2} and M_{3+4} equal in length to M_{3+4}; M from m–cu to r–m one-half as long as M from r–m to origin of M_{1+2} and M_{3+4}; r–m less than five-eighths as long as the latter sector, and scarcely longer than Rs from r–m to origins of R_5 and R_{3+4}. Cell 2nd $R_{1+}R_2$ one-third as high as long, obliquely truncate at apex; cell R_5 over two and one-half times as long as high, at apex subacute. Legs black, the tarsi mahogany-red, with dense, silvery pubescence, that of the tarsi shorter and dirty-white or yellowish.

Petiole transverse, with a dense apical band of silvery pubescence and long, erect silvery pilose hairs; ventrally with a weak median longitudinal carina, not dentiform produced. Second tergite with punctures moderately coarse, close to contiguous, bearing erect to decumbent silvery hairs; laterally with a wide margin on each side of fine, sericeous hairs, simulating "felt-lines" arising from close, fine micropunctures; apical margin with a prominent band of silvery sericeous pubescence. Second sternite with similar, but sparser, coarser punctures, sparsely silvery pubescent. Apical tergites with a broad band of moderate, rather sparse punctures; progressively on each segment the punctures become denser and coarser; those of the pygidium considerably closer and denser; with sparse, erect, silvery hairs. Apical sternites with similar punctures, but smaller and less close; pubescence similar, if anything, more sparse; hypopygium more coarsely and densely punctured, a dark brown, with short and long moderate silvery pubescence.

Holotype: Musquiz Canon, Fort Davis, Texas, July 6, 1917 (Cornell University Expedition), in collection of Cornell University (Type No. 2191).

Paratypes: North Dakota, Medora, August 3, 1923 (O. A. Stevens), one male; South Dakota, Philip, August 7, 1924, one male; Wyoming, Weston County, July 15, 1939, two males; Arizona, Tucson, June 13 and June 15, 1938 (R. H. Crandall) two males. A subsequent specimen (not paratypic) has been seen from South Dakota: Grass Rope, June 21, 1934 (H. C. Severin).

This very easily identified, abundantly distinct new species is related most closely to *grisea* and *ecarinata*. It differs from all the species of the genus known to me in that the vertex is conically produced. The frontal aspect of the species at once identifies it, the vertex being strongly elevated, the elevation terminating in a glabrous, shining tubercle or prominence in the middle of the ocellar region (the head, in frontal profile, thus acquiring a decidedly sharply angular profile between the eyes). The hyaline wings, as well as the very small ocelli are also of importance in distinguishing the species. The brownish buff to somewhat fuscous hypopygium (never clearly yellowish, never totally blackish) appears to be a constant distinguishing characteristic. In the entirely silvery white vestiture of vertex, mesonotum, and disk of tergite two, this species differs from the other members of the GRISEA complex that have similar (i.e., noncarinate) tegulae and fuscous hypopygia.

In Bradley's key (1916) the species keys out to *grisea*. It differs from the latter in the contour of the vertex, in the slightly larger ocelli, and in the form of the subantennal carinae (which are strongly dentiform produced on each side, about half their distance to the clypeal margin, and there connected by a transverse ridge), in the lack of infuscation of the wings, and in the lack of sericeous vestiture of tergites 3–4 of the abdomen.

The female, judging from the range of size of the species (averaging only 7–9 mm.; smaller than our other North American species of *Ephuta*), may very well be *E. minuta* sp. n., which is uniformly the smallest species known in the female sex.

A male *Ephuta,* lacking the head, has been examined, and differs from the present species in having the scutellum nearly gibbous, less coarsely punctured, and in having the second tergite very finely, shallowly, punctured, compared with the present species. This specimen, from Jemez Springs, New Mexico (8,000 feet), May 22, 1916 (J. Woodgate), may possibly belong here, but probably represents a new species. It appears advisable to await more complete material before describing it, however.

Females of the *Albiceps* and *Grisea* Complexes not Correlated with any Species of Males[18]

The seven species assigned here belong almost certainly, without exception, to males here assigned to the Species Group *Grisea.* They are dealt with as a unit here in order to make comparison between them simpler. Of the seven species known in the female sex, three were assigned previously to their respective males (*E. conchate, argenticeps* and *floridana*), therefore have already been dealt with, on pages 23, 16, and 34. The four remaining females cannot readily be assigned to known males, although *E. coloradella* may be the female sex of *E. grisea,* while it is possible that *E. baboquivari* is the female of *E. ecarinata.* The species involved have been keyed out in Couplets 5–12 in the Key given on pp. 31–32, in Part I. However, the complexity of the group is so great that the following supplementary key may be of value at this point:

1. Vertex with the erect and appressed vestiture either glistening white or ivory-white; second tergum of abdomen with discal maculae of appressed hairs 2
    2. Genal-postgenal carinules complete; terga 3–5 with median third silvery pubescent; head white to ivory-white pubescent. **E. albiceps** sp. n.

[18] The females of these two complexes (defined on p. 16 of Part I) are superficially very similar, agreeing in the following respects: presence of sericeous, decumbent, fine microvestiture of the front and vertex, in addition to the erect, stiff setae; usual presence of maculae of the second tergum, formed of similar hairs; the simple hypopygium, without an elevated biramose, V-shaped process; the presence of a distinct pygidial area. The species, as a consequence, are very similar and are easily confused with each other in some cases.

2. Genal-postgenal carinules incomplete; head silvery white pubescent, glistening; eyes small: the front 1.4–1.5 the eye-length; eye-length 0.77–0.79 the eye width 3
    3. Terga 3–5 entirely fuscous pubescent; hypopygium at base with merely a pair of low tubercles ...... **E. coloradella** sp. n.
    3. Terga 3–5 with a median line of thin, silvery hairs; hypopygium with a sharp, transverse, basal carina ...... **E. argenticeps** sp. n.

1. Vertex with the appressed, sericeous vestiture varying from golden-yellow to fuscous (in the latter case often inconspicuous); second tergum with maculae present or absent 4
    4. Second abdominal tergum without any trace of discal maculae; second tergum with small, very close, regular puncturation; hypopygium with a complete, sharp, basal transverse carina 5
        5. Head a brilliant golden pubescent; eyes large, the minimal width of front between eyes only 1.2–1.3 the eye-length; genal-subgenal carinules complete. **E. baboquivari** sp. n.
        5. Head fuscous to golden-fuscous pubescent, dull in appearance; eyes smaller, the front 1.3–1.6 the eye-length; genal-subgenal carinules incomplete (*E. floridana*) 6
            6. Head with decumbent sericeous vestiture dull, fuscous to griseous-fuscous. Florida. **E. floridana floridana** sp. n.
            6. Head with decumbent sericeous vestiture yellowish to golden, relatively bright in color. **E. floridana dietrichi** sp. et subsp.n.
    4. Second abdominal tergum with small to obvious discal maculae of pale, sericeous, appressed hairs 7
        7. Vertex with decumbent vestiture golden or golden-yellow; brilliant; distal maculae of second tergum conspicuous; genal-postgenal carinules complete; eyes large: minimal frontal distance apart 1.0–1.2 the eye-length .... **E. auricapitis** sp. n.
        7. Vertex with dull, fuscous sericeous vestiture; discal maculae small and inconspicuous; genal-postgenal carinules incomplete; eyes smaller; front between eyes 1.3–1.6 the eye-length. *E. conchate* Mkl.

On the basis of the vestiture, a basic breakdown into two groups is possible here, one including *E. albiceps* and *E. auricapitis* (in which the discal maculae are large and conspicuous and the head is very densely sericeous pubescent), the second group including the remaining five species is characterized by the following series of features in common: in the minute or entirely eliminated discal maculae of tergum two, in the relatively less sparsely developed sericeous vestiture of the vertex and front of the head, and in the presence of a more or less distinct pair of basal hypopygial tubercles (often connected by a transverse glabrous ridge). Furthermore, all five species agree in the much smaller eyes and broader front (the latter 1.3–1.6 the maximum eye-length). In the latter character, *baboquivari,* with the front 1.2–1.3 the eye-length proves intermediate between the two species complexes. In the reduction of the discal maculae, reduction of sericeous vestiture of the head, development of hypopygial tubercles this latter group of species approaches the complex of species to which *E. puteola* belongs. Indeed, when the silky microvestiture of the head is fuscous, rather thin, and inconspicuous (as in *E. floridana floridana*) a very close superficial similarity to *E. puteola* obtains.

In contrast, the first group, with a relatively brilliant vestiture and with discrete maculae, strongly suggests the *Sudatrix* Complex (*E. sudatrix* and *E. margueritae*). The distinct pygidium of the entire complex dealt with here, and absence of such a pygidial area in the *Sudatrix* Complex effectively separate the two.

Ephuta coloradella sp. n.

FEMALE. Length 3.5 mm. Integument testaceo-ferruginous throughout, the antennae slightly darker, and the apices of the distal abdominal tergites a little tinged with piceous but the legs, head, alitrunk and greater part of abdomen nearly uniformly pigmented. Head with a thin vestiture of sericeous decumbent, silvery white hairs on vertex, and anterior part of disk of second abdominal tergite with vestigial maculae of similar hairs. Pygidial area relatively broad, defined; hypopygium laterally and distally entire, the disk at base with a pair of lateral, obscure tubercles not connected by a discrete ridge.

Head 0.93 mm. wide, rounded obtrapezoidal, somewhat evenly narrowed behind the eyes; with rather coarse, close to contiguous punctures on front, with the intervals virtually devoid of interspersed punctulations, bearing sparse, irregular suberect brownish-tinged hairs; vertex with smaller and more distant punctures, the relatively broad intervals more or less roughened and somewhat punctulate, the punctulations giving rise to fine, decumbent, sparse silvery hairs; coarser punctures of vertex with suberect, longer hairs, silvery on vertex and occiput, golden or brownish on front. Genae with coarse, rather close punctures and with scattered interspersed punctulations, the entire vestiture (erect and decumbent) silvery white. Hypostomal-subgenal ridges becoming obsolete above hypostomal spines. Front 0.53 mm. wide; eyes 0.37 mm. long, 0.32 mm. wide. Antennae scarcely darker than head; pedicel obtrapezoidal in outline, wider than long, 0.65 mm. long; first flagellar segment 0.09 mm. long $\times$ 0.10 mm. wide; second flagellar segment 0.09 mm. long.

Alitrunk elongate, more or less obovate-elliptical, 1.17 mm. long, 0.69 mm. wide at prothoracic spiracles, 0.64 mm. wide at apex of the more conspicuous propodeal spiracles; with moderately coarse, close and contiguous to confluent puncturation dorsally and laterally, the puncturation much closer than on disk of abdominal tergite two. Vestiture dorsally sparse, of stiff, erect hairs and shorter, decumbent hairs, those of the dorsum of pronotum white, those of the meso-metanotal regions somewhat fuscous-tinged; the pleural faces uniformly whitish pubescent, sparsely and nearly equally so (the lateral pronotal faces without denser vestiture; the propodeum uniformly, sparsely pale pubescent and lacking indication of stripes).

Abdomen with disk of second tergite with moderately, distinctly separated oval, setigerous punctures not coarser than those of alitrunk, giving rise to subdecumbent fuscous, stiff hairs; base of tergite, as well as apical border and lateral fifths with the subdecumbent hairs white; apex of tergite with a broad, equally wide band of sericeous, curly hairs, interrupted in the middle, the lateral portions of the tergite with obscure regions of thinner, similar vestiture; anterior part of disk with a pair of vestigial maculae of similar hairs; integument of tergite rufo-testaceous, except the apical portion (underlying the silvery band), which is a translucent testaceous. Second sternite with very coarse, well-separated, round punctures and polished intervals. Tergites 3–5 with rather sparse and small setigerous punctures bearing long, suberect, fuscous hairs; intervals wide and polished. Pygidial tergite with lateral regions with close to contiguous moderately coarse punctures, bearing suberect fuscous and silvery hairs; central portion glabrous and impunctate, defined on distal fourth by delicate carinules and forming a relatively broad pygidial area, 0.13 mm. wide, which is obscurely granulose-rugulose distally. Hypopygium with a pair of low basal tubercles, not connected by a sharp transverse ridge; disk rather small, with distinctly separated punctures; apex not distinctly dentate, but each side just before apex with a minute vestigial tubercle on the lateral margins.

Holotype: Colorado Springs, Colorado, June 15–30, 1897, 6000–7000 ft. (H. F. Wickham), in collection of University of Minnesota.

This species I believe to be the female sex of *grisea*. The rather distinct sericeous vestiture of the head and body of *grisea* and *coloradella* suggests this, as well as the distribution. Since any concrete proof is lacking, the form will have to be considered nomenclatorially distinct for the present.

The species is extremely closely related to the female, *E. conchate.* It differs from the latter in the less obviously granulose pygidial area, the less close puncturation of the disk of the second tergite, the white (instead of fuscous) sericeous vestiture of the head and the pale integument of the apex of tergite two of the abdomen. The essential body dimensions, eye-size, form of hypostomal teeth and carinules, and type of hypopygium are identical in both species, and both have the sericeous vestiture of the head very sparse (giving them the appearance of *puteola* and its allies), the integument of the body virtually concolorous throughout and rufo-testaceous, as well as the maculae of the second tergite obscure and minute.

Both species are related, though relatively distantly, to *E. floridana* and *baboquivari,* as well as *argenticeps,* but differ from all three of these species in the absence of a discrete ridge connecting the basal hypopygial tubercles. The relationship appears especially close to *floridana,* which has the head also more densely sericeous pubescent, but no maculae of the disk of the second abdominal tergite.

Ephuta albiceps sp. n.

FEMALE: Length 4.1 mm. Head densely appressed and erect white pubescent; the second tergite with a pair of silvery sericeous pubescent maculae on basal third; pygidial area clearly defined by lateral carinae.

Head transversely oval, not full in the temples; the punctures of frons rather close, but much less so than in *sudatrix,* much less sharply defined, not at all foveate; the pubescence entirely ivory-white and silvery, appressed sericeous, decumbent, and erect setaceous, except for a row of very long infuscated setaceous erect hairs encircling each eye. Antennae a yellow testaceous, the antennal tubercles not prominent, pedicel scarcely shorter than the first flagellar segment, which is wider than long, and shorter than the second flagellar segment; scape round in section, not carinate except at base, sparsely punctured, with decumbent sparse silvery hairs. Supraclypeal flange quadridentate, the teeth small, their intervals wide; the flange not strongly produced downward. Hypostomal region with a carina on each side running back from the posterior mandibular articulation, ending in a dentate process, continued dorsad as delicate, complete postgenal carinules.

Alitrunk obovoid, the head about 1.25 as wide; punctures close, contiguous; pubescence rather long, shaggy, silvery, except for the mesonotum, which is golden to ferruginous pubescent; the anterior pronotal margin is densely silvery, sericeous pubescent; the propodeum has a median and a dorsolateral line of pubescence on each side, of appressed sericeous silvery hairs; the pleura are rather densely silvery pubescent (much more so than in *sudatrix*); in addition to the normal, moderately long pubescence there are some scattered, very long, setaceous silvery hairs.

Abdomen rather densely, rather shaggy pubescent, the pubescence chiefly silvery. Petiole short, transverse, very densely sericeous silvery pubescent, with some scattered erect setaceous silver hairs. Second tergite with the punctures close, rather coarse, at times contiguous; coarser laterally; the posterior two-thirds of disk largely ferruginous to fuscous pubescent; basal third sparsely decumbent silvery pubescent; broad lateral margins similarly pubescent, with much appressed sericeous silvery hairs in addition; apical margin with a broad band of dense silvery sericeous hairs, interrupted by a V-shaped median tuft of infuscated hairs; basal third of disk with a pair of prominent maculae of silvery, appressed sericeous hairs. Tergites three to five with median third silvery pubescent, the lateral area dusky pubescent. Tergite six laterally with silvery and golden, long pilose erect hairs; the pygidium defined laterally by carinae that extend about one-fifth the length of the tergite; the defined area broad (between a third and a fourth as wide as the tergite), nearly impunctate (slightly roughened by obscure fine punctulation) and shining. Petiole ventrally with a median keel, obsolete posteriorly, anteriorly weakly produced into a rounded median tooth. Second sternite coarsely foveately punctured, the punctures rather well-separated, bearing silvery decumbent hairs; pubescence denser apically. Apical sternites, except hypopygium with a narrow densely punctured apical band bearing a thin row of silvery hairs. Hypopygium with apical half coarsely punctured, but the punctures not so coarse as to render the sculpture rough and obscure; the closely sculptured area wider than long, not bearing a pair of tubercles and apically not dentate, not bearing hypopygial teeth, with long, silvery pilose hairs.

Holotype: Tyler, Texas, September 1, 1937 (Christenson 3753), in collection of United States Museum.

This new species is easily recognized by the dense, white and ivory white pubescence of the head (neither glittering silvery as in *argenticeps*, nor golden yellow as in the related *auricapitis*). The sericeous pubescent maculation of the propodeum, and of the midline of the apical abdominal tergites, as well as the size of the maculae of the disk of the second tergite recall the closely related *auricapitis*. As in the latter, there is quite distinct development of the delicate undulate carinules connecting the genal tubercles and the occipital ridge; however, the hypopygium is not quadridentate apically. The relationship of the two species is exceedingly close, and the similar degree of coarseness and closeness of puncturation, as well as entire facies suggests that perhaps the specific differentiation I draw between them is not valid.

Ephuta auricapitis sp. n.

FEMALE. Length 4.5 mm. Integument of head testaceo-ferruginous, the alitrunk and abdomen deep ferruginous, antennae and legs testaceo-ferruginous to yellowish, paler than body. Head conspicuously, densely appressed golden yellow pubescent on front and vertex. Propodeum with indefinite median and dorsolateral lines of silvery decumbent, sericeous hairs. Second abdominal tergite with large, conspicuous maculae of silvery, decumbent, sericeous hairs. Tergites 3–5 fuscous erect pubescent, except for a vague median longitudinal line of sparse, silvery, sericeous decumbent hairs. Pygidial area defined, the defined region nitid and smooth; hypopygium quadridentate distally, not perceptibly tuberculate basally.

Head testaceo-ferruginous, transversely oval, wider than alitrunk. Supraclypeal ridge obtusely angulate, equally quadridentate. Front and vertex closely, moderately coarsely, deeply punctured, the narrow to vestigial intervals closely setigerously punctulate (giving rise to the decumbent conspicuous vestiture); genae similarly punctured and punctulate; front and vertex with dense, decumbent, sericeous, brilliant golden yellow vestiture, and with a sparse vestiture of rather short-clipped, similarly pigmented, erect hairs (shorter than the row of erect, slender, setose fuscous hairs margining the eyes); the genae with sparse, erect, and rather sparse decumbent silvery vestiture. Eyes large, silvery, asymmetrically ovate; their minimum frontal distance apart equal to 1.15 the eye-length; distance between lower corners of eyes and apex of posterior mandibular condyles 0.4 the eye-length. Antennae testaceous, the first flagellar segment strongly transverse (1.5 as wide at apex as long), about 1.1–1.2 as long as the much narrower pedicel, virtually equal in length to the second flagellar segment. From the posterior mandibular condyles a pair of high, sharp carinae run backward and obliquely mesad, soon terminating in a sharply, angulate, erect tubercle on each side; from these tubercles or teeth run back a pair of sinuous, delicate low carinules (obsolete for a short distance a little above the teeth), that at first gently converge, then diverge, finally ending in the ventro-lateral portions of the occipital ridge.

Alitrunk in general shape in dorsal outline rather narrow ovate, but somewhat wider anteriorly (thus slightly obovate), deeply ferruginous throughout. Dorsal surface and pleura very uniformly contiguously or closely, regularly punctured, the punctures rather coarse, round, deep, sharply defined, similar in size to those of genae. Pleura and propodeum with sparse, erect, and suberect, rather long, white hairs; the dorsum of pronotum, mesonotum, and metanotum with similar, fuscous hairs; lateral pronotal faces, in addition, with rather conspicuous appressed, sericeous, glittering white hairs, and the propodeum with three, vague, ill-defined, similar bands of hairs; one median, the others one on each side at juncture of dorsal and lateral propodeal faces. Legs yellow or testaceo-ferruginous, with sparse, white vestiture.

Gaster deep ferruginous, nearly uniformly so. Petiole with normal transverse band of decumbent sericeous white hairs; ventrally with a median, short, longitudinal high ridge, slightly higher anteriorly, but not dentate. Second tergite with punctures about as coarse as on alitrunk, but even closer, more elongate, the transverse intervals vestigial (the punctures thus more or less confluent in longitudinal rows); disk and a narrow median apical interruption with sparse, moderately long, decumbent and suberect fuscous black hairs, arising from the coarse punctures; marginal portions of tergite with similar, white hairs; base of disk in addition, with a conspicuous pair of maculae formed by decumbent, fine, sericeous, glittering pale hairs, and the apex of disk with a similar broad band of hairs (medially interrupted, but otherwise subequally wide, except for lateral anterior extensions). Second sternite very coarsely, contiguously, deeply punctured, with sparse, white vestiture. Tergites 3–5 finely, inconspicuously punctulate, with rather sparse and long, suberect to erect fuscous hair (except for a narrow, vague, median line of decumbent and appressed, silvery, sparse, sericeous hairs). Pygidium with virtually entirely pale hairs, with a median, nitid, glabrous region, which, on the posterior fourth of the segment is defined by a pair of delicate, arcuate, converging carinules (thus delimiting a rather broad and short, nitid and impunctate pygidial area). Hypopygium with a distal, coarsely, contiguously punctured area, wider at base than long, entirely lacking all trace of the basal tubercles or transverse ridge; the apex clearly quadridentate.

Holotype: Edinburgh, Texas (Stanley Mulaik), in collection of University of Minnesota.

This distinctive species occupies an intermediate position between the *sudatrix* complex and the *baboquivari* complex. In the very densely golden pubescent head, the prominent maculae of the second abdominal tergite, and the undulate, delicate, but complete carinules running up from the hypostomal tubercles to the occipital carina, the species resembles *sudatrix* and its allies. It differs from those at once by the relatively broad, distinctly defined pygidial area of the last tergite, and by the pubescent-maculate propodeum (which bears three obscure stripes of silvery decumbent hairs). In this species the eyes are slightly smaller (their frontal distance apart about 1.15 their length), while in the *sudatrix* complex they are larger (their frontal distance apart varying from 0.98–1.07 their length). In the combination of maculate second tergite, sericeous pubescent head, and defined pygidium, the species agrees with the *albiceps* (*baboquivari*) complex, with which it further agrees in the complete hypostomal-postgenal carinules. The relatively large maculae of the second tergite ally it to *albiceps.* It differs from the latter in the golden pigmentation of the vestiture of the head and in the quadridentate hypopygium.

The golden vestiture of the head separates the species from all the species of the *baboquivari* complex, except for *baboquivari* itself. It differs from the superficially similar appearing *baboquivari* as follows: the propodeum trilineate; maculae of second tergite large; hypopygium not distinctly armed at base (distinctly transversely carinate in *baboquivari*) ; eyes larger, their frontal distance apart only 1.15 their length (1.2–1.3 in *baboquivari*) ; distal tergites with a narrow median line of silvery hairs.

Ephuta baboquivari sp. n. (Figs. 39, 41).

FEMALE. Length 3.9 mm. Uniformly ferruginous, with unusually fine and regular puncturations. Head with large silvery eyes and a conspicuous dorsal vestiture of glittering yellowish sericeous hairs; hypostomal-subgenal carinules complete, distinctly arcuate and quite sharp and glabrous throughout their length. Abdomen with the discal maculae of the second tergite quite lacking; distal segments largely to nearly entirely fuscous pubescent; pygidium defined, glabrous and nitid; hypopygium with a distinct basal transverse carina, the apex not quadridentate, entire.

Head rufo-ferruginous, transversely oval-obtrapezoidal, 0.87 mm. wide; eyes 0.44 mm. long and 0.35 mm. wide, large and silvery; front 0.53 mm. wide (1.20 the eye-length); malar length 0.24 mm. (the eye-length 1.83 the malar distance). Front closely and contiguously, moderately and rather hexagonally punctate, the punctures giving rise to stiff, long, sparse, erect golden-brown or fuscous hairs, and with thin sericeous curly decumbent golden yellow hairs; vertex with close but scarcely contiguous, round punctures, giving rise to suberect yellowish hairs, and with interspersed punctulations, giving rise to decumbent, curly sericeous glittering yellowish hairs, sufficiently dense to obscure the sculpture; genae closely punctured, the intervals punctulate and giving rise to a thin whitish sericeous vestiture. Hypostomal-subgenal carinules complete and obvious, the ventral, oblique portions bordering the oral region ending in triangular moderate teeth, from which run back undulate carinules ending in the margin of the occipital ridge; the area mesad of the carinules nitid and impunctate, and a narrow strip laterad of the carinules similarly nitid and impunctate. Antennae with distal parts of flagellum darker and subfuscous, the basal part testaceo-ferruginous; pedicel 0.07 mm. long; first flagellar segment 0.093 mm. long and 0.12 mm. wide; second flagellar segment 0.085 mm. long and 0.125 mm. wide.

Alitrunk 1.17 mm. long, 0.74 mm. wide at the apices of the pronotal spiracular plates, 0.76 mm. wide at the apices of the propodeal spiracles, with the distance between front and rear spiracles 0.39 mm. Integument ferruginous throughout; puncturation fine, very regular, close and contiguous to subconfluent; vestiture sparse, on meso-metanotal region and posterior part of pronotum fuscous, elsewhere white or silvery; pronotum lacking conspicuous silvery sericeous vestiture on the lateral faces; propodeum with inconspicuous silvery sericeous vestiture, not distributed in vague lines, the lateral angles scarcely more densely pubescent. Legs rufo-testaceous at base, the tibiae at least somewhat subfuscous distally.

Gaster nearly uniformly ferruginous. Petiole with ventral carina low posteriorly, dentiformly produced anteriorly, second tergite with unusually fine and regular, close and contiguous, occasionally subconfluent puncturation on the disk, the punctures ca. 0.04 mm. in diameter, becoming slightly more distant laterally; vestiture of disk all fuscous, stiff, suberect or slightly decumbent, with no trace of sericeous discal maculae; apex of tergite with a distinct, equally wide band of silvery sericeous hairs, interrupted medially by fuscous hairs; with thin scattered sericeous silvery hairs bordering the lateral edges of the tergite. Second sternite with coarser, more irregular, close to confluent puncturation. Tergites three to five entirely fuscous, erect, and suberect pubescent, except the extreme lateral margins which bear whitish hairs. Sternites three to six sparsely silvery pubescent. Pygidium with a well-defined area 0.11 mm. wide (0.25 the width of the last tergite), the area very obscurely and finely granulose-punctate, appearing smooth at moderate magnifications. Hypopygium basally with a transverse glabrous, rounded ridge connecting the lateral tubercles; apex appearing entire.

Holotype: Baboquivari Mountains, Arizona, in collection of Cornell University.

This species is the only member of the *baboquivari* complex in which the head is brilliant golden yellow pubescent. In this feature it approaches *auricapitis,* of the *albiceps* complex. In the relatively large eyes (with the front only 1.2 the eye-length) it also approaches the *albiceps* complex and differs from the other members of the *baboquivari* complex. The total absence of maculae of the second tergite, and the transversely carinate base of the hypopygium will at once separate it from the *albiceps* complex; furthermore, the uniformly sparse vestiture of the propodeum is a feature not found in *albiceps* and its allies.

Within the *baboquivari* complex the species is most closely similar, superficially, to *E. floridana dietrichi:* it differs from the latter as follows: the eyes are larger; the puncturation is much finer, smaller and more regular; the sericeous vestiture of the head is more brilliant; the hypostomal-postgenal carinules are complete and sharply indicated. The absence of maculae of the second tergite, and the moderately developed vestiture of the head, as well as the presence of a transverse hypopygial ridge appear to ally the two species. The species is also clearly related to *argenticeps:* it shares with the latter the complete carinules of the under side of the head, the brilliancy of vestiture of the head, and the distinct transverse ridge of the hypopygium. However, the silvery color of the vestiture of the head, the bimaculate disk of the second tergite, the smaller eyes, and the coarser sculpture will separate *argenticeps* from *baboquivari.*

Ephuta yucatana (Blake) (comb. nova)

1871 *Mutilla yucatana* Blake, Trans. Amer. Ent. Soc. 3: 231, female (Mexico)

I have carefully studied the type of this species (Type 4588, in collection of Academy of Natural Sciences, Philadelphia), since from its description it could not be separated from *puteola* (described eight years later by Blake). Blake describes the head as "thinly clothed with erect black hairs." This would put the species in the *puteola* complex. Careful study reveals the presence, in addition to the erect, sparse fuscous hairs, of a rather thin, sparse vestiture of silvery, sericeous, decumbent hairs. Their presence immediately separates the species from *puteola* and its relatives.

The species is most closely allied to *baboquivari,* sp. n., with which it shares the following critical characteristics: the interrupted band of silvery sericeous hairs of the apex of abdominal segment two is subequally wide throughout; the alitrunk, head, and second abdominal tergum bear very fine, dense, contiguous regular puncturation; the head bears a distinct (if rather inconspicuous vestiture) of brilliant, sericeous hairs; the disk of abdominal tergum two lacks all trace of sericeous pubescent maculae; the head has the subgenal-hypostomal carinules sharp and complete throughout; the eyes are rather large and prominent.

The species differs at once from *baboquivari* (which has a very dense golden decumbent vestiture of the head) in the relatively sparse vestiture of the head, the decumbent sericeous portion of which is silvery on the front and vertex, becoming fuscous (like the erect hairs) on the posterior portion of the vertex. I had no opportunity to compare the two types, hence was unable to check for other differences.

The species is Mexican and known only from the type. It is included here because it may eventually be found northward across our borders, and because the original description is quite meaningless and misleading. In the relatively sparse sericeous vestiture (arising from puncturations scattered among the coarser cephalic punctures), which is relatively dull, at least on the vertex, the species approaches *E. floridana dietrichi.* It differs from the latter at once in the sharp, complete, carinules separating the genae from the postgenae.

FEMALES NOT CORRELATED WITH ANY SPECIES OF MALES

TUMACACORI COMPLEX

The solitary included species is very distantly related to any other North American species of *Ephuta.* It is barely possible that it may be the female of *E. rufisquamis* André.

The following characters diagnose the group: the very curiously armed hypopygium, with a distinct elevated V-shaped process; the well-developed, dorsally expanded subgenal-hypostomal carinules; the very large size; the setigerously punctured pygidial area; the dense bands of silvery hairs of the distal abdominal tergites, interrupted by a median patch of fuscous hairs. These characteristics all give the species a very unique appearance. In the silvery pubescent head and distinctly bimaculate disk of the second abdominal tergite the species resembles the *albiceps* and *sudatrix* complexes, and it is probably most closely related to these.

Ephuta tumacacori sp. n.

Female. Length 9.0–9.5 mm. Integument ferruginous throughout; head with dense, pale golden decumbent and erect vestiture; propodeum trilineate with weak fasciae of white, sericeous hairs; second abdominal tergite bimaculate on anterior part of disk with a pair of rather large, prominent maculae of pale, decumbent and appressed, sericeous hairs; tergites 2–5 with broad, prominent, dense apical bands of white sericeous, appressed, curly hairs, interrupted medially by fuscous and brownish hairs, the interruptions becoming progressively more narrow from segment two to segment five; pygidium with a defined, closely, setigerously punctured median region, obscured by a median fascia of decumbent, long, dense white hairs; hypopygium distally distinctly quadridentate, near base with two glabrous tubercles, one on each side, and on disk with a characteristic V-shaped biramose elevation, the arms of the V converging, and meeting along midline, posteriorly, before apex of hypopygium, the arms distinctly elevated, forming glabrous ridges.

Head transversely oval, subparallel for a short distance behind eyes, the integument ferruginous throughout. Front and vertex with rather coarse, dense, contiguous to confluent puncturation; genae similarly punctured, if anything, less closely so; intervals densely setigerously punctulate, bearing a dense, conspicuous vestiture of pale golden to ivory colored hairs on front and vertex, and a sparser, pale vestiture on the genae; in addition there is a sparse erect and suberect vestiture of rather short-clipped, stiff hairs, ivory white to pale yellowish in color on front and vertex, white on the genae. Supraclypeal flange weakly arcuate, rather strongly downward produced and arcuate, sharply quadridentate, the teeth acute, rake-like. Eyes moderately large, 1.11 mm. long, 0.68 mm. wide, their distance apart on front 1.30 mm. (1.17 eye-length); distance between lower eye-margins and apex of ventral mandibular condyle 0.58 mm. Antennae with pedicel 0.16 mm. long, first flagellar segment distinctly elongate, obconical-truncate, 0.29 mm. long, 0.23 mm. wide at apex; second flagellar segment 0.22 mm. long on outer (longest) face, 0.25 mm. wide. Genal ridges running back and mesad from posterior mandibular condyles high, sharp, ending in a prominent, angular spinose tooth on each side; the genal-postgenal ridges running up from these well developed, at first slightly convergent, then gently flaring outward, ending above in the occipital ridge, and distinctly dilated before attaining the occipital ridge, forming a hyaline, lamellate process on each side; occipital ridge shaply carinate, acute, above and laterally, ventrally merely an acute fold. Head 2.35 mm. wide.

Alitrunk ferruginous throughout, rather narrowly obovate, widest in mesothoracic region and considerably narrowed behind, 3.04 mm. long, 1.98 mm. wide at prothoracic spiracular tubercles, 1.76 mm. wide between apices of the tuberculiform produced propodeal spiracles; the distance between anterior and posterior spiracles 1.03 mm. Puncturation very uniform throughout on dorsum and pleura, only moderately coarse, but very dense, sharply defined, the punctures deep, contiguous. Vestiture sparse, stiff, erect and suberect, not shaggy, stained yellow on notum but white laterally; pronotum, especially on side, with some fine, curly, sericeous white hairs as well, and the rest of the pleura with similar vestiture scattered over the surface; propodeum with distinct dorso-lateral stripes of white sericeous hairs, and a short dorsomedian stripe of similar hairs, between which the integument is dark ferruginous. Legs concolorous with body, with rather short, yellowish-stained vestiture.

Gaster ferruginous throughout. Petiole transverse, dorsally with a dense transverse band of fine, sericeous white hairs. Second tergite punctured as coarsely as alitrunk, but more closely so, the punctures contiguo-confluent, sharp, deep, the occasionally vestigial intervals sharp and thin; vestiture erect, or suberect, sparse, stiff, fuscous on disk and whitish on lateral, basal and apical margins; in addition, the disk near the base bears a pair of conspicuous maculae formed by pale, sericeous hairs, and the apex bears a wide border of similar hairs (interrupted medially by a fuscous band about as wide as the distance between the maculae); tergites 3–5 with similar broad, apical, pale, sericeous bands, with the median interruption progressively narrower, poorly developed on tergite five, the lateral margins of tergites 3–5 with some fuscous hairs as well. Sternite two extremely coarsely punctured, rather irregularly and rugosely sculptured, near apex somewhat strangulate, the portion distad of the strangulation less coarsely sculptured; vestiture white, sparse. Pygidium laterally fuscous pubescent, dorsally whitish pubescent, the hairs dense, rather long and shaggy; the vestiture erect or suberect, except for a median, pale stripe of decumbent hairs, that completely obscure the pygidium; a distinct pygidial area present, 0.33 mm. wide, closely setigerously punctured, except at extreme apex. Hypopygium sharply quadridentate at apex, the distal teeth on each side forming a channel for the sting, the lateral teeth forming small, erect processes clasping the sides of the pygidium; disk of hypopygium closely, coarsely sculptured and hirsute, except for a pair of basal glabrous, sublateral tubercles, not connected by a transverse ridge, and a V-shaped, high, biramose process, highest posteriorly, where it ends in a sharp, elevated point, shortly before the apex of the segment.

Holotype: Tumacacori Mountains, Arizona, September 1, 1931 (I. Wilson) in collection of R. M. Bohart.

This interesting, distinctive new species is not closely allied to any other species occurring in America north of Mexico. I have been unable to determine its affinity to the neotropical species, since the descriptions of the earlier writers, particularly of Cameron, are unreliable or incomplete, as regards significant characteristics. The punctate and appressed-hirsute pygidial area, clearly laterally defined, is at once diagnostic of this species. Because of the golden pubescent head and the pair of maculae of the anterior portions of the disk of the second tergite, this species bears a certain superficial resemblance to such species as *E. sudatrix* and *E. baboquivari.* The pubescent pygidium, as well as the characteristic dense bands of sericeous white hairs on abdominal tergites 3–5 (entirely similar to that of the apex of tergite two) at once distinguishes the present species from these forms. Structurally as well as in the superficial characters of pigmentation and sculpture, the species diverges widely from the other species of *Ephuta* known from our area. In the lamellate expansion of the upper portions of the postgenal ridges the species differs from all our other forms; in the very characteristic biramose, acutely V-shaped elevated process of the disk of the hypopygium the species is also very distinct from the other nearctic species. In addition, the sharply, coarsely dentate, transverse, arcuate supraclypeal ridge is different in appearance from that of the other species. The species is also much larger and more massive than our other known forms.

(*Continued from page 6*)

members and five guests present. The following were proposed for membership in the Society: Miss Mary John, Mr. Andrew Turchinsky, Mr. Francis Costello and Mr. Mathew E. Turner.

President Vishniac outlined the program for the remainder of the year. The Secretary reviewed the work done during the past summer in the matter of the sorting and proper housing of publications of the Society. Assisting the Secretary were Drs. Clausen and Forbes and Mr. Huberman. The Secretary called attention of the members to certain entomological works that are available at very low prices.

As this was the first meeting of the fall session various members spoke about their summer experiences. Dr. Ruckes reviewed his work on the Hemiptera collection of the American Museum, the integration of the extensive Olsen collection of Homoptera (about 10,000 specimens) into that of the Museum, the rearrangement of the Heteroptera from South America

(*Continued on page 94*)

THE RELATIONSHIPS OF THE TYROGLYPHOID MITE, HISTIOSTOMA POLYPORI (OUD.) WITH THE EARWIG, FORFICULA AURICULARIA LINN.

By Basanta Kumar Behura

Department of Zoology, Ravenshaw College, Cuttack, Orissa, India

Introduction

Insects are often infected with mites which do not assume a parasitic role. These mites represent that peculiar stage in the life cycle of members of Tyroglyphoidea, known as the "hypopus" stage. The hypopial phase in the life cycle of the Tyroglyphoid mite is regarded as a typical adaptation for resisting adverse conditions such as scarcity of food and a dry climate, involving a high temperature and a low humidity (Vitzthum, 1932; Solomon, 1943; Hughes, 1948). They are also regarded as a dispersal phase, because they cling to animals and are carried from one place to another. Specimens of the common European earwig, *Forficula auricularia* L., taken from the field in Edinburgh, Scotland were often found to be heavily infected with the hypopi of *Histiostoma polypori* (Oud.). It was assumed that the mobile hypopi, as in other cases, were merely riders on *Forficula.* During my investigations on the life-history of *H. polypori* and *F. auricularia,* I discovered that the association of the hypopus with *Forficula* was of greater significance in the life-cycle of the mite than had hitherto been suspected, a preliminary note about which was published earlier (Behura, 1950).

THE ROLE OF THE HYPOPUS OF H. POLYPORI

The hypopus of *H. polypori* (Text-fig. 1) attaches itself to the body of the earwig, not only for the purpose of transportation; but also for the vital purpose of indirectly obtaining its food for the propagation of its species. Sometimes owing to sheer numbers, the hypopi interfere with the feeding and locomotory parts of the earwig (Plate 1) and initiate its early death.

The hypopi attached to the larvae or adults of *Forficula* did not return to the soil at random, but only dropped off if they

(Jour. N.Y. Ent. Soc.), Vol. LXIV (Plate I)

Heavy infection of hypopi of *Histiostoma polypori* (Oud.) on the larva of *Forficula auricularia* Linn.

were carried to a favourable situation. The hypopi usually remained attached to the earwig until it died. It is clear that the decomposing state of the dead tissues and exudation of liquified material induces the transformation of the hypopus to the deutonymph. The deutonymphs fed on the liquefied remains and soon changed into adults which laid eggs in and around the periphery of the available food. A colony of mites was soon established and according to the conditions a varying number of hypopi were again produced.

ATTACHMENT AND POSTURE ON THE BODY OF FORFICULA

The earwigs probably accumulate mites during their nocturnal expeditions. The region of heaviest infection is upon the underside of the head. However, when the infection is heavy, they are also thickly scattered over the dorsal and ventral sides of the body, the antennae and legs (Plate 1).

The hypopi cling to the smooth cuticular surface of the body of the earwig by means of their ventral battery of suckers (Text-fig. 1 B). They cling so tenaciously to the smooth surface that it is extremely difficult to detach them. In the resting position, the anterior two pairs of legs of the hypopus are directed forward, and close together, while the two poorly developed posterior pairs are hidden beneath the body.

The hypopi on the body always face in the opposite direction to that in which the earwig is moving. On the head, the positions of the hypopi are somewhat irregular. On the leg, the hypopi face the distal portion of the joints and they are arranged along the long axis of the joints. On the abdomen the hypopi are arranged in transverse rows on the chitinous plates of the abdomen. This distribution of hypopi on the abdomen is particularly well-marked when the infestation is not too heavy. This orientation of the body with the posterior part of the hypopus facing the direction of movement, presents a streamlined surface which lessens friction and protects the appendages as the earwig moves into crevices. The hypopi are also arranged symmetrically; thus, the balance of the earwig is maintained.

Similar observations have been recorded by Wasmann (1892) on the orientation of hypopi of *Tyroglyphus wasmanni* Moniez on the legs of ants, although he did not apparently discover any special type of orientation in the other infested parts of the body namely the head, thorax and abdomen. Michael (1901) did not discover any regularity of position of hypopi of *Histiostoma rostroserratum* Mégnin on ants, which were noticed in

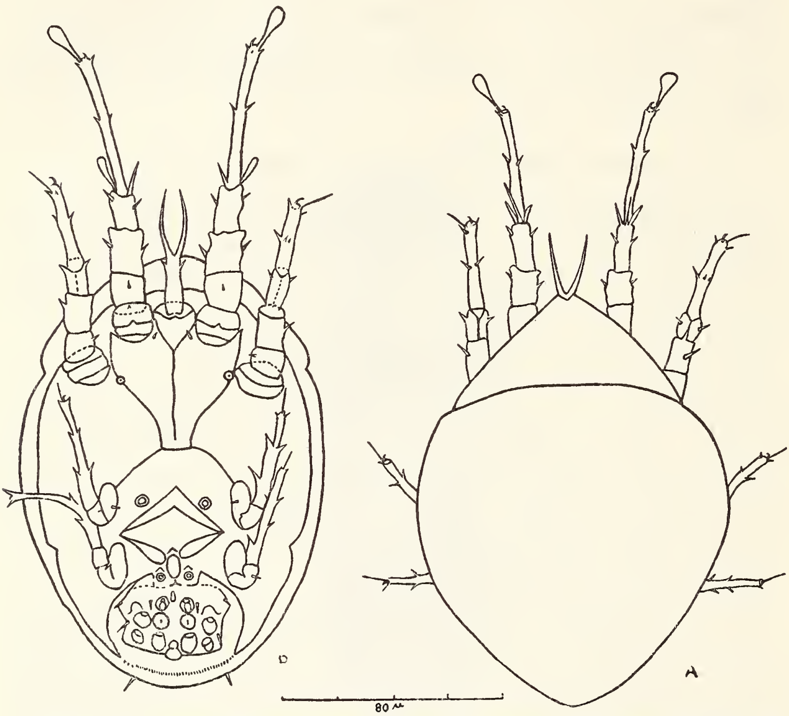

Figure 1. *Histiostoma polypori* (Oud.). Hypopus. A, Dorsal view; B, Ventral view.

crowded masses, especially on the head. However, Janet's (1897) observations on the orientation of a widely different group of Acarina, viz.: the Gamasidae, merits mention. He found that *Antennophorus uhlmanni* Haller and *Cilliba* (*Discopoma*) *comata* Leonardi when found upon the ant *Lasius mixtus* arranged themselves either bisymmetrically or in the median line so as not to upset the balance of the host that carried them. The *Antennophorus* have their anterior ends directed forward when they are on, or rather under the head of the ant, and backward on its abdomen.

MOVEMENT AND MOULTING RELATIONSHIP

The anterior legs of the hypopus are very long (about 101 μ) in comparison to the length of the body (158μ to 179μ). Although they are capable of crawling somewhat rapidly, their long tarsi serve primarily as tactile organs. When they have been given the opportunity of attaching themselves to the earwig they will then move to a suitable habitat. Their movements are unbalanced and cautious. The earwig responds to the movements of the hypopi over the body by rubbing its legs against the body. While crawling, the hypopus completely rests on its legs and in spite of the caroncle or sucker at the top of the first tarsi, they will lose their hold easily if the host is suddenly jerked. On one occasion, a hypopus was removed by a *Forficula* larva from the tarsus as the mite was crawling upward towards the thorax and then devoured.

If the conditions of food and moisture are not favorable the hypopi will remain attached to the same individual earwig from the larva to the adult stage. The hypopi are arranged over the general surface of the body of the active stages. Ecdysis in *Forficula* begins by the splitting of the old skin in the region of the thorax. Before this takes place the hypopi will move toward this region and migrate from the old cuticle to the newly formed cuticle of the next stage. After each fresh moult of the earwig larva, the hypopi are found aggregated in the groove between the head and thorax of the host. When the hypopi as an arranged mass have established themselves on the new cuticle of the next stage they radiate to different parts of the body and orientate themselves into the position previously described.

SENSORY PERCEPTION OF THE HYPOPUS

The synchronisation of hypopial migration on *Forficula* with the moulting process, in itself, merits a special consideration of the sensory perceptions of the hypopus. It is generally known that the active hypopus is highly sensitive to touch. Hence it appears that its whole body acts as some sort of dynamic perceptor organ (Michael, 1901). The perception of the pre-moulting phase of the host by the hypopus is difficult to explain. It is a problem beyond the scope of this present work. But judging from my own observations, this peculiar migration suggests the possibility of the hypopus being able to detect some chemical changes during the pre-moulting phase. It is well known that the waxy secretion coating the surface of the cuticle of the earwig is continuously renewed. The secretions produced by the hypodermis exude from the vertical canals which pierce the cuticle. As a prelude to moulting these secretions will stop because the old cuticle will be separated by the moulting fluid from the new cuticle and hypodermis. It is suggested that this stoppage of the chemical substance detected by the attached hypopus is a stimulus which induces movement. The nature of this stoppage and how it would govern the direction of movement is a separate problem. The setae of the legs are tactile in function. There are two long setae borne on a small basal sclerite representing the non-functional mouth. The leaf-like structures on the tarsi of the legs more closely resemble possible chemo-receptor end organs. Their form and texture are similar to the thin-walled sensory end organs of insects which are credited with this function (Wigglesworth, 1947).

THE RELATIONSHIPS BETWEEN H. POLYPORI AND F. AURICULARIA IN THE NATURAL ENVIRONMENT

Following the investigations in the laboratory and the observations in the field it seemed desirable to consider the relationships between the Anoetid, *H. polypori* and *F. auricularia* in the natural environment.

The availability of freshly decayed vegetable and animal matter, the higher temperatures and humidities during the summer provide the most favourable conditions for the propagation of *H. polypori.* It is during this time that *F. auricularia* exhibit the gregarious habit when both adults and late brood larvae live together in large colonies of about 500–600 (Weyrauch, 1929). Towards the end of the summer the drier climate leads to the formation of hypopi of *H. polypori* in larger numbers. The mites are given the opportunity of climbing onto the earwigs as they forage over the surface of the soil and low-lying vegetation during darkness. The agile hypopi with their well developed tactile sense will experience no difficulty in climbing onto the earwig as it moves with the ventral surface closely applied to the soil. Earwigs collected during summer months are usually heavily infested with hypopi, because, apart from the dry conditions, the gregarious habits of *Forficula* afford suitable opportunities for the hypopi to climb onto different individuals which will later transport them to the separate nests.

The advent of winter breaks up the colonies into separate pairs of males and females which hibernate for the winter (Behura, 1950a). Towards the end of the winter, the female earwig begins laying her first brood of eggs and she ejects the male from the nest. The males either remain outside the nests as single individuals or they may aggregate together in small groups. Before the onset of spring the majority of the males have succumbed to the unfavourable winter conditions. The hypopi which have attached themselves to the males will thus be rewarded by the early death of this sex but the increase in the size of the colony feeding on the dead male earwig in winter is a slow process owing to the retarding effect of the low temperature upon the life-cycle. The dry cold conditions also result in the production of greater numbers of hypopi within the colony. The hypopi attached to the females do not obtain the same opportunity of starting winter colonies.

In the early spring the overwintering female lays the first batch of eggs and some of the hypopi still attached to the females are given the opportunity of transferring themselves to the earwig larvae. The female and somewhat advanced larvae forage at night towards the late spring and hypopi, which have originated from winter colonies of mites formed on dead male earwigs, will be given the opportunity of attaching themselves to the old females and the larvae. The old female will either die at this stage or retreat to her cell to lay a second batch of eggs (Behura, 1950a). The death of the female will naturally provide suitable conditions which will induce the hypopi to change to deutonymphs. The nymphs will feed on the decomposing remains and change to adults resulting in the production of succeeding generations, all thriving within the colony. As the decomposing soft parts dehydrate and only the exoskeletal parts remain, there is an increase of hypopi within the colony.

The *Forficula* larvae produced from the first and second broods become infested with hypopi which have originated either from winter colonies or from spring or early summer colonies formed upon the remains of dead female earwigs.

Hence the overwintering female is also responsible for providing overwintering hypopi with a suitable attachment protected by the favourable conditions of the earthen cell. The survival rate of hypopi produced by winter colonies feeding on dead male earwigs is difficult to estimate. Although the hypopi are designed for existing at a low rate of metabolism there was no real evidence from the results of laboratory tests that their survival rate at very low temperatures was very much higher than the normal forms.

It is therefore clear that a form of synchronised behaviour exists in the relationship of *H. polypori* and *F. auricularia* which is beneficial to the mite other than that of a means of distribution. Attachment of hypopi to the overwintering female earwig protected by her cell, ensures the survival of the species of mite, since the female earwig will in the following early summer die and provide the attached hypopi with conditions ideal for the production of a large colony of mites.

It was also clear that mite colonies were not dependent on decomposing animal remains since they were capable of thriving on moist filter paper. In such cases the mites were probably feeding on a fungus. In the normal environment the mites would therefore feed and multiply upon nutrient substances other than decomposing animal remains. But the fact that the mites are able to feed and thrive upon fungi or decayed vegetation does not itself make them independent of *Forficula.* If, as was previously thought, the hypopi merely dropped at random from the earwig onto the soil after being transported for a variable distance they would frequently drop onto unfavourable soil. The mites are dependent for survival on moist conditions and large colonies will thrive best only when the substratum is saturated with moisture.

The answer to this close relationship therefore lies in the preference of both *H. polypori* and *F. auricularia* for a moist micro-climate. The micro-climate favoured by *Forficula* is ideal for the production of mites. It was also noticeable in the laboratory tests that the hypopi were sensitive to changes in humidity and very moist conditions alone would sometimes induce them to change to normal nymphs. Thus the persistent nature of the attachment of the hypopi to *Forficula* is understandable since the hypopi would be induced to move or change to normal nymphs, only when the moist decomposing soft parts of the dead earwig are made available.

The association is also beneficial to the mite because the earwig, apart from considerable lateral movement on the soil surface, will always select a moist habitat in which to settle. Such habitat also favour the growth of fungi and the presence of decaying vegetation, both suitable as food requirements of the mite.

The attachment of hypopi of *H. polypori* to *F. auricularia* in the natural environment is therefore something more complex and more integrated than the previous assumption that the hypopi are merely picked up and transported for various distances by the earwig as it forages over the surface of the soil and lowlying vegetation.

ACKNOWLEDGMENTS

The present work was carried out at the Department of Zoology, University of Edinburgh, Scotland, during the tenure of an overseas scholarship from the Government of Orissa, India, to whom I am exceedingly grateful. I am particularly indebted to Dr. B. M. Jones, for his constant help, encouragement and guidance and to Prof. James Ritchie for laboratory facilities and interest in my work.

SUMMARY

Forficula auricularia Linn., is often found infected by the hypopi of *Histiostoma polypori* (Oud.). They arrange themselves with their streamlined posterior surface facing the direction in which the earwig is moving. They also arrange themselves symmetrically so that the balance of the earwig is maintained. The hypopus apart from being the distribution phase will remain attached to the earwig until it is either transported to a favourable habitat or until the earwig dies. Hypopi clinging to nymphs of *F. auricularia* migrated to the new cuticle of the moulting earwig and so remained attached to the host until it attained the adult condition and eventually died; its decomposing remains then furnished food for different stages of the mite.

It is suggested that the hypopus, besides possessing a well developed tactile sense, is capable of detecting chemical changes upon the surface of the cuticle.

The relationship between *H. polypori* and *F. auricularia* in the natural environment is discussed.

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and the entertaining of Dr. Petr Wygodzinsky, hemipterist from Tucuman, Argentina, during July. Dr. Ruckes also reported on a swarm of *Megarhyssa lunator* which were observed ovipositing in an old maple infested with *Tremex*. Apparently the female at first holds the ovipositor parallel to the tree's surface and finding the proper place for insertion applies the tip of the ovipositor to that point then slowly backs up so that the ovipositor gradually takes on a vertical position and finally assumes the typical "?" form so often represented in illustrations of the species.

President Vishniac also commented on the peculiar habits of this wasp. He then proceeded to show slides in color of his trip to the Gulf of Mexico and some of the biology encountered there.

(*Continued on page 98*)

THE OCCURRENCE OF THE RAT LOUSE (POLYPLAX SPINULOSA) ON THE NORWAY RAT IN NEW JERSEY[1]

By ELTON J. HANSENS
RUTGERS UNIVERSITY, NEW BRUNSWICK, N. J.

A detailed study of the ectoparasites of the Norway or brown rat (*Rattus norvegicus*) was begun in the spring of 1951 with the cooperation of the N. J. State Department of Agriculture. Previous papers (Hansens and Hadjinicolaou, 1952 and Burbutis and Hansens, 1955) reported on fleas taken from rats throughout the State of New Jersey. The present paper summarizes information on the extent of parasitism of these same rats by the common rat louse, *Polyplax spinulosa*, the only species of Anoplura taken in the survey. A total of 102,428 lice were cellected from rats mostly from municipal dumps but in some instances, from buildings of various types. At least some collections were made in all 21 counties in the state. Methods of collecting rats and handling parasite collections were discussed in the earlier papers. All lice from each rat were examined under a stereoscopic microscope and representative samples of lice and all doubtful specimens were mounted on slides and identification confirmed using the compound microscope. A total of 2759 rats were taken from 88 municipalities. Of these rats, 1692 (61.3%) were infested with *Polyplax spinulosa*. At 9 of the 88 locations no infested rats were taken. From these 9 sites, 24 rats were collected as follows: Long Branch (15), Port Norris (2), and 1 each at Englewood Cliffs, Teaneck, Woodcliff Lake, Vernon, Plainfield, Wrightstown, and Pemberton.

At the other 79 locations, 2735 rats were taken as follows: Bergen County—Englewood (31), Hackensack (56), Lyndhurst (20), North Arlington (142), North Bergen (1), Palisades Park (20), Rutherford (24), Wood Ridge (23); Hudson County—Fairview (138), Jersey City (181), Secaucus (165), Union City (131); Passaic County—Bloomingdale (90); Sussex County—

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, the State University of New Jersey, Department of Entomology, New Brunswick.

McAfee (2), Newton (40); Morris County—Boonton (2), Dover (10), Pine Brook (63); Warren County—Belvidere (26), Hackettstown (43), Phillipsburg (31), Washington (44); Hunterdon County— Flemington (60), Frenchtown (2), Hampton (1), High Bridge (30), Lambertville (13), White House Station (1); Essex County—Newark (213); Union County—Elizabeth (40), Rahway (126), Springfield (1); Middlesex County—Cranbury (32), New Brunswick (3), Perth Amboy (249), South River (163); Somerset County—Bernardsville (40), Raritan (28); Mercer County—Hightstown (41), Hopewell (2), Kingston (6), Pennington (1), Trenton (25); Monmouth County—Allentown (15), Freehold (20); Ocean County—Toms River (1); Burlington County—Bordentown (31), Burlington (15), Palmyra (16), Riverside (29), Riverton (3), Roebling (3); Camden County—Audubon (15), Barrington (19), Camden (46), Pennsauken (11), Westmont (7); Gloucester County—Gibbstown (1), National Park (7), Westville (8), Woodbury (20); Salem County—Pedricktown (5), Penns Grove (11), Pittsgrove (3), Salem (20); Cumberland County—Bridgeton (16), Deerfield (18), Vineland (2); Atlantic County—Atlantic City (12), Somers Point (1); Cape May County—Cape May (6), Wildwood (3), Woodbine (1).

RESULTS

The results indicate the range of parasite population on the animals and variation in lousiness with sex, size of the rats, and time of the year.

There were 37.1 lice per rat collected and 60.5 lice per infested rat. It was found that of the total number of rats taken, 38.7% were not parasitized by lice, 41.0% had less than 10 lice, 12.4% had 10 to 50, 3.5% had 50 to 100, 4.0% had 100 to 1000, and 0.4% had more than 1000 lice. One rat had 16,044 lice, one had 5695, and 9 others had between 1000 and 5000 lice. All but one of these rats was mature. These rats came from 7 locations and the lice from these eleven rats made up 49% of the total lice collected.

Of the total lice, 39.7% were adults and 60.3% nymphs. As far as the rats were concerned there were 1358 males and 1200 females. Of these, 926 males were infested with 64,390 lice and 690 females with 31,475 lice. Thus males were infested with nearly twice as many lice as females. The largest number of rats were between 8 and 9 inches long. The largest infestations were on these rats and larger ones.

Information was also obtained relative to infestations by months. These data are recorded in table 1.

TABLE 1. MONTHLY TOTALS OF RATS AND RAT LICE COLLECTED IN NEW JERSEY

Month	Total rats	Per Cent infested	Total Polyplax spinulosa	Lice per rat
April 1951	11	63.6	648	58.9
May	39	89.7	1729	44.3
June	189	63.4	11146	59.0
July	292	50.0	10446	35.7
August	368	53.9	2764	7.5
September	113	69.9	18628	164.8
November	107	72.0	832	7.8
December	119	87.3	6865	57.7
January 1952	139	69.8	7544	54.3
February	217	78.8	10879	50.1
March	111	70.3	5358	48.2
April	96	82.3	10085	105.0
May	101	72.3	4613	45.7
June	195	75.9	6119	31.4
July	230	41.7	1711	7.4
August	329	43.2	2200	6.7
September	96	48.9	846	8.8

Data in table 1 shows infestation to be highest in late winter and spring, and lowest in the summer, i.e. in July, August, and September. The very high average for September 1951 in this report was due to the capture of one extremely infested animal. Apparently in summer, lice decrease in number just as they do on most other mammals. The burrowing and nocturnal habits of the rat, however, probably favor higher populations of lice than are found on other mammals.

SUMMARY

The rat louse, *Polyplax spinulosa,* was the only species of Anoplura found on 2759 rats collected throughout the year and in all counties of New Jersey. Male rats were more heavily infested than females and mature rats than young. No lice were found on 38.7% of the rats and less than 50 lice were found on an additional 53.4%. The most heavily infested rat had 16,044 lice, but only 11 rats had more than 1000 lice. Rats were most heavily infested in late winter and spring and had fewest lice in summer.

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Dr. Treat spoke about the prevalence of European hornets (*Vespa crabro*) and their damage to maple trees this year.

Miss Gray remarked about some African scorpions that she had procured and mentioned that she is studying the period of gestation in these animals. She also reported that the European mantis (*Mantis religiosa*) was abundant enough in Augusta, Maine, this summer to be considered a pest.

Dr. Treat then described a plague of walking sticks he had observed several years ago and remarked that they were indeed difficult to see while persons in motion were about but could readily be made out if one stood still. Dr. Clausen commented upon the rain-like effect created by the dropping of their eggs which are like small seeds.

Mr. Dix told of his visit to the Harvard Museum and his observations on praying mantids.

Dr. Vishniac then spoke briefly of his work with Dr. Ross during the past summer.

The meeting adjourned at 9:00 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF OCTOBER 18, 1955

The meeting was called to order by President Vishniac at 8:15 P.M. at the American Museum of Natural History. There were twelve members and six guests present.

In the absence of the Secretary, Dr. Asher Treat was appointed Secretary, pro tempore. Reading of the previous minutes was dispensed with. Dr. Treat reported for the program committee on the speakers for the coming meetings through January 17, 1956.

The following were unanimously elected to membership: Andrew Turchinsky, 2012 Vyse Avenue, New York 60, N. Y.; Matthew Xavier Turner, 177 St. George Road, c/o Lee, Staten Island 6, N. Y.; Francis Costello, 934 Bronx Park South, New York 60, N. Y.; Miss Mary C. John, Biological Laboratory, Fordham University, New York 58, N. Y.

(*Continued on page 124*)

A PRELIMINARY LIST OF THE APHIDS OF NEW JERSEY

By Mortimer D. Leonard
Washington, D. C.

The Report of the New Jersey State Museum for 1909, published in 1910, included a Report on the Insects of New Jersey, prepared by John B. Smith. This part, which constituted practically the entire Museum Report, is an annotated list of 10,385 species of insects occurring in the State. This has ever since been widely known among entomologists as "Smith's List." A total of 78 species in the family Aphidae are included, for 33 of which it is uncertain if they were definitely known to occur in New Jersey or were listed because they were common and widely distributed and therefore presumed to be present in the State.

In the section on aphids in "Smith's List" it is stated that "Little systematic collecting has been done in New Jersey in this family. . . . It is probable that numerous additions will be made when our fauna has been more thoroughly studied." The above statement is still largely true. No serious collecting has been done except by the author, mostly at Ridgewood and Haddonfield from 1933 to 1948, and by Cazier, Gertsch and several others of the American Museum of Natural History at several locations near New York City between 1941 and 1946. These latter collections, determined by E. O. Essig, totaled 46 species of which 21 had not been previously recorded from New Jersey. They are referred to by the designation (AMNH). T. L. Guyton has contributed a few records from Bound Brook and Lebanon.

The present paper lists 143 species known to occur in New Jersey and found on 122 food plants plus 7 of uncertain occurrence from "Smith's List." These latter names are preceded by an asterisk. The balance of the 33 species of uncertain occurrence in New Jersey in the 1910 List has been absorbed by synonymy and by subsequent definite records. A total of at least 250 species should much more nearly approximate those to be found in the State.

NJL—refers to statements in "Smith's List."

NJR—refers to statements in Annual Reports of the New Jersey Agricultural Experiment Station. The year is added in each case.

Pepper 1957—Statements so indicated were made in a letter to the author from Dr. Bailey B. Pepper, Head, Department of Entomology, New Jersey Agricultural Experiment Station in February, 1957. These briefly summarize the present status of several of the more important economic aphids in New Jersey as appraised by the staff of the Department.

In the 1910 New Jersey List is the following description of my two principal collecting localities:

Page 822, "Haddonfield, Camden County; Delaware Valley. A rich, well cultivated district, with little, mostly deciduous woodland, usually well elevated."

Page 830, "Ridgewood, Bergen County, Piedmont Plain close to Highlands; three miles northeast of Paterson. A hilly and rolling country with much woodland and rapid brooks in the rocky valleys and gullies."

Records not otherwise designated are to be credited to the author, some of whose determinations were either made or checked by A. N. Tissot and E. O. Essig.

My sincere thanks are due Louise M. Russell of the Agricultural Research Service, United States Department of Agriculture, Washington, D. C., for much help in determining synonymies of most of the names in "Smith's List," for several determinations and records and for reviewing the manuscript of this paper.

Amphorophora crataegi (Monell).
Moorestown, Oct. on hawthorne (in litt. from F. M. Wadley to MDL, Mar. 13, 1939).

Amphorophora rubi (Kalt.). European Raspberry Aphid.
NJL as *Nectarophora*—"A blackberry plant louse which I have seen abundantly at Hammonton and occasionally in smaller numbers elsewhere in the State." NJR 1922—Ridgefield Park, June, (as *Nectarophora*).

Amphorophora sensoriata Mason.
Haddonfield, July and Oct. 1935, a few on the canes of cultivated raspberry bushes.

Amphorophora sonchi (Oestl.).
Ridgewood, Oct. 1938, casual on apple.

Amphorophora vaccinii Mason.
Letter from P. E. Marucci, N. J. Cranberry Station) July 1957—"I have taken *Aphis gossypii* and *Amphorophora vaccinii* on blueberries but find them very rarely."

Anoecia corni (Fab.).
Ridgewood, Oct. 1936 and 1935, a few on leaves of *Cornus*. Ramsey, Oct. 1941, on *Cornus* (AMNH).

Anoecia querci (Fitch).
Ridgewood, 1 alate on *Cornus*, Sept. 1933. Haddonfield, Aug. and Sept. 1933, on roots of a grass; Sept. 1934, on roots of *Panicum* sp., of crabgrass, and of barnyard grass, *Echinochloa crus-galli*, Sept. 1934. Pemberton, 1948, in light trap (Marucci coll.).

Anuraphis cardui (L.). Thistle Aphid. New Brunswick, Oct. 17, 1946, on *Circium lanceolatum* (L. Hagemann coll.).

Anuraphis maidi-radicis (Forbes). Corn Root Aphid.
NJL as *Aphis*—"The corn root louse. . . . In New Jersey of only occasional occurrence." Haddonfield, Aug. 1933, on roots of an undetermined plant, and Sept. 1934, on roots of perennial aster and of *Acalypha virginica*.

Anuraphis persicae-niger (Smith). Black Peach Aphid.
NJL as *Aphis*—"The black Peach Louse. Plentiful throughout the State south of the Piedmont Plain and most abundant in the lighter sandy soils where the root form often does serious injury to young trees. On the Piedmont Plain and Northward it is rare and never injurious." Pepper 1957—"The black peach aphid root infestations are a serious problem where growers attempt to plant peaches following peaches." NJR 1916—Brentwood, Nov. In the Insect Pest Survey files of USDA are the following statements: Rept. N. J. Dept. Ent. (11th) for 1890—"Unusually abundant this year, especially to nursery trees and newly planted orchards." Rept. N. J. Dept. Ent. for 1903—"Reported as injurious from several points in S. Jersey, especially Atlantic and Gloucester Counties, always from young orchards. In previous years had heard of serious injury to nursery trees in Monmouth Co. and of injury to young orchards in Cumberland and Burlington Cos." T. J. Headlee reported April 1932 the presence

of this aphid on peach trees throughout the latter part of the winter.

Anuraphis roseus Baker. Rosy Apple Aphid.
NJR 1916 as *Aphis sorbi* Kalt.—"General." Ridgewood, Nov. 1935, males on apple. Ramsey, May, 1941, on *Ostrya virginica* (AMNH). Pepper 1957—"The rosy apple aphid is a serious pest of apples wherever they are grown in New Jersey."

Anuraphis tulipae (Boyer).
Tulip Bulb Aphid. Ramsey, June 1942, on carrots (AMNH).

Anuraphis viburnicola (Gill.). Snowball Aphid.
Haddonfield, Oct. 1937, on snowball. Ramsey, May 1941, on *Viburnum* sp. (AMNH). Pepper 1957—"This insect is generally distributed throughout New Jersey and stunts blossoms on *Viburnum* wherever it is growing."

Aphis caliginosa H. & F.
Ramsey Oct. 1941, on *Cornus* (AMNH).

Aphis cephalanthi Thomas.
Ridgewood, Aug. 1936, on *Impatiens* sp.

Aphis cerasifoliae Fitch. Chokecherry Aphid.
NJL—"Common on wild cherry in Hunterdon Co." (Sm.) Ramsey, May 1941, on ?Populus. (AMNH).

Aphis coreopsidis (Thos.).
Ridgewood, July 1936, abundant on a small sour-gum, *Nyssa sylvatica*. Bound Brook, July 1936, (Guyton) on *Cosmos* sp.

Aphis cornifoliae Fitch.
NJL—"On the leaves of dogwood and *Crataegus*" (Note by MDL—Another species is undoubtedly on the latter plant). Ridgewood, Oct. 1935, on *Cornus* sp.

Aphis crataegifoliae Fitch.
Bound Brook, May 1936, (Guyton) on *Crataegus*. Pemberton, 1948, in light trap (Marucci coll., Russell det.).

Aphis fabae Scop. Bean Aphid.
Since *A. rumicis* L. is considered to occur only on *Rumex* it is felt that all records on other food plants may fairly safely be referred to *A. fabae* Scop. They are as follows:
NJL—"The bean plant louse. Generally distributed, sometimes common but never, in my experience injurious in New Jersey." From old correspondence from the N.J. Agr. Exp. Station in the

former U.S. Bur. Ent. files: ''Camden, 1907, Chester, 1908, Ocean Grove, 1909, East Orange, 1911 and 1915; all refer to the bean plant louse.'' Haddonfield, Nov. 1938 on *Hydrangea,* Dec. 1938, and Oct., Sept, 1948, on *Nasturtium.* Ridgewood, Oct. 1938, starting colonies on *Hydrangea* and Oct. 1936, on Strawflower, *Helichrysum.* Medford, July 1936, on *Chenopodium album.* Ramsey, May 1941, on burdock (AMNH). Newark, May 1941 (AMNH) on *Viburnum opulus sterile* and Rose of Sharon. Tenafly, May 1942, (AMNH). Middletown, June 1943, (Sanford coll., Mason det.) on *Vicia faba.* Bridgeton, June 1943, (A. T. Gaul coll., Mason det.) on burdock, abundant. Pepper 1957—''This insect is occasionally a pest of bean acreages in Southern New Jersey.''

Aphis forbesi Weed. Strawberry Root Aphid.
NJL—''The strawberry root-louse. Locally and seasonally common in the light sandy soils of southern New Jersey and rarely injurious. In the more northern parts almost absent.'' Pepper 1957—''This insect is generally present in strawberry plantings throughout the State and on occasion causes minor damage.''

Aphis gossypii Glover. Melon or Cotton Aphid.
NJL—''The melon plant louse: Occurs throughout the State but much more commonly in the Southern Counties where it often destroys entire crops. It occurs also on a great variety of weedy plants on which it passes the winter, migrating to the melon fields in June.'' Ramsey, May 1941, on *Beta* sp. (AMNH). Ridgewood, May 1939, moderately abundant on the leaves of a large Rose of Sharon. Newark, May 1941, on *Hibiscus syriacus* (AMNH). In letter from P. E. Marucci, (N. J. Cranberry Station), May 1957—''I have taken *Aphis gossypii* and *Amphorophora vaccinii* on blueberries but find them very rarely.'' Pepper 1957—''Present throughout the State and occasionally causes serious damage to cucurbit plantings.''

Aphis hederae Kalt. Ivy Aphid.
Ridgewood, Mar. 1936, fairly common on tendrils of English ivy plants indoors. NJR 1916—''In greenhouses on English ivy, not common (Weiss).''

Aphis helianthi Monell. Dogwood or Sunflower Aphid.
Bound Brook, June 1936, (Guyton) on *Asclepias.* Ramsey, Oct. 1941, on *Solidago* (AMNH).

Aphis illinoisensis Shimer. Grapevine Aphid.
NJL—As *Nectarophora.* "Montclair, Perth Amboy and generally throughout the State on grape." NJR 1921—"New Brunswick, Perth Amboy, Sewaren and South Orange on grape." Newark, May, 1941, on *Vitis* sp. (AMNH). Ridgewood, June, abundant on most of the tender shoots of a small grape arbor. Tenafly, July, 1942, on *Viburnum* sp. (AMNH). Harrison, Nov. 1941, (West Exterminating Co. coll., Mason det.).

Aphis medicaginis Koch. Cowpea Aphid.
Gloucester, Aug. 1943, on stalk of red clover (M. J. Ramsey coll., Mason det.). Burlington, Aug. 1943, heavy infestation on bean (L. L. Spessard coll., Mason det.).

Aphis nerii Boyer. Oleander and Milkweed Aphid.
NJR 1916—"In greenhouses on *Oleander,* not common (Weiss)."

Aphis oenotherae Oestl.
Ramsey, Oct. 1941, a male on *Solidago* sp. (AMNH).

Aphis pomi DeG. Apple Aphid.
NJL—as *mali* F.—"The apple plant louse. Occurs throughout the State, sometimes in great numbers, causing serious injury." NJR 1916—"Injurious." Pepper 1957—"Present wherever apples are grown throughout New Jersey and necessitates insecticide applications each year to control damage to foliage and fruit."

(*Aphis quercifoliae* Walsh).
NJL—"Feeds on oak, soft maple and buttonball." NJR 1927—Bradley Beach, June, on oak. It is not considered that this species can be recognized from Walsh's description (Note by MDL).

Aphis rubifolii (Thos.).
NJR 1922 as *Nectarophora rubi* Kalt. on blackberry, Ridgefield Park, Sept., presumably refers to this species. Pemberton, July 1933, on wild blackberry leaves. Ridgewood, Oct. 1938, in curled leaves of *Rubus.* Wycoff, Nov. 1935, on leaves of *Rubus.* Lebanon, July 1936, on *Rubus alleghenienis* (Guyton coll.).

Aphis rumicis L. Dock Aphid.
A number of references to and collections of this aphid have been made on several plants in New Jersey but it is considered that this species occurs only on *Rumex,* on which only one collection of it has been definitely recorded: Springfield, Nov. 1943, (Adams and Sanford coll., Mason det.).

Aphis sambucifoliae Fitch. Elder Aphid.
Ramsey, Oct. 1941, (AMNH) on *Sambucus* sp.

Aphis spiraecola Patch. Spiraea Aphid.
Ridgewood, May 1939, abundant on a number of *Spiraea* shrubs; June 1933 on *Spiraea vanhouttei.* Haddonfield, Nov. 1938, a moderate infestation on several *Spiraea vanhouttei.*

Aphis virburniphila Patch.
Ramsey, May 1941, on *Viburnum acerifolium* (AMNH).

Brevicoryne brassicae (L.). Cabbage Aphid.
NJL as *Aphis*—''Occurs throughout the State and often in destructive numbers.'' NJR 1916—Glassboro, June; Allendale, May; Monroeville, Oct. NJR 1919—Metuchen, Oct., Pemberton, 1948, in light trap (Marucci coll., Russell det.). Pepper 1957—''Present throughout New Jersey but more serious in the northern counties on all brassicaceous crops.''

Calaphis betulaecolens (Fitch).
NJL as *Chaitophorus*—''A species of wide distribution on birch.'' Tuckerton, July 1933, on white birch. Ridgewood, May 1936 and May 1939, on birch. Ramsey, May 1941, on *Betula alba* AMNH). Englewood, Sept. 1946, on *Betula* (AMNH).

Calaphis betulella Walsh.
Bound Brook, May 1936, (Guyton coll.).

Calaphis castaneae (Fitch).
NJL as *Chaitophorus*—''On leaves of the American chestnut.'' Ridgewood, Oct. 13, 1935, sexual males and females, not numerous; also June 28, 1936.

Capitophorus hippophaes (Walker).
Haddonfield, July 1936 and Sept. 1946, on *Polygonum pennsylvanicum.* Ridgewood, Aug. 1936, on underside of *Polygonum pennsylvanicum* leaves; Nov. 1936, (males also present) and Oct. 1938, abundant on leaves of three shrubs of Russian olive, *Elaeagnus multiflora.*

Capitophorus ribis (L.). Currant Aphid.
NJL as *Myzus*—''Occurs throughout the State on currant . . . sometimes injurious.'' NJR 1919—Ridgewood, May. NJR 1923—Madison, July 1921; S. Orange, June 1922.

Cavariella aegopodii (Scop.).
NJL—Statement that *Siphocoryne salicis* Mon. ''Occurs on

various species of willows'' may refer to this species. Ridgewood, Oct. 1935, on leaves of *Salix* sp.

**Cavariella essigi* G. & B.

NJL—*Siphocoryne salicis* Mon. ''Occurs on various species of willows'' may refer to this species.

Cavariella theobaldi G. & B. (apterae only). Lake Mohawk, July 29, 1947, on *Heracleum lanatum.*

* *Chaitophorus populifoliae* (Fitch). Clear-winged Aspen Aphid.

NJL—''On leaves of poplar. The New Jersey species found on poplar have not been determined.''

* *Chaitophorus quercifoliae* Fitch.

NJL as *Lachnus*—''On the leaves of oak.''

**Chaitophorus salicellis* (Fitch).

NJL as *Lachnus*—''Found locally on willows.''

Chaitophorus viminalis Monell. Little Black and Green Willow Leaf Aphid.

NJL—''On willow, poplar and maple; locally common.'' Ridgewood, Oct. 1938, common on leaves of a willow and June 1939, on the same tree. Ramsey, May 1941, on *Salix* sp. (AMNH).

Cinara abietis (Fitch).

NJL as *Lachnus*—''Occurs on spruce in the Appalachian and Highlands areas.''

Cinara pini (L.).

Millsboro, May 1941, on *Pinus rigida* (AMNH).

Cinara strobi (Fitch). White Pine Aphid.

NJL—''A feeder on white pine; sometimes locally common.'' NJR 1922—Gladstone, Nov. (as *Lachnus*), NJR 1925—Ralston, Apr., and Plainfield, June, on *Pinus strobus.*

Colopha ulmicola Fitch. Elm Cockscomb Gall Aphid.

NJL—''Makes the well-known cockscomb gall on elm, locally and seasonally common throughout the State.'' NJR 1912—Riverton, July, on elm. Medford, July 1936, old galls abundant on elm.

Drepanaphis acerifolii Thos. Painted Maple Aphid.

Clyde F. Smith has found that several species have been going under this name and has described them as new. It is therefore possible that some of the records here included refer to one or more of Smith's species although those collected by the author from Haddonfield and Pompton Lakes definitely refer to *acerifolii.* NJL as *Drepanosiphum*—"A species of wide distribution on maple; common in New Jersey on the soft maple." NJR 1927—New Brunswick and Phillipsburg, June. Pompton Lakes, Oct. 1935, on maple leaves (viviparae, sexual females and males. Haddonfield, Oct. 1935, July 1936, Sept. 1946, common on *Acer saccharinum.* Ramsey, May 1941, casual on *Betula alba* and Oct. 1941 (AMNH). Englewood, June 1942, Sept. 1947, Sept. 1947, on *Acer* sp.

Drepanosiphum platanoides (Schrank). Sycamore Aphid.
Ridgewood, Sept. 1946, common on *Acer platanoides.*

Eriosoma crataegi (Oestl).
Haddonfield, Sept. 1933, on hawthorn. Bound Brook, July 1936, (Guyton) on *Crataegus* sp.

Eriosoma americanum (Riley). Woolly Elm Aphid.
Tenafly, July 1942, in marginal leaf galls on slippery elm, *Ulmus fulva* (AMNH). New Brunswick, May, 1929.

Eriosoma crataegi (Oestl).
Belle Mead, Sept. 1934, (F. M. Wadley coll.).

Eriosoma lanigerum (Hausm.). Woolly Apple Aphid.
NJL as *Schizoneura*—"More or less common throughout the State but never really injurious . . . also occurs on other plants and trees." Pepper 1957—"Present wherever apples are grown in New Jersey but rarely reaches status of an economic pest."

**Eriosoma rileyi* Thos. Woolly Aphid of elm bark.
NJL as *Schizoneura*—"A woolly louse on American elm." New Brunswick, May, 1929 (identified as *Tetraneura ulmi*).

Euceraphis betulae (Koch).
Haddonfield, Sept. 1934, a "drift" on an oak leaf. Ridgewood, Sept. 1934, abundant on white birch and in Oct. sexuales also present; Oct. 1937, 1938, May 1939, Sept. 1946, on *Betula* sp. Englewood, Sept. 1946, (AMNH).

Euceraphis mucidus (Fitch).
Englewood, June 1941, casual on elm (AMNH).

Forda olivacea Rohwer.
Haddonfield, Aug. 1933, on roots of an undetermined plant.

Hamamelistes spinosus Shimer.

NJL as *Hormaphis*—"Makes galls on fruit buds of witch hazel, N. J." (Beutenmüller).

Hormaphis hamamelidis Fitch.

NJL—"Makes galls on leaves of witch hazel, N. J." (Beutenmüller).

Hyalopteroides dactylidis (Hayhurst. New Brunswick, May 12, 1949, on *Dactylis glomerata,* abundant and injurious (R. S. Filmer coll.).

Hyalopterus pruni (Geoff.). Mealy Plum Aphid.

NJL—"River Edge, Newark, Vineland (USAgr.). A common species on prune and plum." Lebanon, June 1936, on plum (Guyton coll.).

Hysteroneura setaria (Thos.). Rusty Plum Aphid.

NJR 1916—East Rutherford, Sept. Headlee report to Insect Pest Survey of USDA, June 1935—"Present in considerable numbers." Pemberton 1948 in light trap (Marucci coll.).

Idiopterus nephrelepidis Davis. New Brunswick, Jan. 1930, on fern. (C. C. Hamilton coll.).

Kakimia sp.

Bound Brook, June 1936, on Devil's Club, *Fatsia horrida* (Guyton coll.).

Kakimia essigi G. & P.

Bergenfield, June 1936, fairly abundant on columbine.

Kakimia houghtonensis (Troop). Gooseberry Witch-broom Aphid.

NJR 1916—Riverton, gooseberry (Headlee). NJR 1922—Paterson, Aug., Rumson, June.

**Lachnus larifex* Fitch.

NJL—"Occurs on the American larch or tamarac."

Lachnus salignus (Gmelin). Giant Willow Aphid.

Princeton, Aug. 1943, on willow (Spessard coll., Mason det.).

Longistigma caryae (Harris).

NJL—"Locally common on hickory, walnut, linden etc. and accused of killing trees in some instances." NJR 1925—Red Bank, Sept. NJR 1926—Woodbury, Sept. Haddonfield, Nov. 1935, scarce on sycamores; abundant on all the many sycamore trees in town in Sept. 1945, and observed in greater of less numbers in each of the intervening years. Milltown, Oct. 4, 1946, on pin oak (L. Hagemann coll.).

Macrosiphonella sanborni Gill. Chrysanthemum Aphid.
NJR 1916—"In greenhouses" (Weiss). NJR 1922—Flemington, Nov., on chrysanthemum. Haddonfield, moderate infestations during summer to fall observed from 1935–1946 on many chrysanthemums in gardens. Ridgewood, Oct. 1938, on chrysanthemums. Tenafly, May, 1942 (AMNH). Pepper 1957—"Present throughout New Jersey and often stunts growth of plant and flowers."

Macrosiphonella tanacetaria (Kalt.).
Lebanon, June 1936, on *Tanacetum vulgare* (Guyton coll.).

Macrosiphum sp.
NJL—"*Nectarophora lactucae* Kalt. Lettuce plant louse" may refer to one or more species of Macrosiphum. A Macrosiphum was very abundant on the flower stalks of a garden patch of lettuce which was going to seed in Haddonfield in the fall of 1945 but the specimens were not preserved.

Macrosiphum sp.
Bound Brook, July 1936 on *Eupatorium purpureum* (Guyton coll.).

Macrosiphum ambrosiae (Thos.). Brown Ambrosia Aphid.
NJL—*Aphis ambrosia* Raf. may refer to this species: "On the various species of ragweeds." Bridgeton, July 1936, on *Lactuca.* Haddonfield, Sept. 1938, on garden aster (Tissot det. with query); also det. with query, Sept. 1945, on *Ambrosia trifida,* abundant, parasitized by *Aphidius polygonaphis* and a secondary parasite, *Pachyneuron* sp., was also present (C. F. Smith det.); very abundant on a very large area of *Ambrosia trifida,* Sept. 1946. Ridgewood, Oct. 1935, (Essig det. with query) on *Helichrysum,* strawflower. New Brunswick, Oct. 17, 1946, on bull thistle, *Circium lanceolatum* (L. Hagemann coll.).

Macrosiphum asterifoliae Strom.
Bound Brook, July 1936, (Guyton coll.), on ?*Erigeron.*

Macrosiphum erigeronensis (Thos.). Canadian Fleabane Aphid.
Haddonfield, Sept. 1946, abundant on the flower stems of a considerable planting of fireweed, *Erechtites hieraceifolia* (Essig det. with query).

Macrosiphum granarium (Kirby). English Grain Aphid.
NJR 1919—Freehold, Apr. and Jamesburg, May. Pepper 1957

—"Attacks many grasses and occasionally reaches economic importance attacking oats and other small grains during the spring."

?Macrosiphum gravicornis Patch.
Haddonfield, Sept. 1946, on *Oenothera* (Essig det. with query).

Macrosiphum liriodendri (Mon.). Tuliptree Aphid.
NJL as *Nectarophora*—"Sometimes common on leaves of tuliptrees. In harmful numbers at Vineland in 1899." NJR 1925—Flemington, Sept. as *Nectarophora.* Haddonfield, July 1936, common on tuliptrees. Ramsey, May 1941, casual on *Quercus primus* (AMNH). Englewood, July 1942, on *Liriodendron tulipifera* (AMNH).

Macrosiphum pisi (Kalt.). Pea Aphid.
NJL as *Nectarophora*—"The pea louse. Throughout the State south of the Piedmont Plain and seasonally common and destructive. Less abundant in the more northern counties." Pepper 1957—"A serious pest of peas on coastal plain area annually. Attacks alfalfa wherever it is grown throughout the State and causes serious damage on coastal plain area and occasionally in Piedmont region."

Macrosiphum pseudorosae Patch.
Ridgewood, Aug. 1936, on *Impatiens.* Haddonfield, Sept. 1946, on *Oenothera.*

Macrosiphum rosae L. Rose Aphid.
NJL as *Nectarophora*—"Throughout the State on rose; often common and injurious." Haddonfield, observed in varying numbers each season from 1934 for at least ten years; on Dec. 4, 1938, eggs were present in moderate numbers on a number of rose bushes but all aphids were dead following low temperatures. Newark, May on rambler rose (AMNH). Pepper 1957—"Present and economically important wherever roses are grown in New Jersey."

Macrosiphum rudbeckiae (Fitch). Goldenglow Aphid.
NJL as *Nectarophora*—"Occurs commonly on ragweed, golden rod and other plants." Note by author—These food plants would indicate reference to several related species. Ridgewood, Sept. 1933, on *Rudbeckia* and Oct. 1938 (Tissot det. with query), very abundant on a number of large plants of *Lactuca* sp., some males present. Haddonfield on *Rudbeckia hirta* and very abun-

dant on a large garden planting of hardy purple aster. Note—This species is undoubtedly widespread throughout the State and often unsightly and injurious to goldenglow or coneflower.

Macrosiphum solanifolii (Ashm.). Potato Aphid.
NJL as *Nectarophora cucurbitae* Thos.—"On squash and pumpkins. Sometimes rather abundant late in the season, but never in harmful numbers." NJL—Undoubtedly referring to this species is the following: "*Rhopalosiphum solani* Thos. The tomato plant louse; sometimes does serious injury in parts of Salem and Gloucester Counties (Sm.)." Haddonfield, Sept. on *Calendula* stems. Ridgewood, Oct. 1935, on *Iris* leaves but not common; May 1938, a few on tulip leaves. Ramsey, Oct. 1941, a "drift" on *Cornus* (AMNH). New Brunswick, Sept. 30, 1946, on eggplant (L. Hagemann coll.). Pepper 1957—"Annually causes damage to potatoes growing in southern and central New Jersey and occasionally produces severe damage to tomato plantings particularly in Gloucester County area. Requires spray applications every year to control on vegetable plantings."

(?)*Macrosiphum solidaginis* (Fab.).
Haddonfield, Aug. 1935, on oxeye daisy (Tissot det. with query).

Macrosiphum sonchellum (Monell).
Ramsey, May 1941, on *Rubus* (AMNH).

Mastopoda pteridis Oestl.
Tenafly, July 1942, on a fern (AMNH).

Melanocallis caryaefoliae (Davis). Black Pecan Aphid.
Haddonfield, Sept. 1934, on hickory leaves, viviparae, sexual males and females present.

Melaphis rhois (Fitch).
NJL as *Pemphigus*—"Common on leaves of sumach (Bt.); throughout the State (Sm.); Caldwell (USDA)."

Micromyzus violae (Pergande). Violet Aphid.
NJL—"*Rhopalosiphum violae* Pergande. On violets in greenhouses throughout the State."

Monellia caryae (Monell). American Walnut Aphid.
NJL as *Chaitophorus*—"Found on hickory and walnut." NJR 1925—Plainfield, July, on walnut, as *Callipterus*. Bridgeton, July 1936, on walnut. Ridgewood, May 1938, on hickory, not uncommon.

Monellia caryella (Fitch).
NJL—"A species of wide distribution on hickory." Ridgewood, May 1936, on hickory leaves and May 1938, on *Juglans.*

Monellia costalis (Fitch). Black-margined Aphid.
Ridgewood, July 1936, on leaves of *Quercus* sp.

Monellia nigropunctata Granovsky.
Haddonfield, Sept. 1934, on hickory leaves. Ridgewood, May 1938, on hickory leaves.

Mordwilkoja vagabunda (Walsh). Poplar Vagabond Aphid.
NJL—"Sometimes locally abundant on poplar."

Myzaphis rosarum (Kalt.).
NJR 1916 as *Myzus*—"On roses in greenhouse (Weiss)."

Myzocallidium riehmi Börner.
Haddonfield and Moorestown, July 19, 1956, on *Melilotus alba* (D. W. Jones coll.).

Myzocallis alhambra Davidson.
Beaver Lake, Aug. 1936, on *Quercus* sp. Ridgewood, June 1936, a few on leaves of oak.

**Myzocallis alnifoliae* (Fitch).
NJL as *Lachnus*—"Occurs on leaves of alder."

Myzocallis asclepiadis (Mon.).
NJL as *Chaitophorus*—"A common species on milkweeds." Saddle River, June 1939, scarce on *Asclepias* sp. Ridgewood, 1940, common on a number of milkweeds. Englewood, July 1942, on *Asclepias* (AMNH). Haddonfield, 1946, abundant on a number of milkweeds. Lake Mohawk, July 28, on milkweed.

Myzocallis bella (Walsh).
NJL as *Chaitophorus*—"Infests red and other oaks." Ridgewood, Oct., a "drift"; Sept. 1937 and Oct. 1937, on *Quercus velutina;* Pine Rest, Ridgewood, Sept. 1946, on *Quercus.* Haddonfield, Sept. 1934 and 1946, on *Quercus.* Ramsey, May 1941 and Oct., on *Quercus alba* (AMNH).

Myzocallis discolor Mon.
NJL as *Chaitophorus*—"A feeder on oak. There are several species of this genus that occur on oak and our forms have not been determined." Ridgewood, May 1936, on oak leaves. Ramsey, May 1941, on *Quercus alba* and Oct. 1941 (AMNH).

Myzocallis marginella (Fitch).
Ramsey, May 1941, on *Quercus alba* (AMNH).

Myzocallis punctata (Mon.).
Ridgewood, July 1936, on *Quercus alba.*

Myzocallis tiliae (L.). Linden Aphid.
Haddonfield, Sept. 1934, viviparae, sexual males and females and May 1938, on *Tilia americana.* Ridgewood, Sept. 1937, May and Oct. 1938, common on leaves of many large linden trees. Englewood, June 1942, Sept. 1946, on *Tilia* sp. (AMNH).

Myzocallis ulmifolii (Mon.). Elm Leaf Aphid.
NJL as *Callipterus*—"On leaves of American elm." Ridgewood, Oct. 1935, on leaves of elm.

Myzocallis walshii (Mon.).
Haddonfield, Sept. 1934, on leaves of *Quercus.* Ridgewood, May 1938, and Sept. 1937, fairly common on leaves of black oak, *Quercus velutina.*

Myzus cerasi (F.). Black Cherry Aphid.
NJL—"Very abundant throughout the State on cherry and sometimes does severe injury." "*Aphis prunicola* Kalt. Newark and Vineland on plum" presumably refers to this species. Tenafly, May 1942, on cherry (AMNH).

Myzus ligustri (Mosley). Privet Aphid.
NJR 1927 as *Rhopalosiphum ligustri* (Kalt).—Upper Montclair, June on privet.

Myzus lythri (Schrank).
NJR 1916 as *mahaleb* Koch—"Bergenfield and Fanwood on plum."

Myzus persicae (Sulz.). Green Peach Aphid.
NJL as *Rhopalosiphum dianthi* Schrank.—"On pinks, carnations and German ivy. In greenhouses throughout the State." This statement probably refers to a complex of species, including *persicae,* in the genus *Myzus.* Ridgewood, Nov. 1935, fall migrants and males on cherry leaves; Oct. 1939, very abundant on underside of leaves of bindweed, *Convolvulus arvensis.* Blackwood, May 1937, 100 acres of young cabbage plants badly infested (Ernest Burch coll.). Haddonfield, Nov. 20, 1938, fairly common on a large bed of nasturtiums and parasitized to a considerable extent by *Diaeretus rapae* (Curt.), det. Muesebeck; on Dec. 4 same bed of nasturtiums with many live aphids still present after being covered with about a foot of snow and following 20°F. temperature. Ramsey, Oct. 1941, casual on *Alnus*

(AMNH). NJL—"The green peach louse. Throughout the State but never in harmful numbers so far as I am aware." New Brunswick, Sept. 30, 1946, on eggplant. (L. Hagemann coll.). Pepper 1957—"Present in peach plantings throughout the State and occasionally becomes important on potato and tomato plantings particularly in the vicinity of peach orchards."

Myzus physocarpi Pepper.
Ridgewood, Oct. 20, 1934, a few and Nov. 1935, abundant on a large ninebark bush, many sexuales and on the bark many eggs; also on Nov. 8, 1936, Oct. 3, 1937, May 22, 1938 and Oct. 19, 1938.

Myzus porosus Sanderson. Yellow Rose Aphid.
Madison, intercepted on rose at the Washington, D.C. Plant Quarantine House by W. J. Wood on Apr. 28, 1920 (Mason det.). Although this is said to be our commonest rose aphid, especially in the Southern States, the writer has failed to find it during the examination of many rose bushes at both Ridgewood (Northern N.J.) and Haddonfield (Southern N.J.) during a period of at least ten years.

Myzus scammelli Mason.
Described from many specimens collected by H. B. Scammell at Whitesbog, summer of 1914 and 1916, and at Pemberton June 1, 1915; Nov. 12, 1914 (sexual females and eggs); Nov. 28, 1916 (male); Oct. 28, 1916 (male). Letter from P. E. Marucci, Cranberry and Blueberry Research Laboratory, Pemberton, N.J. May 1957—"During recent years *Myzus scammelli* has been difficult to find on cranberry bogs in New Jersey. The most severe infestations I have ever observed of this insect were when I placed cranberry turf in cages to observe development of other insects. This suggests that there is probably a very efficient natural control of this aphid on cranberry bogs. Certainly in the past 5 to 10 years it has never been so abundant as to have required control operations."

Neosymidobius annulatus (Koch).
"N. Jersey" June 8, 1911, one slide (3 alates) in USDA collection. On birch.

Neothomasia populicola (Thos.).
Ramsey, July 1941, on *Populus* sp. (AMNH).

Pemphigus brevicornis (Hart.).
NJL as *Tychea*—"Chester, Aug. on roots of lettuce (Marsh).

This may be a synonym of "*Rhizobius lactucae* Fitch. The common lettuce root louse; found locally injurious."

Pemphigus populi-caulis Fitch. Poplar Leaf-petiole Gall Aphid.

NJL—"Makes galls at junction of stem and leaf of *Populus monolifera.* Passaic (Beutenmüller); also elsewhere in the State."

Pemphigus populi-globuli Fitch. Poplar Bullet Gall Aphid.

NJL—"Found on *Populus* at Passaic (Beutenmüller)."

Pemphigus populi-transversus Riley. Poplar Petiole Gall Aphid.

NJR 1919—Rahway, May, and Morristown, June, on *Populus.*

Pemphigus ulmifusus Walsh Riley.

NJR 1916—Gall on leaf of *Ulmus pubescens* (Weiss).

Pentatrichopus minor (Fbs.).

Pemberton, May 1915, on strawberry (H. B. Scammell coll.).

Pentatrichopus thomasi H.R.L.

Bridgeport and Hammond, in letter to U.S.D.A. of April 4, 1950, from F. A. Gilbert, on strawberry.

Pergandeidia trirhoda (Walk.).

Haddonfield, Oct. 1937 on *Aquilegia.* Bergenfield, common. Ridgewood, May 1938, 1939, fairly abundant; Sept. 1946 (at Pine Rest).

Periphyllus lyropictus (Kess.). Norway-Maple Aphid.

Haddonfield, May 1934, becoming abundant on hard maples; Sept., Oct. 1934, oviparous females on hard maples; bad infestation on the many hard maples all over town in the summer and fall of 1938 and 1946. Ridgewood, May 1938, on hard maples, *Acer saccharum;* considerable infestation on many hard maple street shade trees in mid-Sept., 1946; sexuales present in Nov. 1935. Pepper 1957—"Present throughout New Jersey and occasionally causes a serious nuisance by virtue of honeydew secretions underneath trees."

Periphyllus negundinis (Thos.). Boxelder Aphid.

NJL—as *Chaitophorus*—"Found infesting boxelder." Ridgewood, May 1938, on *Acer negundo.* Haddonfield, Sept. 1946, abundant on several large boxelder trees.

Phorodon humuli (Schr.). Hop Aphid.

NJL—"Occurs throughout the northern part of the State wherever hops are grown and reported also at Freehold (USAgr.)." Bound Brook, June 1936, on plum (Guyton coll.).

Phyllaphis fagi (L.).

NJL—"Trenton; on beech." NJR 1921—West Orange, June, on beech. NJR 1922 Mar. on beech. Ridgewood, Nov. 1935, on beech leaves, scarce. Springfield, Nov. 5, 1943, on *Fagus sylvatica pendula* (Adams and Sanford coll., Special Port. Surv.). Abundant on underside of leaves of many large beech trees bordering Hoppy's Pond, Haddonfield, during several years in the mid 1930's.

Prociphilus erigeronensis (Thos.).

Ridgewood, Oct. 1936, common on roots of a number of marigold plants (Mason det. with query). Haddonfield, Sept. 1934, on roots of perennial aster; Oct. 1945, on roots of aster and a grass in association with the ant, *Lasius* (*Acanthomyops*) *claviger* (Roger) (M. R. Smith det.).

Prociphilus fraxinifolii (Riley).

Pemberton, July 1933, in rolled edge of an ash leaf.

Prociphilus imbricator (Fitch). Beech Blight Aphid.

NJL as *Pemphigus*—"Occurs on the leaves of beech" Note by MDL: Since this species occurs on the larger branches of beech the statement may refer to *Phyllaphis fagi* (L.). NJR 1920—Plainfield, May. Only definite record: Rutgers Campus, New Brunswick, 1903 (no plant mentioned with the specimens).

Prociphilus tessellatus (Fitch). Woolly Alder Aphid.

NJL as *Pemphigus*—"The alder blight. Sometimes very common locally in Sept. and Oct., forming conspicuous masses." Also in NJL as *Pemphigus acerifolii* Riley—"Found throughout the State on the underside of maple leaves and sometimes abundant at New Brunswick."

Prociphilus venafuscus (Patch).

Ramsey, Oct. 1941, casual on oak (AMNH).

Pterocomma salicis (L.).

Ramsey, May 1941, on *Salix* sp. (AMNH).

Pterocomma smithiae (Mon.).

NJL as *Cladobius saliciti* Harris—"Occurs on willows, poplar, sometimes common at New Brunswick late in the season, the relatively large winter egg attracting attention." Englishtown, July 1936, a number of willows considerably infested. Netcong, Sept. 1937, on willow (O. W. Barrett coll.). Ridgewood, Oct. 1938, scarce on willow.

Rhopalosiphum berberidis (Kalt.).
Ridgewood, June 1936, on a barberry hedge.

Rhopalosiphum conii (Davidson).
Haddonfield, Oct. 1935, common on underside of leaves of a large flowering currant shrub, *Ribes odoratum;* Oct. 1934 on *Symphoricarpos vulgaris;* Oct. 1937, on leaves of honeysuckle, alates and a few pale young; Nov. 1935, a few alates taken singly on honeysuckle. Ramsey, Oct. 1941, on a presumably umbelliferous plant (AMNH).

Rhopalosiphum fitchii (Sand.). Apple Grain Aphid.
NJL as *Aphis prunifolii* Fitch—"A widely distributed species on plum." NJL as *Nectarophora avenae* Fab.—"The wheat louse. Occurs throughout the State and, in the southern counties sometimes in destructive numbers. Ordinarily kept in check by its natural enemies." NJR 1919—East Orange, Oct. Bound Brook, May 1936, on apple and *Crataegus* Ridgewood, Nov. 1935, males and sexual females and a few eggs on apple and abundant on leaves of a quince tree. Ramsey, May 1941, casual on *Populus* sp. (AMNH). Pepper 1957—"Present on apples wherever they are grown but rarely injurious to apple or grass or grain hosts."

Rhopalosiphum maidis Fitch. Corn Leaf Aphid.
NJL as *Aphis*—"Sometimes quite plentiful but not injurious in New Jersey." Freehold, Aug. 1943, on corn (L. A. Mayer coll., Mason det., Sp. Port Surv.). Cumberland, Sept. 1943, (N. J. Ramsey coll., Mason det., Sp. Port Surv.). Harrison, Nov. 1941, (West Exterminating Co. coll., Mason det.). Pepper 1957—"Present annually on corn plantings but only rarely causes economic damage particularly in the coastal plain area."

Rhopalosiphum nymphaeae (L.). Waterlilly Aphid.
Haddonfield, June 1933, on *Saggitaria* sp.; July 1942, abundant and injurious to waterilies; every summer this aphid has been scarce to abundant in the same private fish pools on *Nymphaea* and waterchestnut; in Sept. 1946, they were abundant to the point of badly injuring the leaves of waterchestnut but almost none could be found on the waterlilies in the same pools. Pemberton, 1948, in light trap, (Marucci coll.). Ridgewood, Sept. 1946, fairly abundant in a fish pool at Pine Rest.

Rhopalosiphum pseudobrassicae (Davis). Turnip Aphid.
NJR 1916—The first determination of this species in New Jersey made in 1916, Freehold, Oct., on turnip. The following notes are

taken from the old Insect Pest Survey records in USDA: First taken in N.J. in 1916 but undoubtedly here and in injurious numbers for several to perhaps many years. (Davis believes present wherever wild mustard grows). In N.J. Hort. Soc. Rept., 1919—"large areas suffered severely in Monmouth Co., in damaging numbers only on turnip (Headlee)." Same statement in Rept. for 1925. J. B. Schmitt in May 1938 reports this species of very little importance in New Jersey; records of the past 25 years are, one record in 1916, two in 1917, one in 1925, one in 1928, one in 1929, one in 1932 and one in 1935. USDA's Truck Crop Insect Survey for June 1944 states this aphid to be fairly abundant on rutabagas in S. Jersey and fields of 300 acres showed some conspicuous damage. Pepper 1957—"Present wherever turips are grown and often produces damage requiring control measures."

Rhopalosiphum rhois Monell.
Ridgewood, July 1936, abundant on many sumach bushes; May 1938, on poison ivy but only a few. Pemberton, 1948, in light trap (Marucci coll.). Milltown, July 3, 1947, on sumach (L. Hagemann coll.).

Stegophylla quercicola (Baker).
Ridgewood, Oct. 1935, fairly common on leaves of several oak trees. Haddonfield, Sept. 1946, on *Quercus sp.*

Stegophylla quercifoliae (Gill.).
Ramsey, Oct. 1941, a male on *Quercus* sp. (AMNH).

* *Tetraneura ulmi* DeG.
NJL—"Underside of leaves of European and American elms."

* *Therioaphis trifolii* (Monell). Yellow Clover Aphid.
NJL as *Callipterus*—"One of the clover-leaf plant-lice."

FOOD PLANTS

Acalypha virginica (Virginia Copperleaf)
  Anuraphis maidi-radicis
Acer sp. (Maple)
  Drepanaphis acerifolii
  Drepanosiphum platanoides
  Prociphilus tessalatus
Acer negundo (Box Elder)
  Periphyllus negundinis
Acer platanoides (Norway Maple)
  Drepanosiphum platanoides
Acer saccharinum (Silver or Soft Maple)
  Drepanosiphum acerifolii
Acer saccharum (Sugar or Hard Maple
  Periphyllus lyropictus
Alder—see *Alnus*

Alfalfa—see *Medicago sativa*
Alnus sp. (Alder)
  Myzus persicae
  Prociphilus tesselatus
Ambrosia psilostachya (Ragweed)
  Macrosiphum ambrosiae
Ambrosia trifida (Giant Ragweed)
  Macrosiphum ambrosiae
American Cranberrybush Viburnum—see *Viburnum trilobum*
American Hop Hornbeam—see *Ostrya virginiana*
Apple—see *Pyrus malus*
Arctium lappa (Burdock)
  Aphis fabae
Aquilegia sp. (Columbine)
  Kakimia essigi
  Pergandeidia trirhoda
Arrowhead—see *Sagittaria*
Asclepias sp.—see Milkweed
  Myzocallis asclepiadis
  Aphis helianthi
Ash—see *Fraxinus*
Aster sp. (Aster)
  ?Macrosiphum erigeronensis
  Macrosiphum rudbeckiae
  Anuraphis maidi-radicis
Avena sativa (Oat)
  Macrosiphum granarium
Barberry—see *Berberis*
Barnyardgrass—see *Echinochloa*
Bean—see *Phaseolus*
Beech—see *Fagus*
Beet see—*Beta vulgaris*
Berberis sp. (Barberry)
  Rhopalosiphum berberidis
Beta vulgaris (Beet)
  Aphis gossypii
Betula sp. (Birch)
  Calaphis betulaecolens
  Calaphis betulella
  Euceraphis betulae
  Neosymidobius annulatus
Betula alba (Gray Birch)
  Calaphis betulaecolens
  Euceraphis betulae
Bindweed—see *Convolvus arvensis*
Birch—see *Betula*
Blackberry—see *Rubus*
Blackeyed Susan—see *Rudbeckia hirta*
Black Oak—see *Quercus velutina*
Boxelder—see *Acer negundo*
Brassica campestris (Rutabaga)
  Brevicoryne brassicae
  Rhopalosiphum pseudobrassicae
Brassica oleracea (Brussels Sprouts)
  Brevicoryne brassicae
Brassica oleracea botrytis (Cauliflower)
  Brevicoryne brassicae
Brassica oleracea capitata (Cabbage)
  Brevicoryne brassicae
  Myzus persicae
Brassica rapa (Turnip)
  Rhopalosiphum pseudobrassicae
Blueberry—see *Vaccinium vacillans*
Broadbean—see *Vicia faba*
Brussels Sprouts—see *Brassica oleracea*
Bull Thistle—see *Circium lanceolatum*
Burdock—see *Arctium lappa*
Cabbage—see *Brassica oleracea capitata*
Calendula sp. (Marigold)
  Macrosiphum solanifolii
  Prociphilus erigeronensis
Carrot—see *Dacus carota*
Carya sp. (Hickory)
  Melanocallis caryaefoliae
  Monellia caryae
  Monellia caryaella
  Monellia nigropunctata
Castanea dentata (Chestnut)
  Calaphis castaneae
Cauliflower—see *Brassica oleracea botrytis*
Cherry—see *Prunus*
Chestnut—see *Castanea*
Chrysanthemum sp. (Chrysanthemum)
  Macrosiphum sanborni
Chrysanthemum leucanthemum (Oxeye Daisy)
  ?Macrosiphum solidaginis
Circium lanceolatum (Bull Thistle)

Anuraphis cardui
Microsiphum ambrosiae
Clover—see *Trifolium*
Columbine—see *Aquilegia*
Common Red Currant—see *Ribes*
Convolvulus arvensis (Bindweed)
Myzus persicae
Coneflower—see *Rudbeckia*
Corn—see *Zea mays*
Cornus sp. (Dogwood)
Anoecia corni
Anoecia querci
Aphis caliginosa
Cosmos sp.
Aphis coreopsidis
Cow Parsnip—see *Heracleum lanatum*
Crabgrass—see *Digitaria*
Cranberry—see *Vaccinium*
Crataegus sp. (Hawthorn)
Amphorophora crataegi
Eriosoma crataegi
Rhopalosiphum fitchii
Aphis crataegifolii
Cucumber—see *Cucumis sativus* (Cucumber)
Cucumis melo (Muskmelon)
Aphis gossypii
Cucumis sativus
Aphis gossypii
Cucurbita maximus (Squash)
Aphis gossypii
Macrosiphum solanifolii
Dactylis glomerata (Orchard grass)
Hyalopteroides dactylidis
Daucus carota (Carrot)
Anuraphis tulipae
Devil's Club—see *Fatsia horrida*
Digitaria sp. (Crabgrass)
Anoecia querci
Dock—see *Rumex*
Dogwood—see *Cornus*
Eastern Poplar—see *Populus deltoides*
Echinochloa crus-galli (Barnyard-grass)
Anoecia querci
Eggplant—see *Solanum melogena*
Elder—see *Sambucus*
Elaeagnus multiflora (Russian olive)
Capitophorus hippophaes
Elm—see *Ulmus*
English Ivy—see *Hedera helix*
Erechtites hieraceifolia (Fireweed)
Macrosiphum erigeronensis
? *Erigeron* sp. (Fleabane)
Macrosiphum asterifoliae
Eupatorium purpureum (Joe Pye Weed)
Macrosiphum sp.
Evening Primrose—see *Oenothera strigosa*
Fagus sp. (Beech)
Phyllaphis fagi
Fagus sylvatica pendula (Beech)
Phyllaphis fagi
Fatsia horrida (Devil's Club)
Kakimia sp.
Fern
Idiopterus nephrelepidis
Mastopoda pteridis
Fireweed—see *Erechtites hieraceifolia*
Fleabane—see *Erigeron*
Flowering Currant—see *Ribes odoratum*
Fragaria sp. (Strawberry)
Aphis forbesi
Pentatrichopus minor
Pentatrichopus thomasi
Fraxinus sp. (Ash)
Prociphilus fraxinifolii
Giant Ragweed—see *Ambrosia trifida*
Goldenrod—see *Solidago*
Gooseberry—see *Ribes grossularia*
Grape—see *Vitis*
Gray Birch—see *Betula alba*
Hamamelis virginiana (Witch Hazel)
Hormaphis hamamelidis
Hamamelistes spinosus
Hard Maple—see *Acer saccharum*
Hawthorn—see *Crataegus*
Hedera helix (English Ivy)
Aphis hederae
Helichrysum sp. (Strawflower)
? *Macrosiphum ambrosiae*
Heracleum lanatum (Cow Parsnip)

Hibiscus syriacus (Rose of Sharon)
Aphis gossypii
Hickory—see *Carya*
Honeysuckle—see *Lonicera*
Horsebean—see *Vicia faba*
Indiancurrant Coralberry—see *Symphoricarpos orbiculatus*
Impatiens sp. (Jewelweed)
Aphis cephalanthi
Macrosiphum pseudorosae
Iris sp. (Iris)
Macrosiphum solanifolii
Jewelweed—see *Impatiens*
Joe Pye Weed—see *Eupatorium purpureum*
Juglans sp. (Walnut)
Monellia caryae
Monellia caryella
Knotweed—see *Polygonum pennsylvanicum*
Lactuca sp. (Lettuce)
Macrosiphum ambrosiae
Macrosiphum rudbeckiae
Macrosiphum sp.
Pemphigus brevicornis
Lettuce—see *Lactuca*
Ligustrum sp. (Privet)
Myzus ligustri
Linden—see *Tilia americana*
Liriodendron tulipifera (Tulip Tree)
Macrosiphum liriodendri
Lonicera sp. (Honeysuckle)
Rhopalosiphum melliferum
Lycopersicon esculentum (Tomato)
Macrosiphum solanifolii
Myzus persicae
Maple see—*Acer*
Mapleleaf Viburnum—see *Viburnum acerifolium*
Marigold—see *Calendula*
Medicago sativa (Alfalfa)
Macrosiphum pisi
Melilotus alba (White Sweetclover)
Myzocallidium riehmi
Milkweed—see *Asclepias*
Muskmelon—see *Cucumis melo*
Nasturtium—see *Tropaeolum*
Ninebark—see *Physocarpus opulifolius*
Norway Maple—see *Acer plantanoides*
Nymphaea sp. (Waterlily)
Rhopalosiphum nymphaeae
Nyssa sylvatica (Sour Gum)
Aphis coreopsidis
Oak—see *Quercus*
Oat—see *Avena sativa*
Oenothera strigosa (Evening Primrose)
? *Macrosiphum gravicornis*
? *Macrosiphum pseudorosae*
Oleander sp. (Oleander)
Aphis nerii
Orchard grass—see *Dactylis glomerata*
Ostrya virginiana (American Hop Hornbeam)
Anuraphis roseus
Ox-eye Daisy—see *Chrysanthemum*
Peach—see *Prunus persica*
Phaseolus sp. (Bean)
Aphis medicaginis
Physocarpus opulifolius (Ninebark)
Myzus physocarpi
Pinebarren Goldenrod—see *Solidago fistulosa*
Pin Oak—see *Quercus palustris*
Pinus rigida (Pitch Pine)
Cinara pini
Pinus strobus (White Pine)
Cinara strobi
Pitch Pine—see *Pinus rigida*
Platanus occidentalis (Sycamore)
Longistigma caryae
Plum—see *Prunus*
Poison Ivy—see *Rhus toxicodendron*
Polygnum pennsylvanicum (Knotweed)
Capitophorus hippophaes
Poplar—see *Populus*
Populus sp. (Poplar)
Mordwilkoja vagabundus
Neothomasia populicola
Pemphigus populi-globuli
Pemphigus populi-transversus
Populus deltoides (Eastern Poplar)
Pemphigus populicaulis
Potato—see *Solanum tuberosum*

Privet—see *Ligustrum*
Prunus sp. (Cherry)
Myzus persicae
Prunus sp. (Plum)
Hyalopterus pruni
Hysteroneura setariae
Myzus lythri
Prunus japonica (Quince)
Rhopalosiphum prunifoliae
Prunus persica (Peach)
Anuraphis persicae-niger
Pumpkin—see *Cucurbita pepo*
Pyrus malus (Apple)
Anuraphis rosea
Aphis pomi
Rhopalosiphum fitchii
Quercus sp. (Oak)
Monellia costalis
Myzocallis alhambra
Myzocallis bella
Myzocallis discolor
Myzocallis walshii
Stegophylla quercicola
Stegophylla quercifoliae
Quercus alba (White Oak)
Myzocallis bella
Myzocallis discolor
Myzocallis marginella
Myzocallis punctata
Quercus palustris (Pin Oak)
Longistigma caryae
Quercus velutina (Black Oak)
Myzocallis bella
Myzocallis walshii
Quince—see *Prunus japonica*
Ragweed—see *Ambrosia psilostachya*
Red Raspberry—see *Rubus strigosus*
Rhus sp. (Sumach)
Melaphis rhois
Rhus glabra (Smooth Sumach)
Rhopalosiphum rhois
Rhus toxicodendron (Poison Ivy)
Rhopalosiphum rhois
Ribes rubrum (Common Red Currant)
Capitophorus ribis
Ribes grossularia (Gooseberry)
Aphis houghtonensis
Ribes odoratum (Flowering Currant)
Rhopalosiphum conii
Rosa sp. (Rose)
Macrosiphum rosae
Myzus porosus
Myzus rosarum
Rose—see *Rosa*
Rose of Sharon—see *Hibiscus syriacus*
Rubus sp. (Blackberry)
Amphorophora rubi
Aphis rubifolii
Rubus allegheniensis
Aphis rubifolii
Rubus strigosus (Red Raspberry)
Amphorophora sensoriata
Rudbeckia sp. (Coneflower)
Macrosiphum rudbeckiae
Rudbeckia hirta (Blackeyed Susan)
Macrosiphum rudbeckiae
Rumex sp. (Dock)
Macrosiphum sonchellum
Russian Olive—see *Elaeagnus multiflora*
Rutabaga—see *Brassica campestris*
Sagittaria sp. (Arrowhead)
Rhopalosiphum nymphaeae
Salix sp. (Willow)
Cavariella aegopodii
Chaitophorus viminalis
Clavigerus salicis
Clavigerus smithii
Lachnus salignus
Pterocomma salicis
Sambucus sp. (Elder)
Aphis sambucifoliae
Silver Maple—see *Acer saccharinum*
Slippery Elm—see *Ulmus fulvus*
Snowball—see *Viburnum*
Snowberry—see *Symphoricarpos*
Soft Maple—see *Acer saccharinum*
Solanum melogena (Eggplant)
Macrosiphum solanifolii
Myzus persicae
Solanum tuberosum (Potato)
Macrosiphum solanifolii
Myzus persicae

Solidago sp. (Goldenrod)
Aphis helianthi
Aphis oenotherae
Solidago fistulosa (Pinebarren Goldenrod)
Macrosiphum rudbeckiae
Sour Gum—see *Nyssa sylvatica*
Spiraea vanhouttei (Vanhoutte Spiraea)
Aphis spiraecola
Squash—see *Cucurbita maxima*
Strawberry—see *Fragaria*
Strawflower—see *Helichrysum*
Sugar maple—see *Acer saccharum*
Sumach—see *Rhus*
Sycamore—see *Platanus occidentalis*
Symphoricarpos orbiculatus (Indiancurrant Coralberry)
Rhopalosiphum conii
Tanacetum vulgare (Tansy)
Macrosiphonella tanacetaria
Tansy—see *Tanacetum vulgare*
Tilia americana (Linden)
Myzocallis tiliae
Tomato—see *Lycopersicon esculentum*
Trapa natans (Waterchestnut)
Rhopalosiphum nymphaeae
Trifolium pratense (Red Clover)
Aphis medicaginis
Therioaphis trifolii
Tropaeolum majus (Nasturtium)
Aphis fabae
Myzus persicae
Tulip Tree—see *Liriodendron tulipiferae*
Tulipa sp. (Tulip)
Macrosiphum solanifolii
Turnip—see *Brassica rapa*
Ulmus sp. (Elm)
Colopha ulmicola
Eriosoma rileyi
Myzocallis ulmifolii
Ulmus fulva (Slippery Elm)
Eriosoma americana
Ulmus pubescens
Pemphigus ulmifusus
Vaccinium sp. (Cranberry)
Myzus scammelli
Vaccinium vacillans (Blueberry)
Amphorophora vaccinii
Aphis gossypii
Vanhoutte Spiraea—see *Spiraea vanhouttei*
Viburnum sp. (Snowball)
Aphis illinoisensis
Aphis viburnicola
Viburnum acerifolium (Mapleleaf Viburnum)
Aphis viburniphila
Viburnum opulus sterile
Aphis fabae
Viburnum trilobum (Snowball or American Cranberrybush Viburnum)
Anuraphis viburnicola
Vicia faba (Broadbean or Horsebean)
Aphis fabae
Viola sp. (Violet)
Micromyzus violae
Violet—see *Viola*
Virginia Copperleaf—see *Acalypha virginica*
Vitis sp. (Grape)
Aphis illinoisensis
Walnut—see *Juglans*
Waterchestnut—see *Trapa natans*
Waterlilly—see *Nymphaea*
White Oak—see *Quercus alba*
White Pine—see *Pinus strobus*
White Sweetclover—see *Melilotus alba*
Willow—see *Salix*
Witch Hazel—see *Hamamelis*
Zea mays (Corn)
Rhopalosiphum maidis

(*Continued from page 98*)

There were no proposals for membership, miscellaneous business, or new business.

Dr. Treat then introduced the speaker of the evening, Dr. William S. Creighton, Professor of Biology, The City College of New York. The subject of his address was "Some Phragmotic Patterns in Ants." Phragmosis was defined as the habit of blocking the nest entrance by the major workers, whose heads (and in some species also thoraces) are modified for this purpose. The modifications were illustrated by line drawings from the speaker's publications, and the position of the occluding major or "janitor" in the nest entrance was illustrated by chalk drawings. Three examples of phragmosis were discussed in some detail. The first was in the formicine ant *Camponotus* (*Colobopsis*) *papago* Creighton, an arboreal species of southwestern North America. The signal by which the minor workers gain admission to the nest is of unknown character and has not been artificially reproduced. In this species the queens are also phragmotic and are structurally modified accordingly. The second example was another southwestern arboreal ant, *Cryptocerus texanus,* in which the thorax as well as the head participates in the occlusion of the entrance passage, and may occasionally trap an entering minor. Queens in this species, like those of the preceding example, are also phragmotic. *Camponotus* (*Maniella*) *ulcerosus* the third example, is a southwestern species, like the others, but unlike them is ground-dwelling. Phragmosis in this species was first observed by the speaker, who showed kodachromes of the well-concealed "cartons" that form the entrance to the subsoil nests. The ground-dwelling habit and the fact that the queens of this species are unmodified for phragmosis are regarded as primitive characters. Dr. Creighton suggested and discussed the possibility that the structural modifications of *Camponotus papago* and *Cryptocerus texanus* were acquired during a ground-dwelling phase of their evolutionary history, and that these modifications thereafter proved advantageous in arboreal life, perhaps having been the key adaptation which made the change to tree-dwelling existence possible for these species. Pinned specimens of all three of the species used to illustrate phragmosis were presented for inspection.

A lively discussion followed Dr. Creighton's remarks.

The meeting adjourned at 10 P.M.

ASHER E. TREAT, *Secretary,* pro tempore

MEETING OF NOVEMBER 1, 1955

A regular meeting of the New York Entomological Society was held on November 1, 1955, in Room 129, American Museum of Natural History, President Vishniac in the chair. There were nine members and two guests present. The minutes of the preceding meeting were accepted as read.

The Secretary called the attention of the New York Entomological Society to the new book "Spider, Egg and Microcosm." This book has a dual interest to the members, for the "Microcosm" section is about our own

(*Continued on page 128*)

AN ABERRANT MAXILLARY PALPUS AND OTHER ABNORMALITIES IN A FEMALE OF ACRONYCTA GRISEA WALKER

By Asher E. Treat[1]
The City College of New York

The normal maxillary palpus in the noctuid genus *Acronycta* is a minute, two-jointed vestige, discernible only by manipulation or dissection under strong magnification. In the female of *Acronycta grisea* shown in the accompanying figures, the organ is extraordinarily developed on the right side, though normal on the left. The right prothoracic coxa is conscpicuously shortened, and its femur is represented by a short, bluntly rounded stump, devoid of tibia and tarsus.

The moth, somewhat worn and frayed, was taken at light in Tyringham, Massachusetts, on 31 August, 1956. Its aberrant features were not noticed until it was removed from the killing jar. At this time the palpus and legs were clothed with scales and were still pliable. The hypertrophied palpus articulates with a soft membrane just posterior to the right pilifer at the base of the proboscis. Its basal portion is a small, knob-like elevation from which extends a slender stalk bearing a club-shaped terminal enlargement set at an acute angle with the rest of the appendage. Although distinct joints are not clearly evident, the structure appears, except for its size, essentially similar to the normal palpus. When dry, the terminal portion was collapsed and spoon-like as suggested in Figure 3.

The occurrence of the two abnormalities on the same side of the body leads to speculation as to their possible ontogenetic relationship. Could the truncation of the one organ be causally related to the hypertrophy of the other? Do both reflect a common genetic aberration, or are they the consequences of some developmental accident or injury? It is noteworthy that the intervening labial and cervical regions, including the labial palpus, were entirely normal and symmetrical with those of the left side.

[1] Public Health Research Fellow of the National Institute of Allergy and Infectious Diseases.

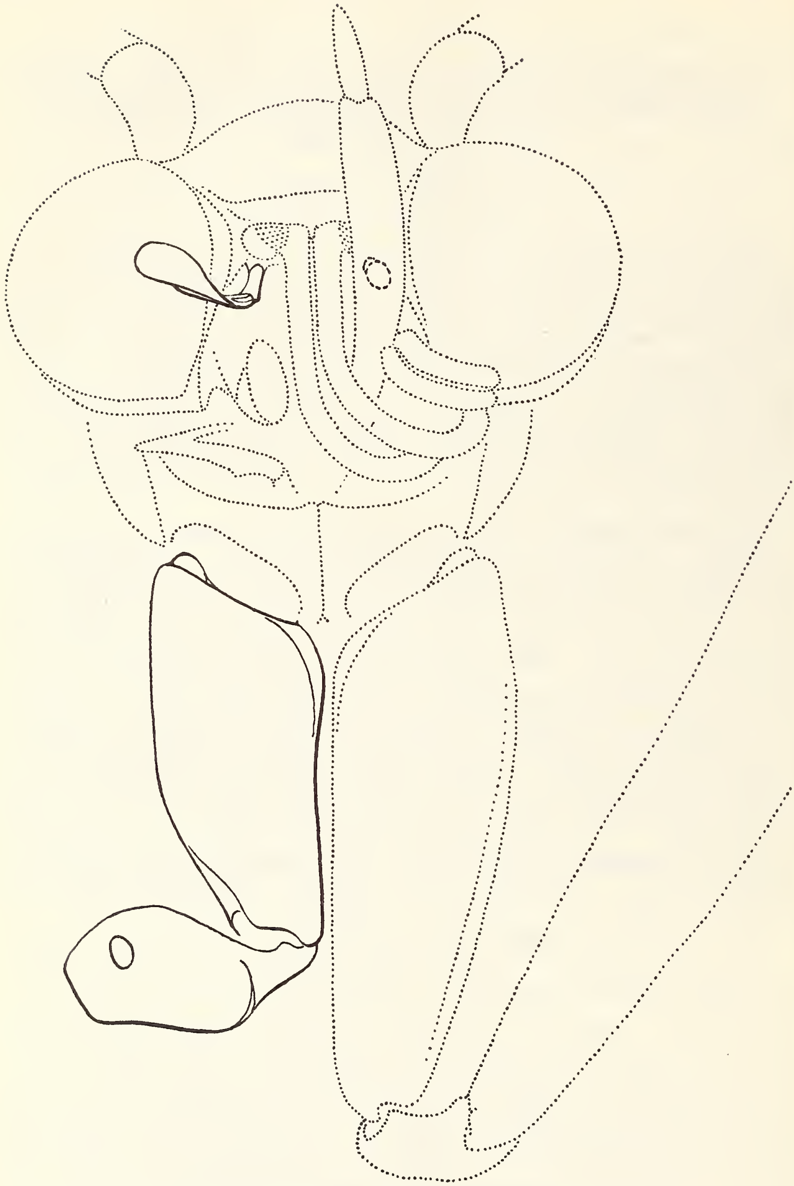

Fig. 1. *Acronycta grisea* Wlk. ♀ with aberrant mxp and leg.

(JOUR. N.Y. ENT. SOC.), VOL. LXIV (PLATE II)


Figure 2


Figure 3

Figure 1 indicates the aberrant structures (in solid lines) as they appeared in a ventral view of the dry and denuded specimen. The right labial palpus is shown as though cut off at its base. The broken ring enclosed within the outline of the left labial palpus represents the position and size of the normal maxillary palpus, concealed from below the larger appendage. Figure 2 shows the parts in question in a view similar to that of the drawing. The coxo-trochanteral joint is obscured by the blurred image of the pin on which the specimen was mounted. Figure 3 shows the enlarged right maxillary palpus from in front, with the right labial palpus displaced and not visible. Photographs by William N. Tavolga. Specimen in the collection of the author.

(*Continued from page 124*)

President, Dr. Vishniac, and the ''Spider'' portion is about Dr. Alexander Petrunkevitch, who is an honorary member of the Society.

Mr. Teale called the attention of the Society to the fact that Honorary member SuZan Swain is bringing out a new book.

Mr. Huberman and Dr. Vishniac shared dual honors in introducing the scientific speaker of the evening, Dr. R. von Rümker. Dr. von Rümker spoke on ''Research and Development in Organic Insecticides.'' Her remarks were concerned chiefly with systemic insecticides.

Dr. von Rümker traced the development of pesticides. It has proceeded chiefly by the trial and error method. The analogs and homologs of DDT were developed by an empirical approach.

There is an approach other than empirical. This can be illustrated by the development of the organic phosphates. Here we have the synthesis of optimal chemicals with minimal side effects, in short, tailor-made chemicals. This is because in the organic phosphates we understand their basic biological action.

Three things must be considered in the development of any pesticide: 1. the pest, 2, the plant, and 3. the toxicant.

The organic phosphates inhibit cholinesterase, that is, they prevent the normal physiological destruction of acetylcholine. The organic phosphates are attracted to this enzyme. This attraction is stable and blocks further chemical action. Intoxication by organic phosphate is really acetylcholine intoxication.

The organic phosphate must be stable at the point of application. It must be able to readily reach the nervous system.

Metcalf and Marsh have demonstrated that different amounts of the chemical have different species toxicities. For example, the methyl homologs are effective against the boll weevil, while the ethyl homologs are effective against other species. It is therefore possible that a degree of specificity against various insect pests might be made.

(*Continued on page 136*)

FLIES ON THE FACES OF EGYPTIAN CHILDREN[1]

By J. D. De Coursey[2] and J. S. Otto[3]
U. S. Naval Medical Research Unit No. 3, Cairo, Egypt

Flies of the genus *Musca* are present in great numbers in rural Egypt. They are very numerous on the faces of children and may be seen moving continuously from face to face visiting the mucous membranes of the eyes, nose and mouth. This has been considered as contributory to the transmission of certain diseases. According to Matheson (1932), as early as 1888 L. Howe stated that the number of cases of conjunctivitis in Egypt increased in proportion to the increase in flies. Mackie et al. (1948) said that there was positive proof for the fly transmission of thirty different diseases including cholera, typhoid, tetanus, amebic and bacillary dysentery, trachoma, yaws, leprosy, tuberculosis, and certain helminth infections.

Flies breed in human stools scattered more or less indiscriminately throughout the villages. Other types of breeding places are latrine dumps, compost piles, animal rooms, and fuel cakes (Holway 1951). According to Peffly (1953) *Musca sorbens* breeds primarily in human feces and is present in greater proportion than *Musca domestica vicina* in collections of flies from the faces of children. "Therefore, this species may be largely responsible for the tremendously high incidence of various eye infections in Egypt." Holway (1951) said that over 97 percent of 1396 flies trapped and reared were identified as *M. d. vicina.* He further stated that there appears to be general agreement that a very high percentage of the houseflies are *vicina* and he made no attempt to separate the small numbers of other species that might have been present.

It was noted that in July 1955, the percentage of flies taken from the faces of children were about equally *M. sorbens* and

[1] The opinions or assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Department or the naval service at large.

[2] Commander (Medical Service Corps), U. S. Navy.

[3] HMC, U. S. Navy.

The authors wish to express their appreciation to Captain C. B. Galloway, MC, USN; C. E. Yunker, and members of W.H.O. for their kind assistance in the conduct of this study.

M. d. vicina. The purpose of this study was to determine the relative abundance of the two species on the faces of children throughout the year. Variation of the incidence of the two species during various seasons of the year, might conceivably have a bearing on their role in the transmission of disease.

PROCEDURE

Flies were captured during July and August, 1955, from Sindbis village, near Cairo, Egypt. It soon became evident, however, that the cooperation of the inhabitants in Mit Halfa, a similar village, was such that the flies could be collected more rapidly. Investigation indicated that the incidence of the two common species of *Musca* was approximately the same in Mit Halfa in September as they had been in Sindbis during the month of August. All flies from September 1955 through June 1956 were taken from Mit Halfa.

M. sorbens and *M. d. vicina* were the only species considered. No effort was made to separate the "domestica complex" i.e. *vicina* and *cuthbertsoni* (including the form *nebulo* Fabr.), since progeny of *vicina* and *cuthbertsoni* overlap slightly in certain combinations of characters (Sabrosky 1952).

The flies were collected regularly between the hours of 9 and 11 in the morning throughout the year. A plastic centrifuge tube one and one-fourth inches in diameter was utilized to capture individual flies, the open end being placed against the child's face over the fly. Two hundred tubes were used during each day's collection. More than one fly was often captured in a tube, due to the abundance of the flies.

Periodically, a sweep net was used throughout the village over fruit, vegetables, fresh meat, garbage and feces. This was done to determine the relative incidence of the two species of flies in such locations for comparison with those taken from faces.

DISCUSSION

As stated above, Peffly found that *M. sorbens* was the most common species emerging from human stools throughout the year. It also occurred in all other breeding materials, but the greater numbers came from latrine dumps and compost heaps. The adults were attracted to the moist, sweet surfaces of sugarcane, dates, oranges, and to freshly butchered meat. Patton (1936) noted this species sitting on food stuffs of all kinds, and commonly feeding on secretions from sores, wounds and particularly on discharges from the eyes. In view of these habits, he believed it to be an important carrier of pathogenic organisms, especially of bacteria which cause conjunctivitis and other diseased conditions of the eyes. Sabrosky (1952) collected *M. sorbens* in many places in Egypt, but did not find it abundant anywhere. He considered its habits to be so unlike *M. d. vicina* that ordinary collecting methods did not give a fair idea of individuals per unit area. Meng and Winfield (1938), working in China, found the density of *M. sorbens* out of doors to be about equal to that of other species.

M. d. vicina breeds in various kinds of animal excrement, prefers horse and human excrement as an oviposition media, but is found mostly in latrine dumps, animal stables, and compost piles (Peffly 1953). According to Holway (1951), outside counts began to drop in May, were extremely low during July and August, but increased again during the Fall. They showed an abrupt drop the latter part of December, continuing to decline through January, to the annual low point in February. Peffly noted *M. d. vicina* at times, feeding at muco-cutaneous margins of children's eyes, noses, and mouths. He found the other member of the "complex," *cuthbertsoni* on children's faces and on freshly butchered meats. *M. d. vicina* was attracted to dung, vegetables and animal refuse for feeding and ovipositing.

RESULTS

In the present study a total of 8,719 flies were taken from children's faces throughout the year. Four thousand three hundred fifty-two of these were *M. d. vicina* (49.9%), of which 87.9 percent were females, and 4,367 were *M. sorbens* (50.1%) with 80 percent females. This indicates that the flies taken from faces did not follow the population trend as shown by Holway (1951) for those trapped and reared from two villages (97 percent *M. d. vicina*). During the year the ratio of *vicina* vs. *sorbens* changed. The ratio was approximately one to one from August through October. *M. d. vicina* increased to 85.2 percent of the total collected from November to December, and by January had reached 98.6 percent with *M. sorbens* at the low rate of 1.4 percent. *M. sorbens* gradually took the lead from February to April reaching 63.6 percent, and by June it had increased to 88 percent (Table 1).

TABLE 1. *Musca domestica vicina* and *M. sorbens* collected in two Egyptian villages.

Date	No. visits during month	Area	Flies Collected from Faces of Children									Flies Collected with a Sweep Net								
			M. d. vicina			*M. sorbens*			Total Flies	% *M. vic.*	% *M. sorb.*	*M. d. vicina*			*M. sorbens*			Total Flies	% *M. vic.*	% *M. sorb.*
			♀	♂	♀&♂	♀	♂	♀&♂				♀	♂	♀&♂	♀	♂	♀&♂			
July 1955	5	Sindbis	274	55	329	337	58	395	724	45.4	54.6									
Aug 1955	15	Sindbis	913	175	1088	964	271	1235	2323	46.8	53.2									
Sep 1955	2	Mit Halfa	144	23	167	154	36	190	357	46.8	53.2	245	268	513	1	1	2	515	99.6	0.4
Oct 1955	2	"	125	20	145	113	30	143	288	50.3	49.7									
Nov 1955	4	"	283	31	314	196	52	248	562	55.9	44.1	130	146	276	1	0	1	277	99.6	0.4
Dec 1955	1	"	120	7	127	19	3	22	149	85.2	14.8									
Jan 1956	4	"	732	90	822	10	2	12	834	98.6	1.4									
Feb 1956	2	"	359	24	383	44	5	49	432	88.7	11.3									
Mar 1956	2	"	258	23	281	113	14	127	408	68.9	31.1									
Apr 1956	6	"	444	42	486	686	162	848	1334	36.4	63.6	876	239	1115	16	3	19	1134	98.3	1.7
May 1956	3	"	125	24	149	491	158	649	798	18.7	81.3									
*June 1956	2	"	48	13	61	366	83	449	510	12.0	88.0	913	411	1324	56	12	68	1392	95.1	4.9
Totals for Year			3825	527	4352	3493	874	4367	8719	49.9	50.1	2164	1064	3228	74	16	90	3318	97.3	2.7

* During the month of June, collections from faces were stopped on the 11th with 88% *M. sorbens.* Sweepings on that date yielded 21.5% *M. sorbens* with only 205 insects. An extra sweeping was made on 27 June with 1,131 insects collected of which 1.05% were *M. sorbens.* This brought the monthly total to 1,392 insects with **4.9% *M. sorbens.***

The ratio of *M. sorbens* to *M. d. vicina* collected from the faces of children throughout the year is shown diagrammatically in Figure 1 together with the mean temperatures and humidities

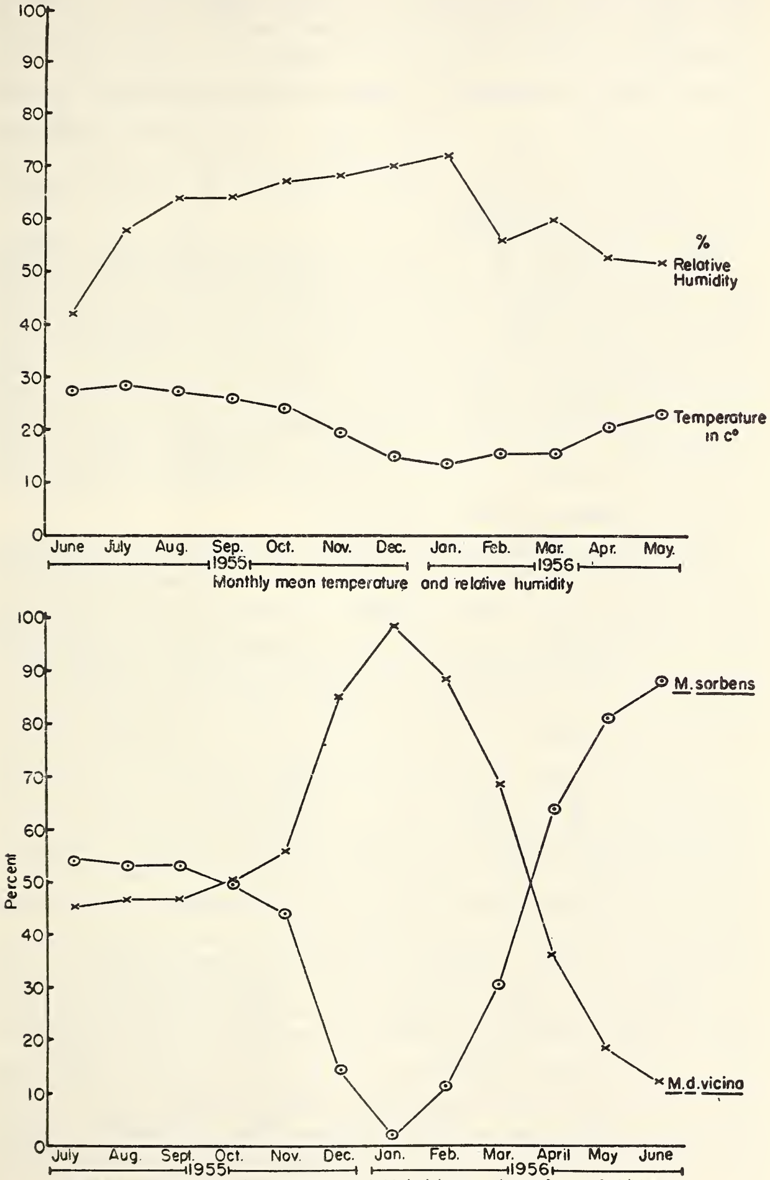

Fig. 1. Percentage by month of *M. sorbens* and *M. d. vicina* caught on faces of children.

registered for the Cairo area. It is clear that *M. d. vicina* was predominant on faces from December through March and *M. sorbens* from April to July. Sabrosky (1952) working during June and July 1950 states that "In my experience, *sorbens* was more often directly annoying to humans than either *vicina* or *cuthbertsoni.* In Cairo, about two-thirds of the flies that were collected while annoying me were *sorbens,* even though general Cairo collections were overwhelmingly *vicina* and *cuthbertsoni.*" The data given in Table 1 does not show population trends for the two species, but the ratio of *M. d. vicina* to *M. sorbens* collected from the faces of children.

Male and female *M. d. vicina* occasionally had small unidentified mites of the Sub Order Megostegmata attached between the coxae of the forelegs. One fly was noted to be carrying 39 such mites. A larger mite, *Machrocheles* sp. was also attached singly to the flies. Bonier and Gaschen (1944) found as many as 35 mites on individual flies, firmly attached and engorged with hemolymph. "It appeared that the parasitism caused intense hunger in the flies as they attacked man freely and ignored attempts to disturb them."

Flies were collected with a sweep net over fruit, vegetables, garbage, fresh meat, and feces (human, dog, goat, camel, sheep, horse, donkey and water buffalo). Sweepings were especially made over fresh human feces, since human stools are the principal source of *M. sorbens* in Egyptian villages (Peffly 1953). The net was used during four months of the year before the incidence of *M. sorbens* on children's faces had markedly declined. In September and November, 1955 when 53 and 44 percent respectively of *M. sorbens* were removed from the faces the net yielded only 0.4 percent of this species in 792 flies. In April, 1956, when *M. d. vicina* was declining and 63.6 percent *M. sorbens* was removed from faces, sweepings gave 1.7 percent of the latter species (1,115 flies). In June the rate on faces was 88 percent *M. sorbens* and the sweepings showed only 4.9 percent of 1,392 flies (Table 1*). This would seem to indicate that the use of a net over fly breeding and feeding areas does not give a true picture of the relative populations of the two species. This bears out Sabrosky's (1952) contention that the habits of *M. sorbens* were so unlike those of *M. d. vicina* that ordinary collecting methods did not give a fair idea of individuals per unit area.

Certainly, *M. sorbens* was not taken in numbers by sweeping close to the ground, and this would seem to indicate that a true estimate of the incidence of this species would not be obtained through the use of the Scudder grill although no studies were made with this equipment. In this connection, Peffly (1953) stated that "the use of Scudder's grill to determine the fly index provides a means for comparison of densities but does not provide a true population estimate."

SUMMARY

Flies were collected from the faces of children from July 1955 through June 1956. A total of 8,719 flies were taken in this manner throughout the year, 49.9 percent were *Musca domestica vicina* Macq. and 50.1 percent were *M. sorbens* Wied. The former was predominant on faces from December through March and the latter from April to July. Mites were attached to a number of the flies. The use of a sweep net over fly breeding and feeding materials does not give a true estimate of the incidence of the two species considered.

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(*Continued from page 128*)

Application of organic insecticides is to the foliage or as a soil drench. Problems of translocation must be considered. This is because translocation takes place more readily in the xylem than in the phloem.

In spraying, consideration must be given to the relative surface/weight of fruit. Commercial application is to the leaves before the fruit appears. In Cruciferae (the cabbage and allies), the outer (wrap) leaves contain the residues.

When used as a soil drench, the toxicant is much more evenly distributed. If done with the transplant water, time is present during growth for metabolism and detoxication.

Dr. von Rümker's paper was illustrated with some highly informative and ingenious lantern slides. The meeting adjourned at 9:15 P.M.

Louis S. Marks, *Secretary*

Meeting of November 15, 1955

A regular meeting of the Society was held at the American Museum of Natural History at 8:00 P.M., November 15, President Vishniac presiding.

Mr. Teale called the attention of the members to a new book, ''Insects And Their World'' by Honorary Member Su Zan Swain.

Dr. Edward S. Hodgson was proposed for membership.

The speaker, Dr. Arne Johansson, of the University of Oslo, Norway, discussed hormones in insect reproduction. He briefly reviewed the evidence which has led to the great amount of attention now centered around the phenomenon of neurosecretion in insects, especially the work of the Scharrers and Ellen Tomsen. He noted that direct functions of the corpus allatum had received relatively little study, and described his own experiments designed to elucidate the function of the corpus allatum in the bug, *Oncopeltus fasciatus*. It is known that the corpus allatum produces the juvenile hormone which modifies the action of the brain hormone, thus inhibiting metamorphosis to the adult form. Dr. Johansson's studies indicated that the corpus allatum also has a direct effect upon development of the reproductive system, for removal of the corpora allata from last-instar nymphs results in modification of the reproductive system of the adults. The effects in early adult life were most striking on development of the ovaries, and apparently continued maintenance of normal ovarian function depends upon hormones from the corpora allata. It was shown by appropriate transplantation experiments that effects upon size and function of ovaries were independent from the influence of brain hormones.

In response to a question from Dr. Vishniac, Dr. Johansson also commented on entomology in Norway. The Entomological Society at Oslo is about 50 years old, and has about 80 members. Most of the work of Norwegian entomologists is systematic and ecological in approach. The society publishes a journal irregularly, usually one number every second year.

(*Continued on page 147*)

UNDESCRIBED SPECIES OF CRANE-FLIES FROM THE HIMALAYA MOUNTAINS (TIPULIDAE, DIPTERA), I*

By CHARLES P. ALEXANDER
AMHERST, MASSACHUSETTS

During recent years great accessions of Tipulidae from various parts of the Himalaya Mountains have become available that have added vastly to our knowledge of this hitherto poorly known region. The late Enrico Brunetti described some 240 species of these flies, a considerable proportion from Darjeeling (Darjiling), in extreme northern Bengal, India, providing us with our first knowledge of the rich fauna of the eastern Himalayas. Very important collections have been made by Dr. Fernand Schmid in Pakistan, Kashmir and Jammu, pertaining to the western Himalayas. At this time I am describing species that were taken in Nepal by my friend and former student, Dr. Edward I. Coher, assisted by other members of the World Health Organization staff, particularly Mr. Gobinda Prasad Joshi. I am very greatly indebted to Messrs. Coher and Joshi for this important collection that has given us our first real knowledge of the Tipulidae of Nepal.

It is of unusual interest to note the great differences in species composition between this material from Nepal and the large series described from Darjeeling by Brunetti, as noted above. A great proportion of the Nepal species are distinct from those recorded from Darjeeling and this may perhaps be accounted for in part by the fact that much of the Nepal materials were taken in October, representing the autumnal fauna, whereas Brunetti's species pertained more often to the vernal and summer forms. It appears certain, however, that there is an actual marked difference in the crane-fly fauna of the two regions, despite the fact that they are separated by so relatively short a distance.

The largest and most important series in the present material comes from Simbhanjang Pass, in the Mahabharat Range, on the Bhainse-Katmandu road, at altitudes between 7900 and 8190 feet.

* Contribution No. 1256 from the Department of Entomology, University of Massachusetts.

Most of the other specimens are from Amlekhgang, south of Katmandu, altitude about 1690 feet, site of much active field work of the World Health Organization in the control of malaria and other insect-borne diseases.

Cylindrotoma nigritarsis new species

General coloration yellow, patterned with blackish gray, including a solid shield on the praescutum; antennae black, scape and pedicel yellow; tibiae and tarsi black; wings with a brownish tinge, restrictedly patterned with darker brown at origin of Rs and along the cord.

SEX? Length about 7.5 mm.; wing 8 mm.

Rostrum brown; palpi brown, terminal segment pale outwardly, subequal to or a little longer than the preceding two segments combined. Antennae with scape and pedicel yellow, flagellum black; flagellar segments oval, a trifle longer than the verticils. Head dark brown.

Pronotum yellow. Mesonotol praescutum with the disk virtually covered by confluent grayish black stripes, forming a discal shield, restricting the ground to the lateral borders; scutellum light brown; mediotergite blackish gray. Pleura yellow, conspicuously patterned with blackish gray on the ventral anepisternum and more extensively on the sternopleurite. Halteres with stem light brown, yellow at base, knob darker brown. Legs with the coxae and trochanters yellow; femora obscure yellow basally, passing into brown, the tips gradually blackened; tibiae and tarsi black. Wings with a brownish tinge, the prearcular and costal fields more yellowed; stigma long-oval, pale brown; distinct brown clouds at origin of *Rs*, along cord and over outer end of cell *1st* M_2; veins brown, more fulvous brown in the brightened parts. Venation: *Rs* slightly longer than R_3; petiole of cell M_1 a trifle longer than *m; m–cu* about one-third its length beyond the fork of *M*.

Abdomen light brown, the outer segments more yellowed; subterminal segments black, forming a ring; terminal segments broken so sex cannot be affirmed but from the structure of the antennae it is probably a female.

Holotype, Sex?, Simbhanjang Pass, Nepal, 8190 feet, October 27, 1956 (Coher).

The only approximately similar described regional species is *Cylindrotoma pallidipes* Alexander, of northeastern Burma, most readily told by the yellowish white tarsi and the less heavily patterned wings. It should be noted that the species described by Brunetti (1911) as *Cylindrotoma quadricellula* from the Darjeeling District belongs to the genus *Stibadocera* Enderlein, an entirely different fly.

Pedicia (Tricyphona) perpallens new species

Thorax light brown to buffy gray, praescutum with a central darker stripe; antennae brown throughout; legs dirty white to pale brown, the outer tarsal segments darker; wings subhyaline, very pale, the veins pale and indistinct against the ground; outer medial field pectinate by the atrophy of basal section of vein M_3.

MALE. Length about 5.5 mm.; wing 6 mm.; antenna about 0.8 mm.

FEMALE. Length about 5–6.5 mm.; wing 5.5–7 mm.

Rostrum and palpi brown. Antennae short, brown throughout; flagellar segments oval, with short verticils. Head dark brown.

Pronotum darkened medially above, paler on sides. Mesonotum light brown to buffy gray, praescutum with a central darker stripe; posterior sclerites of notum more yellowed. Pleura buffy to light gray, unpatterned. Halteres light yellow. Legs with the coxae and trochanters pale yellow; remainder of legs dirty white to pale brown, outer tarsal segments darker. Wings very pale, subhyaline, unpatterned; veins pale brownish yellow, poorly visible against the ground. Venation: Vein R_3 diverging strongly from R_{1+2}, cell R_2 at margin about three times cell R_3; *r–m* shortly beyond fork of *Rs;* petiole of cell R_4 subequal to *r–m;* outer medial field pectinate, cell M_2 being open by atrophy of basal section of M_3 and cell M_1 present; *m–cu* at fork of *M*.

Abdominal tergites brown, sternites brown, the posterior borders of the segments vaguely paler, in cases the basal segments pale brown, the outer ones, with the hypopygium, darker brown. Ovipositor with both the cerci and hypovalvae very long and slender, nearly straight, tips acute.

Holotype, ♀, Sleepy Hollow, Nepal, 7900 feet, December 1956 (G. P. Joshi). Allotype, ♂, Simbhanjang Pass, Nepal, 8190 feet, October 27, 1956 (Coher). Paratype, a broken ♀, with the allotype, October 1, 1956 (Coher).

The pectinate type of venation is likewise found in *Pedicia (Tricyphona) pectinata* (Alexander), of Japan, and in some Nearctic forms. It is quite distinct from all other Himalayan members of the subgenus in the pale coloration of the body and wings and in the venation.

Nipponomyia joshii new species

Size relatively large (wing of female 13 mm.); mesonotal praescutum with dark pattern reduced to four very small spots; legs yellow, the outer tarsal segments darkened; wings tinged with yellow, with the characteristic *Nipponomyia* pattern; cell *C* with subtransverse darkened lines; crossvein *m* oblique in position.

FEMALE. Length about 15 mm.; wing 13 mm.

Rostrum and palpi brown. Antennae with the scape light brown, pedicel yellow; flagellum broken. Head with anterior vertex light gray; posterior vertex and occiput paling to light brown.

Pronotum yellow, weakly darkened on anterior face. Mesonotal praescutum with the disk brownish yellow, the lateral parts more whitened; scutum brownish yellow; the usual dark pattern of the notum consists of two pairs of very small spots on the praescutum, the anterior pair more reduced; scutal lobes each with two larger black areas on lateral part; scutellum and postnotum testaceous, parascutella with a blackened spot; extreme cephalic-lateral angle of mediotergite with a comparable small black spot; the entire mesonotum thus with a total of twelve dark spots, none large or striking. Pleura and pleurotergite yellowed. Halteres pale yellow. Legs yellow, the outer two tarsal segments brownish black; tips of tibiae and remaining tarsal segments more vaguely darkened. Wings tinged with yellow, patterned with darker yellow in the characteristic pattern of the genus, including a submarginal stripe from the wing base to the tip, more or less bordered by darker; further buffy yellow areas along cord and obliquely across the outer forks and crossvein *m*, these narrowly margined with slightly darker brown; cell *C* with subtransverse brown lines; veins yellow, including those in the darkened areas. Venation: *m* oblique in position.

Abdomen yellow, both tergites and sternites with linear brownish black linear streaks, those of the tergites smaller, submarginal, occurring on segments two to five; markings of sternites more elongate and more nearly marginal in position.

Holotype, ♀, Simbhanjang Pass, Nepal, 8190 feet, October 1, 1956 (Coher & Joshi).

This fly is named for the collector, Mr. Gobinda Prasad Joshi, of the World Health Organization in Nepal. By my key to the known species of *Nipponomyia* (Philippine Jour. Sci., 56: 551–552; 1935), the fly runs to *Nipponomyia novem-punctata* (Senior-White), common in the Khasi Hills, Assam, differing in the virtually uniform yellow legs and the reduced dark pattern of the mesonotum, including twelve small areas instead of nine chiefly larger ones.

Dicranota (Eudicranota) dione new species

General coloration of thoracic notum brownish gray, praescutum with three pale brown stripes; postnotal mediotergite darkened, pleurotergite and pleura abruptly white; halteres and legs white; wings whitish subhyaline, with a conspicuous dark brown chiefly costal pattern; a supernumerary crossvein in cell R_1 but none in any other cells.

FEMALE. Length about 9 mm.; wing 9 mm.

Rostrum and palpi brown. Antennae with scape dark brown, pedicel obscure yellow, flagellum pale brown; flagellar segments oval, shorter than the longest verticils. Head light brown; anterior vertex broad.

Pronotum brown medially, the sides broadly white. Mesonotal praescutum whitish gray, with three broad pale brown stripes that are inconspicuous against the ground; scutum uniformly grayish brown; scutellum very pale gray; mediotergite brownish gray; pleurotergite and pleura abruptly and entirely white. Halteres white. Legs white, only the outer three tarsal segments brown. Wings whitish subhyaline, conspicuously patterned with dark brown, including the base and cells *C* and *Sc*, the latter sending posterior extensions over the origin of *Rs* and more narrowly along cord and vein R_2; outer end of cell *1st* M_2 less evidently darkened; veins pale yellow, darker in the patterned fields. Venation: *Rs* angulated at origin; vein R_3 upcurved at outer end; basal section of R_5 short; cell M_1 subequal to its petiole; *m* transverse, shorter than basal section of M_3; *m–cu* more than one-half its length beyond the fork of *M*.

Abdomen elongate; tergites yellowish brown basally, darker outwardly, with darker brown setigerous punctures; sternites pale brown; outer segments and the powerful cerci dark brown to brownish black.

Holotype, ♀, Simbhanjang Pass, Nepal, 8190 feet, October 1, 1956 (Coher).

The most recent key to the subgenera of *Dicranota* Zetterstedt is one by the writer (Arkiv för Zoologi, 42 A, no. 2 : 17–18 ; 1949). The present fly is quite distinct from *Dicranota* (*Eudicranota*) *dicranotoides* Alexander, of eastern Asia, more resembling species in the subgenera *Dicranotella* Alexander or *Rhaphidolabina* Alexander but being readily told by the subgeneric characters.

Hexatoma (Eriocera) coheri new species

Belongs to the *lunata* group; general coloration dark; antennae of male greatly elongated, basal segments yellow, outer flagellar segments darkened; fore and middle legs chiefly yellow, posterior tibiae conspicuously modified, lengthened and enlarged, provided with abundant dark setae; wings whitish hyaline, strikingly patterned with brown, including a series of transverse brown lines in cell *C*; only two branches of *M* reach the wing margin.

MALE. Length about 8 mm.; wing 10 mm.; antenna about 27 mm.

Type specimen badly broken. Mouthparts greatly reduced. Antennae of male very long, as shown by the measurements; scape and pedicel obscure yellow, proximal two flagellar segments clearer yellow, the incisures narrowly darkened, outer flagellar segments passing into brownish black; individual flagellar segments very long, the first about two-thirds as long as the second; segments with scattered erect black setae. Front and anterior vertex light brown; vertical tubercle of moderate size.

Thorax chiefly dark brown, conspicuously hairy. Halteres brownish yellow, knob a little darker. Legs with the femora yellow, the posterior pair with a vague darker subterminal ring; fore and middle tibiae yellow; proximal two tarsal segments yellow, tips very narrowly darkened, outer segments passing into dark brown; posterior legs modified, tibiae very long, enlarged, covered with abundant erect black setae, slightly infuscated but appearing darker because of the vestiture; tarsi yellow, the outer three segments darker. Wings whitish hyaline, strongly patterned with brown, the arrangement somewhat as in the normal *Pedicia* wing, including major darkenings at base and in cells *R* and *M*, all of R_1, and in the outer radial field, the marking continued backward along the cord to the margin; less evident darkenings in basal three-fourths of cell *Cu* and along vein *2nd A;* the ground color occurs near outer end of cells *R* and *M* and in distal ends of outer radial cells, largest in cell R_4; outer medial field and more than one-half of cell *2nd A* of the ground color; cell *C* with transverse paler brown lines, variable in number and distinctness; veins fulvous brown, more yellowed in the clear areas. Venation: *Rs* moderately long, nearly twice *R;* R_2 oblique, directed basad, about one-half R_{1+2}; veins R_3 and R_4 upcurved at tips, R_5 strongly decurved, cell R_4 widened at margin; cell *1st* M_2 present; only two branches of *M* reach the margin, interpreted as being M_{1+2} and M_{3+4}; *m–cu* at or just beyond fork of *M*.

Abdomen dark colored.

Holotype, ♂, Nagagavu, Nepal, 1690 feet, September 8, 1956 (Coher).

I am very pleased to dedicate this striking fly to Dr. Edward I. Coher, to whom I am indebted for this interesting series of Tipulidae. The known described relatives are from Indonesia, Sumatra and Borneo, all differing conspicuously from the present fly in the venation, *Hexatoma* (*Eriocera*) *perlunata* Alexander and *H.* (*E.*) *perornata* Alexander, of Borneo, having four branches of Media, while *H.* (*E.*) *lunata* (Westwood) of Borneo, and *H.* (*E.*) *ornata* (Enderlein), of Sumatra, have three such branches. The presence of only two such branches in the present insect marks the greatest reduction so far found in the subgenus *Eriocera* Macquart, although known in other groups, as *Hexatoma* s.s., *Cladolipes* Loew and *Parahexatoma* Alexander.

Cheilotrichia (Empeda) paratytthos new species

Size very small (wing of male about 2.2 mm.); general coloration dark brownish gray or plumbeous; halteres with knobs obscure yellow; legs brown; wings tinged with gray, without pattern; wing veins unusually glabrous; vein R_3 almost erect, cell M_2 open by atrophy of *m*, *m–cu* at or close to fork of *M;* male hypopygium with the dististyles long and slender.

MALE. Length about 1.6–1.8 mm.; wing 2.1-2.2 mm.

FEMALE. Length about 2.5 mm.; wing 2.5–2.6 mm.

Rostrum and palpi black. Antennae dark brown; flagellar segments oval. Head dark gray.

Pronotum and mesonotum dark brownish gray or plumbeous, without distinct pattern; pseudosutural foveae brownish black. Pleura dark brown. Halteres with stem dusky, narrowly yellowed at base, knob more obscure yellow. Legs with coxae brown; trochanters yellow; remainder of legs brown. Wings tinged with gray, without pattern; veins pale brown. Veins virtually glabrous, involving all veins beyond cord except for a sparse series of trichia on R_1 and one or few on distal section of R_5. Venation: *Sc* short,

Sc_1 ending just beyond origin of *Rs*, Sc_2 immediately before this origin, Sc_1 short; vein R_3 almost erect, separated on costa from R_{1+2} by a distance greater than its own length; R_2 faint, longer than R_{2+3+4}; R_{3+4} nearly four times R_3 and longer than R_4; cell M_2 open by atrophy of *m*; cell M_3 about twice its petiole; *m–cu* at or close to fork of *M*; vein *2nd A* straight.

Abdomen, including the male hypopygium, dark brown. Ovipositor with the cerci very long and straight, more than one-third the remainder of abdomen. Male hypopygium with the apical lobe of basistyle slender, pale yellow, with abundant setae. Both dististyles long and slender, the longer outer one dark-colored, forking at near midlength into two unequal arms, the outer longer and more obtuse at tip; inner style a long very slender paler blade that expands very gradually outwardly, the tip obtuse. Gonapophyses appearing as large flattened plates. Apex of phallosome apparently not narrowly produced and blackened, as in tytthos, but this may be due to injury of the unique specimen on slide.

Holotype, ♂, Amlekhgang, Nepal, 1690 feet, July 30, 1956 (Coher). Allotopotype, ♀, August 26, 1956. Paratopotypes, 4 ♂♀, July 30, 1956 (Coher).

Cheilotrichia (*Empeda*) *paratytthos* is quite distinct from all other regional members of the subgenus, the closest ally being *C.* (*E.*) *tytthos* Alexander, of Kashmir. The two flies are evidently allied despite important differences in the venation, including the radial and medial fields, and in the structure of the male hypopygium. These two species are among the smallest crane-flies known from the Oriental region.

Erioptera (Tasiocerodes) nepalensis new species

General coloration yellowish brown, pleura pale yellow; setae of head unusually strong, black, erect to subproclinate; legs yellow, scales tristriate; wings brownish yellow, cord seamed with darker; male hypopygium with the outer dististyle darkened, split into two blades; inner style subterminal, very pale; gonapophyses appearing as powerful divergent curved horns.

Male. Length about 3 mm.; wing 3.5 mm.

Rostrum and palpi brown. Antennae with scape and pedicel light brown; flagellum broken. Head light brown, with unusually strong black bristles, those of the anterior vertex erect to subproclinate.

Pronotum brownish yellow in front, whitened behind, with a transverse row of about four powerful erect setae; pretergites white. Mesonotum yellowish brown, the praescutum with a slightly darker brown central stripe, widest in front, becoming obsolete far before the suture; pseudosutural fovae very narrow, transverse, black; posterior sclerites of notum more testaceous yellow. Pleura and pleurotergite chiefly very pale yellow, the mesepisternum weakly darkened. Halteres with stem pale, knob weakly darkened. Legs with coxae and trochanters pale yellow; remainder of legs yellow but appearing darker by the abundant vestiture of setae and scales;

scales long and narrow, each with three parallel central striae. Wings brownish yellow, the prearcular and costal fields clearer yellow; a narrow pale brown seam over the cord; cubital and anal cells weakly darkened; veins yellow, slightly darker in the infuscated areas. Venation: As in the subgenus, *Rs* being in direct longitudinal alignment with R_4; R_{2+3} perpendicular at end of Rs and in transverse alignment with basal section of R_5; R_2 virtually in transverse alignment with the above or lying slightly more basad, slightly angulated and here with a short spur jutting into cell R_1; cell M_3 longer than its petiole; *m–cu* approximately its own length beyond the fork of *M*; vein *2nd A* only slightly sinuous.

Abdomen light brown, hypopygium a trifle more yellowed. Male hypopygium very different from that of the other known species. Two dististyles, the outer terminal, darkened, deeply split into two blades, the shorter inner one more obtuse at tip; inner style a pale blade, subterminal in position, enlarged and twisted on outer half. Gonapophyses appearing as two powerful divergent curved horns that narrow very gradually into acute points.

Holotype, ♂, Baridamas, Nepal, 1690 feet, September 3, 1956 (Coher).

This unusually interesting fly is the first representative of the subgenus *Tasiocerodes* Alexander to be discovered in Continental Asia. The two described species, *Erioptera* (*Tasiocerodes*) *persessilis* Alexander, of Honshu, and *E.* (*T.*) *subsessilis* Alexander, of Formosa, differ conspicuously in the structure of the male hypopygia.

Erioptera (Erioptera) pompalis new species

Size large (wing of female 8 mm.); general coloration of head and thorax dark gray, praescutum with a narrow brownish black central vitta; halteres light yellow; antennae and legs black; wings brownish yellow, conspicuously patterned with dark brown, including especially a seam over the cord; vein M_{3+4} very short.

FEMALE. Length about 7.5 mm.; wing 8 mm.

Rostrum and palpi black. Antennae black throughout; basal flagellar segments short-suboval, passing into subcylindrical, about equal to the verticils. Head gray.

Pronotum dark gray, scutellum brownish black medially, paling to brown on sides. Mesonotum dark gray, praescutum with a narrow brownish black central vitta, the posterior third suffused with brown; pseudosutural foveae conspicuous; posterior sclerites of notum blackened, pruinose; centers of scutal lobes infuscated, posterior sclerites more evidently black. Pleura and pleurotergite, with the dorsopleural membrane, dark gray. Halteres clear golden yellow throughout. Legs with the coxae dark gray; remainder of legs black. Wings tinged with brownish yellow, prearcular field clearer yellow; a conspicuous darker pattern, including a darker brown seam from stigma across the cord, and over Sc_2 and fork of M_{3+4}; less intense brown washes in basal half of cells *C* and *Sc* and as seams along veins M_3 and Cu_1; Anal cells extensively washed with pale brown; veins dark brown, yellowed at wing base. Venation: M_{3+4} very short, only a little longer than basal section of M_{1+2}; *m–cu* immediately before fork of *M*; vein *2nd A* strongly sinuous.

Abdomen brownish black, the subterminal segments more intensely blackened. Ovipositor with the valves elongate, horn-colored.

Holotype, ♀, Simbhanjang Pass, Nepal, 8190 feet, October 1, 1956 (Coher).

Erioptera (*Erioptera*) *pompalis* is quite distinct from other regional species of the subgenus, differing especially in the coloration of the body, wings and appendages. The most similar such species is the smaller *E.* (*E.*) *orientalis* Brunetti, which differs in all details of coloration and in the venation, especially veins M_{3+4} and *2nd A*. The species next described as *E.* (*E.*) *impensa* new species is fully as large but quite distinct in the coloration of the body and appendages, as the blackened knobs of the halteres.

Erioptera (Erioptera) impensa new species

Size very large (wing of male 7 mm., of female 8 mm. or more); general coloration of thorax light gray and brown; basal segments of antennae reddish yellow, remainder of flagellum black; knobs of halteres brownish black; femora yellow, passing into brown; wings strongly yellowed, with a conspicuous brown seam over the cord; male hypopygium with the posterior border of the tergite unequally trilobed, the margins scabrous; outer dististyle a narrow glabrous blade; inner style narrowed and recurved at tip.

MALE. Length about 6.5 mm.; wing 7 mm.

FEMALE. Length about 7–7.5 mm.; wing 8–9 mm.

Rostrum dark brown; palpi black. Antennae with basal segments reddish yellow, remainder of flagellum black. Head buffy in front, darker behind.

Pronotal scutum narrowly dark brown medially, paling to obscure yellow on sides, scutellum and pretergites yellow. Mesonotal praescutum with the center of the disk light gray, the cephalic end paler but with a capillary darkened central line; humeral region brownish yellow, sides concolorous to light gray; scutal lobes light brown, scutellum darker brown, more or less pruinose; postnotum testaceous. Pleura darkened dorsally, the ventral sclerites, including sternopleurite, meron and metapleura more fulvous; dorsopleural membrane pale. Halteres with stem pale, knob brownish black. Legs with fore coxae darkened, remaining coxae and all trochanters yellow; femora yellow basally, the tips broadly brown to dark brown; tibiae brown to dark brown; tarsi outwardly still darker. Wings strongly yellowed, with a narrow but conspicuous brown seam over the cord, paler on *Cu* to the posterior margin; paler brown to scarcely perceptible clouds over veins M_3 and M_4; veins bright yellow, dark in the band at cord. Venation: Vein *2nd A* very long and sinuous, as in the subgenus, ending opposite or beyond *m–cu*.

Abdomen brownish yellow, the outer segments, including the genitalia, dark brown to brownish black. Male hypopygium with the posterior border of tergite unequally trilobed, the obtuse lateral lobes with abundant coarse setigerous tubercles and projections, the smaller central lobe with somewhat similar but smaller points. Basistyle near apex produced into a conical lobe. Both dististyles terminal; outer style a simple slender glabrous blade, gradually narrowed to the acute tip; inner style shorter and stouter, terminating in a strongly recurved spine. Phallosome including the lyriform aedeagus, with very long recurved arms, and the shorter horn-colored apophyses.

Holotype, ♂, Sleepy Hollow, Nepal, 7900 feet, October 1, 1956 (Coher). Allotype, ♀, Simbhanjang Pass, Nepal, 8190 feet, October 1, 1956 (Coher & Joshi). Paratypes, 5 ♀♀, with the allotype.

Erioptera (*Erioptera*) *impensa* is readily told from other described regional members of the subgenus by the large size and pattern of the wings. In these respects it somewhat approaches the otherwise very distinct *E.* (*E.*) *pompalis* new species.

Erioptera (Ilisia) grumula new species

Allied to *areolata;* general coloration buffy brown to gray, mesonotal praescutum with three darker brownish gray stripes; antennae black, first flagellar segment yellowed; halteres pale yellow; legs brownish yellow, tarsi darker; wings almost uniformly light yellow, stigma slightly darker; cell *1st* M_2 small; male hypopygium with the outer dististyle compact, with a spiculose outer arm and an inner acute projection; inner style pale, bent strongly at near midlength; phallosome with two pairs of slender simple rods, one conspicuously hairy, the other glabrous.

MALE. Length about 4.8–5 mm.; wing 5.5–5.8 mm.

FEMALE. Length about 5.5 mm.; wing 5.3–6.2 mm.

Rostrum and palpi dark brown. Antennae black, first flagellar segment more yellowed. Head brownish gray to gray.

Pronotum brown medially; scutellum and pretergites light yellow. Mesonotal praescutum of holotype light gray, with three dark bronwish gray stripes, the humeri buffy; pseudosutural foveae chestnut; posterior sclerites of notum dark brown, more or less patterned with dusky; mediotergite slightly darker on posterior two-thirds. In specimens other than the holotype the thorax is more buffy than gray, the praescutal stripes paler. Pleura chiefly light gray. Halteres pale yellow. Legs with coxae and trochanters yellow; femora and tibiae brownish yellow, tarsi darker. Wings almost uniformly light yellow, stigma slightly darker, ill-delimited; veins and trichia yellow. Venation: Cell *1st* M_2 small, narrowed at base, *m* longer than basal section of M_3; veins M_3 and M_4 turned strongly upward at outer ends; vein *2nd A* straight.

Abdomen brownish black, including the hypopygium; in the paratype male hypopygium somewhat brighter but damaged. Male hypopygium with the basistyle produced beyond the insertion of the dististyles into a stout lobe. Two dististyles, the outer compact, black, including a stout slightly curved outer arm provided with abundant spinous points and appressed spines, and an inner shorter projection that terminates in a strong black spine; inner style pale, bent strongly at midlength, the outer half tapering to the narrow obtuse tip. Phallosome including two pairs of slender simple rods, one conspicuously hairy, the other glabrous, broader on more than the basal half, thence narrowed to the subobtuse tip.

Holotype, ♂, Simbhanjang Pass, Nepal, 8190 feet, October 1, 1956 (Coher). Allotype, ♀, Sleepy Hollow, Nepal, 7900 feet, October 1, 1956 (Coher). Paratopotype, 1 broken ♂; paratype, 1, with the allotype.

The most similar regional species is *Erioptera* (*Ilisia*) *dichroa* Alexander, of western China, which differs in the slightly patterned wings and in all details of structure of the male hypopygium.

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Dr. Johansson noted that the insect fauna of Norway is largely unexplored, and mere description of it could keep many generations of entomologists busy.

A lively discussion followed, and persisted well after President Vishniac closed the official part of the meeting at 9:15 P.M.

EDWARD S. HODGSON, *Secretary*, pro tempore

MEETING OF DECEMBER 6, 1955

A regular meeting of the Society was held in Room 129, American Museum of Natural History. President Vishniac presided. The minutes of the previous meeting were accepted as amended. Dr. Edward S. Hodgson, 570 West 183rd Street, New York, New York was elected to membership. A nominating committee was appointed to consist of Mr. Teale, Mr. Soraci, and Dr. Clausen, chairman. Also appointed was an auditing committee composed of Dr. Treat and Dr. Forbes, chairman. Dr. Hodgson reported on the Cincinnati meeting of the Entomological Society of America. Two hundred papers were read in the four days. Dr. Hodgson analyzed the number of papers in the various disciplines. One hundred were in the field of applied entomology. Fifty were pure physiology. Fifty were in ecology. Two were in morphology and three were in taxonomy. Of the three taxonomic papers, only one could be classified as pure taxonomy.

The scientific paper of the evening was given by Dr. Alexander B. Klots of the College of the City of New York, on arctic entomology.

The study of arctic entomology prior to 1945 was very spotty. It had, according to Dr. Klots, a romantic, explorer quality about it. With the exception of the Greenland material in the Danish Museums, only a few thousand Lepidoptera were known.

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Two factors have changed all this; first, air travel in the Arctic, second, the Northern Insect Survey instituted under Dr. Freeman's direction by the Canadian Department of Entomology. There have been as many as five parties of one to three entomologists at work in the extreme arctic. The results show as several hundred thousands of pinned insects from the North American Arctic in museums. In 1952, Dr. Klots brought back 35,000 pinned specimens from the arctic. The work of the Canadian survey is aimed at mosquito control. In this connection, Dr. Klots told of an effort to control mosquitoes at an airfield and its surrounding five mile radius. The number of mosquitoes was estimated at about 5,000 per foot. One half hour after DDT spraying there were no mosquitoes. Three days later they were back in full force. This is because the flight range of adult mosquitoes is 50–100 miles. This had been ascertained by radioactive tracers. This indicates that mosquito eradication is not feasible on the continental land mass.

Dr. Klots then discussed the geographic and ecological nature of the arctic. The geographer defines the arctic as that area within the arctic circle i.e. north of 66° 32 minutes North Latitude.

From a physical environmental point of view the arctic may be defined as that area north of 10°C. July isotherm. Biologically, it can be defined as the area north of the timber line. The tree line and the isotherm coincide to a remarkable extent. The arctic persists in lower latitudes as the Arctic-Alpine area of the Western Mountains and three localities in the Eastern Mountains of the United States.

The tundra represents the climax formation in the arctic. This is a thick mat of lichens and spermatophytes of the family Ericacae. Where the tundra is wetter there is a subclimax of grasses and sedges. The other subclimax, particularly in the sub arctic, is an interdigitation of sheltered valleys of "Elfen Wood." These interdigitations being semi-isolated localities are fertile areas for extensive subspeciation.

Recent glaciation is everywhere in evidence. It has produced an arctic rock desert. Dr. Klots emphasized that the "bareness" of the arctic is not due to cold but to the scouring movements of the glaciers. The arctic is a dry area. It is a new country, ecologically speaking. There is no organic matter. The arctic as an ecological area is less than 10,000 years old. It may be only 2,000 years old. The most successful plants are the lichens.

Dr. Klots then surveyed the animal life of the arctic. The vertebrates of the arctic are well known. Their life cycles however are not too well known. There are barely a dozen mammals. The musk ox and the reindeer are the two large mammals. The arctic fox, a ground squirrel, the lemming, the arctic wolf, the wolverine and *Microtus pennsylvanicus,* the common meadow mouse extending into the United States complete the list. No arctic mammal hibernates. True hibernation or diapause is a phenomenon of the temperate zone. Of the birds, the ptarmigan and gyrfalcon are permanent residents. However, many migratory birds spend the summer in the arctic.

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THE ABUNDANCE AND HABITS OF LAELAPS ECHIDNINUS ON RATS IN NEW JERSEY[1]

By H. ALLEN THOMAS
RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY

Several years ago an investigation was set up to make a complete study of the bionomics of rat ectoparasites of New Jersey as a cooperative project of the Department of Entomology, Rutgers University, and the New Jersey State Department of Agriculture. Among the ectoparasites collected was the mite, *Laelaps echidninus,* which is widely encountered on rats and was found in considerable numbers on rats in New Jersey.

The precise status of the mite *L. echidninus* (Berlese) as a disease causal agent vector has yet to be fully established. Even the exact constitution of the genus *Laelaps,* of which *L. echidninus* is a member, has been subject to a great deal of confusion. Despite the fact that this mite can only rarely be induced to feed on man and that Hirst in England uncovered only negative results in his attempts to transmit bubonic plague with *L. echidninus,* the ability of these mites to carry and transmit certain infectious pathogenic agents such as *Heptazoon muris* (Miller, 1908) among rats establishes them as organisms which are potentially vectors of disease.

Although the life history of this mite has been known since the work of Miller (1908), its biology has been rather neglected. No precise facts are known of its habits in a given locale.

L. echidninus (Berlese) is often found in the adult and nymphal stages as well as the less commonly encountered larval stage on several species of rats and particularly the Norway or brown rat, *Rattus norvegicus* (Erxleben), and the black rat, *Rattus rattus rattus* (Linnaeus).

Ectoparasite surveys have shown the distribution of *L. echidninus* to be more or less cosmopolitan. It has been recovered from *Rattus norvegicus* in London (Hirst, 1914), on three species

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, The State University of New Jersey, Department of Entomology, New Brunswick. A revision of a thesis presented to the graduate faculty of Rutgers University in partial fulfillment of the Master of Science requirements.

of rats in Malta (Zammit, 1918), and from rats in Lagos, Nigeria (Connal, 1926). It was also recovered from *Mus decumanus* in West Africa (Macfie, 1922) and from white rats in Toulon (Brumpt, 1946). In the United States the mite has been found in at least fifteen states.

The female probably lays eggs singly. The eggs hatch to six-legged larvae, which within a few days moult several times and become adult males and females. Unlike ticks the mites feed frequently and take only a small amount of blood at each feeding (Miller, 1908). Instead of blood meals, the males feed on animal or vegetable detritus. The mites apparently feed largely during the night; during the day they leave the host and live in the litter. When there are only a few hosts, the mites tend to remain on their respective hosts all the time and may be found in large numbers on the back of an animal. The female mite leaves the rat to deposit her egg in the litter.

Several methods, as described by Hansens and Hadjinicolaou (1952), were used in the collection of the mites used in this study. The original plan was set up to make a detailed study of rat ectoparasites from about twenty municipalities in that northeastern area representing metropolitan New Jersey by at least monthly collections of about twenty rats from each collection point. Secondly, outlying areas were to be surveyed throughout the State as time permitted.

Rats were collected predominantly from garbage and refuse dumps. Usually the rats were caught by driving calcium cyanide into their burrows and clubbing them when they were forced from the burrows. Parasites were then washed off the rats in an insecticide bath, and later the mature female mites were counted by means of a binocular dissecting microscope. Females were readily recognized by a characteristic arrangement of the plates located on the dorsal and ventral surfaces of the body.

Rats were collected from a total of seventy-six locations between April 1, 1951, and September 30, 1952. The large dumps where the rat and rat-ectoparasite populations were large were trapped more frequently than some of the smaller dumps, giving a better year-long representation where animals were more easily obtained.

At the sites visited, both sexes and all sizes of rats were taken. Only the brown or Norway rat, *Rattus norvegicus,* was encountered, and a total of 2,738 rats was collected. Table I presents information on *L. echidninus* on rats collected from dumps at one time or another during the survey.

TABLE I. *L. Echidninus* INFESTATION BY LOCALITY

County	Location	Total Rats	Per Cent Rats Infested	Average No. Mites Per Rat	Average No. Mites Per Infested Rat
Bergen	Englewood	31	71	9.9	14.0
	Fairview	138	50	3.9	7.8
	Hackensack	56	12	0.3	2.7
	Lyndhurst	16	50	4.5	9.0
	North Arlington	142	55	2.9	5.2
	Palisades Park	20	15	0.3	2.0
	Rutherford	24	62	13.7	21.9
	Woodcliff Lake	1	100	1.0	1.0
	Wood Ridge	23	17	0.3	2.0
Passaic	Bloomingdale	90	1	0.01	1.0
Hudson	Jersey City	168	39	2.5	8.4
	Secaucus	165	88	5.7	6.4
	Union City	109	50	4.8	9.6
Essex	Newark	189	76	9.3	12.3
Morris	Pine Brook	63	2	0.01	1.0
Union	Elizabeth	40	52	3.6	6.8
	Rahway	126	3	0.0	1.0
Somerset	Raritan	25	4	0.04	1.0
Middlesex	Perth Amboy	269	1	0.01	1.3
Burlington	Bordentown	33	82	16.6	2.2
	Riverside	29	10	0.1	1.3
Camden	Audubon	15	20	1.0	3.7
	Barrington	19	78	11.3	1.7
	Camden	11	73	8.0	11.0
	Westmont	7	74	20.7	24.1
Gloucester	Westville	8	25	0.4	1.5
	Woodbury	20	30	1.1	3.8
Salem	Pennsgrove	11	9	0.09	1.0
	Salem	23	8	0.5	6.0

Although the survey included points well distributed over the State of New Jersey, only certain areas proved to be inhabited by rats parasitized by this mite; and in large portions of the State, no specimens of *L. echidninus* could be found. The following points were inhabited by rats free of *L. echidninus*. After each location the total number of rats collected is noted: Allentown (Monmouth County) 15, Atlantic City (Atlantic County) 12, Belvidere (Warren County) 21, Bernardsville (Somerset County) 40, Boonton (Morris County) 2, Bridgeton (Cumberland County) 16, Burlington (Burlington County) 15, Cape May (Cape May County) 6, Cranbury (Middlesex County) 32, Dover (Morris County) 10, Freehold (Monmouth County) 20, Elizabeth (Union County) 1, Englewood Cliffs (Bergen County) 1, Flemington (Hunterdon County) 55, Frenchtown (Hunterdon County) 2, Gibbstown (Gloucester County) 1, Hampton (Warren County) 1, Hackettstown (Warren County) 43, Hasbrouck Heights (Bergen County) 4, High Bridge (Hunterdon County) 30, Hightstown (Mercer County) 42, Jersey City (Hudson County) 28, Kingston (Middlesex County) 6, Lambertville (Hunterdon County) 13, Long Branch (Monmouth County) 15, Springfield (Union County) 1, National Park (Gloucester County) 7, Newark (Essex County) 4, Newton (Sussex County) 40, North Brunswick (Middlesex County) 3, Palmyra (Burlington County) 16, Pedricktown (Salem County) 5, Pemberton (Burlington County) 1, Pennington (Mercer County) 1, Pennsauken (Camden County) 11, Phillipsburg (Warren County) 31, Pittsgrove (Salem County) 3, Port Norris (Cumberland County) 2, Riverton (Burlington County) 3, Roebling (Burlington County) 3, Seabrook (Cumberland County) 19, Somers Point (Atlantic County) 1, South Camden (Camden County) 8, South Plainfield (Middlesex County) 1, South River (Middlesex County) 165, Teaneck (Bergen County) 1, Toms River (Ocean County) 1, Trenton (Mercer County) 15, Vernon (Sussex County) 3, Vineland (Cumberland County) 38, Washington (Warren County) 45, White Horse (Mercer County) 16, Wildwood (Cape May County) 4, and Woodbine (Cape May County) 1. At other collection points (Table I), mites were taken on at least one of the visits during the year. At almost every location, the average number of mites per female rat was higher than that per male at the same location, perhaps because females spend more time than males in the burrows. Miller (1918) noted the female mite habit of depositing eggs in the litter of the burrow or cage.

The rats collected were divided arbitrarily into two groups, namely, small and large rats; those under 6½ inches in length were designated as small and those 6½ inches or longer as large. There appear to be no significant difference in mite populations of either group which would indicate a preference on the part of the mite for a young or an old host.

It was also possible to determine whether or not the abundance of the mite was subject to variations throughout the year. Five sites were found to have received visits more regularly than any others during the year, so these sites were chosen for a study of annual patterns.

The data from these five areas (Table II) show that the mite populations at these sites follow similar trends. At the beginning of the year the numbers of rats infested and the numbers of mites are very low or nil. With the advent of warmer weather, the proportion of rats infested as well as the number of mites begins to increase. By the middle of the summer the average number of rats infested has reached a high point. The average number of mites per animal has also reached a high point and leveled off. With the onset of the cooler months, mite abundance per rat and per cent of infestation begin to drop, until by the end of the year the lowest point in numbers of mites was reached. The two bottom lines give the seasonal trends by averages of the five sites listed in Table II in terms of the average number of rats infested by month and the average number of mites per rat by month.

At two of these five locations, Newark and Secaucus, more rats were collected throughout the year than at the other three locations. In each location the per cent of rats infested rises to a high in June, drops slightly in July, and rises again in August. In September the per cent of infestation drops once more and then rises to another high point in November after which the rate of infestation decreases. Three peaks of infestation during the year are thus suggested, which perhaps indicates activities of three generations of mites.

DISCUSSION AND SUMMARY

In a survey for ectoparasites in New Jersey, 2,738 Norway or brown rats were collected from refuse dumps and some buildings, and examined for parasites. Of these animals, 1,911 were found to be infested with *Laelaps echidninus,* a state-wide average in-

TABLE II.

TABLE II. MONTHLY *Laelaps echidninus* INFESTATION OF RATS AT FIVE DUMPS IN NEW JERSEY

Location	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fairview												
Total rats	0	0	0	0	10	23	26	51	10	0	18	0
% rats infested	—	—	—	—	10.0	65.2	50.0	56.8	70.0	—	22.2	—
Av. no. per rat	—	—	—	—	0.2	4.4	1.0	6.7	5.6	—	0.2	—
Jersey City												
Total rats	12	15	0	0	7	11	49	30	9	0	14	0
% rats infested	0	6.6	—	—	28.6	72.7	53.0	26.6	44.4	—	0	—
Av. no per rat	0	0.1	—	—	0.4	2.8	5.4	3.5	2.3	—	0	—
Newark												
Total rats	15	10	0	10	0	10	73	32	30	0	10	0
% rats infested	13.3	10.0	—	70.0	—	90.0	86.3	87.5	83.3	—	90.0	—
Av. no. per rat	0.3	0.1	—	1.6	—	21.3	9.9	14.6	8.4	—	9.4	—
North Arlington												
Total rats	0	10	0	0	0	10	32	51	28	0	11	0
% rats infested	—	20.0	—	—	—	20.0	78.1	64.7	64.2	—	0	—
Av. no. per rat	—	0.3	—	—	—	4.0	4.6	3.3	2.3	—	0	—
Secaucus												
Total rats	6	8	0	0	11	35	41	27	24	0	10	3
% rats infested	66.6	0	—	—	36.3	74.2	58.5	88.8	41.6	—	80.0	0
Av. no. per rat	2.0	0	—	—	4.3	11.1	6.8	4.3	3.0	—	1.3	0
% rats infested	19.3	9.3		70.0	29.1	67.4	68.3	63.8	64.6		33.3	0
Av. no. mites per rat	0.8	0.1		1.6	1.6	8.7	5.5	6.5	4.3		2.2	0

festation of 69 per cent. On these 1,911 rats, 6,567 specimens of *L. echidninus* were found, for an average of 3.4 mites per infested rat. A small number of rats was collected from dwellings, 5 per cent of which were infested with this mite.

A total of 76 locations was trapped for rats, and 29 were found to be inhabited by rats infested with this mite. The areas of heaviest infestation were found around northeastern New Jersey and the Camden metropolitan areas. Where a dump was found to be inhabited by high numbers of rats, the numbers of *L. echidninus* were usually also high. Away from densely populated areas and/or port facilities, the numbers of mite-infested rats and of mites were low or non-existent. This relationship suggests that the mite is present in those areas where rats infested with them have been introduced or dispersed by waterway shipping.

Throughout the year the numbers of *L. echidninus* were greater during the warmer months as was the per cent of rats infested by this mite. Perhaps warmer weather was more suitable for mite reproduction and perhaps, also, for increased activity of the host in terms of mating, bearing of young, and ease of movement, all of which may tend to bring about more contact among the rats and greater numbers of the host and the mite.

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The reptiles and amphibians are almost lacking—three species of frogs and a garter snake.

The arctic fish are chiefly marine. The absence of fresh water fish is due to the early freezing of the shallow lakes. This not only kills the fish but the aquatic insects as well. The mosquitoes overwinter as eggs.

The arctic fauna is a homogeneous one; there is no clear demarcation between palearctic and arctic fauna. The holarctic is the proper designation.

Insects with incomplete metamorphosis do poorly in the arctic. An exception are the collembola. The arctic lepidoptera do not hibernate in the pupal stage. They have an obligatory diapause as first, second or third instar larvae.

There are about 30 species of butterflies in the arctic. One (doubtful) Papilonid, six Pierids, 14–15 Satyrids (they are notorious slow growers—they have a two year life cycle), 5 Nymphalids (chiefly *Bolopia*), two Lycaenids and one Skipper.

Dr. Klots illustrated his remarks with Kodachrome slides. After an interesting question period, the meeting adjourned at 9:45 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF JANUARY 3, 1956

The annual meeting of the Society was held on January 3, 1956 in Room 129 American Museum of Natural History. President Vishniac presided. There were 19 members and 19 guests present. The president welcomed the members and guests and introduced Mrs. Su Zan Swain, an honorary member of our Society.

The minutes of the previous meeting were approved as read. As this was the annual meeting, the secretary verified the quorum present.

Th president reported on the state of the society. The state of affairs is good. The society in the recent past has had certain external and internal difficulties. The difficulty of publication of the Journal appears resolved. The Journal will be printed by the old printer. The president has had a letter from Dr. Hagen, our past president. Dr. Vishniac noted all the past

(*Continued on page 163*)

ENDAMOEBA HISTOLYTICA AND CERTAIN OTHER PROTOZOAN ORGANISMS FOUND IN COCK-ROACHES IN CAIRO, EGYPT[1, 2, 3]

By John D. DeCoursey[4] and James S. Otto[5]

INTRODUCTION

A large number of organisms, both pathogenic and non-pathogenic have been found in the colon and feces of cockroaches. Experimentally, the causal organisms of tuberculosis, leprosy, cholera and common enteric pathogens have been retained in a viable state in the colons of roaches (Reed 1933; Mosier 1946; Akkerman 1933; Jansen, 1952). Moiser (1946) in Southern Rhodesia found that 23 per cent of the roaches caught in the thatched huts of patients at a leprosy hospital contained leprosy bacilli.

Staphylococcus albus was isolated in pure culture from the hemolymph of *Blatta orientalis* L. from Mississippi by Tauber and Griffiths (1942). Coxsacki virus was fed to *Periplaneta americana* L. by Fisher and Syverton (1951) and fecal specimens obtained daily for a period of 15 days contained sufficient virus to paralyze mice.

Similarly, roaches are known to harbor several species of protozoan organisms in the colon. One such organism is *Endamoeba histolytica* Schaud., the protozoan causing amoebic dysentery. Amoebic dysentery is endemic in Egypt, and the practice of building toilet openings flush with the floors affords roaches an opportunity to feed upon human feces. The purpose of this investigation was to determine the importance of roaches in the

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[2] The opinions and assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

[3] The authors wish to express their appreciation to Captain C. B. Galloway, MC. USN. who directed this project, B. S. Holderman, HM1. USN. and N. S. Mansour of the Parasitology Department for the determination of organisms, the Photographic Department for micro photographs, and the Egyptian Ministry of Public Health and the Cairo Commissioner of Health for their kind assistance in the conduct of this study.

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[5] HMC. USN.

spread of *E. histolytica* in this area, and to record certain other protozoa found in the colons of these insects.

PERTINENT LITERATURE ON PROTOZOA

Flagellates: *Giardia intestinalis* (Lambl) cysts apparently pass unharmed through the colon of *Periplaneta americana* according to Mackfie (1922). Pessôa and Corrêa (1927) working experimentally with this organism have shown that the cysts may be disseminated by various stages of *Blattella germanica* L., *Periplaneta americana* and *Rhyparobia* (*Panchlora*) *maderae* F. The cysts were found in the excreta in the greatest numbers for forty-eight hours after ingestion, but a few were present for seven days. The cysts of *Lamblia* were recovered by Tejera (1926) 24 hours after they were fed to roaches. Young (1937) working with *P. americana, P. brunnea* Burm. and *Eurycotis floridana* Wlk. found that the cysts may reach the colon in two or three hours, and remain there, in the case of *Periplaneta* for 12 days.

Yakimoff and Miller (1922) found *Lophomonas striata* Bütchli and *L. blattae* in *B. orientalis.*

Amoebae: Among the organisms of the order Amoebina found in cockroaches, Lucas (1927) described *Entamoeba thomsoni* and *Endolimax blattae* from the hindgut of *B. orientalis* and *P. americana. Entamoeba thomsoni* L. was cultivated from *P. americana* by Smith and Barret (1928). *Entamoeba blattarum* was noted in the intestine of *B. orientalis* by Yakimoff and Miller (1922). Morishita and Tsuchimochi (1926) found in feeding experiments that the cysts of *Entamoeba pitheci* Prowazek were passed in the feces of *P. americana, P. australasiae* (F) and *Dorylaea rhombifolia.*

Human feces containing cysts of *Endamoeba histolytica* Schaud. and *E. coli* (Grassi) were fed to *P. americana* by Macfie (1922). Cysts were found in the feces for one to three days in seven of nine experiments. He concluded that "It would seem, that cysts of *E. histolytica* and *E. coli* can pass through the intestines of cockroaches without injury, and may thus be disseminated by these insects, but that they do not produce an actual infection in these hosts." Tejera in 1926, according to Fry and Meleney (1936) found live cysts of *E. coli* in cockroaches caught in a latrine, and cysts resembling those of *E. histolytica* in the feces of those caught in a kitchen near a closet drain. Cultures of *E. histolytica* were fed to *P. americana* by Fry and Meleney (1936) and cysts of the parasite were found in the gut or droppings of all roaches fed. The cysts remained in the crop for some time, but after four to eight hours the majority of them were found in the anterior and middle portion of the intestine, and after 16 hours, in the hind gut. They appeared in the droppings in from 16 to 20 hours. Cysts were found in the hind gut 72 hours after feeding. The authors obtained growth in culture from cysts collected from droppings obtained after 48 hours. Their conclusions were that "it seems quite possible that cockroaches which have access to human feces containing cysts of *E. histolytica,* may under certain conditions contaminate food with their droppings, and thus act as passive transmitting agents of this organism." Schneider and Shields (1948) in Talara, Peru cultured the legs and intestinal contents of 100 roaches in a search for viable cysts of *E. histolytica.* None were found in the leg cultures, but they were found in seven percent of the cultures from the intestinal tracts. The authors concluded that food and utensils can be contaminated by viable forms of *E. histolytica* from the feces of cockroaches, and that the common roach can be incriminated as a carrier of the parasite in Peru.

PROCEDURE AND DISCUSSION

Collection of roaches: The traps utilized consisted of 500 ml. beakers, the insides of which were greased with vegetable shortening to prevent the roaches from escaping. Gauze ramps were used to facilitate entry into the traps. They were baited with cooked raisins (Webster and De Coursey 1954). These traps were placed in 53 restaurants in Abbassia and Gamalia in Cairo, Egypt, through the cooperation of the Egyptian Ministry of Public Health and the City Health Department. The roaches had ample opportunity to feed upon human feces, since the latrine openings are flush with the floors, and are not connected to sewers. The roaches hide in the daytime under the latrine openings near the feces, and migrate to the restaurants at night.

Cockroaches, *Blattella germanica,* and *Periplaneta americana* were captured in only 30 of the 53 restaurants because the proprietors, in many cases, sprayed the traps with insecticide, or even covered them to prevent roaches from entering.

Periplaneta americana were also captured by hand in the villages of Mit Halfa and Sindbis in a rural area where the incidence of *E. histolytica* was higher. These insects had access to human feces around bored hole latrines and on the ground inside and outside the buildings. Examination of the feces of 100 persons from Sindbis village by Weir et al (1952) showed 93 per cent positive for *E. histolytica* cysts. *Iodamoeba* Dobell sp. *Endolimax nana* (Wen. and O'Con), *Endamoeba coli* and *E. histolytica* were found to be common in human feces in villages in this area by Chandler (1954). Other organisms noted by him were *Dientamoeba fragilis* and *Giardia lamblia* Stiles. He quotes Lawless, D. K. (in a personal communication) as having found *Enteromonas hominis* da F. also to be a common parasite.

Laboratory Procedure: The captured roaches were returned to the laboratory, the intestinal tracts removed, and two to four slides prepared from each roach for microscopic study. The slides were fixed with modified Schaudinn's solution and stained with Heidenhain's iron hematoxylin. A search was made for the following protozoan organisms: *Giardia intestinalis, Endamoeba histolytica, E. coli, Dientamoeba, Endolimax* (K. and S.) *Iodamoeba,* and *Enteromonas,* all of which are found in human feces in this area. Records were also kept of the occurrence of *Dobellina* sp. *Gregarina blattarum* S., *Entamoeba blattae* (Bütschli), and *Lophomonas blattarum.*

Protozoa Found in Intestines: Fifty-six per cent of the roaches from the restaurants were infested with one or more of the organisms listed in Table 1. Those in the villages contained 59 per cent. Only one of the 217 insects taken from the restaurants was infested with organisms morphologically similar to large race *E. histolytica* cysts, and eight, representing six restaurants, with those similar to the small race. Two of the 44 insects captured in the villages, contained organisms similar to the large race and three to the small. The overall percentage of insects containing these parasites is so small, in areas where frequent contact with human feces would be expected, that it is believed that danger of food contamination from this source is not great. In the larger restaurants where adequate sanitation is maintained, roaches would not readily come in contact with feces, and would therefore probably not be a source of contamination.

Other forms normally found in human excrement that were present in the roaches, resembled *E. coli, Iodamoeba* sp., *Endolimax* sp., and *Enteromonas* sp. The number of roaches infested with all of the forms studied are given in Table 1. The organisms: *Endamoeba blattae, Gregarina blattarum, Lophomonas* sp. and *Dobellina* sp. were recorded only as of possible interest.

TABLE 1.

Protozoan Organisms Found in Roaches from Restaurants and Villages

Type of Organism	30 Restaurants 217 Roaches		2 Villages 44 Roaches	Total Roaches Infested
	No. Roaches Infested	No. Restaurants with Infested Roaches	No. Roaches Infested	
E. histolytica				
Large race	1	1	2	3
Small race	8	6	3	11
E. blattae	7	5	—	7
E. coli	—	—	1	1
Iodamoeba sp.	50	18	9	59
Endolimax sp.	61	19	13	74
Enteromonas sp.	11	9	4	15
Lophomonas sp.	4	4	3	7
Dobellina sp.	26	12	4	30
Gregarina blattarum	10	5	—	10

SUMMARY

Various authors have reported the retention of *Endamoeba histolytica* cysts in the intestines of cockroaches both from experiments and from the fecal examination of free living roaches. In the area around Cairo, Egypt, roaches have ample opportunity to become contaminated through contact with human feces.

Periplaneta americana and *Blattella germanica* were collected from 30 restaurants in Abbassia and Gamalia. The intestinal contents were examined for the presence of protozoan organisms. Two hundred seventeen roaches were collected. Organisms morphologically resembling *Endamoeba histolytica* large race were found in only one roach. Those of the small race were found in eight roaches taken from six of the thirty restaurants.

Forty-four roaches taken from two rural villages where the incidence of *E. histolytica* has been reported to be much higher, yielded only two roaches with organisms resembling the large race of this parasite, and three roaches with the small race. The small percentage of infested roaches in an area where amoebic dysentery is endemic would seem to indicate that the chance of food contamination from this source is slight.

Other organisms taken from the intestines of roaches were similar to the following: *Endolimax* sp., *Entamoeba blattae, E. coli, Iodamoeba* sp., *Lophomonas* sp., *Enteromonas* sp., *Dobellina* sp., and *Gregarina blattarum.*

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(*Continued from page 156*)

presidents in the room and paid tribute to them all. He noted that a small nucleus in the society did most of the work.

He then called on Dr. Treat in his capacity as chairman of the program committee. Dr. Treat announced the following programs:

January 17—Miss Alice Gray will speak on "The Museums Projected Hall of Insects."

February 7—Dr. Berta Scharrer will speak on "Certain Aspects of Insect Endocrinology."

February 21—Dr. T. C. Schneirla will speak on "Behaviour Cycles in Army and Driver Ants."

March 6—Mr. H. J. Williams will speak on "Colour Cinema."

March 20—Dr. Smith of the State University of Pennsylvania will speak on "Control of Insect Flight."

April 3—Mr. Vladimir Alexieff of the Men's Faculty Club of Columbia University will speak on "Entomological Music by Composers."

(*Continued on page 164*)

(*Continued from page 163*)

Dr. Treat and Dr. Vishniac thanked Mr. Block who sends out the post cards announcing the program.

Mr. Huberman, the treasurer, gave his report. Dr. Forbes, the chairman of the auditing committee reported that his committee had examined the treasurer's books and found them in order.

Dr. Vishniac then announced, before calling the nominating committee that Dr. Marks, Secretary, had declined to run for any elective office in the society for 1956 but had offered to help the society in every way possible.

The chairman of the nominating committee, Dr. Lucy W. Clausen, reported as follows: For president, Dr. Roman Vishniac; for vice president, Dr. Asher Treat; for secretary, Dr. Edward Hodgson; for assistant secretary, Dr. Herbert Ruckes; for treasurer, Mr. Jacob Huberman; for assistant treasurer, Mrs. Patrice Vaurie; for trustees, Mr. Irving Huntington, Dr. James A. Mullen, Dr. A. B. Klots, Dr. F. Rindge and Dr. L. Clausen; the publication committee to include as editor, Mr. Frank Soraci; for editor emeritus, Dr. Harry B. Weiss; for members at large, Mr. Edwin Way Teale, Mr. Herbert Schwarz and Dr. James A. Mullen; the delegate to the New York Academy of Science to be Dr. Lucy W. Clausen.

The slate was unanimously elected.

The scientific paper of the evening was given by Dr. Roman Vishniac, the president, who spoke on the ''Concept of Nature.''

Nature is whatever is not spoiled by man. It is more than lands, plants and animals. Each generation is geting farther and farther away from nature. Man is the latest, greatest and most complicated development of all nature. But mechanization and the materialistic approach are driving man away from nature. What is needed is the natural and humanistic approach.

Dr. Vishniac then showed three extraordinary films, the result of three years research. This technique of cinematography was an entirely new technique using greater contrasts, larger magnifications and better visibility. Results of this new technique, according to Dr. Vishniac, reveal that the smallest animals and plants are as complex as man. Complex systems and organelles are now located in microscopic plans and animals.

In his photography, Dr. Vishniac utilizes only living material under natural conditions.

The meeting was adjourned at 9:40 P.M.

LOUIS S. MARKS, *Secretary*

THE REACTION TIME OF NOCTUID MOTHS TO ULTRASONIC STIMULATION

BY ASHER E. TREAT[1]
THE CITY COLLEGE OF NEW YORK

If night-flying moths use their ears to detect and evade bats or other acoustically oriented predators, it would seem that their reaction time should be roughly of the same order as that of their pursuers. If it were much longer, the response would be too late; if it were much shorter, the insects would probably seldom be caught and might cease to be pursued. Roeder and Treat (1957) have shown that tympanic organs are sensitive to the ultrasonic cries of bats, and various observers have described evasive movements of flying moths in apparent response to such cries.

Reaction times of about 80 and 90 msec. were reported in a previous paper (Treat, 1955) for responses to acoustic stimulation in the northern army worm moth *Pseudaletia unipuncta* (Haworth) and the spotted cutworm moth *Graphiphora c-nigrum* (Linnaeus) respectively. In this earlier work, the stimuli were maximal blasts of a Galton whistle delivering a broad band of frequencies with a maximum intensity at around 11 kcps., well within the range of human audition. In the present study of the same two species, purely ultrasonic stimuli were generated by a piezoelectric crystal plate of Rochelle salt, driven at various frequencies by an oscillator and amplifier. The crystal output was not monitored during the experiments, but was shown in subsequent testing to consist of pure or nearly pure tones with sound pressures at the distance (about 2 cm.) of the experimental insect variable to about 50 dynes per cm². The recording technique was similar to that previously described. During each run, a 120 cycle signal magnet was in continuous operation, so that the effective acoustic stimulus was superimposed upon a background of mixed sound to which the moths were not overtly responsive. A second signal magnet registered the onset of the

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stimulus tone, which was abrupt but was not accompanied by audible transients. The frequency of the stimulus tone varied in different experiments, and was chosen by preliminary testing so as to lie within the range of maximum sensitivity for each in-

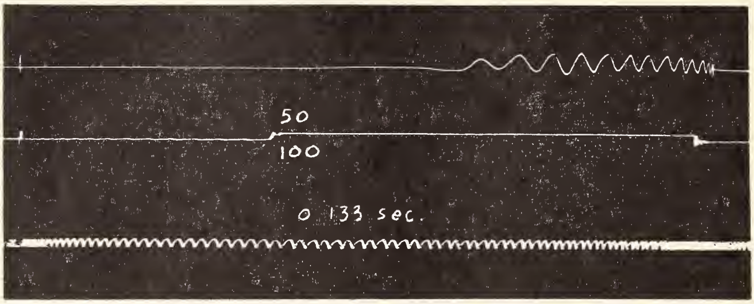

Fig. 1. *Graphiphora c-nigrum*, ♀, 11:40 A.M., 8 August, 1954. Temperature, 21° C. Upper trace: reaction of moth (initiation of stationary flight). Middle trace: stimulus signal (tone of 50 kcps. at full oscillator output). Lower trace: signal magnet vibrating at 120 cps. Reaction time, 133 msec.

sect tested. The reaction recorded was the initiation of flight, starting from a rest position with the wings folded, but with the moth suspended and the feet not in contact with a substrate. It is recognized that the circumstances are far from natural, and

TABLE I

Species	Males			Females			Total Both Sexes		
	Number tested	Number of tests	Average reaction time, msec.	Number tested	Number of tests	Average reaction time, msec.	Number tested	Number of tests	Average reaction time, msec.
G. c-nigrum	17	38	151	7	45	129	24	83	139
P. unipuncta	3	6	183	1	10	137	4	16	143

that the results cannot be regarded as representing true reaction times either of moths in free flight or of moths naturally at rest. The intervals measured include the transit time of the sound in air, which at 2 cm. was negligible, and the time required for the neuromuscular mechanism to impart a registrable movement to the wire on which the insect was impaled. A typical record is shown in Figure 1. The tests were run at various times of day and at various temperatures ranging from 18.5° to 30° C. The age of the moths as adults was known in a few instances only.

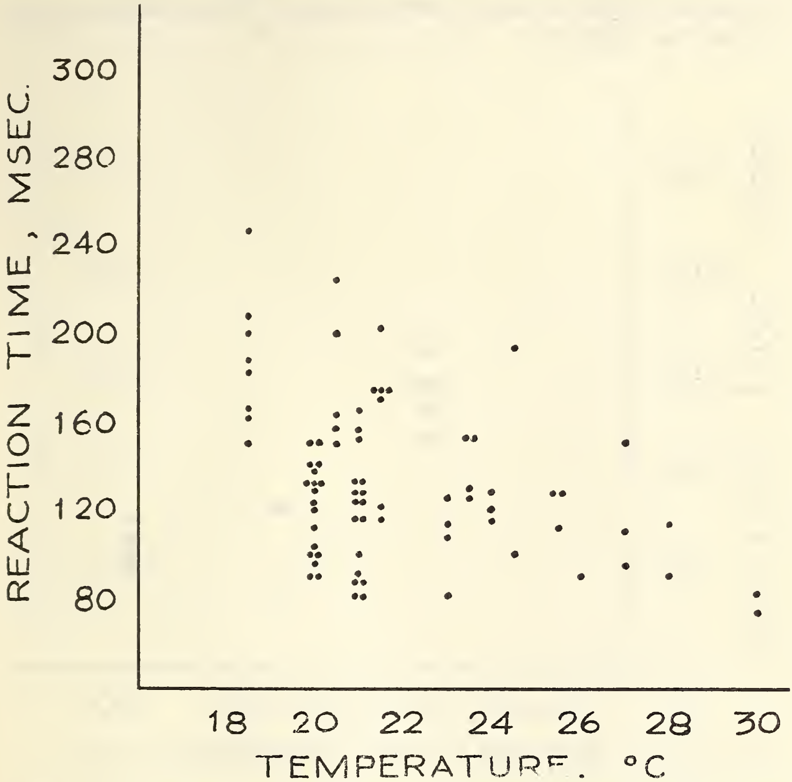

Fig. 2. *Graphiphora c-nigrum.* Reaction times to ultrasonic stimuli plotted against ambient temperatures.

RESULTS

The average reaction time in 83 tests of 24 specimens of *G. c-nigrum* was 139 msec., with a standard error of 5 msec. The shortest time measured was 75 msec., the longest, 252 msec. Since the same moths were being used for other experimental purposes, most were tested only once or twice for reaction time. In one series, however, from 3 to 22 repeated tests were run on each of 8 specimens representing 4 males and 4 females. Reaction times of the males in this series ranged from 122 to 189 msec., averaging 163; those of the females ranged from 118 to 156, averaging 130 msec. Temperatures for the two groups were not significantly different. In all, 38 tests were made on 17 males of this species, and 45 tests on 7 females, the males averaging 151 msec. as compared with 129 msec. for the females. The results are summarized in Table I.

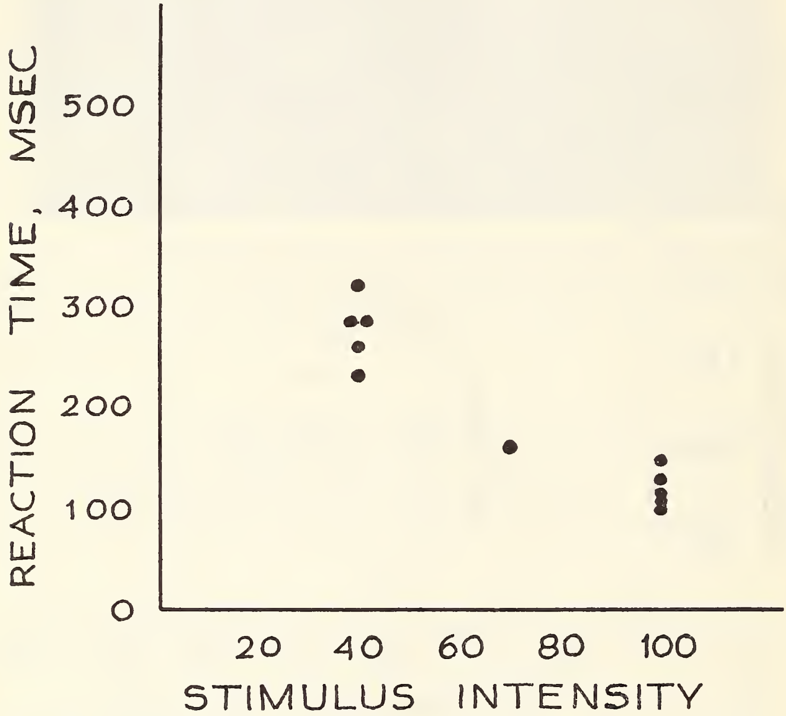

Fig. 3. *Pseudaletia unipuncta* No. 134, ♀, 10 August, 1954. Temperature, 24° C. Reaction times to stimulus of 80 kcps. at various intensities. Intensity units are arbitrary, but may be taken as approximate percentage of maximum available at this frequency—about 30 dynes per cm^2.

Although the laboratory temperature was not experimentally controlled, the records suggest some shortening of the reaction time with increasing warmth (Figure 2).

For *Pseudaletia unipuncta*, the average reaction time in 16 tests on 4 specimens was 143 msec. In this series the 6 tests of the 3 males gave an average reaction time of 183 msec. against

137 msec. for the 10 tests of the single female. Temperature differences were not significant.

One unmated female of *P. unipuncta,* reared in the laboratory, was used in 18 successive tests five days after its transformation from the pupal stage. In this instance it was possible to compare reaction times to ultrasounds of constant frequency but of varied intensity in the same specimen. The results (Figure 3),

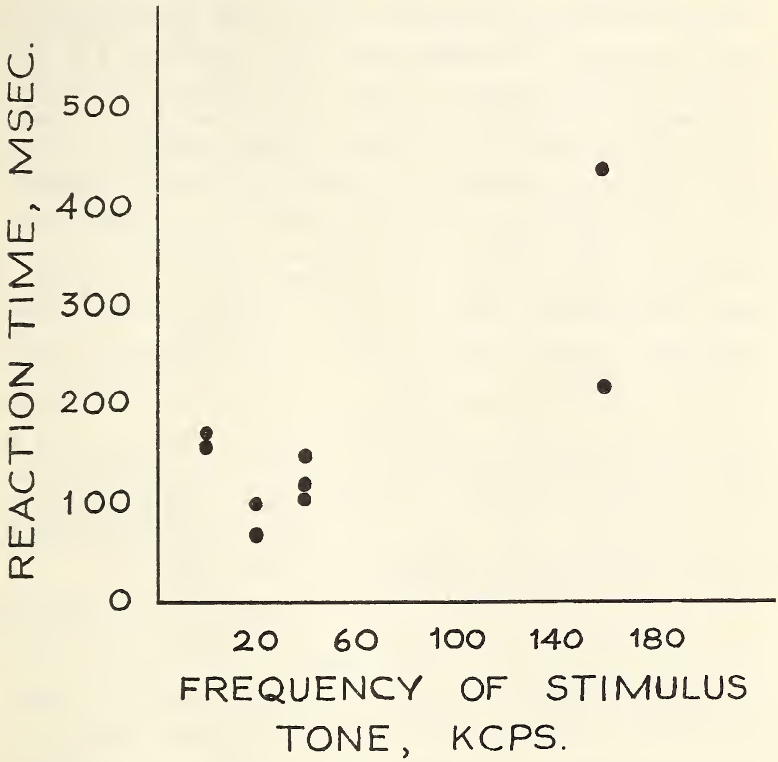

Fig. 4. *Pseudaletia unipuncta* No. 134, ♀, 10 August, 1954. Temperature, 24° C. Reaction times at full (but not constant) generator output, to various frequencies of stimulus tone.

though scanty, clearly suggest a longer latency for responses to the fainter sounds. When sound intensity was kept at the maximum available, the shortest latencies (Figure 4) were observed in the lower portion of the ultrasonic spectrum, where sensitivity is greatest, and where the energy output of the generator is probably maximal. A similar relation of reaction time and stimulus intensity was noted occasionally in *G. c-nigrum* when repeated tests were run on the same specimen. In one instance a half hour rest period yielded a series of 4 values significantly lower than the 7 previously obtained after repeated acoustic stimulation.

DISCUSSION

In the measurement of reaction time by the method here employed, an error of one pulse count in the time signal will yield an error of about 8 msec. in the result, while an even greater error may be introduced by the incorrect estimation of the point on the response trace where the reaction is first indicated. Errors of the first type are likely to be random rather than systematic. Those of the second type, when the records are cautiously interpreted, are more likely to give values too high than too low. Nevertheless, the general averages stated above and in Table I appear significantly different from the results of Galton whistle stimulation reported earlier (1955). The explanation should probably be sought in the suggested influence of stimulus intensity rather than in the difference in frequencies as such. Though the intensities were not measured in absolute terms, there is no doubt that the Galton whistle as operated in the earlier experiments represents maximal or near maximal stimulation for the noctuid tympanic organ, while the crystal-generated sounds may fall far short of this level (Roeder and Treat, 1957).

Because of the complex movements required to extend the wings and initiate the act of flight, it is likely that the time needed for this response would be appreciably longer than that for a mere change of flight path, which presumably would be the effective reaction to the ultrasonic cries of a pursuing bat. If, as seems reasonable from field observations, a flying moth can detect a bat at a distance of 10 feet, it should have ample time to change its direction. For if we assume flight velocities of 15 miles per hour for both (and this is probably excessive for most noctuids), then the maximum relative velocity, that is, for a head-on approach from opposite directions, will be 44 feet per sec. At this velocity 227 msec. will elapse before the distance of 10 feet can be traversed. Taking the moth's reaction time as 140 msec., this would give a minimum margin of safety at 10 feet of 87 msec.

At other angles of approach or at lower relative velocities the margin of safety would be increased. In other words, for a head-on approach at 44 feet per sec., the minimum distance of detection for an effective response by the moth would be a trifle over 6 feet.

The reaction time of bats to acoustic stimuli is not accurately known, but if one assumes it equal to that of the moth, the insect at 10 feet would still have the advantage of about 9 additional msec., representing the transit time of sound over that distance, regardless of whether the bat is oriented by the echoes of its own voice or by the flight sounds of the moth itself. This time, though brief, may be significant in view of the smallness of the target and of the "missile." Distance of detection no doubt varies considerably with the angle of approach and with other factors, however.

Because of its lower inertia and shorter turning radius, a moth, other things being equal, should be able to out-maneuver a bat or a bird at close range, and this is what often appears to happen in moth-bat encounters observed in nature. It is not yet known whether the apparently evasive movements of the moths are random in character or are directionally influenced by the position of the pursuer.

SUMMARY

1. Average reaction times of 139 and 143 msec. respectively are reported for noctuid moths of two species, in response to artificial ultrasonic stimulation.

2. A shorter reaction time is suggested for females than for males, at high than at low ambient temperatures, and to strong than to weak stimulation.

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BOOK NOTICE

Mosquitoes—Their Bionomics and Relation to Disease. By William R. Horsfall. The Ronald Press Company, New York, 1955. $6\frac{3}{8} \times 9\frac{1}{2}$ inches, viii + 723 pp., 206 tables $16.00.

Here is an exceptionally practical volume. Its possession would seem imperative for the applied entomologist, research worker, epidemiologist, health officer and ecologist, and highly desirable for the teacher and general entomologist, who may want a compilation of world-wide available information on mosquito ecology regardless of location. The author's remarks on habitats, behavior of the immature stages and experiments on control methods make it obvious why success in mosquito population reduction depends on bionomics. It is assumed the reader has access to taxonomic keys or can otherwise identify the mosquitoes in his vicinity, hence the table of contents refers directly to the 29 genera and their subgenera. Each of the 1800 species and 300 subspecies, or varieties, is treated uniformly as to topic so far as data permit, these headings are: assimilation, associated mosquito species, dispersal, distribution (climatic, geographic), excretion, feeding, generations, hybridization, latency, longevity, mating, oviposition, ovulation, parasites, predators, pathogenesis, reservoir relations (diseases), resistance, respiration, secretion, stridulation, swarming, taxinosis. Data on incidence of infection, discovered by mosquito dissection, provide much information on internal organisms both harmful and innocuous to man. All metamorphic stages are discussed and it is shown where further research is due. Of special interest are the 206 tables that reveal a great amount of information on distribution, parasites, pathogens, etc., in little space. The work concludes with an appendix containing five sections. A glossary of terms provides precise definitions for many words otherwise possibly confusing or indefinite to the reader. A section on techniques gives references for the appropriate manipulation of all stages in the life cycle. A bibliography contains about 4000 references. There is a separate index to genera and species, and a general index. The book is firmly bound, the contents well organized and the pages readily lie flat when it is opened.—Harold R. Hagan

THE ANOPLURA OF NEW JERSEY[1]

By STUART R. RACE[2]
RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY

The Anoplura of New Jersey have never been the subject of critical research, although the Anoplura of the United States have been treated in the works of Kellogg and Ferris (1915), and again by Ferris (1951). The New Jersey records of lice, both the biting and the sucking lice, were few until 1951, when the present study was begun under the leadership of Dr. Elton J. Hansens, in cooperation with the New Jersey Department of Agriculture and the New Jersey Divison of Fish and Game.

LITERATURE SURVEY

Smith (1910), in his report of the insects known to occur in New Jersey, notes the presence of the following eleven species of sucking lice: *Phthirus pubis* Linnaeus, *Pediculus humanus* (L.), *Haematopinus asini* (L.), *Haematopinus eurysternus* (Nitzsch), *Haematopinus suis* (L.), *Linognathus setosus* (von Olfers,) *Linognathus vituli* (L.), *Haemodipsus ventricosus* (Denny), *Polyplax spinulosa* (Burmeister), *Hoplopleura acanthopus* (Burmeister), and *Enderleinellus suturalis* (Osborn).

Since sucking lice are known to be host specific to a rather high degree, lists of the Anoplura collected in other coastal states are of assistance in studying the New Jersey fauna. Records of lice from this area have been reported by Britton (1923), Leonard (1928), Hasseltine (1929), MacCreary (1945), Kntuson and Szymkowicz (1952), and Ferris (1951).

COLLECTION OF LICE

The specimens of sucking lice were collected in several ways. The lice parasitizing the smaller mammals (mice, rats, shrews,

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, The State University of New Jersey, Department of Entomology, New Brunswick. A revision of a thesis presented to the graduate faculty of Rutgers University in partial fulfillment of the Master of Science requirements.

[2] Now with the Dep't of Botany and Entomology, New Mexico A. and M. College.

etc.) were obtained by placing the freshly captured host in a mason jar which contained water, lindane, and a detergent or wetting agent. The jars were then shaken approximately 100 times which was sufficient agitation to remove the parasites from the host animal. The host was then discarded and the solution in the jar was passed through a 60-mesh screen. The ectoparasites were removed from the screen and stored in 70 per cent ethanol until they were mounted.

ECTOPARASITE MOUNTING TECHNIQUES

Two methods of mounting and preserving lice were used during the present study, (1) the KOH-balsam technique (modified from Holland, 1949) and (2) the Hoyer's medium technique (Baker and Wharton, 1952).

ANIMALS SURVEYED

During this ectoparasite survey, a large number of host animals was surveyed. The majority of these animals was small rodents. A summary of the kinds and number of host animals together with the extent of infestation by lice is presented in Table 1.

New Jersey Anoplura Record

The following section of this paper deals with those species of sucking lice which have definitely been found in New Jersey. In the list of collections, the names of collectors are abbreviated as follows: Paul Burbutis (PB.), Charles T. O'Connor (OC.), William Cavanaugh (WC.), Mrs. Eileen Donohoe (D.), Carl French (F.), Samuel Goldwasser (SG.), Elton J. Hansens (EJH.), William Keller (K.), Robert Messersmith (BM.), Ernest Mills (EM.), John Medoff (JM.), Robert Mangold (RM.), R. J. Sim (SIM.), Walter Roberts (R.), George Pope (GP.), F. Scott Stinson (FS.), and Richard D. Worth (RDW.).

Enderleinellus longiceps (Kellogg and Ferris)

Since only two specimens of this louse were collected during the entire ectoparasite survey, this species may be one of rarer species of Anoplura occurring in New Jersey. This species, like other *Enderleinellus spp.,* is, however, extremely small and some specimens might very well have been overlooked. This louse appears to be restricted to the genus *Sciurus.*

TABLE 1

KINDS AND NUMBERS OF HOST ANIMALS SURVEYED, AND THE EXTENT OF INFESTATION BY LICE

Name	Total Animals	Total Lice Collected	Percent Infested
Virginia opossum (*Didelphis virginiana*)	13	0	0.0
Short-tailed shrew (*Blarina b. brevicauda*)	81	2	0.02
Smoky shrew (*Sorex fumeus*)	1	0	0.0
Common mole (*Scalopus aquaticus*)	1	0	0.0
Star-nosed mole (*Condylura cristata*)	1	0	0.0
Skunk (*Mephitis mephitis*)	4	0	0.0
Weasel (*Mustela novaboracensis*)	3	0	0.0
Raccoon (*Procyon lotor*)	4	0	0.0
Gray fox (*Urocyon cineroargenteus*)	3	0	0.0
Red-backed mouse (*Clethrionomys gapperi*)	2	0	0.0
Meadow mouse (*Microtus p. pennsylvanicus*)	152	142	22.0
Deer mouse (*Peromyscus leucopus*)	157	20	7.0
Pine mouse (*Pitymys pinetorum*)	146	55	6.2
Jumping mouse (*Zapus* sp.)	9	0	0.0
House mouse (*Mus musculus*)	44	0	0.0
Norway rat (*Rattus norvegicus*)	2796	102,130	62.0
Muskrat (*Ondotra zibetlica*)	4	0	0.0
Gray squirrel (*Sciurus coroninensis*)	28	30	32.2
Red squirrel (*Sciurus hudsonicus*)	3	0	0.0
Fox squirrel (*Sciurus niger*)	2	1	50.0
Woodchuck (*Marmota monax*)	3	3	33.0
Cottontail rabbit (*Sylvilagus floridanus*)	381	0	0.0
Beaver (*Castor canadensis*)	1	0	0.0
Dog (*Canis familiaris*)	14	many	—
Deer (*Odocoileus virginianus*)	1	0	0.0
Man (*Homo sapiens*)	5	many	—
Horse (*Equus caballus*)	1	many	—
Cow (*Bos taurus*)	1	many	—
Totals:	3861	102,836	

Previous records. None.
New records. Glen Ridge, 18. Dec. 52, ex *Sciurus carolinensis*, 2M (RDW.).

Enderleinellus marmotae (Ferris)

Although not many of these lice were collected, they are prob-

ably abundant on and restricted to the woodchuck, *Marmota monax* L., wherever that animal is found in New Jersey.
Previous records. None.
New records. New Brunswick, 27. May 53, ex *Marmota monax,* 3F, 4M. (PB.).

Enderleinellus suturalis (Osborn)

Smith (1910), reported that *E. suturalis* occurred on the chipmunk, *Tamias striatus* (L), and the gray gopher, *Citellus franklini* (Sabine), in New Jersey. Neither of these two animals was collected during the present New Jersey ectoparasite survey.
Previous records. Recorded by Smith (1910).
New records. None.

Hoplopleura acanthopus (Burmeister)

This species of Anoplura is very abundant in New Jersey, particularly on the meadow mouse, *Microtus p. pennsylvanicus.*
Previous records. Recorded by Smith (1910).
New records.

Chester, 17. Dec. 52, ex *Microtus pennsylvanicus pennsylvanicus,* 3F. (FS.); 18. Dec. 52, ex *M. p. pennsylvanicus,* 6F, 1M. (FS.).

Elizabeth, 5. April. 52, ex *Blarina brevicauda brevicauda,* 1F. (PB.).

Holland Brook, 17. April. 52, ex *M. p. pennsylvanicus,* 15M, 9F. (PB.) 18 April. 52, ex *M. p. pennsylvanicus,* 4F, 2M. (PB.); 6. May. 2, ex *M. p. pennsylvanicus,* 1F, 2M. (PB.).

Long Valley, 6 Feb. 53, ex *M. p. pennsylvanicus,* 1F. (FS.).

Middlebush, 11. Feb. 53, ex *M. p. pennsylvanicus,* 2F, 9M. (PB.).

New Brunswick, 16. Feb. 53, ex *Peromyscus leucopus,* 1F. (PB.); 10. Feb. 53, ex *Pitymys pinetorum,* 4F, 1M. (PB.); 11. Feb. 53, ex *Pitymys pinetorum,* 10F, 4M. (PB.); 13. Feb. 53, 22F, 7M. (PB.).

Newfoundland, 10. Feb. 53, ex *M. p. pennsylvanicus,* 1F. (FS.).

Newton, 6. Jan. 53, ex *M. p. pennsylvanicus,* 4F, 1M. (FS.).

Princeton, 22. Jan. 53, ex *M. p. pennsylvanicus,* 8F. (R.); 20. Feb. 53, ex *M. p. pennsylvanicus,* 10F , 2M. (GP.).

Riverton, 21. April. 53, ex *Pitymys pinetorum,* 1F. (P.B.).

Robbinsville, 16. Jan. 53, ex *M. p. pennsylvanicus,* 3F, 3M. (GP.).

Rosemont, 14. Jan. 3, ex *M. p. pennsylvanicus,* 1F. (FS.).

Somerville, 22. April. 3, ex *M. p. pennsylvanicus,* 2F, 1M. (PB.).

Somerdale, 6. Feb. 53, ex *M. p. pennsylvanicus,* 1F. (PB.).

Stelton, 17. Feb. 53, ex *M. p. pennsylvanicus,* 1F. (PB.); 19. Feb. 53, ex *M. p. pennsylvanicus,* 1F, 1M. (PB.); 26. Feb. 53, ex *M. p. pennsylvanicus,* 3F, 1M. (PB.); 13. March. 53, ex *M. p. pennsylvanicus,* 8F, 1M. (PB.); 16. March. 53, ex *M. p. pennsylvanicus,* 3F, 1M. (PB.); 24. Feb. 53, ex *Peromyscus leucopus,* 1F. (PB.).

Hoplopleura heaperomydis (Osborn)

This species of sucking louse is widely distributed in New Jersey, and like *H. acanthopus,* is restricted to the smaller animals.
Previous records. None.
New records.

Bordentown, 27. Jan. 53, ex *Peromyscus leucopus,* 1F. (GP.); 27. Jan. 53, ex *Blarina brevicauda brevicauda,* 1M. (GP.).

Clinton, 24. Nov. 51, ex *Microtus pennsylvanicus pennsylvanicus,* 1M. (D.).

Dividing Creek, 15. Jan. 53, ex *Peromyscus leucopus,* 3F. (PB.).

New Brunswick, 3. Feb. 53, ex *Peromyscus leucopus,* 5F, 3M. (PB.); 13. Feb. 53, ex *Pitymys pinetorum,* 2F. (PB.).

Seabrook, 22. Sept. 52, ex *Peromyscus leucopus,* 1F. (EJH.).

Tabernacle, 13. Nov. 53, ex *Peromyscus leucopus,* 1F. (SIM.).

Thompson's Beach, 11. Feb. 53, ex *Peromyscus leucopus,* 1M. (K.).

Polyplax abscisa (Fahrenholz)

This species of Anoplura is probably well established in New Jersey on a variety of small rodents.
Previous records. None.
New records.

Fellowship, 22. Jan. 53, ex *Pitymys pinetorum,* 1F. (FS.).

Pittstown, 16. Jan. 53, ex *Microtus pennsylvanicus pennsylvanicus,* 1M (FS.).

Princeton, 9. Feb. 53, ex *P. pinetorum,* 1M. (GP.).
Robbinsville, 24. July. 53, ex *M. p. pennsylvanicus,* 1M. (WC.).

Polyplax serrata (Burmeister)

According to H. D. Pratt of the United States Public Health Service, *Polyplax serrata* is a rare species of Anoplura in the United States. He remarks in correspondence with the author that "Eads has one Texas record; there are some old United States Public Health records of this species on laboratory mice which may or may not be correct, and there is one collection from Utah." Although more than 150 meadow mice were collected during this survey, only five specimens of *P. serrata* were taken from one of these mice. The species is considered by the author to be extremely rare in New Jersey.

Previous records. None.

New records.

Oldwick, 9. April. 53, ex *Microtus p. pennsylvanicus,* 1F, 4M. (FS.).

Polyplax spinulosa (Burmeister)

The spiny-rat louse was collected in great numbers from rats throughout the entire state of New Jersey. *P. spinulosa* was by far the most abundant species of sucking louse collected during this survey, with 102,130 adult and nymphal lice being collected from 2,796 Norway rats, *rattus norvegicus* (Berkenhout).

Previous records. Recorded by Smith (1910).

New records. Space does not permit the citation of each collection—suffice it to state that the spiny-rat louse was collected from 79 different locations (including collections from all twenty-one counties).

Haematopinus asini (L.), The horse louse

This species of Anoplura is to be found on horses and asses, probably throughout the state.

Previous records. Recorded by Smith (1910).

New records. Clinton, 20. Dec. 46, ex *Equus caballus,* many F, many M. (D.).

Haematopinus eurysternus (Nitzsch), The short-nosed ox-louse.

This louse is occasionally found on dairy and beef cattle, *Bos taurus* L., in New Jersey.

Previous records. Recorded by Smith (1910).
New records. Clinton, 26. Nov. 46, ex *Bos taurus,* many F, many M. (D.).

Haematopinus suis (L.), The hog louse

The hog louse is the largest of the Anoplura to be found in New Jersey.
Previous records. Recorded by Smith (1910).
New records. None.

Neohaematopinus sciurinus Mjoberg

This louse is specific to the family Sciuridae and in New Jersey is commonly found on the gray squirrel, *Sciurus carolinensis leucotis* (Gapper.).
Previous records. None.
New records.

Bound Brook, 15. Jan. 53, ex *Sciurus carolinensis leucotis,* 1F. (RDW.).
Glen Ridge, 18. Dec. 52, ex *S. c. leucotis,* 1F, 1M. (RDW.).
Millburn, 24. Feb. 53, ex *S. c. leucotis,* 2F, 1M. (RDW.).
Montclair, 10. Dec. 52, ex *S. c. leucotis,* 3F, 2M. (RDW.); 7. Sept. 53, ex *S. c. leucotis,* 1F, (RDW.).
Nutley, 12. Jan. 52, ex *S. c. leucotis,* 3F. (RDW.).
Verona, 11. Dec. 53, ex *S. c. leucotis,* 4F. (RDW.).
Westfield, 8. Jan. 53, ex *S. c. leucotis,* 2F. (RDW.); 7. Sept. 53, ex *S. c. leucotis,* 3F. (RDW.).

Linognathus pedalis (Osborn), The sheep foot-louse

This louse can probably be found on sheep, *Ovis aries* L., and goats, *Capra hircus* L., throughout New Jersey.
Previous records. This species was recorded by Smith (1910).
New records. None.

Linognathus setosus (von Olfers), The dog louse

The dog louse is specific to members of the family Canidae and may occur in New Jersey where dogs and/or red foxes are found.
Previous records. Recorded by Smith (1910).
New records.

Clinton, 30. Dec. 52, ex *Canis familiaris,* many F, many M. (D.).

Packanack Lake, 15. Jan. 54, ex *Canis familiaris,* many F, many M. (EJH.).

Linognathus vituli (L.), The long-nosed ox-louse

The long-nosed ox-louse, like the short-nosed ox-louse, is specific to and probably fairly abundant on dairy and beef cattle, *Bos taurus,* throughout the state of New Jersey.
Previous records. Recorded by Smith (1910).
New records. Clinton, 26. Nov. 46, ex *Bos taurus,* many F, many M. (D.).

Pediculus humanus L., The human louse

The species *Pediculus humanus* L. includes the two forms *Pediculus humanus humanus* deGreer and *Pediculus humanus capitis* deGreer, commonly called the body louse and the head louse respectively. These specific parasites of man are to be found in New Jersey wherever their existence is permitted.

P. humanus is a capable vector of diseases such as Epidemic relapsing fever, epidemic typhus fever, trench fever, and possibly other infections. In addition to the above, the intermittent feeding of these lice very often causes serious annoyance to the host.
Previous records. Recorded by Smith (1910).
New records. None.

Phthirus pubis (L.), The pubic louse

In New Jersey, as elsewhere, the pubic louse or crab louse can be found quite frequently on people with low hygienic standards.
Previous records. Recorded by Smith (1910).
New records. New Brunswick, 1. Dec. 53, ex *Homo sapiens,* many F, many M. (OC.).

Haemodipsus ventricosus (Denny)

This species of Anoplura is to be found on rabbits, both domestic and wild.
Previous records. Recorded by Smith (1910).
New records. None.

DISCUSSION

The majority of the host records established during the course of this study are new for New Jersey. The host specificity of

Anoplura is illustrated by the fact that in general, one species of louse parasitizes only one species of host. However, several species of hosts, notably the meadow mouse and the pine mouse, were found to harbor two or more different species of lice.

The Anoplura of New Jersey

The thirteen species of Anoplura collected during the present survey plus the five additional species collected by previous workers, (Smith, 1910), make a total of eighteen species of sucking lice known to occur in New Jersey. These eighteen are discussed on the preceding pages.

In addition, there are thirteen other species of Anoplura that probably occur in New Jersey because their hosts are known to be present in the state, therefore, their ectoparasites are also probably present. Several of these species have been collected in New York state and/or Connecticut.

When these hosts are collected and examined in sufficient numbers in New Jersey, the following Anoplura will probably be added to the list:

1. *Polyplax auricularis* Kellogg and Ferris

Ferris (1951), reports that this louse occurs on members of the genus *Peromyscus,* which is common in New Jersey.

2. *Haematopinoides squamosus* (Osborn)

This louse is found on the common mole, *Scalopus aquaticus* Linnaeus, and has been reported from Iowa, Kansas, Illinois, and New York (Ferris, 1951).

3. *Solenopotes capillatus* Enderlein

This louse occurs on dairy and beef cattle and has been collected in New York state.

4. *Hoplopleura erratica* (Osborn)

This louse parasitizes the chipmunk, none of which was collected during this survey. However, *H. erratica* has been reported from Ossining New York (Ferris, 1928) and from Connecticut (Osborn, 1923).

5. *Hoplopleura sciuricola* Ferris

This louse is found on species of the genus *Sciurus* which are common in New Jersey.

6. *Hoplopleura trispinosa* Kellogg and Ferris

The flying squirrels, *Glaucomys spp.,* which are present in New

Jersey, are reported as the preferred hosts of this species of Anoplura. No *Glaucomys spp.* were collected during this survey.

7. *Neohaematopinus sciuropteri* (Osborn)

This louse also occurs on flying squirrels and probably is present in New Jersey.

8. *Enderleinellus nitzschi* (Burmeister)

This louse is probably present in New Jersey on the family Sciuridae.

9. *Enderleinellus tamiasis* Fahrenholz

This louse probably occurs in New Jersey on the chipmunk.

10. *Microphthirus uncinatus* (Ferris)

According to Ferris (1951), this species of sucking louse parasitizes the flying squirrel. It is probably present in New Jersey.

11. *Linognathus ovillus* (Neumann)

This louse is to be expected in New Jersey on sheep and goats.

12. *Linognathus africanus* Kellogg and Paine

This species of Anoplura parasitizes sheep and goats.

13. *Linognathus stenopsis* (Burmeister)

This louse is commonly found on sheep and goats.

NEW JERSEY HOST LIST

From information collected during this study and from the literature, it is possible to compile a faunal list of the Anoplura occurring in New Jersey as set forth in Table 2.

TABLE 2.

THE NEW JERSEY HOST-LICE RELATIONSHIPS

Host	Louse	Present Study	Previous Record	Probably Occurs
Common mole	*Haematopinoides squamosus*			x
Short-tailed shrew	*Hoplopleura acanthopus*	x*		
	Hoplopleura hesperomydis	x*		
Meadow mouse	*Hoplopleura acanthopus*	x	x	
	Hoplopleura hesperomydis	x*		
	Polyplax abscisa	x		
	Polyplax serrata	x*		
Deer mouse	*Hoplopleura acanthopus*	x		
	Hoplopleura hesperomydis	x		

TABLE 2. (*Continued*)

Host	Louse	Present Study	Previous Record	Probably Occurs
Pine mouse	*Hoplopleura acanthopus*	x		
	Hoplopleura hesperomydis	x*		
	Polylax abscisa	x*		
House mouse	*Polyplax serrata*			x
Gray squirrel	*Neohaematopinus sciurinus*	x		
	Hoplopleura sciuricola			x
	Enderleinellus longiceps	x		
	Enderleinellus nitzschi			x
Red squirrel	*Neohaematopinus sciurinus*			x
	Hoplopleura sciuricola			x
	Enderleinellus longiceps			x
	Enderleinellus nitzschi			x
Fox squirrel	*Neohaematopinus sciurinus*			x
	Hoplopleura sciuricola			x
	Enderleinellus longiceps	x		
	Enderleinellus nitzschi			x
Flying squirrel	*Hoplopleura trispinosa*			x
	Neohaematopinus sciuropteri			x
	Microphthirus uncinatus			x
Chipmunk	*Hoplopleura erratica*			x
	Enderleinellus suturalis		x	
	Enderleinellus tamiasis			x
Gray gopher	*Enderleinellus suturalis*		x	
Black rat	*Polyplax spinulosa*			x
Norway rat	*Polyplax spinulosa*	x	x	
Woodchuck	*Enderleinellus marmotae*	x		
Rabbit	*Haemodipsus ventricosus*		x	
Dog	*Linognathus setosus*	x	x	
Pig	*Haematopinus suis*		x	
Dairy and beef cattle	*Haematopinus eurysternus*	x	x	
	Linognathus vituli	x		
	Solenopotes capillatus			x
Goat and/or sheep	*Linognathus africanus*			x
	Linognathus ovillus			x
	Linognathus pedalis		x	
	Linognathus stenopsis			x
Horse	*Haematopinus asini*	x	x	
Man	*Pediculus humanus*		x	
	Phthirus pubis	x	x	

* Host-lice relationship found during this study and not recorded in the literature.

SUMMARY AND CONCLUSIONS

During the years 1951 and 1953 an ectoparasite survey was conducted in New Jersey by the Department of Entomology, Rutgers University, in cooperation with the New Jersey Department of Agriculture and the New Jersey Division of Fish and Game, in order to study the Anoplura occurring in the state.

A total of 102,386 lice was collected from approximately 3,900 host animals. Thirteen species of Anoplura were found, six of which were not previously recorded from New Jersey. One, *Polyplax serrata,* is probably extremely rare in New Jersey.

The thirteen species collected during this survey plus five additional species collected by Smith (1910), make a total of eighteen species of Anoplura known to occur in New Jersey.

In addition to these eighteen, the author believes that thirteen more species occur in the state, thus making a total of thirty-one species of Anoplura in New Jersey.

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Generic names begin with capital letters. New genera, subgenera, species, varieties and new names are printed in italics.

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