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HUGH B. LEECH

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IN HONOR

HUGH B. LEECH

Hugh B. Leech, retired curator at the California Academy of Sciences and noted specialist in the aquatic Coleoptera, was, for many years, a very active force in the Pacific Coast Entomological Society. Through his energy and support the society has grown and prospered. In recognition of this, and on the occasion of his 70th birthday, recently passed, the Pacific Coast Entomological Society dedicates this issue to Hugh B. Leech.

Many persons were interested in contributing to this issue, but the editors have selected papers on water beetles as being perhaps most appropriate. All of Hugh's friends, whether they are represented in this issue or not, extend their congratulations and best wishes.

Fig. 1. Hugh Bosdin Leech. Photograph taken at the California Academy of Sciences in 1951 by Edward S. Ross.

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HUGH BOSDIN LEECH—A CURATOR'S CURATOR

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It is with great pleasure that, on the occasion of his seventieth birthday, we present the following brief biography of our friend and colleague, Hugh B. Leech.

Hugh Bosdin Leech was born on May 10, 1910 at Kamloops, British Columbia, the son of Daniel Herbert Leech and Olive Roberta Shepherd. His early years spent in rural surroundings, amid the beautiful mountains and valleys of southern British Columbia, have clearly had a profound and lasting impact on his view of life in general and the way he has chosen to live.

He received his early schooling at Lakefield Preparatory School in Lakefield, Ontario, Vernon Preparatory School in Vernon, British Columbia, and Salmon Arm High School in Salmon Arm, British Columbia. He went on to earn a B.S.A. degree from the University of British Columbia, Vancouver, in 1933 and concluded his formal education in 1938 with a M.Sc. degree from the University of California at Berkeley.

In 1932, Hugh met Frances Orchid Quail of Fernie, B.C., while both were attending the University of British Columbia. Married in Fernie in March 1936, they now have a daughter (Mary Kathleen, in Walnut Creek, California), three sons (Robin, in Edmonton, Alberta; Tom, in Novato, California; and Bill, in Costa Mesa, California) and 6 grandchildren living in both Canada and the United States. Hugh brought his family to California in 1947, and he became a naturalized U.S. citizen in 1955.

Hugh's interest in natural history, and insects in particular, began at an early age and was encouraged by his parents (Leech, 1948). His first professional position in entomology was in 1929, as a laboratory assistant for the Canada Department of Agriculture at the Field Crop Pests Laboratory in Vernon, British Columbia. During the years 1930–1947 and when not attending university in Vancouver or Berkeley, he held various technical positions with the Forest Entomology Laboratory in Vernon. It was during this period that he met, worked with, and was influenced by the late Ralph Hopping, whom he acknowledges (Leech, 1942) as his mentor in systematics.

In 1947, Hugh joined the Department of Entomology at the California Academy of Sciences as Assistant Curator and began an association which, to the great benefit of the Academy and its collections, the field of insect systematics, and several generations of insect systematists, continued for 28 years. He retired in May, 1975 as Associate Curator, Department of Entomology, and was immediately appointed Curator Emeritus, the position he now holds.

As any of his many colleagues will agree, Hugh Leech is second to none as a curator. The record of his stewardship for the collection in his charge is unsurpassed, a model for his contemporaries and successors. Under his care and attention, the Academy's Coleoptera collection became one of the best curated in the world and therefore of international importance in systematics. His willingness and promptness in making material available on loan as well as his attentiveness and helpfulness to visitors to the collection have been his trademark. Few curators have had so complete a grasp of contemporary research in their field as Hugh. He routinely followed up on initial loans to researchers with subsequent loans of newly acquired or prepared material—unsolicited, but always welcome additions. He saw to it that any changes in nomenclature and/or classification which appeared in the literature were quickly reflected in the organization of the Academy's collection.

Certain of Hugh's personal traits are especially well suited to curatorial work. He is orderly and precise, tough-minded, independent, but with a keen sense of humor which permits him to keep details in perspective. He is also a superb correspondent, adept at handling the kinds of exchange that characterize the curator's role as interface between collection resources (both specimens and information) and the users of those resources. A trusting person, Hugh has been willing to take a chance on the unproven. Consequently, he has been extremely helpful to students or others just getting started in insect systematics by providing information or loaning specimens when other curators might have refused to do so; and he has done much to foster careers in entomology through his continued encouragement to colleagues, both young and old.

Always interested in literature and writing, Hugh worked hard at building and organizing the entomological libraries at the Academy. The Coleoptera section in particular is especially strong due to his efforts. Perhaps more importantly, he has been an incredible bibliographic resource to his many friends and associates. His command of the literature and ease in providing the key reference in a particular situation have saved many a fellow worker hours which could have been lost in searching through indices and abstracts. His many thorough and detailed book reviews and notices on newly published works (see Appendix A) have been of further service to his colleagues.

Although he has always put his curatorial work first, Hugh's exceptional interest and abilities in both research and fieldwork are well known and respected by his colleagues (see Appendix C for a list of taxa named in his honor). His research has ranged widely over the order Coleoptera (see Appendices A and B) but has centered mainly on the families of aquatic beetles. As with everything he does, Hugh's published works reflect care and precision, as well as a keen eye for details and differences. A recognized authority on several hydradephagan families, as well as the Hydrophilidae, perhaps his best known work is that with H. P. Chandler (Leech and Chandler, 1956) on the aquatic beetles of California. To date, he has described over 50 beetle taxa as new (see Appendix B)—the first (*Agabus vancouverensis* Leech) in 1937, the most recent (two species of *Hygrotus*) in 1966—in an impressive series of papers dealing mainly with western North America.

Hugh has always had great interest in the history of entomology and in entomologists. He is today one of our best single resources on the history of entomology, at least for western North America. His close personal associations with so many entomologists—including M. A. Cazier, W. C. Day, D. G. Denning, J. W. Green, J. L. Gressitt, R. Hopping, P. D. Hurd, Jr., E. L. Kessel, E. R. Leach, E. G. Linsley, E. S. Ross, J. Schuh, G. S. Smith, R. L. Usinger, E. C. Van Dyke, F. X. Williams, E. C. Zimmerman, and many others—span several generations and a period of great change in our field. His detailed biographies of and tributes to deceased colleagues (see Appendix A) provide us with unique and lasting insights into their careers and lives. His concern for the artifacts that make history more tangible, more real, is reflected in his work on and frequent additions to the historical files of the Academy's Entomology Department and of the Pacific Coast Entomological Society.

From his early start in entomology to the present, Hugh has maintained a continued interest in fieldwork. Early in his career, he collected intensely in southern British Columbia. Subsequent opportunities for travel permitted him access to other parts of western North America. He collected in mainland Mexico with E. S. Ross in 1948 and Baja California in 1958–1959 and again in 1963 with P. H. Arnaud, Jr. A particularly productive trip was one to Arizona in July and August, 1952 with J. Wagener Green (see Fig. 2 for some results). However, most of his collecting has been done in California and adjacent states. He has enjoyed collecting either alone or with friends. A close friend and frequent field companion was the late W. C. Day, noted mayfly enthusiast.

As at home in the field as ever, Hugh still enjoys collecting and is usually willing to spend some time in this pursuit at the drop of a hat. Much of his recent effort, as in past years, has been spent collecting insects in the area of his home and, specifically, in rearing insects inhabiting dead wood. He is rapidly accumulating a wealth of information on insect/host plant associations and interspecific interactions.

Hugh officially donated his collection to the California Academy of Sci-

Fig. 2. Dr. Edwin C. Van Dyke and H. B. Leech examining part of the collection made by H. B. Leech and J. W. Green on their expedition to Arizona, July–August, 1952. Photograph taken by Edward S. Ross at the California Academy of Sciences, September 5, 1952.

ences in 1947. At that time, it contained over 30,000 water beetle specimens, including Gyrinidae, Hydrophilidae, and Limnebiidae from the collection of Charles W. Leng. In subsequent years and as a result of his continued productive field activity, he has deposited an incredible amount of additional material in the Academy collection; and accession records of this institution indicate that these contributions now total almost one-quarter of a million specimens. This legacy of carefully prepared and well documented material stands in fitting tribute to his outstanding contribution through fieldwork.

During his career, Hugh has been affiliated with many professional societies, including the American Institute of Biological Sciences, California Academy of Sciences (Fellow), The Coleopterists Society (Executive Council member), Collectors Club (New York), Entomological Society of British Columbia (Past Secretary-Treasurer and Editor), Pacific Coast Entomological Society, Sierra Club, Society of Sigma Xi, and Society of Systematic Zoology. However, his association with the Pacific Coast Entomological Society (PCES) has been a long and fruitful one which deserves special attention.

Hugh's first contact with the Society was in 1931, when he subscribed to volume 7 of The Pan-Pacific Entomologist. He was elected to Society membership at the November meeting, 1947, and to Honorary membership in December 1975. He served as Co-editor of The Pan-Pacific Entomologist (PPE) (with P. D. Hurd, Jr.) for volumes 26 (1950) through 29 (1953). He was Vice-President of the Society in 1955 and President in 1956, served four successive three-year terms on the PCES Publications Committee (1952–1963), has been a member of the PPE Editorial Board since 1954, and was Chairman of the Historical Committee for many years prior to his retirement in 1975. In addition, he reviewed many books for the Society with written reviews and/or actual displays of books at Society meetings; and he was active in circulating duplicate reprints and other literature among Society members. Perhaps most conspicuous among his functions for the Society was as a gracious, informative, and helpful host at the Academy for all attending monthly meetings of the Society.

Following his retirement, Hugh and Frances moved into a log house on 44 acres of land on Howell Mountain, just east of Angwin, in Napa County, California. He keeps himself in excellent condition, working his gardens with hand tools and hours of his labor. He leads a hard and relatively uncluttered life—just the way he likes it; and there are plenty of plants and animals, especially insects, around to entertain and surprise him as they always have.

For his outstanding achievements, for his vital part in our Society for almost 50 years, and for being such a helpful and generous colleague, we salute Hugh B. Leech—a Curator's Curator!

Acknowledgments

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Leech, H. B., and H. P. Chandler. 1956. Aquatic Coleoptera (Chapter 13). Pp. 293–371, figs. 13.1–13.67. *In* Usinger, R. L., Aquatic insects of California, with keys to North American genera and species. University of California Press, Berkeley and Los Angeles, x + 508 pp.

Appendix A

Bibliography of the Entomological Publications of Hugh Bosdin Leech (through 1977)

This bibliography lists all known, published, entomological contributions by Hugh B. Leech in chronological order. It has been compiled from a handwritten manuscript list that was loaned by Leech to the Department of Entomology. We have edited the Leech manuscript extensively, added some titles, and modified others to a consistent style. All items have been checked against the originals except for item 84 (which was not available to us). Untitled notes presented in the Proceedings of the Pacific Coast Entomological Society (PCES) and in other publications are provided with titles cited within brackets. Some bracketed titles cited from the Proceedings of the PCES are quoted from E. Gorton Linsley's "Fifty Years of The Pan-Pacific Entomologist" (Pan-Pac. Entomol., 50(4):309–415), while others are original.

We list remarks and notes presented by Leech at meetings of the PCES and published in the Proceedings of this Society under his authorship, because we feel that this information should be attributed to him, even though it appears in minutes signed by successive Society secretaries.

Dates of publication are given at the end of individual numbered entries when such data were cited in the Leech manuscript.

1930

1. Notes on *Phymatodes vulneratus* LeC. with a new host record (Coleoptera, Cerambycidae). Can. Entomol., 62(9):191–192. Published September 27.

1931

2. Notes on new methods of collecting beetles. Proc. Entomol. Soc. B.C., (1930), 27:11–12. Published March 21.
3. Coleoptera by "smoking" stumps. Bull. Brooklyn Entomol. Soc., 26(1):12. Published April 2.
4. *Drosophila funebris* as a host of the fungus *Stigmatomyces*. Proc. Entomol. Soc. B.C., 28:19–20. Published Fall of 1931, probably November.

1934

5. Almost a cannibal. Bull. Brooklyn Entomol. Soc., 29(1):41. Published February 17.

1935

6. The family history of *Nicrophorus conversator* Walker. Proc. Entomol. Soc. B.C., (1934), 31:36–40. Published February 23.
7. An occurrence of *Trichocera garretti* Alex. and a larval predator (Diptera[,] Trichoceridae and Coleoptera, Staphylinidae). Can. Entomol., 67(8):182–183. Published August 31.
8. British Columbian records of Carabidae and Hydrophilidae (Coleoptera). Pan-Pac. Entomol., 11(3):120–124. Published October 8.

1936

9. A rare *Aphodius*. Bull. Brooklyn Entomol. Soc., 31(2):56. Published April 16.
10. (by G. R. Hopping and H. B. Leech). Sawfly biologies. 1. *Neodiprion tsugae* Middleton. Can. Entomol., 68(4):71–79, pls. 4–5. Published May 9.
11. [*Bessa selecta* possible parasite of larch sawfly]. Can. Insect Pest Rev., 14(2):99.

1937

12. Correction. Proc. Entomol. Soc. B.C., (1936), 33:34. Published February 27.
13. [Insects (or near relatives) of economic importance recently noted in British Columbia]. Orthoptera: *Periplaneta australasiae* (Fabr.). Proc. Entomol. Soc. B.C., (1936), 33:46. Published February 27.
14. (by G. R. Hopping and H. B. Leech). [Insects (or near relatives) of economic importance recently noted in British Columbia]. Hymenoptera: *Mesoleius tenthredinis* Morley. Proc. Entomol. Soc. B.C., (1936), 33:47. Published February 27.
15. A new North American *Agabus,* with notes on other species. (Coleoptera: Dytiscidae). Can. Entomol., 69(7):146–150, figs. 1–4. Published July 31.
16. Notes on certain names in use in the *vespilloides* group of *Nicrophorus* Fab. (Coleoptera: Silphidae). Bull. Brooklyn Entomol. Soc., 32(4):156–159. Published October 7.

1938

17. A new species of *Gyrinus,* with a note on *Dineutus robertsi* Leng. (Coleoptera, Gyrinidae). Can. Entomol., 70(3):59–61. Published April 2.
18. Hibernation of the cerambycid *Plectrura spinicauda* Mann. Pan-Pac. Entomol., 14(2):69. Published June 13.

19. A new species of *Coelambus* from California (Coleoptera: Dytiscidae). Pan-Pac. Entomol., 14(2):84–86. Published June 13.
20. Descriptions of three new species of *Agabus* from Hudson Bay. (Coleoptera: Dytiscidae). Can. Entomol., 70(6):123–127, figs. 1–4. Published July 2.

1939

21. (by Ralph Hopping and H. B. Leech). Summary report of British Columbia section. Ann. Rep. Forest Insect Surv., 1938:10–11.
22. On some Nearctic species of *Agabus,* with the description of a new species. (Coleoptera: Dytiscidae). Can. Entomol., 71(10):217–221, figs. A–C. Published November 3.
23. Three new species of Nearctic rove beetles from the Pacific Coast (Coleoptera, Staphylinidae). Can. Entomol., 71(12):258–261, figs. 1–3. Published December 30.

1940

24. *Dineutus* in California (Coleoptera, Gyrinidae). Pan-Pac. Entomol., 16(2):74. Published May 23.
25. Description of a new species of *Laccornis,* with a key to the Nearctic species (Coleoptera, Dytiscidae). Can. Entomol., 72(6):122–128, pl. 8. Published June 29.

1941

26. Note on the species of *Agabinus* (Coleoptera, Dytiscidae). Can. Entomol., 73(3):53. Published April 5.
27. The species of *Matus,* a genus of carnivorous water-beetles (Coleoptera, Dytiscidae). Can. Entomol., 73(4):77–83, figs. 1–8 on pl. 6. Published May 31.
28. Collecting of the rare water beetle *Laccornis difformis* (LeC.) by the late Ch. Roberts. Can. Entomol., 73(4):96. Published May 31.
29. The male of *Hydroporus coelamboides.* Can. Entomol., 73(4):96. Published May 31.
30. Descriptions of two new species of water beetles of the genus *Hydroporus* from California (Coleoptera, Dytiscidae). Pan-Pac. Entomol., 17(3):129–132, figs. 1–9. Published July 31.
31. The generic name *Thermonectus* Dejean (Coleoptera, Dytiscidae). Can. Entomol., 73(11):197. Published December 5.
32. [Book review]. British water beetles. Ann. Entomol. Soc. Amer., 34(4):808. Published December 19.
33. The dates of publication of two articles on Coleoptera by John L.

LeConte, issued in 1845. Entomol. News, 52(10):290–291. Published December 30.

1942

34. [Obituary]. Ralph Hopping (1868–1941). Proc. Entomol. Soc. B.C., (1941), 38:2–4, 1 pl. Published February 7.
35. [Announcement of the deaths of Ralph Hopping and F. C. Hennessey]. Entomol. News, 53(2):60. (data supplied by H. B. Leech).
36. The dates of publication of certain numbers of the Proceedings of the Entomological Society of British Columbia. Proc. Entomol. Soc. B.C., (1941), 38:29–36. Published February 7.
37. Mandibular shapes in water beetles of the genus *Thermonectus* (Coleoptera, Dytiscidae). Can. Entomol., 74(3):56, figs. 1–2. Published March 31.
38. Dimorphism in the flying wings of a species of water beetle, *Agabus bifarius* (Kirby) (Coleoptera: Dytiscidae). Ann. Entomol. Soc. Amer., 35(1):76–80, figs. 1–3. Published April 21.
39. Female mutillids eating butter. Pan-Pac. Entomol., 18(2):89. Published April 29.
40. New or insufficiently known Nearctic species and subspecies of *Agabus* (Coleoptera, Dytiscidae). Can. Entomol., 74(7):125–136, pl. 10. Published August 26.
41. Key to the Nearctic genera of water beetles of the tribe Agabini, with some generic synonymy (Coleoptera: Dytiscidae). Ann. Entomol. Soc. Amer., 35(3):355–362, pl. 1. Published September 30.
42. *Agabus ontarionis* Fall. Proc. Entomol. Soc. B.C., 39:22. Published October 10.
43. *Hemichroa crocea* (Fourcroy). Proc. Entomol. Soc. B.C., 39:35. Published October 10.
44. *Gyrinus pectoralis* LeConte. Proc. Entomol. Soc. B.C., 39:35. Published October 10.
45. Dr. F. Guignot's synonymy of *Agabus dispositus* Guignot (Coleoptera: Dytiscidae). Can. Entomol., 74(10):194. Published November 18.

1943

46. Fall flight of Bruce's measuring worm, *Operophtera bruceata* Hulst. (Lepidoptera, Geometridae). Can. Entomol., 75(1):20. Published February 18.
47. Black flour beetle, *Tribolium madens* Charp., in British Columbia (Coleoptera, Tenebrionidae). Can. Entomol., 75(2):40. Published March 10.

48. *Berosus exilis* LeConte a *Hemiosus* (Coleoptera, Hydrophilidae). Pan-Pac. Entomol., 19(2):61–62. Published May 22.
49. Further note on *Thermonectus* (Coleoptera, Dytiscidae). Can. Entomol., 75(8):145. Published September 17.
50. *Culicoides gigas* R. & H. at Vernon, B.C. (Diptera: Ceratopogonidae). Proc. Entomol. Soc. B.C., 40:23. Published September 20.
51. *Marathyssa inficita* Walker at Oliver, B.C. (Lepidoptera: Phalaenidae). Proc. Entomol. Soc. B.C., 40:25. Published September 20.
52. Miscellaneous records of beetles in British Columbia (Coleoptera: Hydrophilidae, Elateridae, Buprestidae, Lathridiidae, Chrysomelidae, Curculionidae). Proc. Entomol. Soc. B.C., 40:26–27. Published September 20.
53. *Tropisternus paredesi,* neuvo coleoptero acuatico palpicornio de Nayarit, Mexico (Coleoptera, Hydrophylidae [sic!]). Rev. Soc. Mex. Hist. Nat., 4(1–2):17–20, figs. 1–6.
54. (by G. R. Hopping, H. B. Leech, W. G. Mathers, and C. V. G. Morgan). [The larch sawfly in the Okanagan Valley and Trinity Valley district, British Columbia]. Can. Insect Pest Rev., 21(2):258.
55. (by W. G. Mathers, H. B. Leech, and C. V. G. Morgan). [Parasitism of the larch sawfly by *Mesoleius* and *Tritneptis* in British Columbia]. Can. Insect Pest Rev., 21(2):258.
56. (by Geo. R. Hopping, H. B. Leech, and Cecil V. G. Morgan). The larch sawfly, *Pristiphora erichsonii* (Hartig) in British Columbia, with special reference to the cocoon parasites *Mesoleius tenthredinis* Morley and *Tritneptis klugii* (Ratzeburg). Sci. Agric., 24(2):53–63, fig. 1.

1944

57. List of six species of gyrinid water beetles collected by J. L. Gressitt in China and Japan. (Coleoptera, Gyrinidae). Pan-Pac. Entomol., 20(1):22. Published January 31.
58. Spring flight of *Atimia dorsalis* (Coleoptera, Cerambycidae). Pan-Pac. Entomol., 20(1):30. Published January 31.
59. *Laccophilus shermani,* a new species of water beetle from Arizona and Texas (Coleoptera: Dytiscidae). Entomol. News, 55(1):4–6.
60. The cerambycid beetle, *Phymatodes dimidiatus,* in cedar structural timbers. Can. Entomol., 76(10):211. Published November 10.
61. Death of Gustaf Falkenström. Can. Entomol., 76(10):211. Published November 10.
62. [Recent literature]. Stoneflies of southwestern British Columbia, by

William E. Ricker; British Columbia dragonflies with notes on distribution and habits, by F. C. Whitehouse; The caddis flies, or Trichoptera, of Illinois, by Herbet [sic!] H. Ross; Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera), by Charles Duncan Michener; British Columbia Provincial Museum, Handbook Series. Proc. Entomol. Soc. B.C., 41:front cover verso. Published December 8.

63. Corrections, vols. 38 & 40. Proc. Entomol. Soc. B.C., 41:front cover verso. Published December 8. (unsigned note).
64. Virtual absence of vespine wasps in the summer of 1944 (Hymenoptera, Vespidae). Proc. Entomol. Soc. B.C., 41:4. Published December 8.
65. Note on *Dalopius tristis* and *D. insulanus* (Coleoptera, Elateridae). Proc. Entomol. Soc. B.C., 41:25. Published December 8.
66. *Eucorethra underwoodi* at Summerland, B.C. (Diptera: Culicidae). Proc. Entomol. Soc. B.C., 41:36. Published December 8.
67. The flea beetle *Orestioides robusta* in British Columbia (Coleoptera: Chrysomelidae). Proc. Entomol. Soc. B.C., 41:36. Published December 8.
68. *Campylenchia latipes* on aster (Homoptera: Membracidae). Proc. Entomol. Soc. B.C., 41:36. Published December 8.
69. The bug *Corythucha padi* on bracken fern. (Hemiptera: Tingidae). Proc. Entomol. Soc. B.C., 41:36. Published December 8.
70. Summary report of Forest Insect Survey, British Columbia and western Alberta. Ann. Rep. Forest Insect Surv., Forest Insect Invest., 1943:62–68. Received by mail at Vernon, B.C., January 17, 1945.

1945

71. A few additions and corrections to R. E. Blackwelder's "Checklist of the coleopterous insects of Mexico, Central America, the West Indies, and South America. Part I." Entomol. News, (1944), 55(10):266–268. Published January 25.
72. On three species of *Agabus* recorded from the State of Montana (Coleoptera, Dytiscidae). Pan-Pac. Entomol., 21(1):16.
73. The specific characters and distribution of *Agabus vancouverensis* and *A. hypomelas* (Coleoptera, Dytiscidae). Can. Entomol., 77(5):77–78. Published September 10.
74. Three new species of Nearctic *Deronectes* (Coleoptera, Dytiscidae). Can. Entomol., 77(6):105–110, figs. 1–4. Published November 2.

75. Summary report of the Forest Insect Survey, British Columbia and Rocky Mountain National Parks. Ann. Rep. Forest Insect Surv., Forest Insect Invest., 1944:62–70. Published in November.
76. [Recent literature]. An annotated list of the Scolytoidea of Washington, by Gordon K. Patterson and Melville H. Hatch; Field crop insects in the Prairie Provinces, Bulletin No. 5, published by Line Elevators Farm Service; A source-book of biological names and terms, by Edmund C. Jaeger; Checklist of the coleopterous insects of Mexico, Central America, the West Indies and South America, by Richard E. Blackwelder. Proc. Entomol. Soc. B.C., 42:front cover verso. Published December 8. (unsigned book reviews).
77. *Eros thoracicus* in British Columbia (Coleoptera: Lycidae). Proc. Entomol. Soc. B.C., 42:2. Published December 8.
78. *Aphodius alternatus* in British Columbia (Coleoptera: Scarabaeidae). Proc. Entomol. Soc. B.C., 42:2. Published December 8.
79. British Columbia and Alberta records in E. C. Lerch's "A list of Homoptera from Ontario." Proc. Entomol. Soc. B.C., 42:8. Published December 8.
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227. Earliest record of *Carabus nemoralis* in San Francisco, California. Coleopt. Bull., 13(4):98. Published December 30.

1960

228. [Report on a recent winter collecting trip to the Cape region of Baja California, Mexico]. *In* Proc. Pac. Coast Entomol. Soc., 263rd meeting. Pan-Pac. Entomol., 36(1):42–44. Published March 18.
229. [*Cuterebra latifrons* Coquillett]. *In* Proc. Pac. Coast Entomol. Soc., 263rd meeting. Pan-Pac. Entomol., 36(1):41. Published March 18.
230. [Photography of *Metriona bicolor* (Fabricius)]. *In* Proc. Pac. Coast Entomol. Soc., 264th meeting. Pan-Pac. Entomol., 36(1):46. Published March 18.
231. [Loan of W. H. Edward's letters]. *In* Proc. Pac. Coast Entomol. Soc., 267th meeting. Pan-Pac. Entomol., 36(1):51. Published March 18.
232. [Correspondence files of E. R. Leach and Owen Bryant]. *In* Proc. Pac. Coast Entomol. Soc., 267th meeting. Pan-Pac. Entomol., 36(1):51. Published March 18.
233. [Visit with The Rev. Edward Guedet]. *In* Proc. Pac. Coast Entomol. Soc., 267th meeting. Pan-Pac. Entomol., 36(1):51. Published March 18.
234. [Prediction by Owen Bryant of mercury vapor lights as best insect attractant light]. *In* Proc. Pac. Coast Entomol. Soc., 267th meeting. Pan-Pac. Entomol., 36(1):51. Published March 18.
235. [Recent literature]. The Galápagos Islands, a history of their exploration, by Joseph Richard Slevin. Pan-Pac. Entomol., 36(2):68. Published June 15. (unsigned listing).
236. [Recent literature]. The Scolytoidea of the Northwest. Oregon, Washington, Idaho and British Columbia, by W. J. Chamberlin. Pan-Pac. Entomol., 36(2):74. Published June 15. (unsigned listing).
237. [Recent literature]. Obligatory and facultative insects in rose hips: their recognition and bionomics, by W. V. Balduf. Pan-Pac. Entomol., 36(2):98. Published June 15. (unsigned listing).
238. [Recent literature]. Cynipid galls of the Pacific Slope (Hymenoptera: Cynipoidea), an aid to their identification, by Lewis H. Weld. Pan-Pac. Entomol., 36(2):104. Published June 15. (unsigned listing).
239. [Book review]. The beetles of the Pacific Northwest. Part II: Staphyliniformia, by Melville H. Hatch, with the collaboration of Milton W. Sanderson and Gordon Marsh. Pan-Pac. Entomol., 36(3):141–142. Published August 9.

1961

240. [Recently published]. [Four titles of publications listed]. Pan-Pac. Entomol., 37(1):52. Published March 24. (unsigned listing).

241. [Book notice]. Dictionary of word roots and combining forms. Compiled from the Greek, Latin, and other languages, with special reference to biological terms and scientific names. By Donald J. Borror. Pan-Pac. Entomol., 37(1):52. Published March 24.
242. [Collecting trips by Borys Malkin and P. D. Hurd, Jr.]. *In* Proc. Pac. Coast Entomol. Soc., 269th meeting. Pan-Pac. Entomol., 37(1):61–62. Published March 24.
243. [Exhibition of two books]. *In* Proc. Pac. Coast Entomol. Soc., 271st meeting. Pan-Pac. Entomol., 37(1):64. Published March 24.
244. [Set of *Entomological Newsletter* donated to Historical files]. *In* Proc. Pac. Coast Entomol. Soc., 272nd meeting. Pan-Pac. Entomol., 37(1):65. Published March 24.
245. Note on two editions of J. C. Bradley's 1919 paper "An entomological cross-section of the United States." Pan-Pac. Entomol., 37(2):84. Published June 14.
246. [Book notice]. Forest and shade tree entomology. By Roger F. Anderson. Pan-Pac. Entomol., 37(2):143–144. Published June 14.
247. (by H. B. Leech and Joe Schuh). *Graphoderus perplexus* (Sharp) in California (Coleoptera: Dytiscidae). Pan-Pac. Entomol., 37(4):234. Published November 7.

1962

248. [Book notices]. The Aphidoidea of the Middle East, by F. S. Bodenheimer and E. Swirski; Check-list and bibliography on the occurrence of insects in birds' nests, by E. A. Hicks; Wonder-workers of the insect world, by H. J. Herbert, foreword by Lucy W. Clausen. Pan-Pac. Entomol., 38(1):28. Published March 28.
249. [Book notices]. A monograph of the immature stages of Neotropical timber beetles (Cerambycidae), by E. A. J. Duffy; Mites or the Acari, by T. E. Hughes. Pan-Pac. Entomol., 38(1):39–40. Published March 28.
250. [Recent literature]. [List of five items published in the *University of California Publications in Entomology,* 1958–1961]. Pan-Pac. Entomol., 38(1):43. Published March 28.
251. [Recent literature]. [Two publications listed]. Pan-Pac. Entomol., 38(1):48. Published March 28.
252. [Book notice]. Modern insecticides and world food production. By F. A. Gunther and L. R. Jeppson. Pan-Pac. Entomol., 38(1):55. Published March 28.
253. [Book notice]. Bionomics, systematics, and phylogeny of *Lytta,* a genus of blister beetles (Coleoptera, Meloidae). By R. B. Selander. Pan-Pac. Entomol., 38(1):62. Published March 28.
254. [Book notices]. Insect migration, by C. B. Williams; Collecting, pre-

serving and studying insects, by Harold Oldroyd. Pan-Pac. Entomol., 38(1):62. Published March 28.

255. [Exhibition of two new books]. *In* Proc. Pac. Coast Entomol. Soc., 273rd meeting. Pan-Pac. Entomol., 38(1):65. Published March 28.
256. [Science Fair judging]. *In* Proc. Pac. Coast Entomol. Soc., 274th meeting. Pan-Pac. Entomol., 38(1):66. Published March 28.
257. [Book notice]. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska. Part 2. By Carl H. Lindroth. Pan-Pac. Entomol., 38(1):73–74. Published March 28.
258. [Book review]. A manual of common beetles of eastern North America. By Elizabeth S. and Lawrence S. Dillon. Pan-Pac. Entomol., 38(2):112–115. Published June 29th.
259. [Discovery in books]. Soil animals. By D. Keith McE. Kevan. Pac. Discovery, 15(4):31. Published June 29.
260. [Discovery in books]. Pacific Insects. Official organ of the program "Zoogeography and Evolution of Pacific Insects," published by the Department of Entomology, Bernice P. Bishop Museum, Honolulu. Pac. Discovery, 15(5):31. Published August 28.
261. Live *Buprestis aurulenta* in boards of a house built in 1923 (Coleoptera: Buprestidae). Pan-Pac. Entomol., 38(3):159–161, figs. 1–3. Published September 27.
262. [Book notice]. The Cerambycidae of North America. Parts I–III. By E. Gorton Linsley. Pan-Pac. Entomol., 38(4):214. Published December 28.
263. [Book notice]. The Anobiidae of Ohio (Coleoptera). By Richard E. White. Pan-Pac. Entomol., 38(4):214. Published December 28.

1963

264. [Discovery in books]. The strange lives of familiar insects. By Edwin Way Teale. Pac. Discovery, 16(1):32. Published January 9.
265. [Recent literature]. Biological characteristics of the mutillid subgenus *Photopsis* Blake and their systematic values (Hymenoptera), by William E. Ferguson; A revisional study of the bees of the genus *Perdita* F. Smith, with special reference to the fauna of the Pacific Coast, (Hymenoptera, Apoidea), Part V, by P. H. Timberlake. Pan-Pac. Entomol., 39(1):18. Published March 29.
266. [Book notice]. Revision des hydrocanthares d'Afrique (Coleoptera Dytiscoidea). By Félix Guignot. Pan-Pac. Entomol., 39(1):18. Published March 29.
267. [Notice of the death of Gordon Stace Smith]. *In* Proc. Pac. Coast Entomol. Soc., 278th meeting. Pan-Pac. Entomol., 39(1):59. Published March 29.

268. [Notice of the death of Mrs. Ralph Hopping]. *In* Proc. Pac. Coast Entomol. Soc., 281st meeting. Pan-Pac. Entomol., 39(1):62. Published March 29.
269. [Collection of beetles received from Burdette E. White]. *In* Proc. Pac. Coast Entomol. Soc., 281st meeting. Pan-Pac. Entomol., 39(1):62. Published March 29.
270. [Notice of the death of Georg Pronin]. *In* Proc. Pac. Coast Entomol. Soc., 282nd meeting. Pan-Pac. Entomol., 39(1):63. Published March 29.
271. *Centrodera spurca* (LeConte) and two new species resembling it, with biological and other notes (Coleoptera: Cerambycidae). Proc. Calif. Acad. Sci., (G Dallas Hanna Anniversary Volume), (4)32(7):149–218, figs. 1–28. Published May 20.

1964

272. [Book notice]. A catalogue of the Nearctic Chalcidoidea (Insecta: Hymenoptera). By Oswald Peck. Pan-Pac. Entomol., 40(1):10. Published March 30.
273. [Book notice]. Insect pathology. An advanced treatise. Volume 1. Edited by Edward A. Steinhaus, with seventeen contributing authors. Pan-Pac. Entomol., 40(1):12. Published March 30.
274. [Recent literature]. [List of four items from the *University of Utah Biological Series*]. Pan-Pac. Entomol., 40(1):20. Published March 30.
275. [Book notice]. Experiments in genetics with *Drosophila*. By Monroe W. Stickberger. Pan-Pac. Entomol., 40(1):32. Published March 30.
276. [Book notice]. A review of the biological control attempts against insects and weeds in Canada. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England. Pan-Pac. Entomol., 40(1):60. Published March 30.
277. A new species of *Agabus* from the Death Valley region of California (Coleoptera: Dytiscidae). Coleopt. Bull., 18(3):79–82, figs. 1–6.
278. [Lawrence W. Saylor collection of scarabaeid beetles now in the California Academy of Sciences]. Acad. Newsletter, 299:[3]. Published late October or early November. (unsigned note).
279. [Acquisition by the California Academy of Sciences of the J. R. Helfer collection of Buprestidae]. Acad. Newsletter, 301:[5]. January, 1965 issue. Published December 24. (unsigned note).

1965

280. [Recent literature]. The skippers of the genus *Hesperia* in western North America with special reference to California (Lepidoptera: Hesperiidae). By C. Don MacNeill. Pan-Pac. Entomol., 41(1):29. Published March 4.

281. [Recent literature]. The ecology and morphology of *Thinobius frizzelli* Hatch, an intertidal beetle, by Trevor Kincaid; The staphylinid genera *Pontomalota* and *Thinusa,* by Trevor Kincaid. Pan-Pac. Entomol., 41(1):53. Published March 4.
282. *Haliplus subguttatus* Roberts from Washington and Oregon (Coleoptera: Haliplidae). Wasmann J. Biol., 22(2):323–329, figs. 1–4. Published May 24.
283. [Recent literature]. The Cerambycidae of North America. Part IV, Taxonomy and classification of the subfamily Cerambycinae, tribes Elaphidionini through Rhinotragini; Part V, Taxonomy and classification of the subfamily Cerambycinae, tribes Callichromini through Ancylocerini; by E. Gorton Linsley. Pan-Pac. Entomol., 41(2):113. Published June 11.

1966

284. [Recent literature]. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska. Part 3. By Carl H. Lindroth. Pan-Pac. Entomol., 42(1):24. Published March 3.
285. (by John L. Carr and H. B. Leech). The rediscovery of *Agabus audeni* Wallis, and a note on *Agabus coxalis* Sharp (Coleoptera: Dytiscidae). Can. Entomol., 98(5):544–550, figs. 1–18. Published in May.
286. *Ochthebius bruesi* Darlington in California and Utah (Coleoptera: Hydraenidae). Pan-Pac. Entomol., 42(2):137–139, figs. 1–3. Published June 14.
287. [Book notice]. Index Litteraturae Entomologicae, Series II: Die Welt-Literatur über die gesamte Entomologie von 1864 bis 1900. Band I, A–E. Von Walter Derksen und Ursula Scheiding. Pan-Pac. Entomol., 42(2):155. Published June 14.
288. Descriptions of the larva and pupa of *Necydalis cavipennis* LeConte and the pupa of *Ortholeptura insignis* Fall (Coleoptera: Cerambycidae). Occas. Pap. Calif. Acad. Sci., 57, 13 pp., figs. 1–13. Published June 30.
289. The *pedalis*-group of *Hygrotus,* with descriptions of two new species and a key to the species (Coleoptera: Dytiscidae). Proc. Calif. Acad. Sci., (4)33(15):481–498, figs. 1–14, pl. 1 (colored). Published July 8.
290. A note on two editions of S. S. Haldeman's descriptions of insects in the Stansbury Report (Lepidoptera, Hymenoptera, Hemiptera (s. lat.), Orthoptera, Coleoptera). Pan-Pac. Entomol., 42(3):208–210, figs. 1–2. Published August 30.
291. A British Columbia record for *Xenos peckii* Kirby. J. Entomol. Soc. B.C., 63:40. Published December 1.
292. Were they hydrophilids? (Coleoptera). Coleopt. Bull., 20(4):128. Published December 22.

1967

293. Georg Pronin (1898–1962). J. Lepid. Soc., 21(1):74–76. Published February 21.
294. The cicadellid *Parabolocratus viridis* attended by the ant *Formica* (*F.*) *altipetens* (Homoptera: Cicadellidae and Hymenoptera: Formicidae). Wasmann J. Biol., 24(2):279–280. Published in March.
295. Historical material. *In* Proc. Pac. Coast Entomol. Soc., 306th meeting. Pan-Pac. Entomol., 43(1):93. Published April 11.
296. [Book review]. The beetles of the Pacific Northwest. Part IV: Macrodactyles, Palpicornes, and Heteromera. By Melville H. Hatch and collaborators. Quart. Rev. Biol., 42(1):70. Issue for March.
297. (by H. B. Leech and Perez Simmons). Roy Seymour Wagner, 9 November 1895–15 October 1958. Pan-Pac. Entomol., 43(2):134–136, 1 fig. Published July 14.
298. (by H. B. Leech and G. A. Sugden). *Solenobia triquetrella* Hübner, a flightless parthenogenetic moth, in British Columbia (Lepidoptera: Psychidae). J. Entomol. Soc. B.C., 64:56–59, figs. 1–6. Published August 1.

1968

299. [Recent literature]. Facsimile editions of standard works.—A history of entomology, by E. O. Essig; A textbook of arthropod anatomy, by R. E. Snodgrass; Handbook of the mosquitoes of North America, by Robert Mathewson. Pan-Pac. Entomol. (1967), 43(4):273. Published February 28.
300. [Recent literature]. A classification of the large carpenter bees (Xylocopini) (Hymenoptera: Apoidea). By Paul D. Hurd, Jr., and J. S. Moure, C.M.F. Pan-Pac. Entomol., 44(1):68. Published June 28.
301. [Announcement of the death of Father Edward F. Guedet, and the illness of Dr. F. X. Williams]. *In* Proc. Pac. Coast Entomol. Soc., 313th meeting. Pan-Pac. Entomol., 44(1):80. Published June 28.
302. Distribution of the cerambycid beetle *Ergates pauper* Linsley. *In* Proc. Pac. Coast Entomol. Soc., 315th meeting. Pan-Pac. Entomol., 44(1):86. Published June 28.
303. [Recent literature]. Comparative behaviour of bees of Onagraceae.—I. *Oenothera* bees of the Colorado Desert, II. *Oenothera* bees of the Great Basin, III. *Oenothera* bees of the Mohave Desert, California, by E. G. Linsley, J. W. MacSwain, and P. H. Raven; The genus *Baris* Germar in California (Coleoptera, Curculionidae), by Edward E. Gilbert. Pan-Pac. Entomol., 44(1):86. Published June 28.
304. John Wagener Green—September 18 [sic!], 1889–June 20, 1968. The Casual Crier [Calif. Acad. Sci., Mimeograph], 2(1):2. Published July 1.

1969

305. John Wagener Green (September 25, 1889–June 20, 1968). Entomol. News, 79(10):284.

1970

306. *Copelatus glyphicus* (Say) and *Suphisellus bicolor* (Say), water beetles new to California and presumably introduced (Coleoptera: Dytiscidae and Noteridae). Proc. Calif. Acad. Sci., (4)37(6):237–247, figs. 1–8. Published March 6.
307. [Slides and comments on a common lampyrid beetle and of Mr. Jack Balfour-Browne]. *In* Proc. Pac. Coast Entomol. Soc., 324th meeting. Pan-Pac. Entomol., 46(1):67. Published March 19.
308. [Gift of photographs to historical files by Mrs. Roxana Ferris]. *In* Proc. Pac. Coast Entomol. Soc., 329th meeting. Pan-Pac. Entomol., 46(1):71. Published March 19.
309. *Gnophaela latipennis* trapped by flowers of milkweed (Lepidoptera: Pericopidae). *In* Proc. Pac. Coast Entomol. Soc., 329th meeting. Pan-Pac. Entomol., 46(1):71–72. Published March 19.
310. [Two recently published books]. *In* Proc. Pac. Coast Entomol. Soc., 330th meeting. Pan-Pac. Entomol., 46(1):73–74. Published March 19.
311. Grooved entomology. *In* Proc. Pac. Coast Entomol. Soc., 331st meeting. Pan-Pac. Entomol., 46(1):76–77. Published March 19.
312. [Acquisition to historical files of over 1,000 glass lantern slides from Stanford University]. *In* Proc. Pac. Coast Entomol. Soc., 331st meeting. Pan-Pac. Entomol., 46(1):78. Published March 19.
313. The aegeriid *Ramosia fragariae* in a flight trap, and the interpretation thereof. J. Lepid. Soc., 24(3):189. Published August 3.
314. Vasco M. Tanner—A lifetime with beetles. Great Basin Natur., 30(4):213–215. Published December 31.

1971

315. Flight from the surface of water and skimming: beetles, with comments on bugs and flies (Coleoptera, Heteroptera, Diptera). Wasmann J. Biol., (1970), 28(2):237–244. Published in January.
316. [Two new publications]. *In* Proc. Pac. Coast Entomol. Soc., 333rd meeting. Pan-Pac. Entomol., 47(1):72. Published April 13.
317. [Valuable material received for the society archives]. *In* Proc. Pac. Coast Entomol. Soc., 337th meeting. Pan-Pac. Entomol., 47(1):78. Published April 13.
318. [Book review]. The Kodiak Island refugium, its geology, flora, fauna and history. Thor N. V. Karlstrom and George E. Ball, editors. Pan-Pac. Entomol., 47(1):83. Published April 13.

319. [Book review]. Directory of Coleoptera collections of North America (Canada through Panama). Written, compiled and edited by Ross H. Arnett, Jr., and G. Allan Samuelson, assisted by Gerard E. Flory, Edward C. Mignot, C. Dietrich Schaaf, Eric H. Smith. Pan-Pac. Entomol., 47(2):100. Published June 8.
320. [Book notice]. Gall midges of economic importance. Vol. VIII. Gall midges—Miscellaneous. By W. Nijveldt. Pan-Pac. Entomol., 47(2):116. Published June 8.
321. [Book notices]. [Four facsimile printings of standard works]. Pan-Pac. Entomol., 47(2):122. Published June 8.
322. [Book review]. An English-Classical dictionary for the use of taxonomists. Compiled by Robert S. Woods. Pan-Pac. Entomol., 47(2):126. Published June 8.
323. [Book review]. The comparative anatomy of the male genital tube in Coleoptera. 1969 reprint without change. By David Sharp and Frederick A. G. Muir. Pan-Pac. Entomol., 47(2):145. Published June 8.
324. [Discovery in books]. The natural history of Mendocino. By Jacques R. Helfer. Pac. Discovery, 24(4):32. Published June 17.
325. (by H. B. Leech and Ian Moore). Nearctic records of flights of *Cafius* and some related beetles at the seashore (Coleoptera: Staphylinidae and Hydrophilidae). Wasmann J. Biol., 29(1):65–70, fig. 1. Published June 23.
326. [Book notice]. Ecology, behavior, and adult anatomy of the *albida* group of the genus *Epicauta* (Coleoptera, Meloidae). By Richard B. Selander and Juan M. Mathieu. Pan-Pac. Entomol., 47(3):183. Published September 21.
327. [Book notice]. The natural history of Mendocino. By Jacques R. Helfer. Pan-Pac. Entomol., 47(3):214. Published September 21.
328. [Book notice]. The new field book of freshwater life. By Elsie B. Klots, drawings by Suzan Noquchi [sic!] Swain. Pan-Pac. Entomol., 47(3):219. Published September 21.
329. [Book notice]. Introduction to zoology. By Theodore H. Savory. Pan-Pac. Entomol., 47(3):242. Published September 21.
330. [Book notice]. The pocket encyclopaedia of plant galls in colour. By Arnold Darlington. Pan-Pac. Entomol., 47(3):243. Published September 21.
331. [Book notice]. Beetles. Written and illustrated by Wilfrid S. Bronson. Pan-Pac. Entomol., 47(3):243. Published September 21.
332. [Book notice]. The bionomics of blister beetles of the genus *Meloe* and a classification of the New World species. By John D. Pinto and Richard B. Selander. Pan-Pac. Entomol., 47(3):243. Published September 21.

333. [Book notice]. Practical entomology. A guide to collecting butterflies, moths and other insects. By R. E. L. Ford. Pan-Pac. Entomol., 47(3):244. Published September 21.
334. [Book notice]. The distributional history of the biota of the Southern Appalachians. Part I: Invertebrates. Edited by Perry C. Holt, with the assistance of Richard L. Hoffman and C. Willard Hart, Jr. Pan-Pac. Entomol., 47(3):244. Published September 21.

1972

335. F. C. Hottes, 1899–1970. *In* Proc. Pac. Coast Entomol. Soc., 338th meeting. Pan-Pac. Entomol., 48(1):67. Published May 5.
336. Death of E. R. Leach. *In* Proc. Pac. Coast Entomol. Soc., 341st meeting. Pan-Pac. Entomol., 48(1):74. Published May 5.
337. On the photocopying of entomological literature. *In* Proc. Pac. Coast Entomol. Soc., 342nd meeting. Pan-Pac. Entomol., 48(1):76. Published May 5.
338. The Australian sod fly *Altermetoponia rubriceps* (Macquart) in Marin County, California. *In* Proc. Pac. Coast Entomol. Soc., 342nd meeting. Pan-Pac. Entomol., 48(1):76–77. Published May 5.
339. [Items received for historical files in 1971]. *In* Proc. Pac. Coast Entomol. Soc., 343rd meeting. Pan-Pac. Entomol., 48(1):78.

1973

340. [Observations based on the Society's biographical forms]. *In* Proc. Pac. Coast Entomol. Soc., 349th meeting. Pan-Pac. Entomol., 49(1):92.
341. [Book review]. Monografia da tribo Ibidionini (Coleoptera, Cerambycinae). Partes I–VI. By Ubirajara R. Martins. Pan-Pac. Entomol., 49(2):101. Published July 11.
342. (by Marius S. Wasbauer and H. B. Leech). A biological note on two species of *Ageniella* from California (Hymenoptera: Pompilidae). Pan-Pac. Entomol., 49(2):182–183. Published July 11.
343. [Book review]. American entomologists. By Arnold Mallis. Pan-Pac. Entomol., 49(3):281–282. Published October 19.
344. [Book review]. Monographie der Familie Platypodidae Coleoptera. By Karl E. Schedl. Pan-Pac. Entomol., 49(3):282–283. Published October 19.

1975

345. [Book notice]. The biology of *Tribolium* with special emphasis on genetic aspects. By A. Sokoloff. Pan-Pac. Entomol., 51(1):48. Published June 12.

1977

346. [Apparent resistance of some tenebrionid beetles to cyanide]. *In* Proc. Pac. Coast Entomol. Soc., 375th meeting. Pan-Pac. Entomol., 53(1):77.

Appendix B

New Taxa of Coleoptera Proposed by Hugh B. Leech

ADEPHAGA

Family Haliplidae

Haliplus leechi subsp. *carteri,* 1949, Can. Entomol., (1948), 80(1–12):90. T-D: Prince Rupert, British Columbia, Canada, July 8, 1944 (N. Carter). Can. Nat. Collect., Ent. Type No. 5777.

Haliplus stagninus, 1949, Can. Entomol., (1948), 80(1–12):89–90, fig. 1. T-D: Kamloops, British Columbia, Canada, August 1, 1937 (Geo. J. Spencer). Can. Nat. Collect., Ent. Type No. 5776.

Family Dytiscidae

Agabus antennatus, 1939, Can. Entomol., 71(10):217–218. Remarks: *nom. nov.* for *Agabus clavatus* LeConte, 1859 (*nec clavatus* Latreille, 1804).

Agabus browni, 1938, Can. Entomol., 70(6):126–127, fig. 4. T-D: Churchill, Manitoba, Canada, July 1, 1937 (W. J. Brown). Can. Nat. Collect., Ent. Type No. 4356.

Agabus colymbus, 1938, Can. Entomol., 70(6):125–126, figs. 1–2. T-D: Churchill, Manitoba, Canada, June 23, 1937 (W. J. Brown). Can. Nat. Collect., Ent. Type No. 4357.

Agabus hoppingi, 1942, Can. Entomol., 74(7):135, fig. 9. T-D: Gray Meadow, Lot 13, Tulare County, California, U.S.A., July 3, 1913 (Ralph Hopping). Can. Nat. Collect., Ent. Type No. 5354.

Agabus hudsonicus, 1938, Can. Entomol., 70(6):123–124, fig. 3. T-D: Churchill, Manitoba, Canada, July 7, 1937 (W. J. Brown). Can. Nat. Collect., Ent. Type No. 4355.

Agabus lutosus subsp. *mimus,* 1942, Can. Entomol., 74(7):132–133. T-D: Library lily pond on the campus of the University of British Columbia, Vancouver, British Columbia, Canada, January 28, 1931 (Hugh B. Leech). Can. Nat. Collect., Ent. Type No. 5356.

Agabus nectris, 1942, Can. Entomol., 74(7):133–135, fig. 5. T-D: a weedy ditch, Lumby, British Columbia, Canada, September 20, 1939 (Hugh B. Leech). Can. Nat. Collect., Ent. Type No. 5355.

Agabus pandurus, 1942, Can. Entomol., 74(7):128–129, fig. 1. T-D: Eel River, Pepperwood, Humboldt County, California, U.S.A., May 16, 1938 (Hugh B. Leech). Calif. Acad. Sci., Ent. Type No. 5316.

Agabus pisobius, 1950, Wasmann Collect., (1949), 7(6):246–248, fig. 4. T-D: ephemeral pond at an elevation of 2,000 feet, Creston, British Columbia, Canada, March 18, 1947 (Gordon Stace Smith). Calif. Acad. Sci., Ent. Type No. 6153.

Agabus rumppi, 1964, Coleopt. Bull., 18(3):79–80, 82, figs. 1–6. T-D: 2.7 miles east of Death Valley Junction, elevation 2,200 feet, Inyo County, California, U.S.A., May 18, 1958 (Norman L. Rumpp). Calif. Acad. Sci., Ent. Type No. 8815.

Agabus solus, 1950, Wasmann Collect., (1949), 7(6):248–250, fig. 2. T-D: latitude 61°58′N, longitude 141°03′W, elevation 3,200 feet, a pond near Beaver Creek, Alaska, U.S.A., August 27, 1944 (Goef B. Leech). Calif. Acad. Sci., Ent. Type No. 6155.

Agabus vancouverensis, 1937, Can. Entomol., 69(7):146–148, figs. 1–3. T-D: Hollyburn Ridge, 3,000 feet, Vancouver, British Columbia, Canada, June 28, 1931 (Hugh B. Leech). Can. Nat. Collect., Ent. Type No. 4218.

Agabus vandykei, 1942, Can. Entomol., 74(7):129–130. T-D: Yosemite, California, U.S.A., August, 1935 (Edward S. Ross). Calif. Acad. Sci., Ent. Type No. 5317.

Agabus velox, 1939, Can. Entomol., 71(10):219–220, figs. A–C. T-D: Churchill, Manitoba, Canada, August 18, 1937 (W. J. Brown). Can. Nat. Collect., Ent. Type No. 4545.

Bidessus leachi, 1948, Proc. Entomol. Soc. B.C., (1947), 44:11–12, figs. 1, 3. T-D: Mendocino County, California, U.S.A., May 29, 1922 (E. R. Leach). Calif. Acad. Sci., Ent. Type No. 5837.

Bidessus youngi, 1948, Proc. Calif. Acad. Sci., (4)24(11):392–393, fig. 12. T-D: lagoon, twenty miles north of Comondu, Baja California, Mexico, July 23, 1938 (A. E. Michelbacher and Edward S. Ross). Calif. Acad. Sci., Ent. Type No. 5463.

Deronectes dolerosus, 1945, Can. Entomol., 77(6):109–110, fig. 4A–B. T-D: Coalinga, California, U.S.A., March 5, 1937 (Hugh B. Leech). Calif. Acad. Sci., Ent. Type No. 5455.

Deronectes spenceri, 1945, Can. Entomol., 77(6):105–106, fig. 2A–C. T-D: 13 Mile Lake, Dog Creek Road, northwest of Clinton, British Columbia, Canada, October 11, 1943 (Hugh B. Leech and Cecil V. G. Morgan). Can. Nat. Collect., Ent. Type No. 5636.

Deronectes titulus, 1945, Can. Entomol., 77(6):106–108, fig. 3A–B. T-D: Green Valley, Brewster County, Texas, U.S.A., July, 1926 (J. Wagener Green). U.S. Nat. Mus., Ent. Type No. 76878.

Hydroporus bidessoides, 1941, Pan-Pac. Entomol., 17(3):130–132, figs. 7–9. T-D: Caspar, Mendocino County, California, U.S.A., December 16, 1939 (Jacques R. Helfer). Calif. Acad. Sci., Ent. Type No. 4978.

Hydroporus laetus, 1949, Can. Entomol., (1948), 80(1–12):90–92, figs. 2, 10–11. T-D: stream adjacent to Lake Hope, Vinton County, Ohio, U.S.A., August 30, 1945 (W. C. Stehr). Calif. Acad. Sci., Ent. Type No. 5940.

Hydroporus rossi, 1941, Pan-Pac. Entomol., 17(3):129–130, figs. 1-3. T-D: Pigmy Forest, Fort Bragg, Mendocino County, California, U.S.A., May 5, 1938 (Edward S. Ross). Calif. Acad. Sci., Ent. Type No. 4976.

Hydroporus tademus, 1950, Wasmann Collect., (1949), 7(6):243–245. T-D: Vernon, British Columbia, Canada, September 11, 1937 (Hugh B. Leech). Calif. Acad. Sci., Ent. Type No. 6151.

Hygrotus diversipes, 1966, Proc. Calif. Acad. Sci., (4)33(15):482–483, 485–486, figs. 2, 5–6. T-D: 8.5 miles northwest of Midwest, Dugout Creek, Natrona County, Wyoming, U.S.A., July 27, 1964 (Hugh B. Leech). Calif. Acad. Sci., Ent. Type No. 9048.

Hygrotus fontinalis, 1966, Proc. Calif. Acad. Sci., (4)33(15):490–495, figs. 4, 13. T-D: Travertine Hot Springs, 2 miles southeast of Bridgeport, altitude 6,700 feet, Mono County, California, U.S.A., August 11, 1962 (Hugh B. Leech). Calif. Acad. Sci., Ent. Type No. 9049.

Laccophilus shermani, 1944, Entomol. News, 55(1):4–6. T-D: Bear Canyon, Santa Catalina Mountains, Arizona, U.S.A., January 2, 1938 (Edwin C. Van Dyke). Can. Nat. Collect., Ent. Type No. 5553.

Laccornis pacificus, 1940, Can. Entomol., 72(6):123, 125, figs. 4, 6. T-D: stream, Salmon Arm, British Columbia, Canada, May 24, 1937 (Hugh B. Leech). Can. Nat. Collect., Ent. Type No. 5053.

Matus ovatus, 1941, Can. Entomol., 73(5):79, 81–82, figs. 1–2, 6–7. T-D: Lexington, Massachusetts, U.S.A., May 1, 1926 (Darlington; John George Gehring Collection). Mus. Comp. Zool., Ent. Type No. 25257.

Matus ovatus subsp. *blatchleyi,* 1941, Can. Entomol., 73(5):82. T-D: Brighton, Okeechobee, Florida, U.S.A., June 16, 1929 (Darlington; P. J. Darlington Collection). Mus. Comp. Zool., Ent. Type No. 25258.

Family Gyrinidae

Gyrinus hoppingi, 1938, Can. Entomol., 70(3):59–60. T-D: Tributary to Vance Creek, Trinity Valley, British Columbia, Canada, September 17, 1937 (Hugh B. Leech). Can. Nat. Collect., Ent. Type No. 4302.

POLYPHAGA: HYDROPHILOIDEA

Family Hydrophilidae

Anacaena sternalis, 1948, Proc. Calif. Acad. Sci., (4)24(11):447–448. T-D: San José del Cabo, Baja California, Mexico (from collection of Charles W. Leng). Calif. Acad. Sci., Ent. Type No. 8136.

Berosus blechrus, 1948, Wasmann Collect., 7(2):38–40. T-D: Fort Davis, Texas, U.S.A., March 29, 1946 (J. Wagener Green). Calif. Acad. Sci., Ent. Type No. 5911.

Berosus (*Berosus*) *dolerosus,* 1948, Proc. Calif. Acad. Sci., (4)24(11):433–434, fig. 13. T-D: in pool, Rosario, Baja California, Mexico, June 17, 1938 (A. E. Michelbacher and Edward S. Ross). Calif. Acad. Sci., Ent. Type No. 5465.

Cymbiodyta dorsalis subsp. *columbiana,* 1948, Wasmann Collect., 7(2):46. T-D: muddy spring alongside the Trans-Canada Highway, about a mile west of the side road to Walhachin, British Columbia, Canada, September 11, 1945 (Hugh B. Leech). Can. Nat. Collect., Ent. Type No. 5757.

Cymbiodyta pacifica, 1948, Wasmann Collect., 7(2):43–45. T-D: Langley, British Columbia, Canada, February 1, 1935 (Kenneth Graham). Can. Nat. Collect., Ent. Type No. 5756.

Enochrus hamiltoni subsp. *pyretus,* 1950, Wasmann Collect., (1949), 7(6):255. T-D: Bad Water, Death Valley, Inyo County, California, U.S.A., April 14, 1938 (John J. du Bois). Calif. Acad. Sci., Ent. Type No. 6173.

Enochrus hamiltoni subsp. *pacificus,* 1950, Wasmann Collect., (1949), 7(6):253–255. T-D: salt water lagoon at Huntington Beach, Orange County, California, U.S.A., July 19, 1943 (George P. Mackenzie). Calif. Acad. Sci., Ent. Type No. 6159.

Enochrus horni, 1950, Wasmann Collect., (1949), 7(6):250–252, fig. 6B. T-D: Norton's Pond, Salmon Arm, British Columbia, Canada, September 5, 1937 (Hugh B. Leech). Calif. Acad. Sci., Ent. Type No. 6157.

Enochrus (*Methydrus*) *rossi,* 1948, Proc. Calif. Acad. Sci., (4)24(11):451–452. T-D: Coyote Cove, Concepcion Bay, Baja California, Mexico, July 24, 1938 (A. E. Michelbacher and Edward S. Ross). Calif. Acad. Sci., Ent. Type No. 5467.

Hydrochus ouelleti, 1948, Wasmann Collect., 7(2):36–38. T-D: St. Remi, Quebec, Canada, May 20, 1920 (J. Ouellet). Calif. Acad. Sci., Ent. Type No. 5909.

Hydrochus setosus, 1948, Wasmann Collect., 7(2):35–36. T-D: Chicago, Illinois, U.S.A., April 17, 1934 (D. Lowrie). Calif. Acad. Sci., Ent. Type No. 5908.

Tropisternus (*Pristoternus*) *orvus,* 1946, Can. Entomol., (1945), 77(10):183–184. T-D: Mendocino, California, U.S.A., August 16, 1940 (Jacques R. Helfer). Can. Nat. Collect., Ent. Type No. 5635.

Tropisternus (*Pristoternus*) *paredesi,* 1943, Rev. Soc. Mex. Hist. Nat., 4(1–2):17–20, figs. 1, 3, 5. T-D: en un charco en la cuenca del río, altura de 600 a 900 metros (2,000 a 3,000 pies), Sierra de Zápotan, Nayarit, Mexico, noviembre de 1942 (Eugenio Paredes). Coleccíon Nacional de Insectos Mexicanos de la Escuela N. de Ciencias Biológicas, Instituto Politécnico, México, D. F., México.

POLYPHAGA: STAPHYLINOIDEA
Family Staphylinidae

Coprophilus sexualis, 1939, Can. Entomol., 71(12):259–261, fig. 1. T-D: flying in University woodlot, Vancouver, British Columbia, Canada, March 20, 1939 (Anges M. Gwyn). Can. Nat. Collect., Ent. Type No. 4884.

Dacnochilus fresnoensis, 1939, Can. Entomol., 71(12):261, fig. 3. T-D: Fresno, California, U.S.A., June 5, 1931 (R. S. Wagner). Calif. Acad. Sci., Ent. Type No. 4930.

Trigonodemus fasciatus, 1939, Can. Entomol., 71(12):258–259. T-D: Vancouver, British Columbia, Canada, March 26, 1933 (Hugh B. Leech). Can. Nat. Collect., Ent. Type No. 4883.

POLYPHAGA: DASCILLOIDEA
Family Helodidae

Sarabandus, 1955, Pan-Pac. Entomol., 31(1):34. T-S: *Cyphon robustus* LeConte, 1875, by orig. des.

POLYPHAGA: CHRYSOMELOIDEA
Family Cerambycidae

Centrodera autumnata, 1963, Proc. Calif. Acad. Sci., (4)32(7):173–178, figs. 8–11, 13, 15–16, 18. T-D: Mill Valley, Marin County, California, U.S.A., August 16, 1949 (Hugh B. Leech). Calif. Acad. Sci., Ent. Type No. 8526.

Centrodera dayi, 1963, Proc. Calif. Acad. Sci., (4)32(7):178–181, 183–184, figs. 4, 7, 9–11, 13–15, 17. T-D: Scott River at Klamath River, Siskiyou County, California, U.S.A., August 1, 1949 (W. C. Day). Calif. Acad. Sci., Ent. Type No. 8527.

Appendix C

Some Taxa Named in Honor of Hugh B. Leech

CLASS ARACHNIDA

Order Araneae

Family Gnaphosidae

Cesonia leechi Platnick and Shadab, 1980 (Mexico).

CLASS INSECTA

Order Diplura

Family Japygidae
Evalljapyx leechi Smith, 1960 (California).

Order Ephemeroptera

Family Baetidae
Baetis leechi Day, 1954 (California).

Order Hemiptera

Family Reduviidae
Stenolemopsis leechi Wygodzinsky, 1966 (Mexico).

Order Coleoptera

Family Bostrychidae
Dendrobiella leechi Vrydagh, 1960 (Mexico).
Micrapate leechi Vrydagh, 1960 (Mexico).
Family Buprestidae
Anthaxia leechi Cobos, 1958 (California).
Chrysobothris leechi Barr, 1974 (California).
Conognatha leechi Cobos, 1959 (Chile).
Family Cantharidae
Chauliognathus limbicollis subsp. *leechi* Wittmer, 1967 (Mexico).
Discodon leechi Wittmer, 1959 (Ecuador).
Malthodes leechi Fender, 1951 (California).
Troglomethes leechi Wittmer, 1970 (California).
Tylocerus leechi Wittmer, 1953 (Philippine Islands).
Family Carabidae
Pericompsus leechi Erwin, 1974 (Mexico).
Trechisibus leechi Uéno, 1972 (Peru).
Family Cerambycidae
Callidium leechi Linsley and Chemsak, 1963 (California).
Canonura leechi Dillon, 1956 (Arizona).
Derobrachus leechi Chemsak and Linsley, 1977 (California).
Juninia leechi Lane, 1966 (Peru).
Neocompsa leechi Martins, 1970 (Peru).
Family Chrysomelidae
Euryscopa leechi Monrós, 1952 (Texas).
Phyllobrotica leechi Blake, 1956 (California).
Timarcha cerdo subsp. *leechi* Jolivet, 1948 (Oregon).
Family Coccinellidae
Hyperaspis leechi Miyatake, 1961 (China).
Toxotoma leechi Gordon, 1975 (Peru).

Family Curculionidae
- *Alcidodes leechi* Haaf, 1962 (Philippine Islands).
- *Cryptolepidus leechi* Ting, 1940 (California).
- *Grypidius leechi* Cawthra, 1957 (Colorado).
- *Listronotus leechi* Sleeper, 1955 (British Columbia).

Family Dytiscidae
- *Hydaticus leechi* Satô, 1961 (Borneo).

Family Eucnemidae
- *Fornax leechi* Cobos, 1965 (Chile).

Family Gyrinidae
- *Macrogyrus leechi* Mouchamps, 1951 (Irian Barat).

Family Haliplidae
- *Haliplus leechi* Wallis, 1933 (British Columbia).

Family Hydraenidae
- *Ochthebius leechi* Wood and Perkins, 1978 (California).

Family Hydrophilidae
- *Chaetarthria leechi* Miller, 1974 (California).
- *Cymbiodyta leechi* Miller, 1964 (Washington).
- *Elophorus leechi* McCorkle, 1965 (British Columbia).
- *Epimetopus leechi* Rocha, 1969 (Brazil).
- *Hydrochara leechi* Smetana, 1980 (New Mexico).
- *Paracymus leechi* Wooldridge, 1969 (Mexico).

Family Lycidae
- *Plateros leechi* Nakane, 1971 (Formosa).
- *Xylobanus leechi* Nakane, 1971 (Formosa).

Family Malachiidae
- *Attalus leechi* Marshall, 1957 (Arizona).

Family Monommidae
- *Hyporhagus leechi* Freude, 1955 (Mexico).

Family Nitidulidae
- *Thalycra leechi* Howden, 1961 (British Columbia).

Family Scarabaeidae
- *Acoma leechi* Cazier, 1953 (Mexico).
- *Glaphyrocanthon viridis* subsp. *leechi* Halffter and Martinez, 1964 (Mexico).
- *Isonychus leechi* Frey, 1969 (Colombia).
- *Liogenys leechi* Frey, 1967 (Peru).
- *Onthophagus leechi* Frey, 1959 (New Zealand).

Family Staphylinidae
- *Acrolocha leechi* Hatch, 1957 (British Columbia).
- *Acylophorus leechi* Smetana, 1971 (Missouri).
- *Ecbletus leechi* Moore, 1965 (California).
- *Olophrum leechi* Hatch, 1957 (British Columbia).

Philonthus leechensis Hatch, 1957 (British Columbia).
Quedius leechi Smetana, 1971 (Arizona).
Stenus leechi Puthz, 1974 (Mexico).
Family Stylopidae
Stylops leechi Bohart, 1941 (British Columbia).
Family Tenebrionidae
Edrotes leechi Doyen, 1968 (Utah).
Eleodes leechi Tanner, 1961 (Utah-Colorado state line).
Gyriosomus leechi Kulzer, 1954 (Chile).
Heliofugus leechi Freude, 1960 (Chile).
Hemasodes leechi Freude, 1967 (Brazil).
Nyctopetus leechi Freude, 1959 (Chile).
Philorea leechi Kulzer, 1956 (Peru).
Family Throscidae
Throscus leechi Cobos, 1967 (Australia).

Order Trichoptera

Family Lepidostomatidae
Lepidostoma leechi Denning, 1962 (Mexico).

Order Diptera

Family Asilidae
Metapogon leechi Wilcox, 1964 (Mexico).
Family Bombyliidae
Eclimus leechi Hall, 1954 (California).
Family Ceratopogonidae
Culicoides leechi Wirth, 1977 (California).
Family Platypezidae
Agathomyia leechi Kessel, 1961 (California).
Family Scatopsidae
Colobostema leechi Cook, 1978 (California).
Family Scenopinidae
Pseudatrichia leechi Kelsey, 1969 (California).
Family Tabanidae
Esenbeckia leechi Philip, 1978 (Mexico).
Family Tachinidae
Erycia leechi Curran, 1932 (British Columbia).
Family Tipulidae
Gonomyia leechi Alexander, 1964 (California).
Tipula leechi Alexander, 1938 (British Columbia).

Order Hymenoptera

Family Andrenidae
Perdita leechi Timberlake, 1968 (Mexico).

Family Braconidae
  Ecphylus leechi Marsh, 1965 (California).
  Microgaster leechi Walley, 1935 (British Columbia).
Family Ichneumonidae
  Cubocephalus molaris subsp. *leechi* Townes and Gupta, 1962 (British Columbia).
Family Pompilidae
  Dipogon leechi Wasbauer, 1960 (California).
Family Tenthredinidae
  Pristophora leechi Wong and Ross, 1960 (British Columbia).
Family Tiphiidae
  Krombeinia leechi Allen and Krombein, 1964 (Mexico).

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RETICULATE EVOLUTION IN *COLYMBETES* (COLEOPTERA: DYTISCIDAE)

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An unusual situation was discovered in a recent revision of the *Colymbetes* of North America (Zimmerman, in press). Species problems in the genus proved to be particularly vexing and unusual, and the relationship between 2 western species is most intriguing and seems worthy of reporting separately. This issue of this journal which is dedicated to Hugh Leech who provided much of the material for the study of these two species is a particularly appropriate time and place to present this interesting relationship.

Colymbetes species are some of the larger and more derived members of the subfamily Colymbetinae (Sharp 1882, Balfour-Browne 1950). The North American species are easy to recognize because of their size (up to 20 mm) and the transverse grooves on the elytra (Figures 10, 13). There are 7 species in North America and about 13 in Eurasia. Three are found in both hemispheres. It is a holarctic group with no representatives south of North Africa and the Arabian Peninsula.

The North American species can be separated into 3 groups. Three species, *dolobratus* Paykull, *exaratus* Leconte (not of authors), and *sculptilis* Harris readily fall into one group and *dahuricus* Aubé and *paykulli* Erichson fall into another. The 2 species of this report, *densus* Leconte (=*exaratus* of authors) and *strigatus* Leconte occupy an intermediate position to those two groups. The separation is based mainly on the structure of the male pro- and mesotarsi, but there are other characters which support the groupings.

Geographical Distribution

C. strigatus and *densus* are found from southern California to southern Alaska. Each is composed of 2 geographical races (Fig. 1). *C. s. strigatus* extends from the vicinity of San Diego to near San Francisco. It appears to be mainly confined to inland localities with the exception of old records from near San Diego and Los Angeles. It occurs in both mountainous regions and comparatively low-lying areas in the Central Valley. Nowhere is it common.

C. s. crotchi Sharp, the northern race of *strigatus,* is found from Monterey County to Humboldt County in a narrow band hardly more than 50

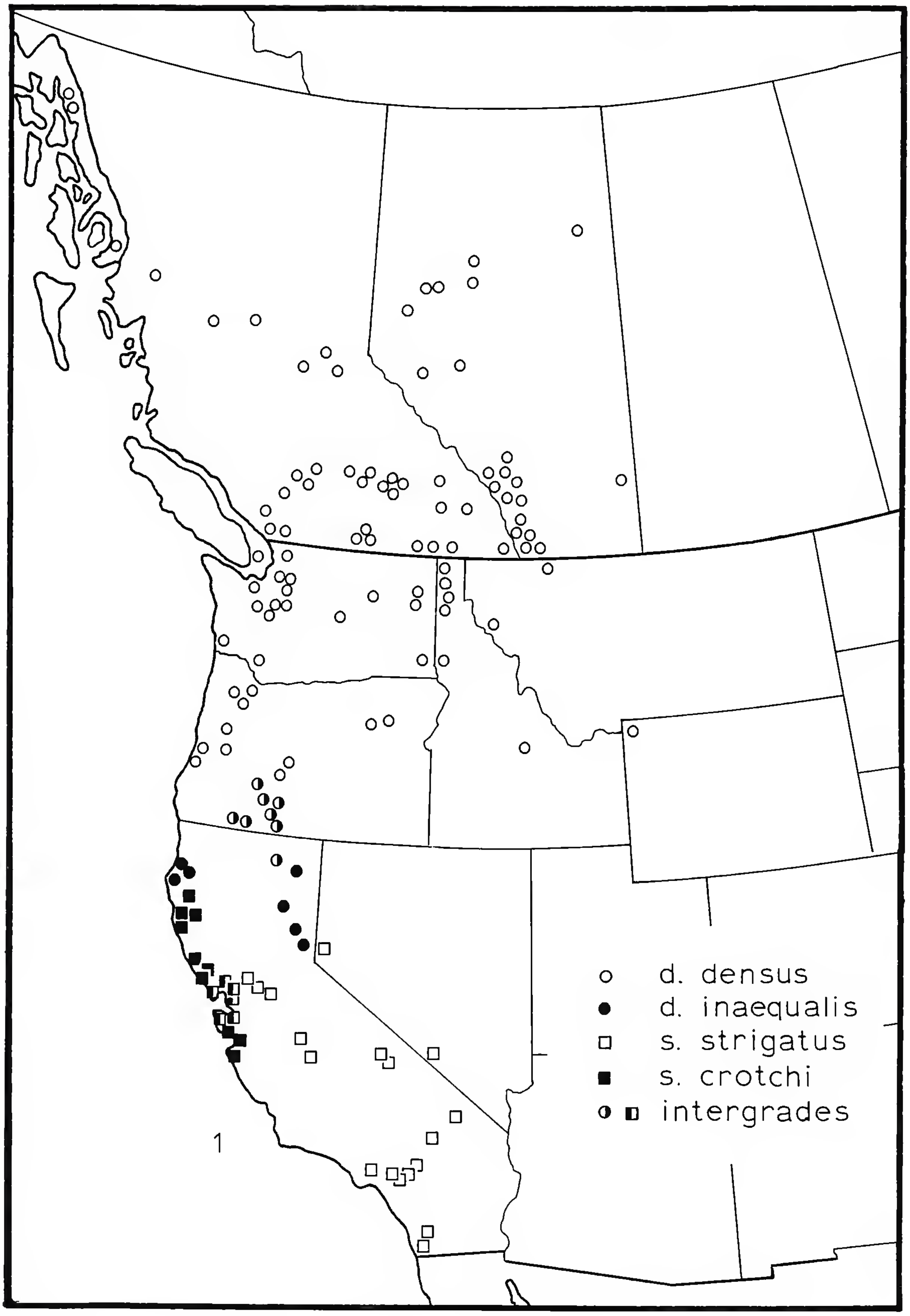


Fig. 1. Distribution of *Colymbetes densus* and *C. strigatus*.

miles inland. It can be found in estuarine habitats along the coast and in pools in the low coast ranges nearby.

Intergrades between the two races of *strigatus* are common in the area surrounding San Francisco Bay. They are easy to detect because of the marked differences (for the genus, that is) between the races. Actually, the

Table 1. Comparison (mm) of 8 mensural characters in *Colymbetes strigatus* and *densus*.

		Subspecies				
Character	(N)	*s. strigatus* (southern)	*s. strigatus* (northern)	*s. crotchi*	*d. inaequalis*	*d. densus*
length	24	15.95 ± 0.80	16.55 ± 0.57	17.99 ± 0.65	17.08 ± 0.53	16.93 ± 0.59
width	24	7.64 ± 0.31	7.97 ± 0.30	8.58 ± 0.27	8.08 ± 0.20	8.05 ± 0.27
femur length	24	3.75 ± 0.25	3.82 ± 0.13	4.19 ± 0.10	4.09 ± 0.10	4.05 ± 0.12
femur width	24	1.16 ± 0.07	1.19 ± 0.05	1.30 ± 0.06	1.28 ± 0.05	1.26 ± 0.06
tibial length	24	3.29 ± 0.25	3.35 ± 0.13	3.72 ± 0.09	3.60 ± 0.09	3.57 ± 0.12
tarsal length	24	2.64 ± 0.28	2.69 ± 0.13	3.21 ± 0.11	3.20 ± 0.11	3.14 ± 0.15
aedeagus	10	4.48 ± 0.26	4.93 ± 0.24	6.61 ± 0.20	5.97 ± 0.20	5.70 ± 0.19
width of protarsomere	10	0.68		0.83	0.87	0.88

influences of *crotchi* on *strigatus* can be found on numerous specimens which occur some distance from the zone of intergradation. This influence shows not only in the male tarsi, but also in mensural characters (Table 1).

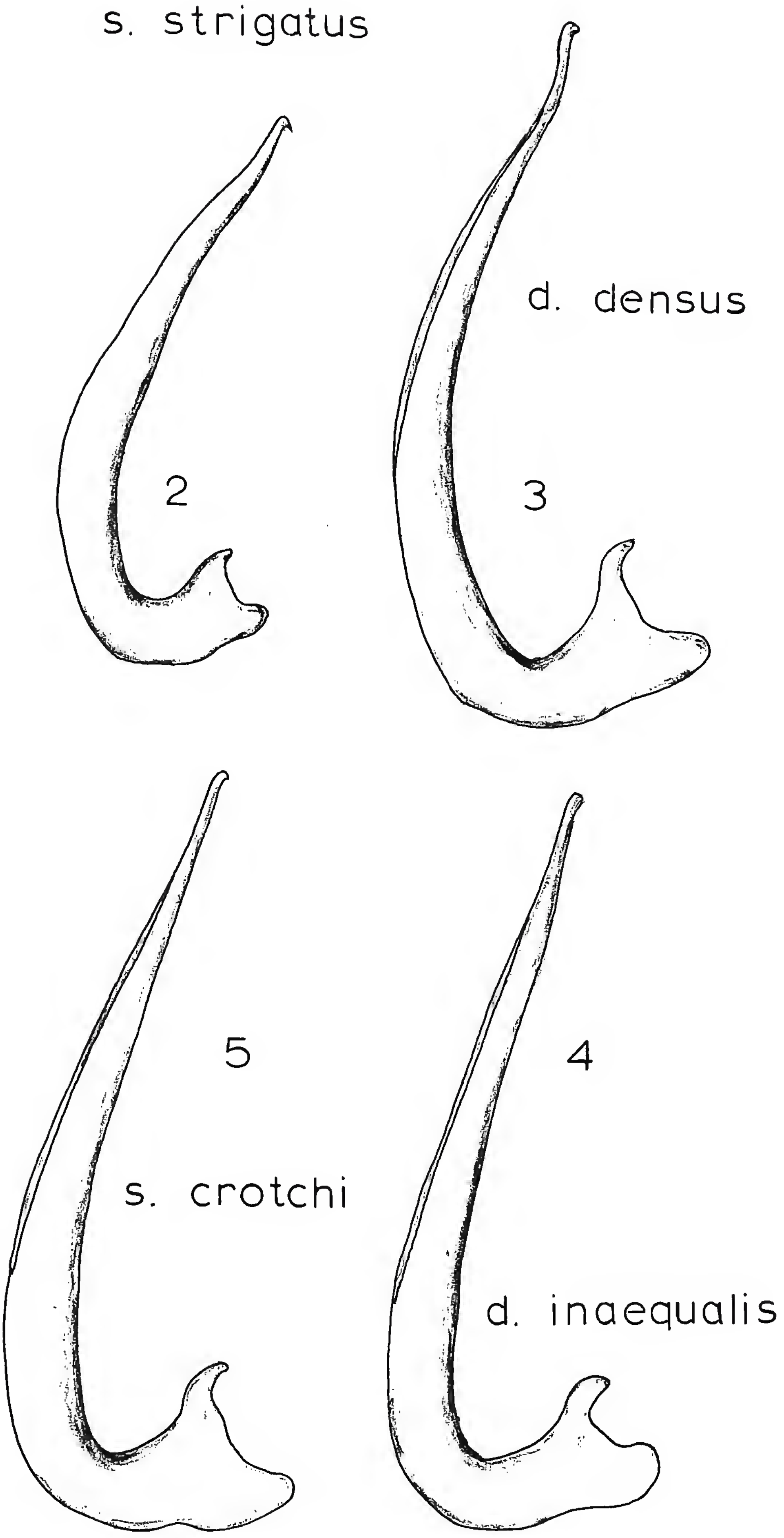
C. d. densus is the most widely distributed of the 4 races of these 2 species. Its range is from southern Alaska to Oregon and inland to Alberta and Wyoming. It intergrades with *d. inaequalis* Horn in southeastern Oregon and Siskiyou County, California.

The known distribution of *d. inaequalis* is limited to 2 separated areas–one in the northern Sierra Nevadas including Mt. Lassen, and the other in Humboldt County on the coastal lowlands and at a few sites slightly more inland. Specimens from the two areas are quite similar and do not appear to merit subspecific separation. The gap between them may be due more to lack of collecting than any real discontinuity in distribution. It is evident, however, that two contrasting habitats are used by the two populations.

As far as is known, the two species, *strigatus* and *densus,* are allopatric to one another. The Sierra populations of *d. inaequalis* and *s. strigatus* approach each other and may occur together, but these rather rare taxa have not yet been taken together. Also, *d. inaequalis* and *s. crotchi* are both found in Humboldt County, but there is still a separating gap of 50 to 75 miles.

Species Limits and Anatomical Relationships

The unusual feature of these 2 species is that *strigatus crotchi* bears a closer anatomical relationship in most characters to *densus inaequalis* than to *s. strigatus.* If it were not for the unmistakable series of intergrades between *s. crotchi* and *s. strigatus,* one would surely conclude that *s. crotchi* was an allopatric conspecific relative of *d. inaequalis.*



Figs. 2–5. Lateral views of aedeagi of subspecies of *Colymbetes densus* and *C. strigatus*.

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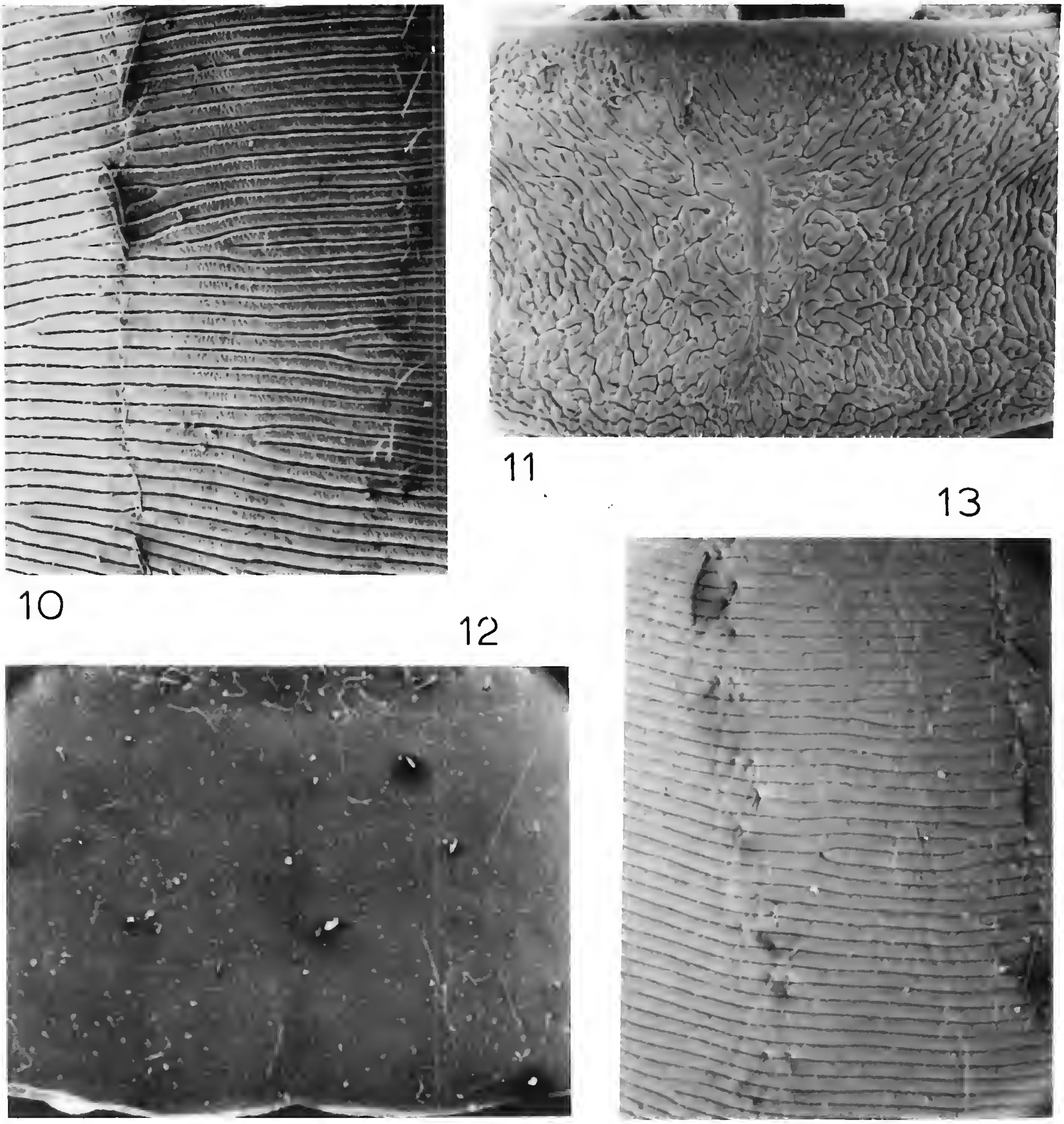
Figs. 6–9. Protarsi of 6) *C. s. strigatus* from Fresno Co., 7) *C. s. strigatus* from Yolo Co., 8) *C. s. strigatus* from San Diego Co., and 9) *C. s. crotchi* from Marin Co.



Figs. 10–13. Fig. 10. SEM of discal area of the elytra of female of *C. d. inaequalis* from Humboldt Co. Fig. 11. SEM of female pronotum of *C. d. inaequalis* from Humboldt Co. Fig. 12. SEM of pronotum of female of *C. s. crotchi* from Marin Co. Fig. 13. SEM of discal area of the elytra of male of *C. sculptilis*.

The relationship is apparent through their size, shape, sexual characters, and in habitat utilization. Table 1 is a comparison of 8 mensural characters including the length of the aedeagus. In all of those characters *s. crotchi* is closer to *d. inaequalis* than to the two samples of *s. strigatus*. Configuration as well as overall length of the aedeagus is more similar also (Figs. 2–5).

The most striking character is the nature of the male pro- and mesotarsi. There are 2 distinct types of tarsal adornment in *Colymbetes* as indicated

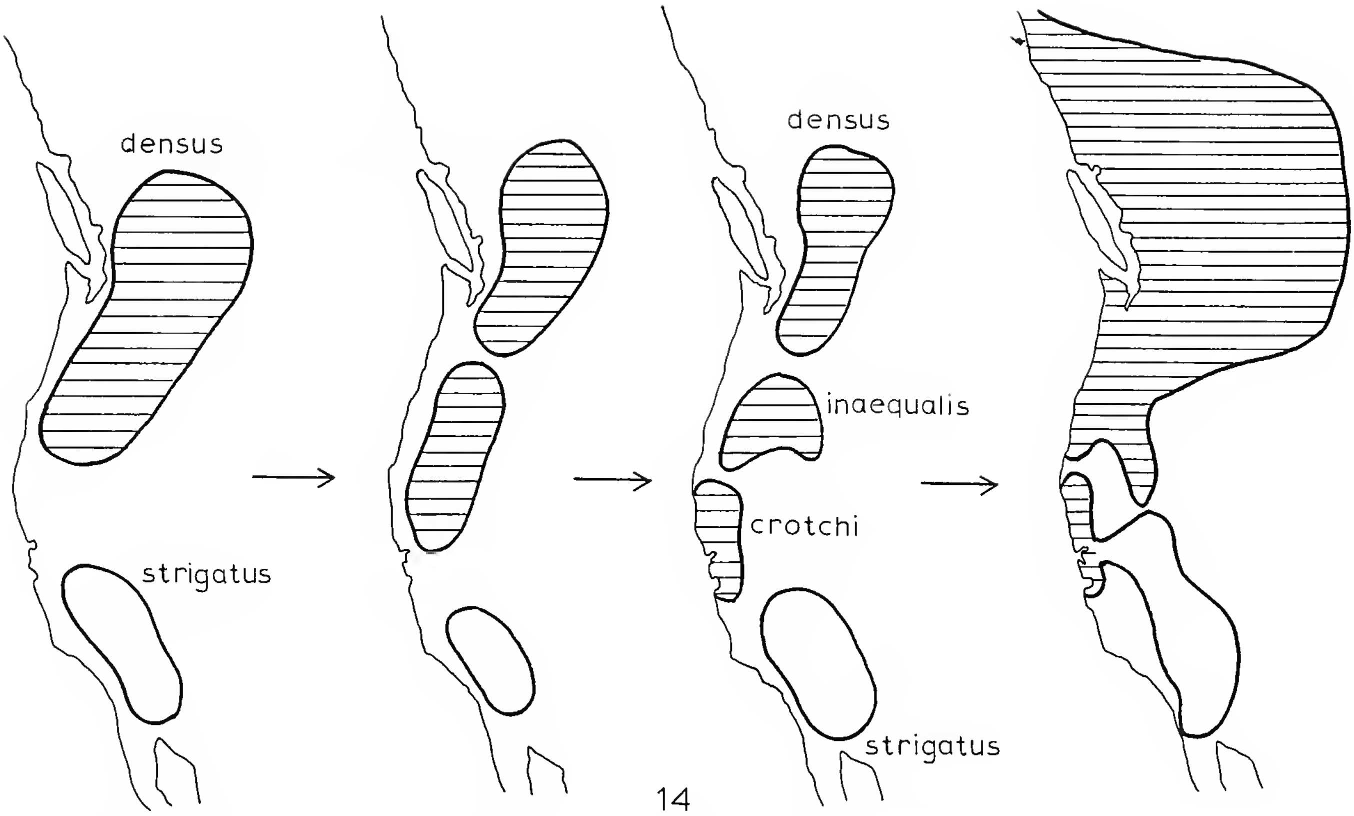


Fig. 14. Diagram of reconstruction of probable isolation and subsequent joining of populations leading to present situation in *C. densus* and *C. strigatus*.

in the introduction. The most common and probably the ancestral type is the condition with enlarged flattened "palettes"—rounded adhesive discs as seen in Figure 8. This is the type found in the southernmost populations of *s. strigatus*. Populations to the north show a transition in the basal row of palettes. The size of the terminal disc decreases and tends to become a double row of 25 or more (Figs. 6, 7). This condition is what Leech recognized in his key to the California species (Leech and Chandler 1956).

The other type of adhesive structures and probably the derived condition, is that found in the *dahuricus* group. The adhesive structures take the form of over a hundred or more stout setae with slightly expanded tips.

There is an intermediate condition, however, and it is found in both races of *densus* and in *strigatus crotchi*. The basal group of adhesive structures in these are setae, but the distal ones are palettes (Fig. 9). The cline in size and number of palettes in *s. strigatus* appears then to be introgression of the genes for the setal form from *s. crotchi*.

Other characters which intergrade in *strigatus* are the shape and length of the aedeagus, overall size, the amount of secondary mesh on the pronotum, and the degree of swelling of the frons next to eye above the antennal base.

Intergradation in *densus* is seen primarily in two characteristics, both sexual. The two races are so similar in other characters that it is quite difficult to find differences. The aedeagus of *d. densus* is distinctive in that it is strongly curved laterally before the apex while that of *d. inaequalis* is only slightly so (Fig. 3, 4). Intermediates to these conditions can readily be recognized with experience. The females of *d. inaequalis* have the elytra duller (velvety) than any other North American *Colymbetes.* This is due to the widening of the elytral grooves and the strong development of the surface microreticulation on the interspaces between the grooves (Fig. 13). In its most extreme form this condition covers the anterior $^4/_5$ or more of the elytron. The intergrades have variable amounts of the elytron so affected. The condition is found to some degree in a few females from throughout the range of *d. densus.*

Characters which indicate a close affinity between *d. inaequalis* and *s. crotchi* are seen in the male tarsi, frons swollen above the antennal base, the pale subsutural line, in the similarity of the size and shape of the aedeagus, and the general size and shape of the whole animal. In fact, there are only 2 characters which permit ready separation, but fortunately these are ones that are easily evaluated. The smooth pronotum of *s. crotchi* in contrast to the pebbled surface on that of *d. inaequalis* (Figs. 11, 12) is a character that can be discerned even in the field with but a hand lens and serves as an excellent indicator of the presence of mixing or not. The smooth pronotum is a character unique to *s. crotchi* and can be used to separate it from any other North American *Colymbetes.*

The second feature is the previously mentioned velvety appearance of the female elytra in *d. inaequalis,* but which is not present in *s. crotchi.* It, of course, is useful only in comparing females, but in many species of dytiscids only the male serves in verification of intergradation.

Evolutionary Considerations

The evidence is clear that *C. strigatus* is composed of two rather different races. The southern race, *strigatus,* would readily be placed in the *sculptilis* group of species, i.e., the group with only palettes on the male tarsi; but *s. crotchi* is so similar to *densus,* which has setae (which seem to be a derived character) as well as palettes, that one would include it with that species if there were not intergradation between these two.

One has to conclude that *crotchi* originally was derived from ancestral *densus,* separated from that species, and has subsequently come into contact with *strigatus* and in the absence of any reproductive barrier merged with it. The geographical positions of the 4 taxa support this view. The possible sequence of events is diagrammed in Figure 14.

Originally *strigatus* and *densus* were separate species. At this time we lack enough evidence to show their probable origins, and it is even possible that *densus* arose from ancestral *strigatus.* The reverse seems improbable because of the greater number of derived characters in *densus.*

C. densus divided into 2 populations and later the southern one of those divided again. The first division led to a group which could use not only mountainous areas, but also low-lying coastal ponds including the brackish water in quiet estuaries along the California coast. The second division resulted in what are now recognized as *d. inaequalis* in the north and *s. crotchi* in the south. *C. d. inaequalis* occupies both inland and coastal areas as we see today, but *s. crotchi* encountered *strigatus* inland and in the absence of reproductive barriers interbred with it.

As interpreted here, ancestral *strigatus* is apparently derived from the *sculptilis* group. The origin of the ancestral *densus* is problematical. Apparently it has no sister-species in the Old World, because no species has been reported from there which have both setae and palettes on the male tarsi. The presence of setae, larger size, and darker pigmentation are characters which link *densus* and *s. crotchi* to *dahuricus* and *paykulli* and not to the more pleisomorphic *sculptilis* group.

It is possible that ancestral *densus,* which contained what is now *inaequalis* and *crotchi* is a vicariant of ancestral *strigatus.* If so, it had undergone considerable differientiation as evidenced by the male tarsi, expansion of the frons, larger size, and aedeagi. The fact that *s. crotchi* does not show any evidence of intergradation with *d. inaequalis* supports the view that the former had become specifically distinct from the latter. It is true that there exists a slight gap between the ranges of the two, but even so some of the specimens I have examined should show admixture. The gap is due to lack of collecting and does not reflect the real distribution in my opinion. It would be much better if sympatry or intergradation could be shown, however.

It still appears *s. crotchi* had differientiated into a separate entity and has now reunited with *s. strigatus* with the introgression of characters into the latter and separation from *d. inaequalis.* A pattern of hybridization and reticulate evolution is thus realized.

If intermediates are found between *crotchi* and *inaequalis,* then all four geographical entities will be included in *strigatus.* With the evidence at hand, I am hesitant to make a nomenclature change. Those who feel that one species disappears when a speciation event occurs will differ with my interpretation of this situation, but as yet I can not accept that view of species and their evolution.

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A DESCRIPTION OF THE LARVA OF *HELOCOMBUS BIFIDUS* (COLEOPTERA: HYDROPHILIDAE)

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Helocombus Horn is one of the few Nearctic genera of aquatic hydrophilids for which the larval stage is not yet described. The species of this monotypic genus, *H. bifidus* (LeConte), inhabits eastern North America, ranging from Labrador south to Florida and west to Minnesota. This woodland pond species is one of the more infrequently collected hydrophilids in spite of having a large geographical distribution. Larvae described herein were reared from adults collected by Spangler from a woodland pond in Seth State Forest, Talbot County, Maryland.

First-instar larva (Figs. 1–7).—Total length 3.6 mm; width of prothoracic segment 0.5 mm. Color creamy yellow with sclerotized areas light yellowish brown. Integument of abdomen covered with short, dense hairs.

Head quadrangular (Figs. 2, 3), 0.54 mm wide, 0.38 mm from labroclypeus to occipital foramen. Frontoclypeal suture absent. Stem of ecdysial cleavage lines very short, frontal branches delimiting U-shaped frons. Head capsule with setae as illustrated (Figs. 2, 3).

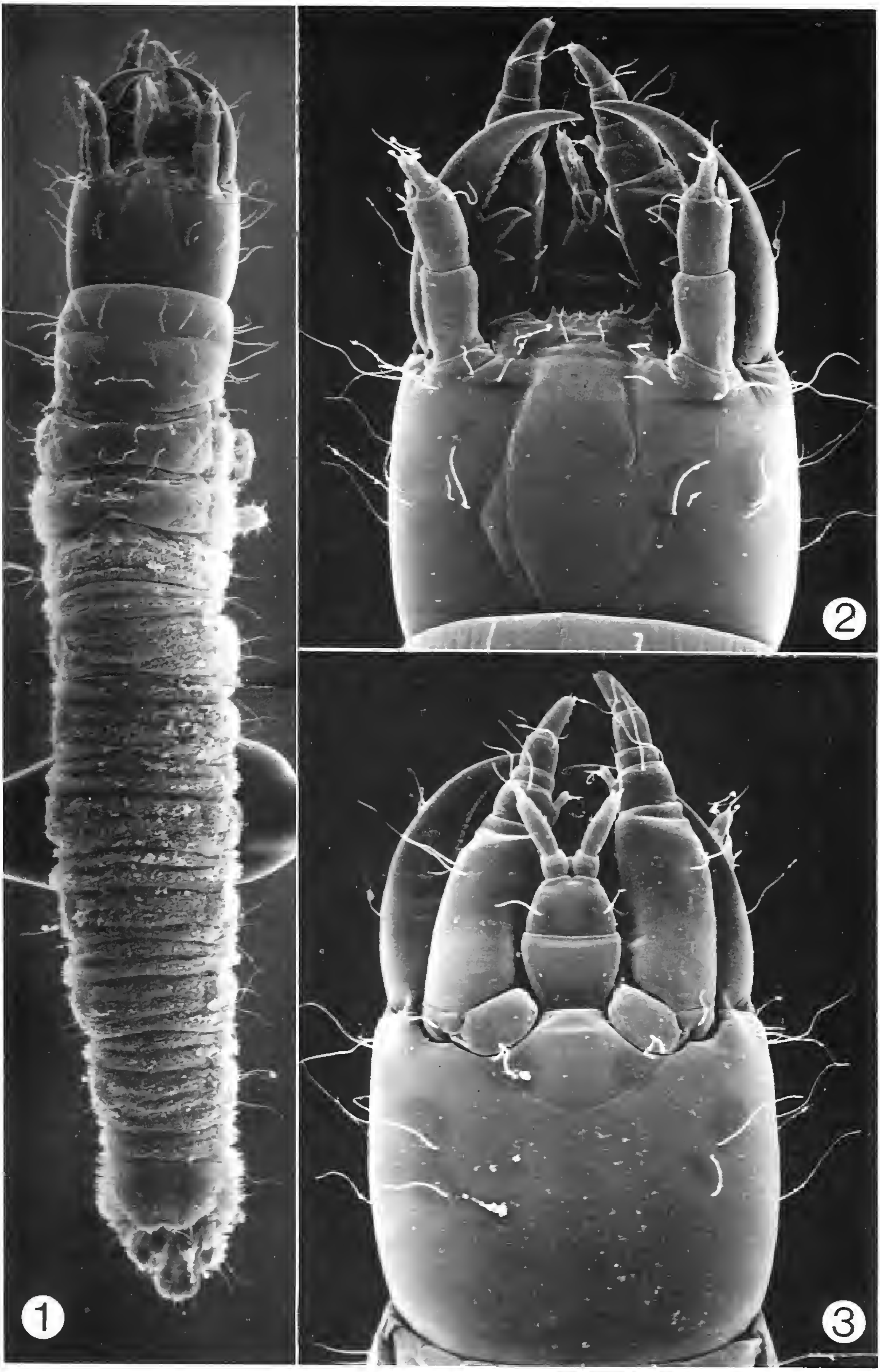
Labroclypeus (Figs. 4, 5) asymmetrical, a pair of prominent teeth on right and on left side, midregion with numerous, small, irregular teeth; tooth on left side as large as tooth on right side, or nearly so.

Antennae (Fig. 4) 3-segmented, slightly longer than stipes. First antennal segment slightly longer than second, without setae. Penultimate antennal segment with a large sensillum and numerous smaller sensilla at apex. Ultimate antennal segment small, cylindrical, terminating in flagelliform setae and sensilla.

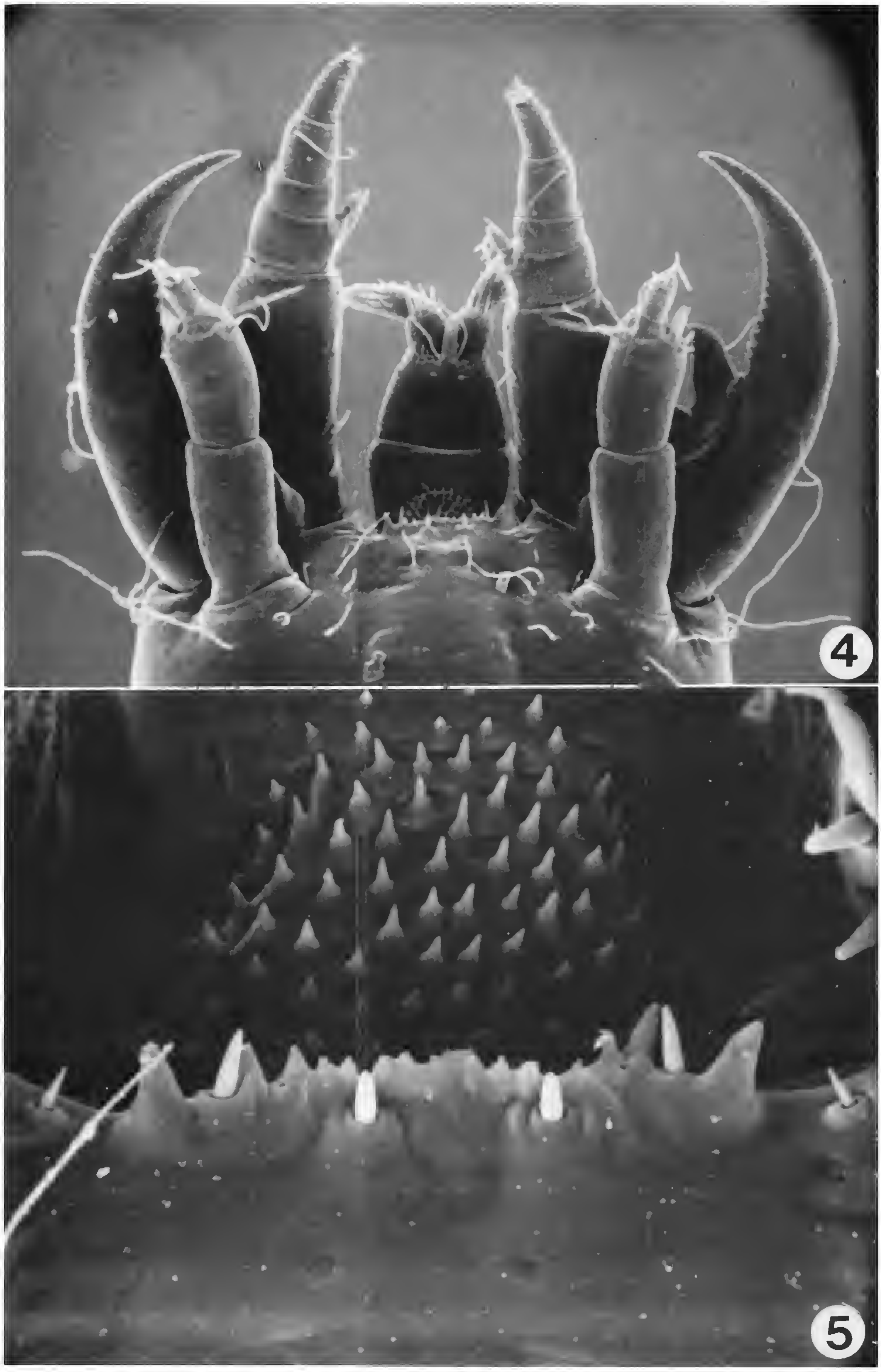
Mandibles (Fig. 2) symmetrical, prominent, sharply pointed apically; inner margin with two teeth, distal larger than proximal; inner margin serrate from apex of mandible to distal tooth; inner margin between proximal tooth and base of mandible with sparse, short spicules.

Maxilla (Figs. 2–4) with stipes longer than combined lengths of palpifer and palpus; stipes with four large, apically bifid setae on inner margin. Palpifer with a large seta on inner margin near base, two long setae on ventral surface (Fig. 3), and a sensory lobe at anteromedial angle. Palpus 3-segmented, with numerous sensilla at apex.

Labium (Figs. 4–7) extending as far forward as apex of stipes. Mentum



Figs. 1–3. *Helocombus bifidus* first-instar larva. Fig. 1, Habitus (60×). Fig. 2, Head, dorsal aspect (150×). Fig. 3, Head, ventral aspect (150×).



Figs. 4, 5. *Helocombus bifidus* first-instar larva. Fig. 4, Mouthparts and anterior margin of head, dorsal aspect (170×). Fig. 5, Labroclypeus and mentum (875×).

Figs. 6, 7. *Helocombus bifidus* first-instar larva. Fig. 6, Apex of labium, dorsal aspect (630×). Fig. 7, Labium, ventral aspect (410×).

with numerous spicules on dorsal surface (Fig. 5). Palpiger with apicodorsal spicules (Fig. 6). Ultimate segment of palpus twice length of penultimate; penultimate segment with long apicodorsal spines; ultimate segment with long spines near midlength, sensory structures apically.

Prothorax broader than long, with dorsal setae as illustrated (Fig. 1). Prosternal sclerite broader than long. Meso- and metathoracic sclerites equal in length, combined length subequal to length of prothorax.

Legs 4-segmented, subequal to length of mandibles; trochanter about half as long as coxa; femur slightly longer than tibiotarsus; tarsal claw single, half as long as tibiotarsus, with two basal setae.

Abdomen (Fig. 1) with 8 distinct segments, ninth and tenth segments reduced; segments 1–8 without tubercles or projections; eighth tergum represented by superior valve of stigmatic atrium, a large, oval sclerite with small apicomedian emargination. Ninth tergum trilobed, median lobe large, with two short and two long setae on caudal margin; lateral lobes indistinct, with four setae. Spiracles present. Mesocerci prominent, conical, with a large apical seta.

Comparative notes.—*Helocombus* first-instar larvae are most similar to those of *Cymbiodyta,* but differ in several respects, including: 1) shape of the labroclypeus, *Helocombus* having tooth on the left side as large as that on the right side (Fig. 5), whereas in *Cymbiodyta* the left tooth is smaller than the right; 2) setae on the medial surface of the stipes are bifid at their apices in *Helocombus,* non-bifid in *Cymbiodyta*; 3) mandibles of *Helocombus* have a patch of small spicules on medial surface between base and proximal tooth, *Cymbiodyta* lacks these spicules; and 4) *Helocombus* larvae have a prominent seta on the anterior margin of each side of the head, midway between the labroclypeus and mandibular articulation, *Cymbiodyta* larvae lack these setae.

Larvae of *Helocombus* will key to the genus *Cymbiodyta* at the second alternative of couplet 11 in Chandler's key (1956, pp. 339–341). The following couplet will separate the two genera:

1. Labroclypeus with tooth on left side smaller than tooth on right side .... *Cymbiodyta* Bedel
   Labroclypeus with tooth on left side equal in size to tooth on right side .... *Helocombus* Horn

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PREDACEOUS WATER BEETLES OF THE GENUS *DESMOPACHRIA* BABINGTON: THE LEECHI-GLABRICULA GROUP (COLEOPTERA: DYTISCIDAE)

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The small, seed-like species of *Desmopachria* (s. str.) are often almost indistinguishable except by the male external genitalia. *D. glabricula* Sharp and the species related to it are separable from other groups by the strongly sclerotized aedeagus and the complex parameres. They differ from the type-species of *Desmopachria* (*nitida* Babington) in having the parameres compacted, not bifid, and from the *convexa-grana* Group in lacking free spurs on the parameres.

Hugh B. Leech, of the California Academy of Sciences, first recognized the complexity of the genitalia in the small species of *Desmopachria* more than 30 years ago. He kindly turned over to me his dissected specimens from Florida which clearly demonstrated that at least three species were then lumped under the name *Desmopachria grana* (LeConte). In the intervening decades, I have assembled material of these "tiny mites" as they were once called by David Sharp. In recent years, the widespread use of the black-light traps (UV traps) has greatly increased the available material. I am happy to name the following new species and to add its name to that of the group in honor of Hugh B. Leech in recognition of his many contributions to the study of the aquatic Coleoptera.

Desmopachria leechi, new species

Diagnosis.—A small brownish *Desmopachria,* 1.3 to about 1.52 mm long by 0.8 to about 1.0 mm wide near the middle of the elytra. Smaller and less coarsely punctate both above and below than *D. convexa* (Aubé), but almost indistinguishable from *D. grana* (LeConte) except for the coarse setate punctation of the last visible abdominal sternite in both males and females. Male external genitalia diagnostic (Fig. 4).

Holotype male.—Total length 1.52 mm; greatest width near middle of elytra about 1.0 mm; width of pronotum at base 0.72 mm; width of pronotum at apex 0.56 mm; length of pronotum at midline about 0.35 mm. Ovate somewhat attenuate behind and moderately convex in lateral profile. Head moderately coarsely, irregularly punctate on vertex and clypeus; clypeus rounded in front, distinctly margined. Disk of pronotum about as coarsely punctate as vertex of head but with punctures denser along anterior margin and at sides of base as usual; pronotal margins distinct; base of pronotum strongly recurved at outer (humeral) angles as in *grana*. Elytra about as coarsely punctate as pronotal disk but punctures more regularly distributed in irregular rows along suture and near base becoming more irregular, shallower, and sparser laterally and more irregularly distributed apically; no indication of a sutural stria; discal stria of coarser punctures not conspicuous. Venter punctate much as in *grana*; hind coxae more coarsely but more shallowly punctate than disk of pronotum; prosternal process much as in *grana*, similar in the sexes; most of venter inconspicuously punctate except for last visible abdominal sternite which is coarsely punctate at apex, along posterior margin, and in middle with light colored setae; middle of sternite feebly impressed. Color much as in *grana*; dorsum nearly uniformly yellowish brown, narrowly darker along bases of pronotum and elytral suture; thorax and head slightly lighter than elytra (feebly bicolorus); venter brownish yellow, darker along joints and sutures as usual.

Allotype female.—Very similar to male. Total length 1.52 mm; greatest width near middle of elytra 1.0 mm; width of pronotum at base 0.72 mm; width of pronotum at apex 0.56 mm; length of pronotum at midline about 0.32 mm. Last visible abdominal sternite with coarse punctures and light colored setae much as in male.

Holotype, allotype, and two male paratypes from: FLORIDA: *Alachua County,* Gainesville, 1–7 August 1956, BLT (UV trap), L. A. Hetrick (FSCA).

Other paratypes.—FLORIDA: *Alachua County*: Gainesville, BLT, 13–14 July 1978, F. N. Young (1 male UMMZ). Flatwoods east of Gainesville, 4 October 1937, F. N. Young (1 male UMMZ). Tiger Bay east of Gainesville, 19 September 1938, F. N. Young (4 males, 1 female). *Collier County*: Canal near Everglades, 15 August 1959, F. N. Young (1 male). *Dade County*: Timms Hammock near Homestead, 24 February 1919, H. S. Barber (1 male NMNH). Royal Palm State Park, 16 March 1924, W. S. Blatchley (1 male, PUC). Homestead, 15–16 August 1973, BLT, R. N. Baranowski (2 males, 3 females FSCA). Homestead, June 1929, P. J. Darlington, Jr. (1 male MCZ). Miami, 13 September 1960, BLT, P. E. Briggs (1 male FSCA). Royal Palm State Park, 20 July 1938, F. N. Young (1 male). Canal Southeast Florida City, 9 July 1962, F. N. Young (2 males, 1 female). *Franklin County*: Dog Island, 16 April 1947, F. N. Young (4 males, 2 females). *Glades County*: Near Harrisburg, 7 August 1972, F. N. Young (3 males, 6 females). *Hillsboro County*: Tampa, 23/4, C. V. Riley Collection (1 male NMNH). *Lee County*: Fort Myers, 18 March 1921, W. S. Blatchley (1 male PUC). *Liberty County*: Ditch 10 miles southeast Telogia, 7 May 1971, F. N. Young (1 male). *Monroe County*: Big Pine Key, pools in pinelands, 9 September 1941, F. N. Young (1 male, 2 females). Big Pine Key, 1–3 July 1978, BLT, L. Strang (10 males and females FSCA). Everglades National Park, 30 July

1969, BLT, C. A. Adamson (1 male, 1 female FSCA). *Sarasota County*: Sarasota, 5 March 1920, John G. Gehring Collection (13 males, 2 females MCZ). *Taylor County*: J. D. Sherman and Frederich Blanchard collections, (6 males MCZ). Ex J. D. Sherman Collection (7 males AMNH). *Volusia County*: Pool west of Daytona Beach, 10 August 1979, F. N. Young (1 male). *County?*: "Florida, Stephensville, J. D. Sherman Collection," (9 males NMNH).

GEORGIA: *Appling County*: Little Satilla R. north of Bristol, 28 August 1961, F. N. Young (1 male). *Lowndes County*: Valdosta, J. D. Sherman Collection, 1920 (1 male NMNH).

MISSISSIPPI: *Jackson County*: Ocean Springs, 24 June 1931, Henry Dietrich (1 male CU). Horn Island, 11 August 1944, light trap (1 male, 3 females CU).

SOUTH CAROLINA: *Kershaw County*: Camden, 18 June 1929, P. J. Darlington, Jr. (2 males, 2 females MCZ).

Desmopachria glabricula Sharp

Desmopachria glabricula Sharp, 1882. Biologia Centrali-Americana. Insecta. Coleoptera 1 (Part 2), p. 18. (Guatemala, Paso Antonio, 400′, Champion).

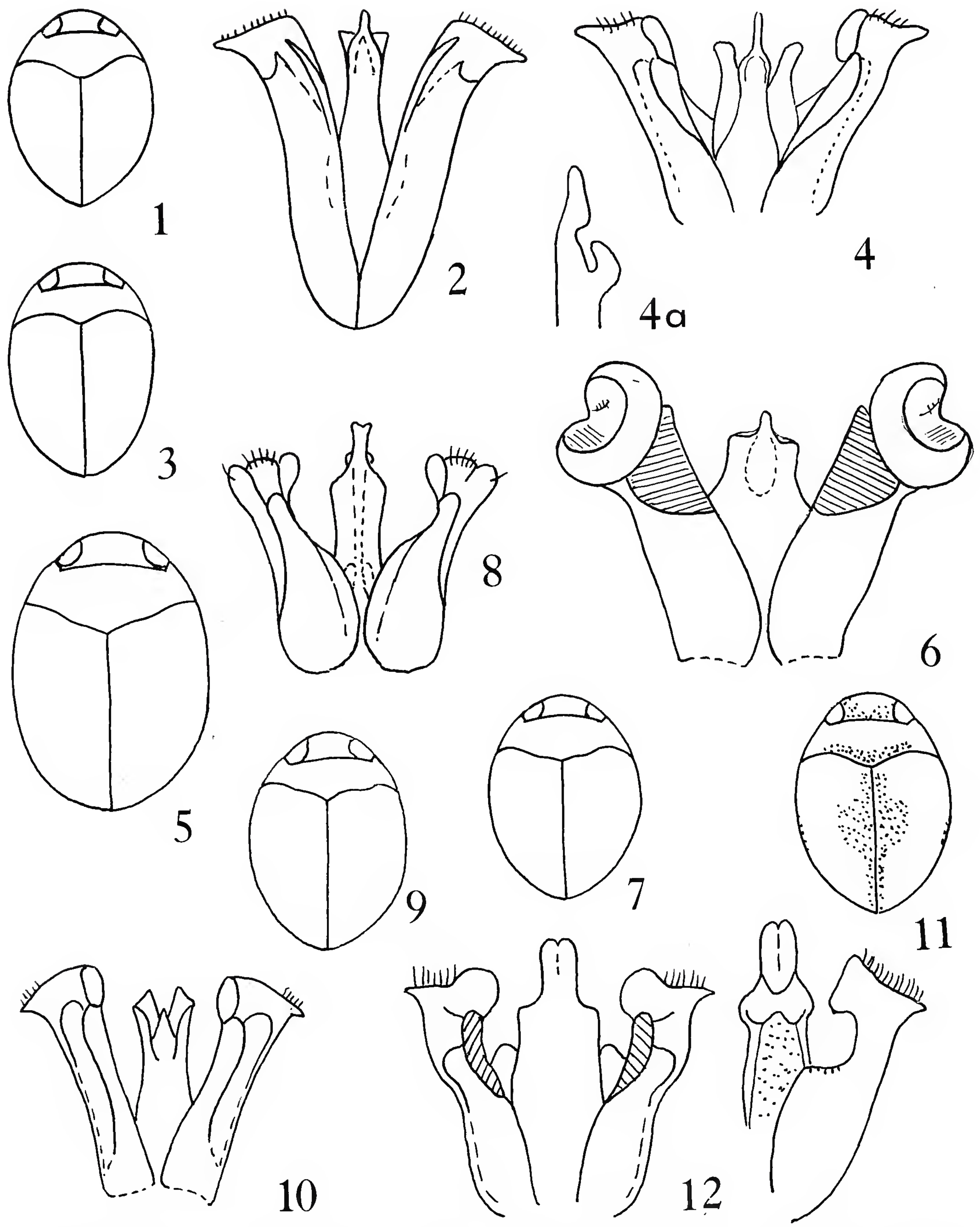
Diagnosis.—A small, brownish *Desmopachria* about 1.3 to 1.4 mm long by about 0.96 to 1.0 mm wide at about middle of elytra. Very similar to *grana* and *leechi*, but punctation finer and color probably darker when fully mature. Last visible abdominal sternite nearly smooth, transversely impressed similar to *grana*, not setate-punctate as in *leechi*. Male external genitalia diagnostic (Fig. 2).

Besides the syntypes, I have seen specimens from Costa Rica, British Honduras, and Panama. Sharp (1887, p. 752, supplement to op. cit.) added specimens from the Pearl Islands (Panama) to the original syntypes which are females. A male from the latter group of specimens has genitalia of the *nitida* type with divided parameres. The female cotypes match well with specimens from other Central American localities, but the Pearl Island specimens are more coarsely punctate—particularly along base and sides of pronotum and on the elytra.

I designate as Lectoholotype a female in the BMNH.

→

Figs. 1–12. Dorsal Outlines and male external genitalia of species of *Desmopachria* of the *leechi-glabricula* Group. Fig. 1. *Desmopachria glabricula* Sharp, lectoholotype dorsal outline. Fig. 2. Same, external genitalia of a male from Costa Rica. Fig. 3. *Desmopachria leechi* n. sp., holotype dorsal outline. Fig. 4. Same, external genitalia of holotype. Fig. 4a. Same, lateral outline of aedeagus. Fig. 5. *Desmopachria strigata* n. sp., holotype dorsal outline. Fig. 6.



Same, external genitalia of holotype. Fig. 7. *Desmopachria flavida* n. sp., holotype dorsal outline. Fig. 8. Same, external genitalia of holotype. Fig. 9. *Desmopachria zimmermani* n. sp., holotype dorsal outline. Fig. 10. Same, external genitalia of holotype. Fig. 11. *Desmopachria volvata* n. sp., holotype dorsal outline with color pattern roughly indicated by stippling. Fig. 12. Same, external genitalia of male at left from above as in copulatory position; at right aedeagus and paramere viewed from below in copulatory position. All external male genitalia have been slightly spread apart before drying and, except for figure 12, are shown from above as in the copulatory position.

Desmopachria flavida, new species

Diagnosis.—A small, light yellowish brown species about 1.4 to 1.5 mm long. Greatest width near basal ⅓ of elytra about 1.0 mm. Similar to *grana* but less regularly oval in dorsal outline and much less coarsely punctate both above and below. Male external genitalia diagnostic (Fig. 8).

Holotype male.—Total length 1.4 mm; greatest width near basal ⅓ of elytra 1.0+ mm; width of pronotum at base 0.76 mm; width of pronotum at apex 0.52 mm; length of pronotum at midline 0.24 mm. Ovate, widest at basal ⅓ of elytra, somewhat attenuate behind. Head very finely, sparsely punctate on front and clypeus; clypeus just detectably truncate in front; clypeal impressions shallow, inconspicuous. Pronotal disk punctate about as on head; coarser basal punctures very sparse except toward sides; anterior transverse row of coarser punctures almost obliterated at middle. Elytral punctation relatively fine, somewhat coarser than on disk of pronotum; discal stria of slightly larger punctures distinct but not conspicuous. Hind coxae finely, sparsely punctate, the punctures about as coarse as those of head; nearly smooth between punctures, shining. Last visible sternite almost smooth, transversely impressed across middle. Color light yellowish brown above and below, narrowly darker along elytral suture and bases and along some sutures and joints.

Allotype female.—Very similar to male in punctation and color. Total length 1.5 mm; greatest width near basal ⅓ of elytra 1.0+ mm; width of pronotum at base 0.76 mm; width of pronotum at apex 0.52 mm; length of pronotum at midline about 0.30 mm.

Holotype and allotype from: MEXICO: *Nayarit,* Ixtlan del Rio, 22 September 1953, Borys Malkin (CAS). Paratypes: *Nayarit,* 25 miles S.W. Tepic, 23 November 1958, Hugh B. Leech (1 male FSCA). Cuernavaca (Flohr), ex cotypes of *D. circularis* Sharp, Biologia Centrali-Americana material (1 male, 2 females BMNH).

Desmopachria zimmermani, new species

Diagnosis.—A small reddish brown *Desmopachria* about 1.3 to 1.4 mm long by about 0.92 to 0.96 mm wide near middle of elytra. Body form short, subovate, somewhat attenuate behind. Punctation finer than in *grana.* Metasternum and hind coxae rather coarsely, but shallowly and sparsely punctate. Color generally yellowish brown or brownish yellow, the elytra slightly darker reddish brown and very much darker along suture and bases of pronotum. Hind coxae somewhat darker light reddish brown. Appendages light brownish yellow. Male external genitalia diagnostic (Fig. 10).

Holotype male.—Total length 1.36 mm; greatest width near middle of elytra 0.92 mm; width of pronotum at base 0.76 mm; width of pronotum at apex 0.48 mm; length of pronotum at midline 0.28 mm. Head finely, sparsely punctate, somewhat more finely so than in *grana*; clypeus rounded anteriorly, distinctly margined. Pronotal disk about as finely, but more sparsely punctate than vertex of head; as usual, punctures along anterior margin and base coarser, but all punctures finer than in *grana*. Elytra with basal punctures coarser and more regularly seriate than those on pronotal disk but distinctly finer than in *grana*. Venter punctate much as in *grana*; last visible abdominal sternite appearing nearly smooth with only a few visible punctures, much as in *grana*. Color much as described above.

Allotype female.—Total length 1.4 mm; greatest width near middle of elytra 0.96 mm; width of pronotum at base 0.76 mm; width of pronotum at apex 0.56 mm; length of pronotum at midline about 0.24 mm. Very similar to male.

Holotype, allotype, and 9 paratypes from: MEXICO: *Sinaloa,* 8 miles east of Concordia, 8 April 1975, J. R. Zimmerman (NMSU). Paratype: MEXICO: J. R. Zimmerman, *Sinaloa,* San Blas, 26 July 1968. P. J. Spangler (1 male NMNH).

I take pleasure in naming this species for James R. Zimmerman of New Mexico State University.

Desmopachria volvata, new species

Diagnosis.—A small *Desmopachria* about 1.3 to 1.5 mm long and about 0.9 to 0.96 mm wide near middle of elytra. Similar to *grana* in shape but more convex in lateral profile. Punctation finer throughout. Last visible abdominal sternite nearly smooth, transversely impressed just before apex as in *grana*. Elytra and pronotal disk vaguely clouded with darker color, and outer coxal laminae and edges of epipleurae dark brown. Male external genitalia diagnostic (Fig. 12).

Holotype male.—Ovate, slightly attenuate behind; convex in lateral profile. Total length 1.36 mm; greatest width near middle of elytra 0.96 mm; width of pronotum at base 0.72 mm; width of pronotum at apex 0.5 mm; length of pronotum at midline about 0.28 mm. Head and clypeus finely, sparsely punctate; clypeus rounded in front, distinctly margined. Pronotal disk appearing almost impunctate with some coarser punctures along anterior margin and base as usual. Elytra finely and shallowly punctate—the punctures sparse and becoming smaller and sparser toward sides and apex; discal stria with some coarse punctures, but inconspicuous. Venter with metasterum and coxae very finely punctate but with some irregular microsculpture. Abdomen appearing almost impunctate; last visible abdominal sternite smooth, shining, transversely impressed just before apex. Head brownish yellow on clypeus and front, the base darker brown. Pronotum brownish yellow at sides with disk vaguely infuscated with reddish brown. Elytra with suture dark brown (piceous) and bases narrowly dark brown;

base and outer margins brownish yellow; disk with vague dark brown cloud. Venter with hind coxae dark brown, metasternum reddish yellow, and appendages, abdomen, epipleurae, and sides of elytra brownish yellow with inner edges of epipleurae very dark brown (piceous).

Allotype female.—Very similar to male. Total length 1.48 mm; greatest width near middle of elytra 0.72; width of pronotum at base about 0.96 mm; width of pronotum at apex 0.56; length of pronotum at midline about 0.32.

Holotype, allotype, and 2 paratypes from: PANAMA: Albrook Forest Site, BLT at 100 feet elevation, 9–10 May 1968, R. S. Hutton. Five other Paratypes from same locality but other dates (NMNH).

Desmopachria strigata, new species

Diagnosis.—Larger, more convex, more coarsely punctate on elytra, and with different body shape from other members of group. Length about 1.6 to over 1.8 mm; greatest width near basal ⅓ of elytra about 1.1 to 1.2 mm. Male external genitalia elaborate with a strigate area suggesting a stridulatory mechanism (Fig. 6).

Holotype male.—Ovate, not very attenuate behind. Total length 1.84 mm; greatest width near basal ⅓ of elytra 1.2 mm; width of pronotum at base 0.96 mm; width of pronotum at apex 0.6 mm; length of pronotum at midline about 0.44 mm. Head moderately finely, sparsely punctate; clypeus somewhat more densely punctate than front, rounded in front, and distinctly margined. Pronotum punctate on disk about as coarsely as on front of head; less densely punctate than clypeus; more coarsely punctate across front margin and coarsely and irregularly punctate along base. Elytra more coarsely and closely punctate at bases and along suture than pronotum; punctures separated by less than their diameter near suture on bases and deeply impressed; irregular in shape but rarely confluent; shallower and sparser laterally and apically as usual. Metasternal wings and hind coxae coarsely, deeply, but sparsely punctate; punctures on coxae separated by more than their diameter. Abdomen almost smooth; last visible sternite transversely impressed across base and acutely so just before apex, the surface nearly smooth but with some coarser punctures and with some setate punctures at middle of penultimate visible sternite. Elytra reddish brown with head and pronotum uniformly light brownish yellow. Elytra deeper brown or piceous along suture and bases. Venter with hind coxae about same color as elytra; most of rest of venter, appendages, epipleurae, and sides of elytra light yellowish brown.

Allotype female.—Similar to male. Total length 1.76 mm; greatest width near basal ⅓ of elytra 1.2 mm; width of pronotum at base 0.96; width of pronotum at apex 0.72 mm; length of pronotum at midline 0.4 mm.

Holotype, allotype, and 17 paratypes from: BRAZIL: Mato Grosso, Corumba, presumably collected at light, collection of A. Zimmermann (ZSBS).

The holotype male of this series may be slightly abnormal in shape, but all the males have similar genitalia, and both males and females approximate in varying degrees the dorsal outline.

Abbreviations

Abbreviations used in this manuscript are as follows: FSCA, Florida State Collection of Arthropods, Gainesville, FL; UMMZ, University of Michigan Museum of Zoology, Ann Arbor, MI; NMNH, U.S. National Museum of Natural History, Washington, DC; PUC, Purdue University Collection, W. Lafayette, IN; MCZ, Museum of Comparative Zoology, Cambridge, MA; AMNH, American Museum of Natural History, New York, NY: CU, Cornell University Collection, Ithaca, NY; NMSU, New Mexico State University Collection, Los Alamos, NM; ZSBS, Zoologische Sammlung des Bayerischen Staats, München, Germany; BMNH, British Museum (Natural History), London, United Kingdom.

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TWO NEW GENERA, TWO NEW SPECIES OF BIDESSINE WATER BEETLES FROM SOUTH AMERICA (COLEOPTERA: DYTISCIDAE)

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Each of the two new genera and species described below are represented by a single male specimen. Hoping more specimens could be obtained, I have kept these specimens since they were collected 11 years ago. Because no more specimens of these unique beetles have been obtained I describe them here and dedicate this article to Hugh B. Leech, my friend and fellow water beetle enthusiast, on the occasion of his 70th birthday.

Hughbosdinius, new genus

Body form (Fig. 1) elongate-oval; lateral margins moderately discontinuous between pronotum and elytra; dorsum moderately convex. Head without transverse cervical stria or suture behind eyes; clypeus not thickened nor margined. Ultimate and penultimate segments of labial palpi broadened, subtriangular. Pronotum with narrow, lightly impressed, incurved plicae not connected by a transverse groove; sides narrowly evenly margined from base to apex. Scutellum concealed. Elytra without basal plicae or sutural striae; narrowly evenly margined laterally; epipleura shallowly excavated basally, without transverse subbasal carina. Prosternum strongly longitudinally carinate on midline; process narrow between midcoxae, apical portion broad, indistinctly but slightly depressed medially and margins indefinite, sides parallel, apex broadly rounded. Intercoxal process of metasternum narrow, the lateral margins continuous with metacoxal cavities. Metasternum deeply, transversely, and broadly depressed behind mesocoxae. Metacoxal processes not strongly incised at middle; with very narrow median longitudinal groove terminating on anterior margin of intercoxal process of metasternum; coxal lines slightly converging anteriorly. Last abdominal sternum moderately concave apicomedially. Anterior and middle tarsi pseudotetramerous; third tarsal segment moderately bilobed. Tarsal claws long, slender, and equal in length. Protibiae evenly arcuately rounded on apex (Fig. 5). Metatibial spurs straight. Metatrochanter and metafemur typically bidessine, not enlarged (Fig. 6). Male genitalia complex, with parameres jointed; median lobe slightly modified hydroporine

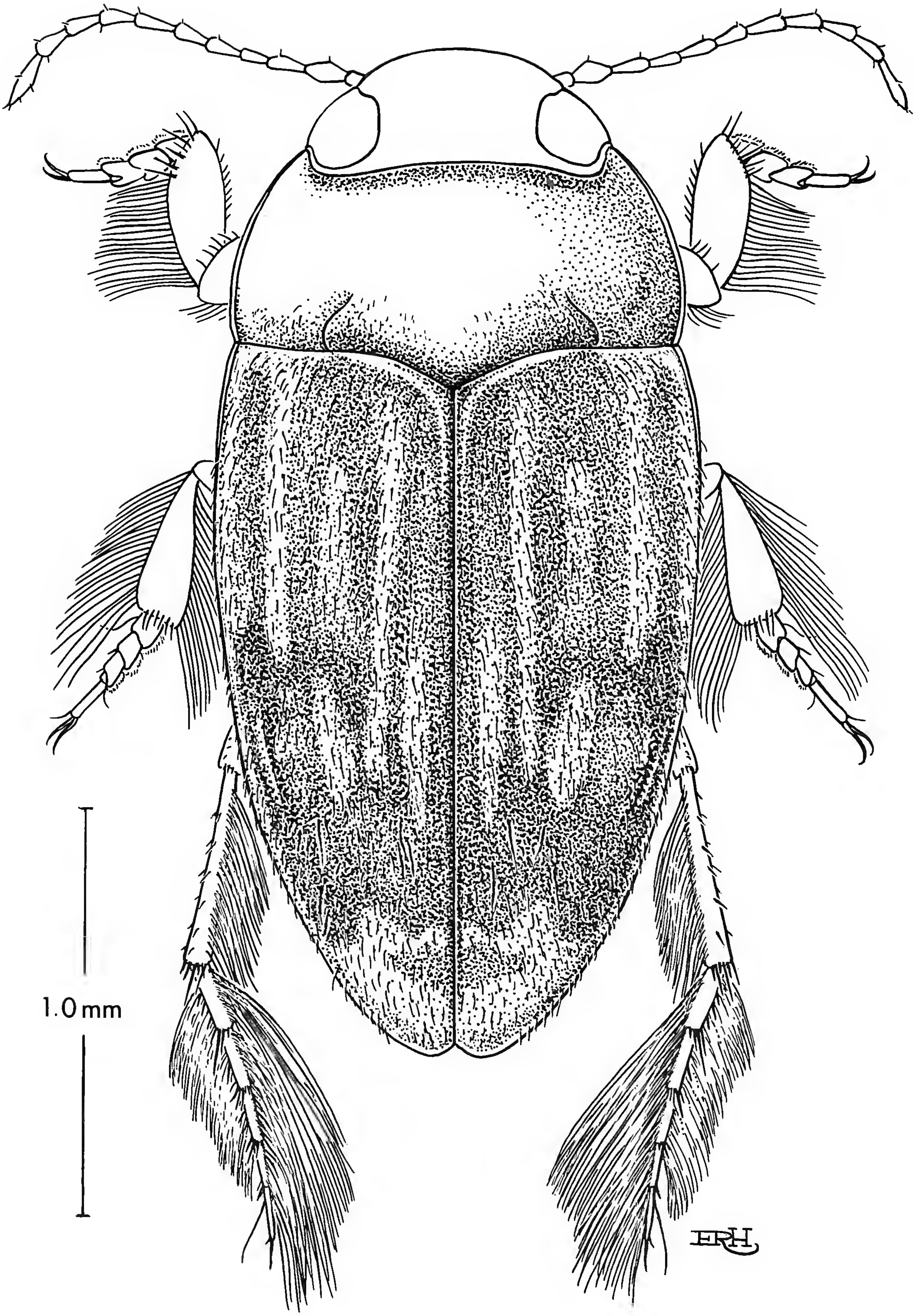


Fig. 1. *Hughbosdinius leechi,* n. gen., n. sp., habitus view.

type. Dorsum moderately finely densely punctate. Integument with opalescent sheen especially on elytra, metasternum, and second abdominal sternum.

Type-species.—Hughbosdinius leechi, new species.

Etymology.—Hughbosdinius, named for Hugh Bosdin Leech, in honor of his 70th birthday, in respect for his many excellent contributions to our knowledge of aquatic Coleoptera, for his years of encouragement and his selfless response to endless requests for assistance in all groups of insects. Gender: masculine.

Hughbosdinius leechi, new species

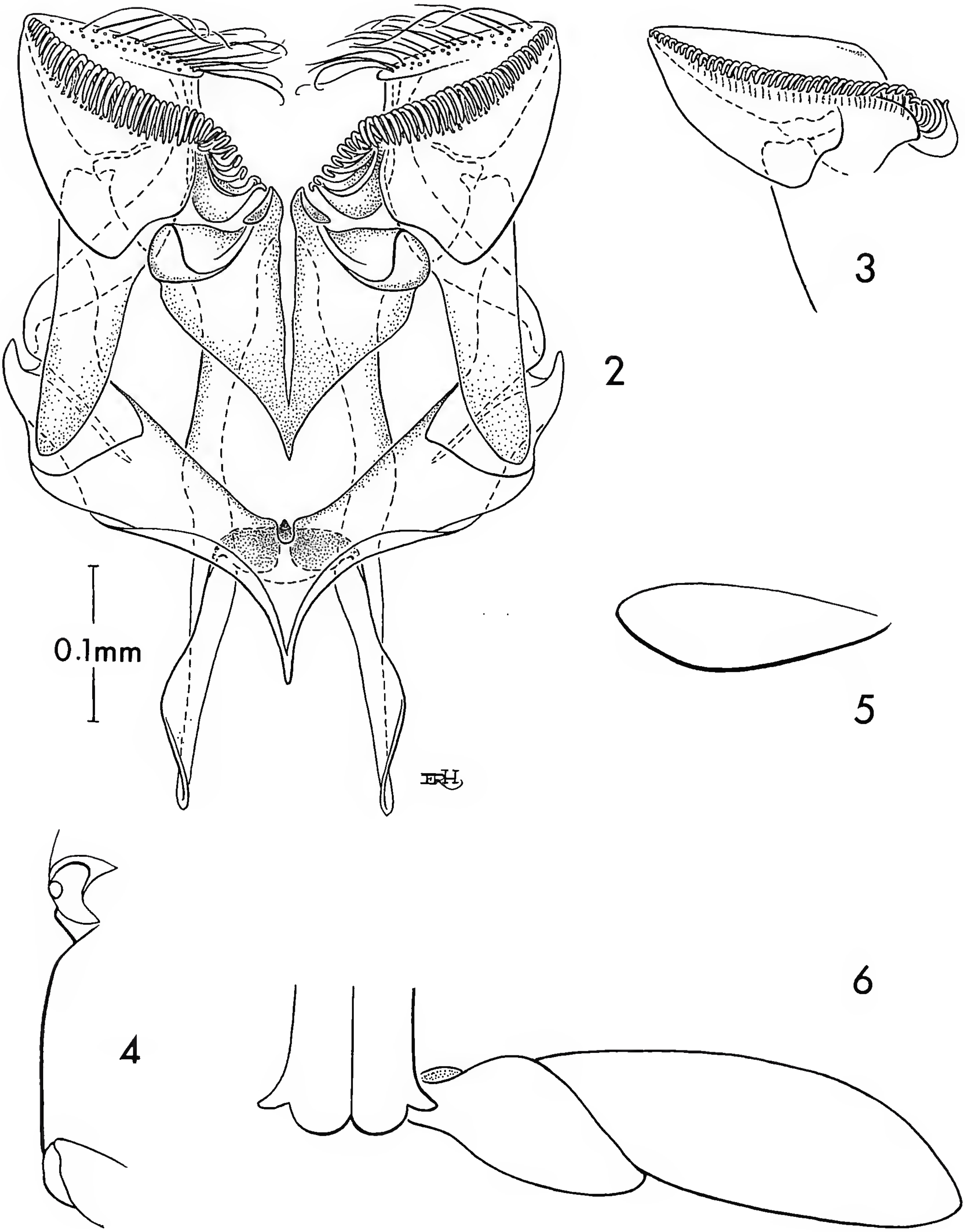
(Figs. 1–6)

Holotype male: Body form (Fig. 1) elongate-oval. Length 2.5 mm; greatest width 1.5 mm. Color reddish brown; head and pronotum concolorous. Elytron indistinctly vittate-fasciate, with dark reddish-brown vittae as follows: a sutural, three on disc, and three lateral maculae in a row (an interrupted lateral vitta); vittae interrupted in humeral area, on lateral third just anterior to midlength, on lateral two-thirds just posterior to midlength, and mostly terminated in a transverse fascia well before apex. Integument of elytra, metasternum, and second abdominal sternum with opalescent reflection in certain light. Venter reddish brown.

Head shining, smooth between fine, sparse punctures; punctures on disc separated by about 4 or 5 times their width; clypeal punctures indistinct; with slender yellowish setae arising from the punctures. Antenna slender, segments not compactly attached. Clypeus not thickened nor margined. Labrum sparsely finely punctate and narrowly deeply emarginate apicomedially. Ventral surface of head very finely and sparsely punctate.

Pronotum arcuate laterally, sides finely evenly margined for entire length; base moderately bisinuate; apicolateral angles acute; posterolateral angles obtuse; punctures coarser than those on head, sparse on disc, slightly closer laterally; discal punctures separated by 5 or 6 times their width; shallow, thin, strongly incurved plicae on base extending forward about one-third length of pronotum; sparse, slender, yellowish setae arising from punctures. Prosternum strongly longitudinally carinate on midline. Prosternal process narrow between midcoxae; apical portion broad, about three times wider than narrowest width between midcoxae; indistinctly but slightly depressed medially and margins indefinite; sides parallel; apex broadly rounded; surface finely densely punctate. Apex of prosternum broadly rounded and extending almost to midlength of mesocoxae. Mesosternum typical, unmodified. Intercoxal process of metasternum separated from posterior part of metasternum by a deep, transverse, broad depression (Fig. 4).

Scutellum hidden.



Figs. 2–6. *Hughbosdinius leechi,* n. gen., n. sp. Fig. 2, Male genitalia, ventral view. Fig. 3, Paramere, medial view of apex. Fig. 4, Metasternum in profile, Fig. 5, Protibia, outline. Fig. 6, Metatrochanter and metafemur, ventral view.

Elytron without basal plicae or sutural stria; arcuate and margined laterally; apex moderately rounded. Surface punctate similarly to head but punctures coarser and slightly denser; punctures on disc separated by 2 or 3 times their width; each puncture bearing a long, slender, yellow seta. Cuticle between punctures microalutaceous. Epipleuron shallowly excavated basally; without a carina; surface microalutaceous; sparsely, finely punctate almost to apex.

Venter mostly microalutaceous. Metacoxal plates microalutaceous; with coarse, seta-bearing, sparse punctures (except posteromedially); punctures separated by 2 or 3 times their width. Abdominal sternum 2 finely microalutaceous; sterna 3, 4, and 5 mostly smooth; sterna 3 and 4 each with a transverse row of seta-bearing punctures near posterior margin. Front and middle coxae moderately densely, moderately coarsely punctate. Hind trochanter smooth except for a few punctures. Femora smooth except for a few coarse sparse punctures. Front and middle legs pseudotetramerous; first, second, and third segments broad, bearing dense pads of setae modified as cupules; fourth segment minute, hidden between lobes of third segment. Tarsal claws slender, elongate, and equal in length. Front, middle, and hind tibiae each with a fringe of long natatory setae on inner and outer surfaces. Front tibia with apex arcuately rounded (Fig. 5). Metatibial spurs moderately long, straight. Metatrochanter and metafemur unmodified, typical bidessine type (Fig. 6).

Male genitalia complex with parameres jointed and hydroporine median lobe as illustrated (Figs. 2 and 3).

Etymology.—*leechi,* named for Hugh B. Leech for the reasons mentioned under the generic etymology and in appreciation for his advice and assistance with numerous aspects of my studies of aquatic beetles through the years.

Type-data.—Holotype male: VENEZUELA: Barinas: Obispo, 25 Feb. 1969, P. and P. Spangler. USNM Type No. 76698, deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Habitat.—The type-specimen was collected along the margin of Rio Masparro in a pool of standing water; elevation 183 m.

Youngulus, new genus

Body form (Fig. 7) elongate-oval; lateral margins moderately discontinuous between pronotum and elytra; dorsum moderately convex. Head without transverse cervical stria or suture behind eyes; clypeus not thickened nor margined; ultimate and penultimate segments of labial palpi unmodified, cylindrical. Pronotum with narrow, lightly impressed, incurved plicae not connected by a transverse groove; sides narrowly evenly margined from base to apex. Scutellum concealed. Elytra without basal plica (or with ex-

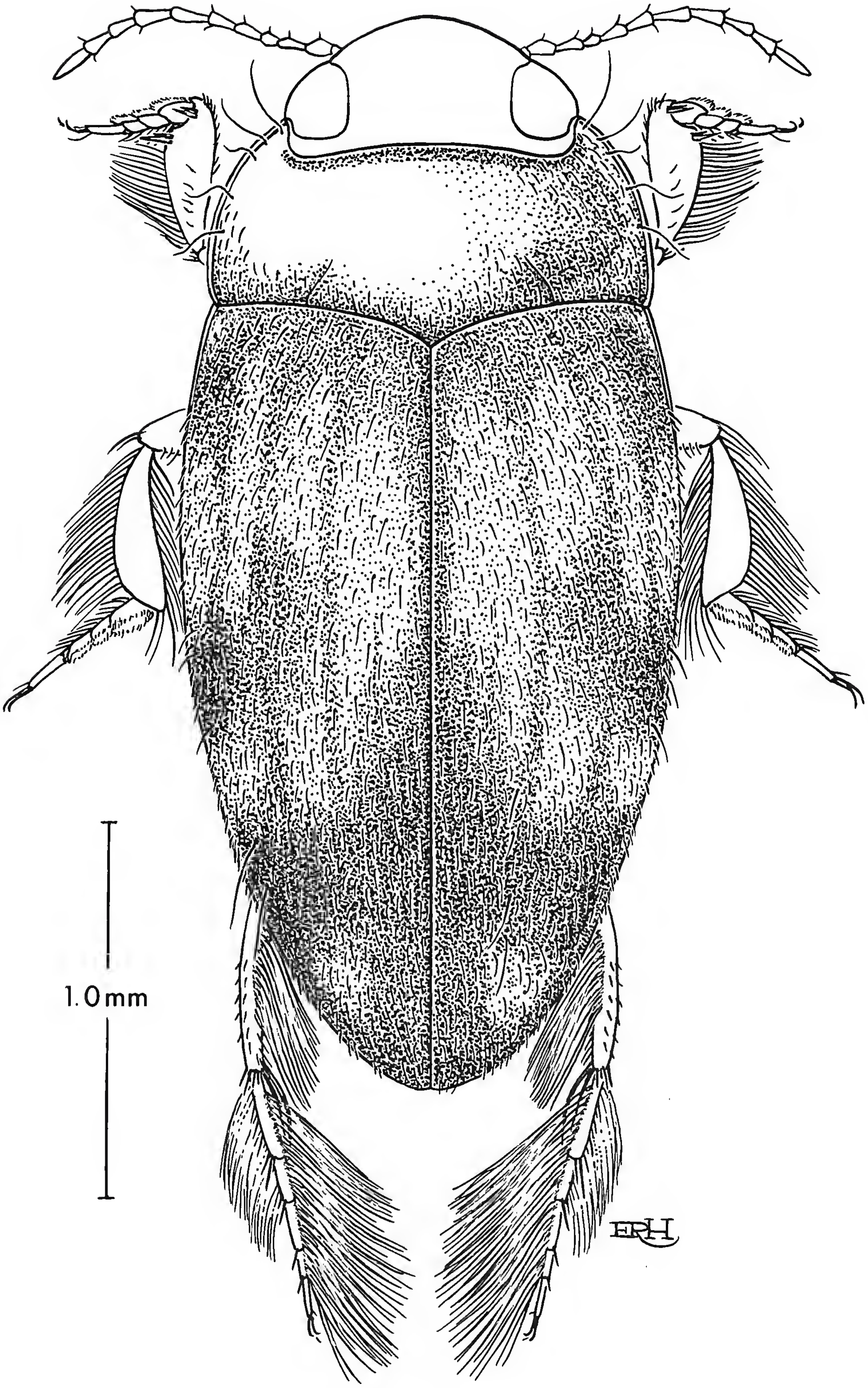


Fig. 7. *Youngulus franki*, n. gen., n. sp., habitus view.

tremely faint indication of one); sides narrowly evenly margined laterally; epipleuron shallowly excavated basally, without transverse carina. Prosternum slightly and moderately broadly elevated on midline before procoxae; process rather broad, shallowly depressed medially and unmargined, sides slightly converging posteriorly, apex obtusely rounded. Intercoxal process of metasternum narrow; the lateral margins continuous with those of middle coxal cavities. Metacoxal processes not strongly incised at middle; with narrow medial longitudinal groove terminating at hind edge of metasternum; coxal lines very slightly divergent anteriorly. Last abdominal sternum with very shallow medial and lateral depressions. Anterior and middle tarsi pseudotetramerous; third tarsal segment moderately bilobed; protarsal claws short, slender, unequal, outer (anterior) claw only about half as long as inner claw; mesotarsal and metatarsal claws long, slender, and equal in length. Protibiae strongly emarginate on apex (Fig. 11). Metatibial spurs long and slender, inner spur longer and strongly curved with apex directed away from body. Metatrochanter and metafemur greatly enlarged, inflated, closely attached (Fig. 12) and the two appearing as a robust wedge-shaped structure. Male genitalia with parameres jointed; median lobe typical hydroporine type. Dorsum moderately finely densely punctate. Integument with opalescent sheen especially on elytra, metasternum, and second abdominal sternum.

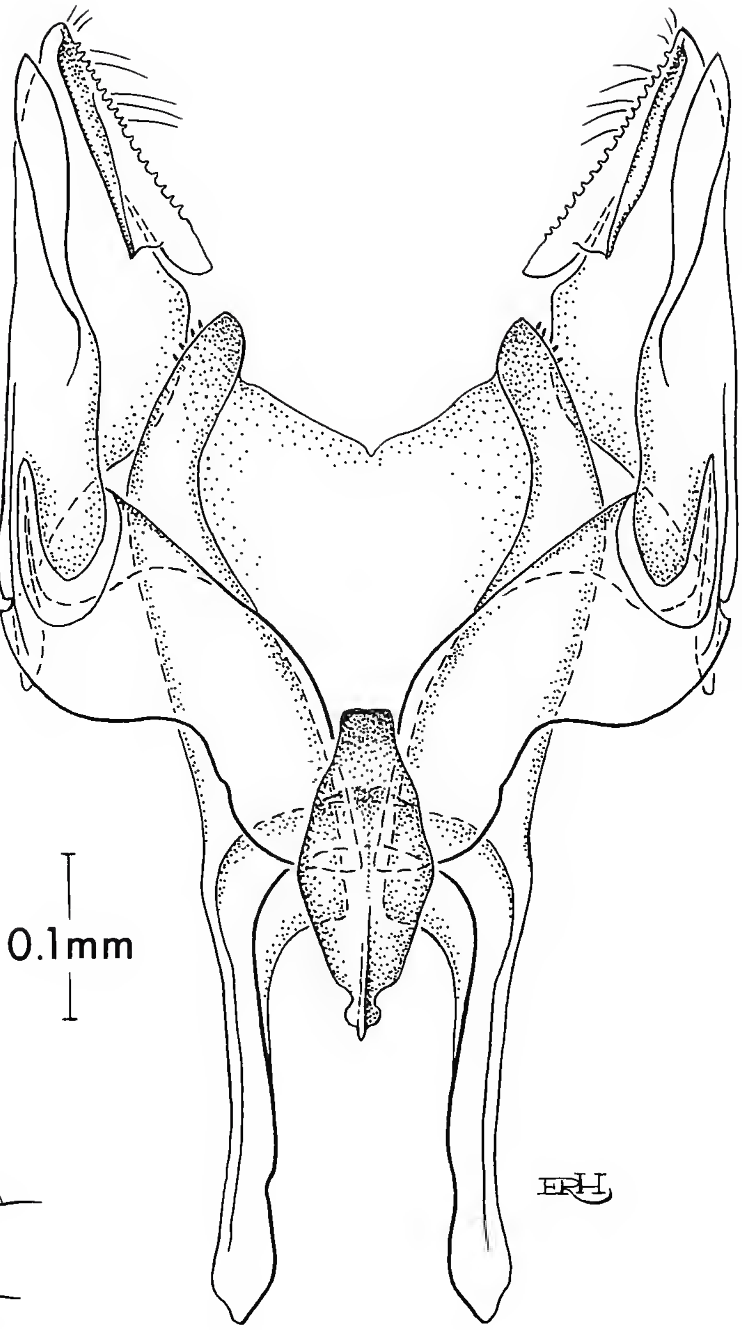
Type-species.—Youngulus franki, new species.

Etymology.—Youngulus, named for Frank N. Young who has contributed many excellent studies on aquatic beetles of the Western Hemisphere, and whose work on the bidessine dytiscids enabled me to recognize this new genus. Gender: masculine.

Youngulus franki, new species
(Figs. 7–12)

Holotype male: Body form (Fig. 7) elongate-oval. Length 3.0 mm; greatest width 1.8 mm. Color reddish brown; head and pronotum concolorous. Elytron indistinctly vittate-fasciate, with dark reddish-brown vittae as follows: a sutural; three vague, narrow ones on disc; and three lateral maculae in a row (an interrupted lateral vitta). Elytral vittae interrupted in humeral area, on lateral area, on lateral third just anterior to midlength, on lateral two-thirds just posterior to midlength and mostly terminated in a transverse fascia well before apex. Integument of elytra, metasternum, and second abdominal sternum with opalescent reflection in certain light. Venter reddish brown.

Head shining, smooth between moderately fine, sparse punctures; punctures on disc separated by about 3 to 5 times their width; clypeal punctures fine and moderately punctate; with slender yellowish setae arising from the



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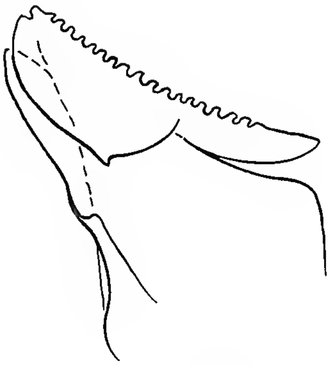

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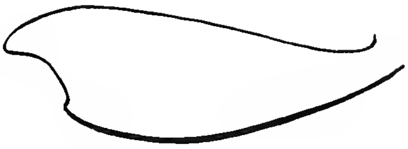

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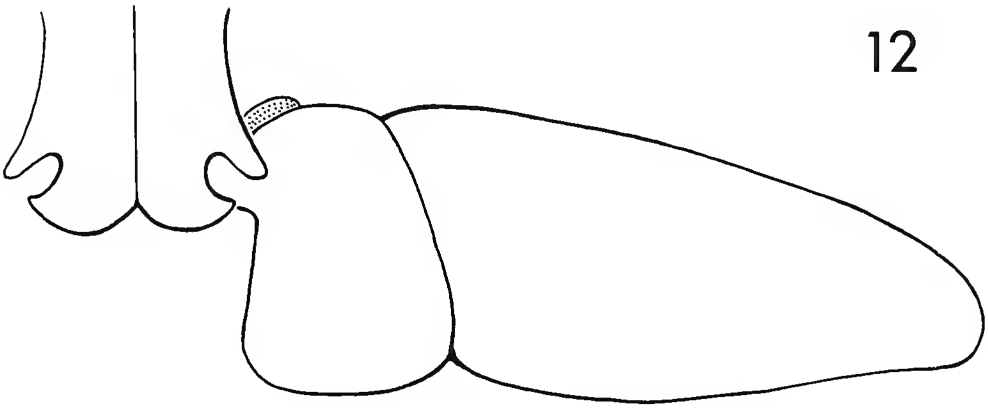

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Figs. 8–12. *Youngulus franki,* n. gen., n. sp. Fig. 8, Male genitalia, ventral view. Fig. 9, Paramere, medial view of apex. Fig. 10, Metasternum in profile. Fig. 11, Protibia, outline. Fig. 12, Metatrochanter and metafemur, ventral view.

punctures. Antenna slender, segments not compactly attached. Clypeus not thickened nor margined. Labrum sparsely finely punctate and broadly deeply emarginate apicomedially. Ventral surface of head smooth.

Pronotum arcuate laterally, sides finely evenly margined for entire length; base moderately bisinuate; apicolateral angles acute; posterolateral angles obtuse; punctures coarser than those on head, sparser on disc and more dense posteriorly and laterally; discal punctures separated by 1 to 4 times their width; shallow, thin, strongly incurved plicae on base extending forward about one-third length of pronotum; sparse slender yellowish setae arising from punctures. Prosternum slightly and moderately broadly elevated on midline before procoxae; process rather broad, shallowly depressed medially and unmargined, sides slightly converging posteriorly, apex obtusely rounded, surface finely densely punctate; apex obtusely rounded and extending almost to midlength of mesocoxae. Mesosternum typical, unmodified. Intercoxal process of metasternum on same plane as posterior part, not interrupted (Fig. 10).

Scutellum hidden.

Elytron without basal plica (or with extremely faint indication of one); arcuate and margined laterally; apex moderately rounded; surface punctate similarly to head but punctures coarser and slightly denser; punctures on disc separated by 1 or 2 times their width; each puncture bearing a long, slender yellow seta; cuticle between punctures microalutaceous; epipleuron shallowly excavated basally, without carina, surface microalutaceous and sparsely finely punctate almost to apex.

Venter mostly microalutaceous. Metacoxal plates microalutaceous; with coarse seta-bearing punctures (except posteromedially), punctures separated by 1 or 2 times their width. Abdominal sternum 2 finely microalutaceous; sterna 3 and 4 smooth except each with two irregular anterior rows and two irregular posterior rows of seta-bearing punctures. Front and middle coxae finely, moderately densely punctate. Hind trochanter smooth except for a few punctures. Front femur practically impunctate on ventral surface; middle femur with several rows of coarse punctures along front and hind margins; hind femur with few fine seta-bearing punctures. Front and middle legs pseudotetramerous; first, second, and third segments broad, bearing dense pads of setae modified as cupules; fourth segment minute, hidden between lobes of third segment. Protarsal claws slender, unequal; outer (anterior) claw only about half as long as inner claw. Mesotarsal and metatarsal claws long, slender, and equal in length. Front, middle, and hind tibiae each with a fringe of long natatory setae on inner and outer surface. Front tibia with apex strongly emarginate (Fig. 11). Metatibial spurs long and slender; inner spur longest and strongly curved, apex directed laterally away from body. Metatrochanter and metafemur greatly enlarged, inflated, closely attached (Fig. 12) and the two appearing as a robust wedge-shaped structure.

Male genitalia complex with parameres jointed and median lobe typically hydroporine as illustrated (Figs. 8, 9).

Etymology.—*franki,* named for Frank N. Young, whose previous publications on the Bidessini allowed me to recognize this new genus, new species, and for numerous favors and gifts of specimens in past years.

Type-data.—Holotype male: COLOMBIA: Meta: Villavicencio (10 km south), 3 and 4 Mar. 1969, P. and P. Spangler. USNM Type No. 76699, deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Habitat.—The type-specimen was collected in a shallow, weedy, roadside ditch; elevation 305 m.

Discussion

The two new genera described here key to the genus *Bidessodes* in Young's (1967) key to the American genera of bidessine dytiscid beetles. However, members of the genus *Hughbosdinius* may be distinguished from members of the genus *Bidessodes* and all other bidessine dytiscids known to me by the distinctive, very deep, transverse, broad depression of the metasternum directly behind the mesocoxae; by the strong longitudinal carina on the midline of the prosternum; and the broad, subtriangular penultimate and ultimate segments of the labial palpi. Members of the genus *Youngulus* may be distinguished from all other bidessine dytiscids known to me by the greatly enlarged, inflated, wedge-shaped, combined metatrochanter and metafemur; by the long slender metatibial spurs; and the inner spur which is the longer and is strongly curved with the apex away from the body.

The following couplets substituted in place of the second rubric of couplet 13 in Young's (1967) key will distinguish the genera *Hughbosdinius* and *Youngulus* from *Bidessodes.*

1. Intercoxal process of metasternum separated from posterior part of metasternum by a very deep, transverse, broad depression; prosternum strongly longitudinally carinate on midline on anterior half; penultimate and ultimate segments of labial palpi modified—broad and subtriangular; Venezuela .... *Hughbosdinius* Spangler
   Intercoxal process of metasternum continued posteriorly uninterrupted and on same plane as posterior part; prosternum not longitudinally carinate; ultimate and penultimate segments of labial palpi unmodified 2
2. Metatrochanter and metafemur greatly enlarged, inflated, closely attached; the two appearing as a robust, wedge-shaped structure; Colombia .... *Youngulus* Spangler
   Metatrochanter and metafemur normal, not enlarged, inflated, nor wedge-shaped; Central and South America ... *Bidessodes* Régimbart

I am very grateful to the administrators of the Smithsonian Institution's Research Foundation for SI Grant No. Sg0633100 for the financial support for fieldwork during which time the new taxa described above were collected. For assistance with the South American fieldwork and for reviewing and typing this manuscript I thank my wife Phyllis M. Spangler. I also extend my thanks to Mrs. Elaine R. Hodges, Smithsonian Institution staff artist, for preparing the illustrations in her usual lucid and attractive style.

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Young, F. N. 1967. A key to the genera of American Bidessine water beetles, with descriptions of three new genera (Coleoptera: Dytiscidae, Hydroporinae). Coleopt. Bull., 21:75–84.

PAN-PACIFIC ENTOMOLOGIST
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KEY TO THE WORLD GENERA OF LARINAE (COLEOPTERA, DRYOPOIDEA, ELMIDAE), WITH DESCRIPTIONS OF NEW GENERA FROM HISPANIOLA, COLOMBIA, AUSTRALIA, AND NEW GUINEA

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The most recent attempt to construct a key to the world genera of Larinae or Larini (he considered them but a tribe) is that of Hinton (1940). His key included 11 genera. Since that time, Delève (1963) has described the genus *Potamolatres* based upon a new African species, resurrected *Potamocares* Grouvelle (1920) and placed in it some of the African species considered *Hydrethus* by Hinton (1937), erected the genus *Potamogethes* for the remaining African species formerly placed in *Hydrethus,* and erected the genus *Omotonus* for the African species previously in *Potamophilinus*. Delève (1967) also noted that *Freyiella* Bollow (1938) was synonymous with *Potamophilinus*. *Freyiella* had not been included in Hinton's key anyway, perhaps because of the wartime delay in publication or distribution of Bollow's paper. Hinton also omitted *Potamophilops* from his key, but stated that it would run to *Hexanchorus,* with which he thought it was probably synonymous. (He had not seen the wing venation or the distinctive larva.) The keys of Coquérel (1851), Grouvelle (1896), and Delève (1963), though limited in coverage, are all of value. It was Coquérel's key that gave me the clue to the existence of one of the new genera described below (*Pseudodisersus*). A second new genus (*Ovolara*) came to light because of biogeographical probability: it seemed unlikely that the genus *Hydrethus* would be restricted to Madagascar and Australia; furthermore, the fact that one Australian species was initially described in the genus *Lutrochus,* which is very different from most Larinae, made me very suspicious of its generic designation. The aedeagus figured by Satô (1973) for beetles he thought to be *Potamophilus papuanus* (Carter) was sufficiently different from that of other species of *Potamophilus* to lead me to guess that it represented a new genus. The impetus for the construction of a key came from my discovery of the new genus *Hispaniolara* and the necessity to describe it in relation to all other known genera. Since the literature is so scattered and illustrations so hard to find, I am taking the liberty of reproducing a number of figures which should be helpful to the reader in addition to my own drawings.

Key to World Genera of Larinae

1. Each elytron with 2 accessory striae at base between sutural and second stria; prosternum broadly truncate or feebly rounded posteriorly (Figs. 1, 14) .... (Africa, Madagascar) (35 spp.) *Potamodytes* Grouvelle 1896

1a. Each elytron with only one accessory basal stria or none between sutural and second stria; prosternum tapering to a subacute apex 2

2 (1a). Elytra with no accessory basal striae 3

2a. Each elytron with one accessory basal stria 9

3 (2). Pronotum on each side with a longitudinal carina or sulcus on basal third 4

3a. Pronotum without a carina or sulcus on each side 5

4 (3). Pronotum broadest at base, without transverse impressions; elytral intervals convex; prosternum very broad between coxae (Fig. 2) .... (Japan, Malaysia) (3 spp.) *Dryopomorphus* Hinton 1936

4a. Pronotum constricted at base, with a transverse impression on each side at apical third; elytral intervals flat; prosternal process long (Figs. 3, 15) .... (South America, West Indies, Central America to Texas) (7 spp.) *Phanocerus* Sharp 1882

5 (3a). Pronotum without transverse impression (Figs. 4, 16) .... (Costa Rica to Ecuador) (2 spp.) *Disersus* Sharp 1882

5a. Pronotum with a distinct transverse impression in anterior third 6

6 (5a). Pronotum with a deep, median, longitudinal impression from base to transverse impression and with posterior angles bidentate (Figs. 5, 61–64) .... (Colombia) (1 sp.) *Pseudodisersus,* new genus

6a. Pronotum without such a median longitudinal impression and with posterior angles simple 7

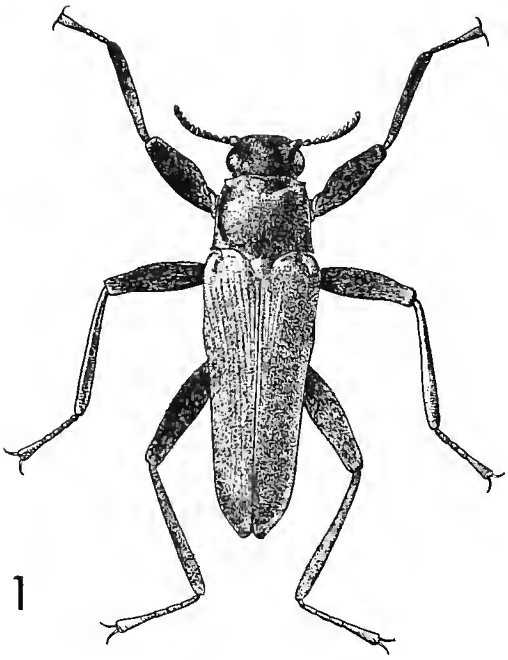
7 (6a). Middle femur longer than body width (Figs. 6, 17, 49–57) .. .... (West Indies: Hispaniola) (1 sp.) *Hispaniolara,* new genus

7a. Middle femur shorter than maximum body width 8

8 (7a). Hind wing with a closed anal cell; large, over 6 mm long (Figs. 7, 18) .... (Brazil, Argentina) (1 sp.) *Potamophilops* Grouvelle 1896

8a. Hind wing without a closed anal cell; smaller, less than 5 mm long (Figs. 8, 19) .... (South America, Central America, Lesser Antilles) (7 spp.) *Hexanchorus* Sharp 1882

9 (2a). Pronotum on each side with a sublateral longitudinal carina or sulcus on at least basal fifth 10



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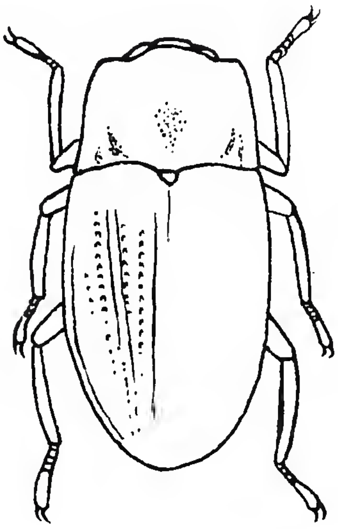

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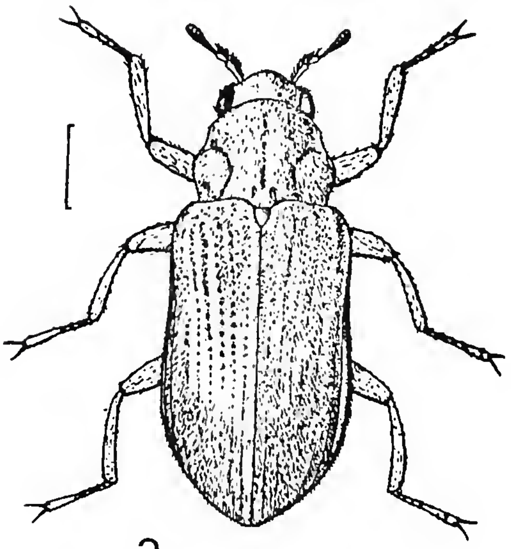

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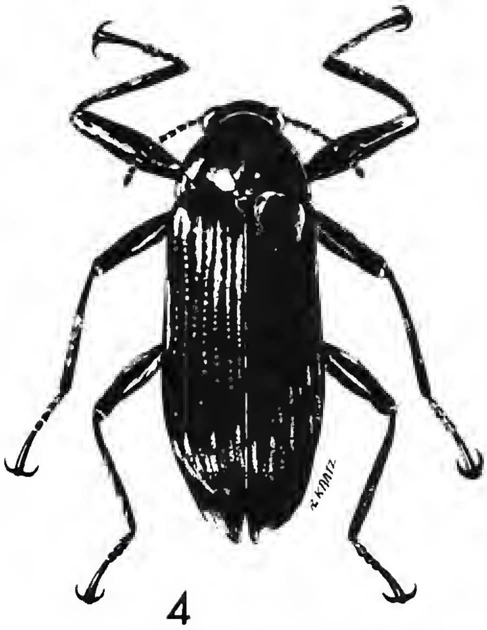

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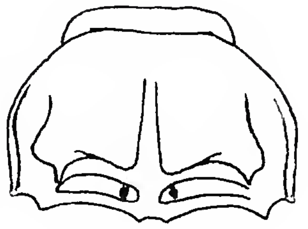
Figs. 1–4. Fig. 1. *Potamodytes ochus,* 7.5 mm. (From Hinton, 1948, Fig. 12.) Fig. 2. *Dryopomorphus nakanei,* 3 mm. (Drawn from photograph by Nomura, 1958, Pl. I, Fig. 4.) Fig. 3. *Phanocerus clavicornis,* 2–3 mm. (From Hinton, 1940, Fig. 56.) Fig. 4. *Disersus longipennis,* 8.5 mm. (From painting by Ramona Kaatz of specimen from near Buenos Aires, Costa Rica.)

9a. Pronotum without basal carinae or sulci 11

10 (9). Body oval or elliptical; antennal club compact; prosternum with anterior margin produced (Figs. 9, 20, 27, 29, 58) .....
.... (Australia) (2 spp.) *Ovolara,* new genus

10a. Body elongate; antennal club not compact; prosternum with anterior margin not produced (Figs. 21, 28, 30) ....
.... (New Zealand, Australia) (8 spp.— additional species from Chile are being described elsewhere) *Hydora* Broun 1882



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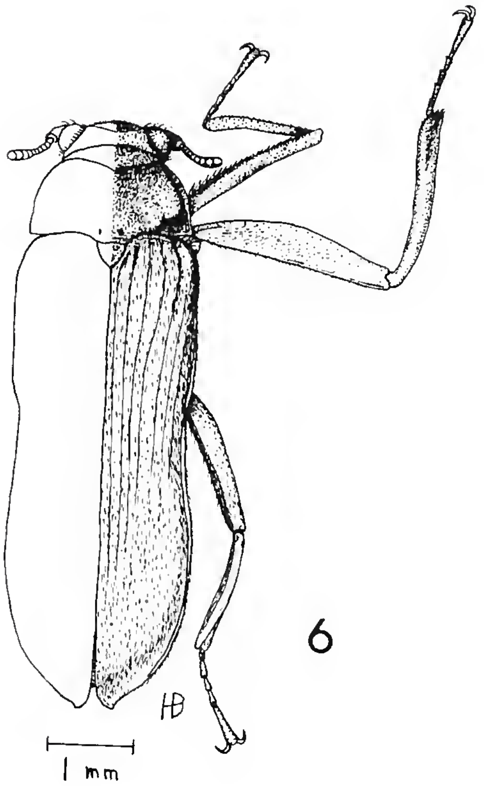

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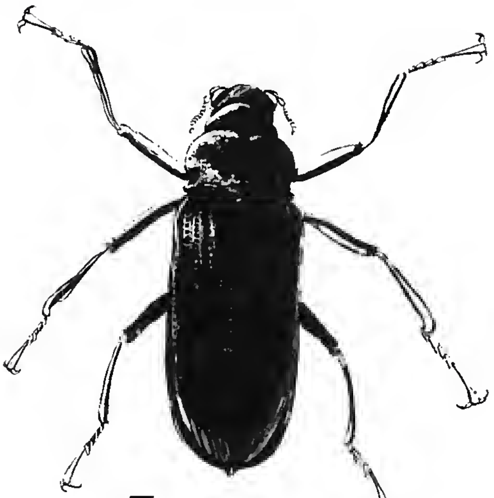

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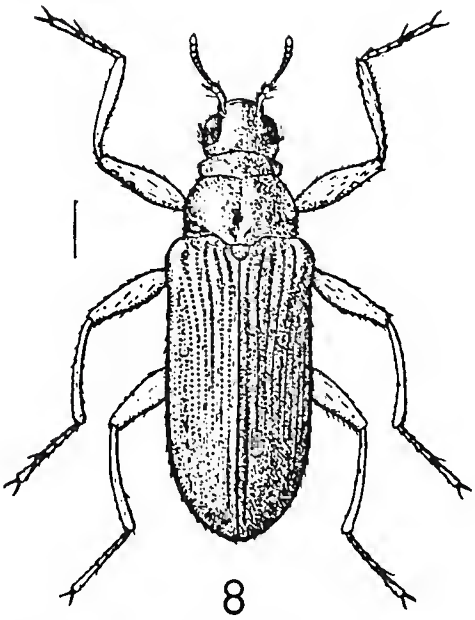

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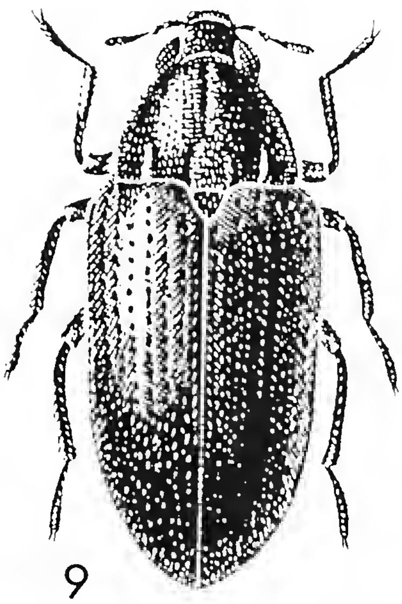

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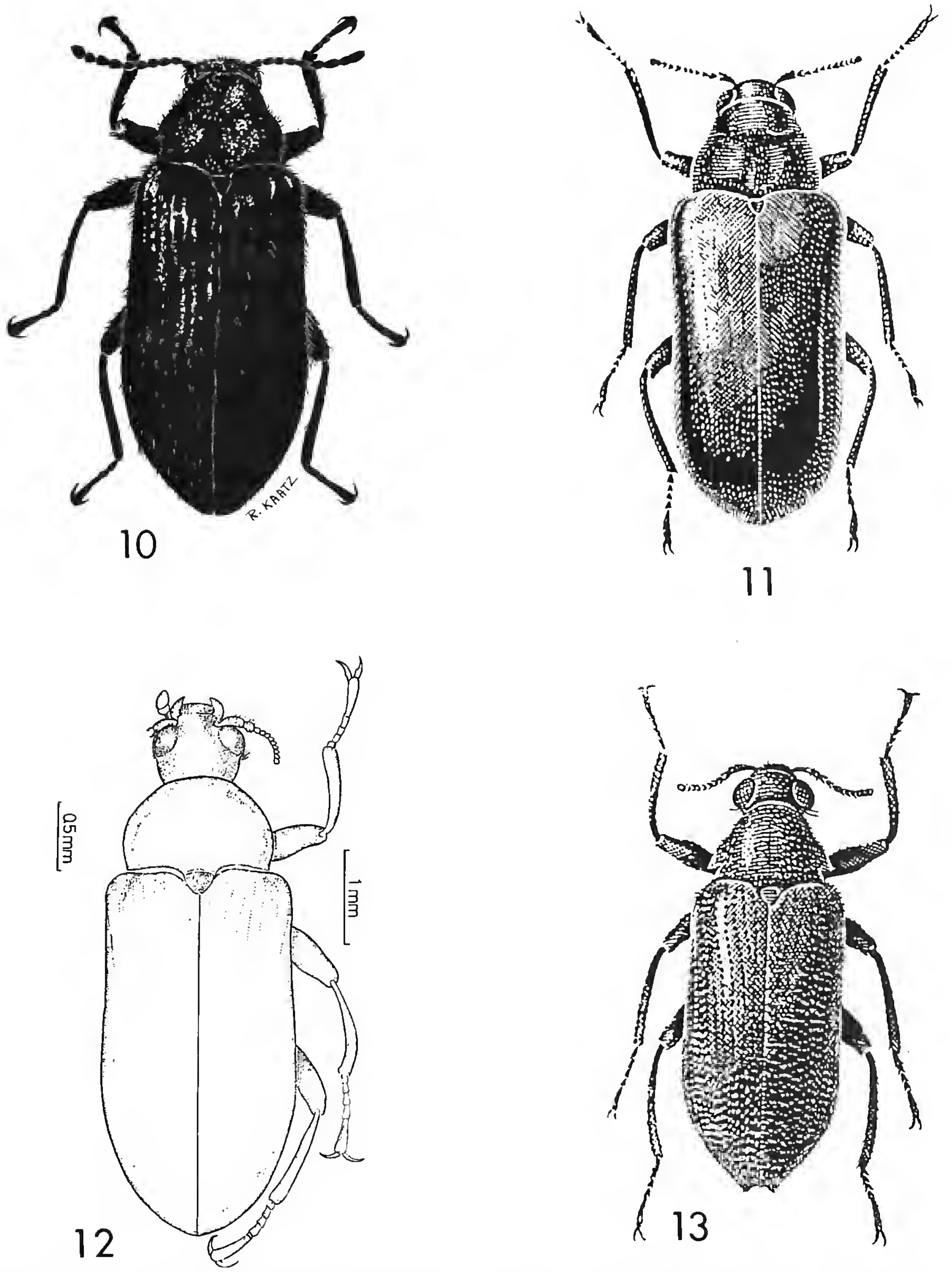
Figs. 5–9. Fig. 5. *Pseudodisersus goudotii,* 7 mm. Pronotum. (From Coquérel, 1851, Pl. 15, Fig. 10.) Fig. 6. *Hispaniolara farri* n. sp., 6.75 mm. Fig. 7. *Potamophilops* sp., 6.5 mm. (From painting by Mary Catron of specimen from Estreito, Maranhão, Brazil.) Fig. 8. *Hexanchorus gracilipes,* 3.5–4.0 mm. (From Hinton, 1940, Fig. 20.) Fig. 9. *Ovolara australis,* 3.5 mm. (From Carter and Zeck, 1929, Pl. III, Fig. 17.)



Figs. 10–13. Fig. 10. *Lara avara,* 7.5 mm. (From painting by Ramona Kaatz of specimen from Latah Co., Idaho.) Fig. 11. *Stetholus elongatus,* 5.3–6.0 mm. (From Carter and Zeck, 1929, Pl. II, Fig. 16.) Fig. 12. *Potamogethes* sp., 5.3 mm. (From Delève, 1966, Fig. 5.) Fig. 13. *Potamophilus papuanus,* 6–7 mm. (From Carter, 1930, Pl. IV, Fig. 1.)

11(9a). Pronotum with rugosities (wrinkles); large (over 6 mm long) .... (Madagascar) (1 sp.) *Potamolatres* Delève 1963

11a. Pronotum without rugosities 12

12(11a). Hind wing with a radial cross-vein (Figs. 10, 22) .... (western North America) (2 spp.) *Lara* Le Conte 1852

12a. Hind wing without a radial cross-vein 13

13(12a). Hind wing with veins $2A_1$ and $2A_2$ separate and distinct (Figs. 24–26) 17

13a. Wing with veins $2A_1$ fused with $2A_2$ (= vein $2A_{1+2}$ in Fig. 23) 14

14(13a). Aedeagus with basal piece greatly reduced, less than one fourth as long as penis (Fig. 31) 15

14a. Aedeagus with basal piece rather well-developed, at least one third as long as penis (Fig. 35) 16

15(14). Elytra with humeri prominent and projecting; striae feeble, effaced in scutellar region; prosternal process with sides subparallel in basal two-thirds (Figs. 23, 32, 34) .... (Africa) (5 spp.) *Omotonus* Delève 1963

15a. Elytra with humeri not projecting; striae distinct, accessory striae always visible; prosternal process subtriangular or tapering from base (Figs. 12, 33, wing venation as in Fig. 23) .... (Africa) (4 spp.) *Potamogethes* Delève 1963

16(14a). Abdominal segments subequal (wing venation as in Fig. 23) ...... (Madagascar) (3 spp.) *Hydrethus* Fairmaire 1889

16a. Abdominal segments 1+2 conspicuously longer than 3+4+5 (Figs. 35, 36, 41) .... (Southeast Asia, East Indies) (11 spp.) *Potamophilinus* Grouvelle 1896

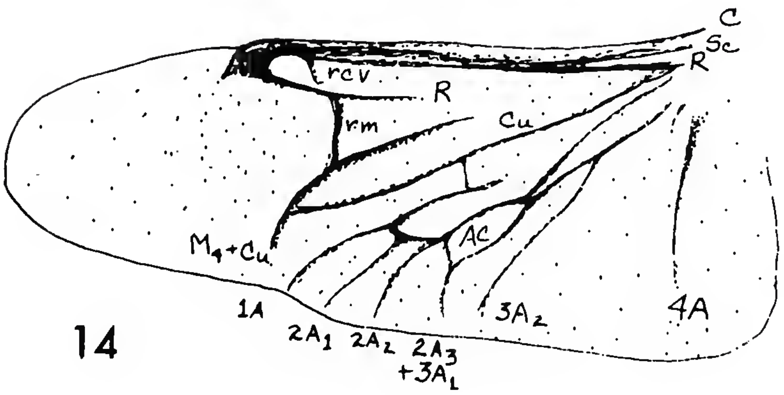
17(13). Pronotum bilobed, with anterior lobe more convex and separated from posterior lobe by a shallow V-shaped depression; hind wing with vein $3A_1$ joining 2A proximal to closed anal cell (Figs. 11, 24) .... (Australia) (1 sp.) *Stetholus* Carter and Zeck 1929

17a. Pronotum not bilobed; hind wing with vein $3A_1$ joining 2A at or along margin of the closed anal cell (Figs. 25, 26) 18

18(17a). Pronotum evenly convex, with lateral margins reflected upward and resembling a gutter (Figs. 25, 31) .... (Africa) (4 spp.) *Potamocares* Grouvelle 1920

18a. Pronotum not evenly convex; with distinct impressions; lateral margins not gutter-like 19

19(18a). Elytral apices divergent and acute; aedeagus with penis and parameres not fused basally and with both tapering conspicuously from base toward apex (Figs. 13, 26, 37, 39, 42, 43, 59, 60) .... (Europe to East Indies) (5 spp.) *Potamophilus* Germar 1811



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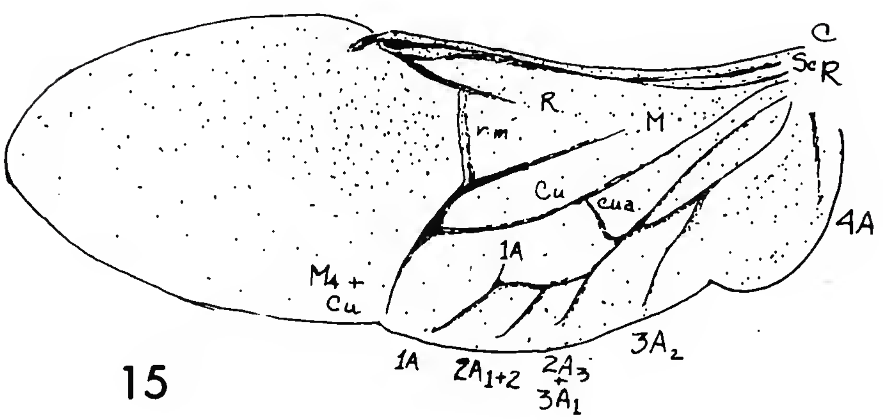

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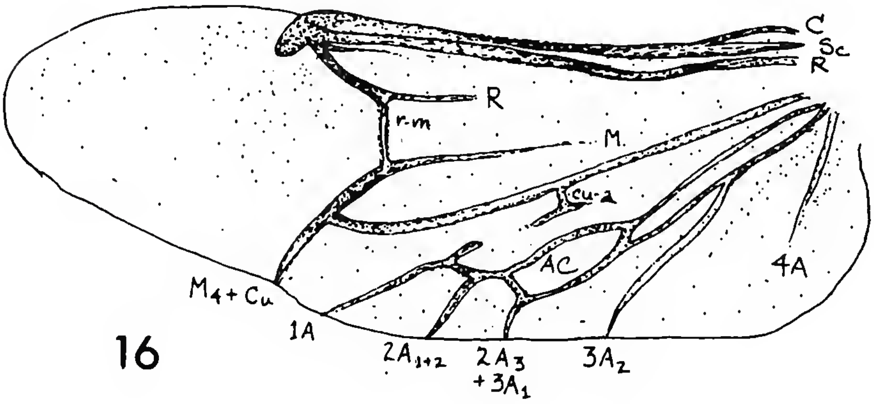

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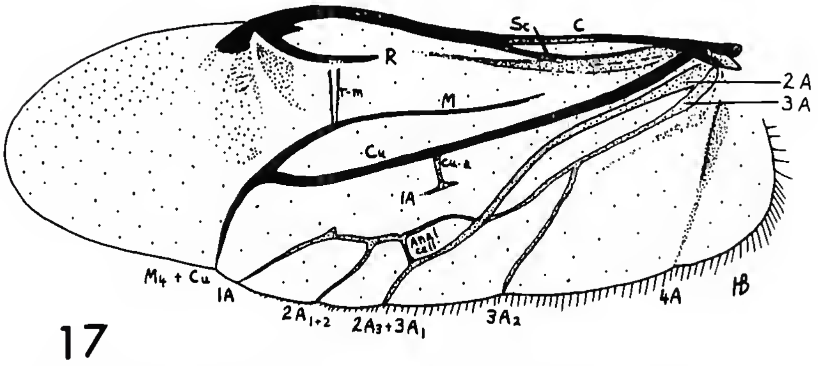

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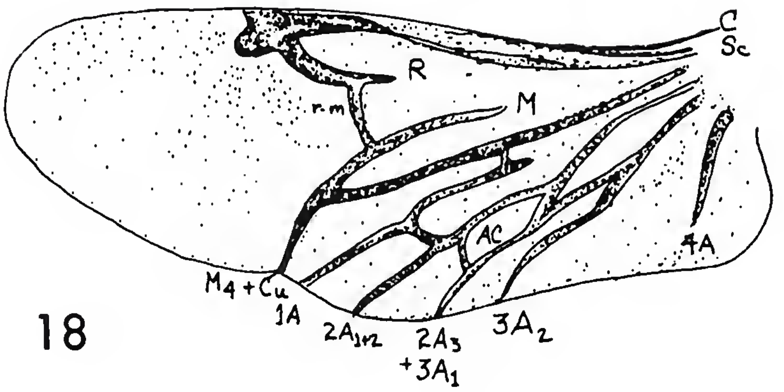
Figs. 14–17. Fig. 14. *Potamodytes tuberosus,* venation of wing, after Forbes (1926). (From Hinton, 1940, Fig. 4.) Fig. 15. *Phanocerus clavicornis,* wing. (From Hinton, 1940, Fig. 57.) Fig. 16. *Disersus longipennis,* wing. Fig. 17. *Hispaniolara farri* n. sp., wing. Like *Disersus,* but with 2A joining 3A before dividing.



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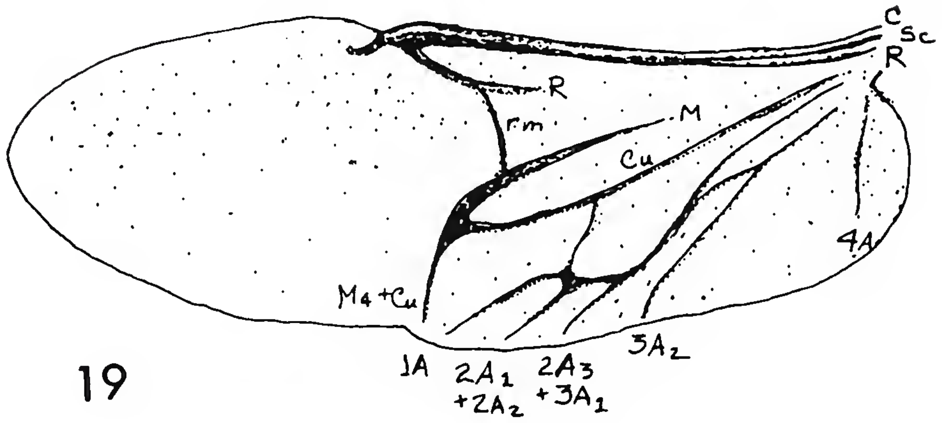

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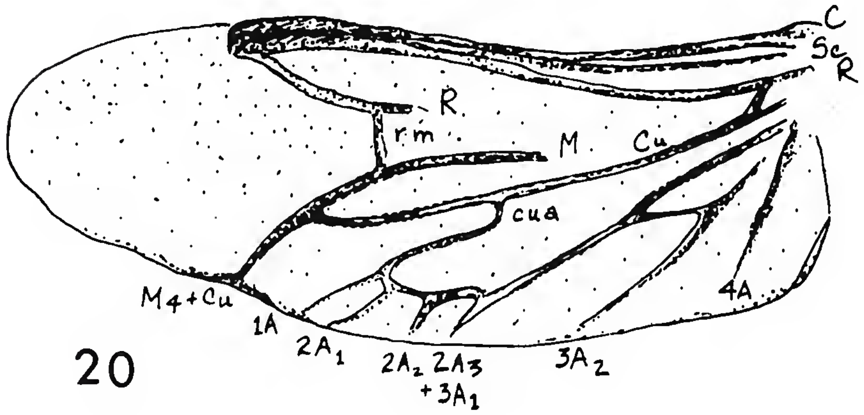

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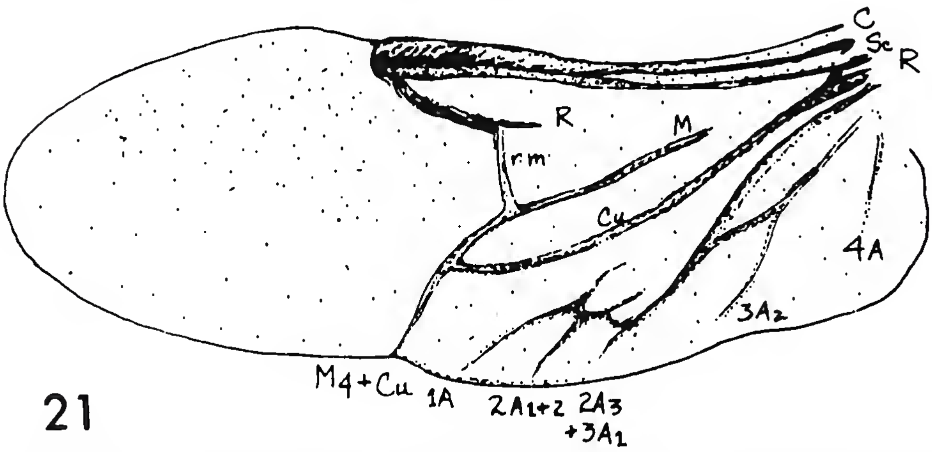

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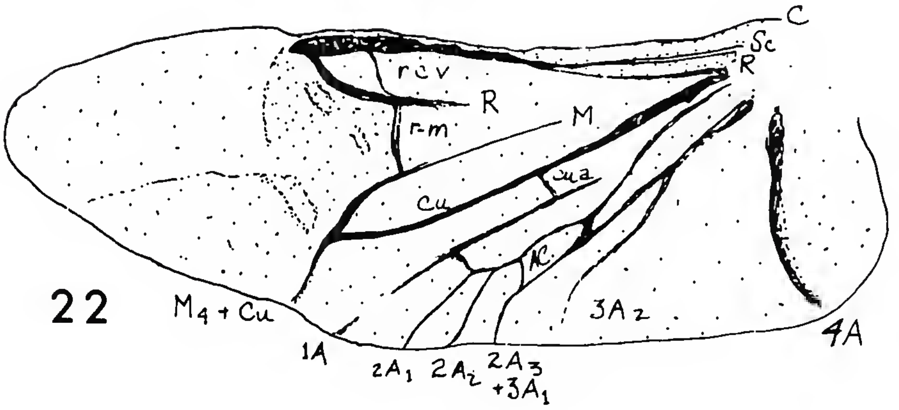
Figs. 18–21. Fig. 18. *Potamophilops* sp., wing. *AC* = closed anal cell. Like *Disersus* but with 1A more complete. Fig. 19. *Hexanchorus gracilipes,* wing. (From Hinton, 1940, Fig. 12.) Fig. 20. *Ovolara australis,* wing. Fig. 21. *Hydora* sp., wing. Differs from *Ovolara* chiefly in having veins $2A_1$ and $2A_2$ fused (?), so that only one vein occurs between 1A and $2A_3+3A_1$.



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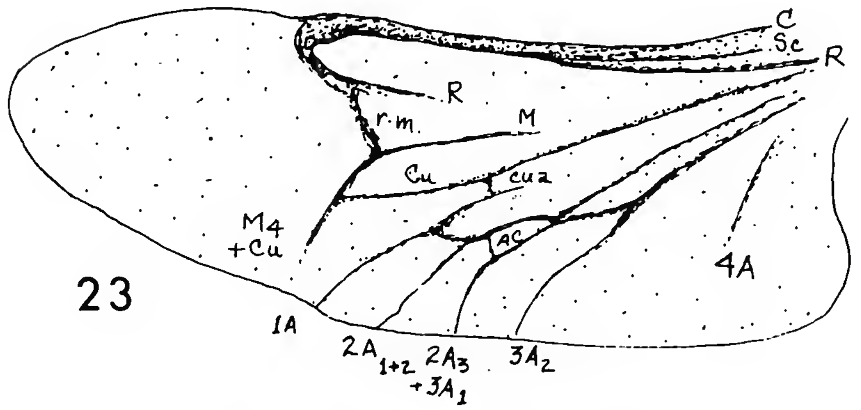

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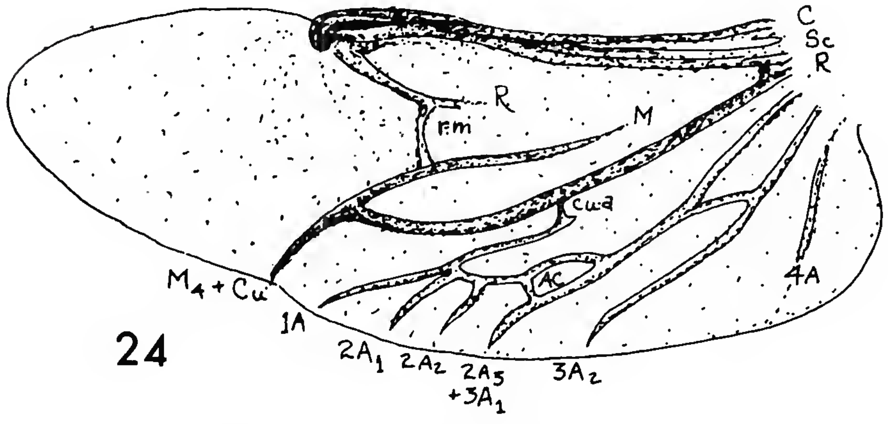

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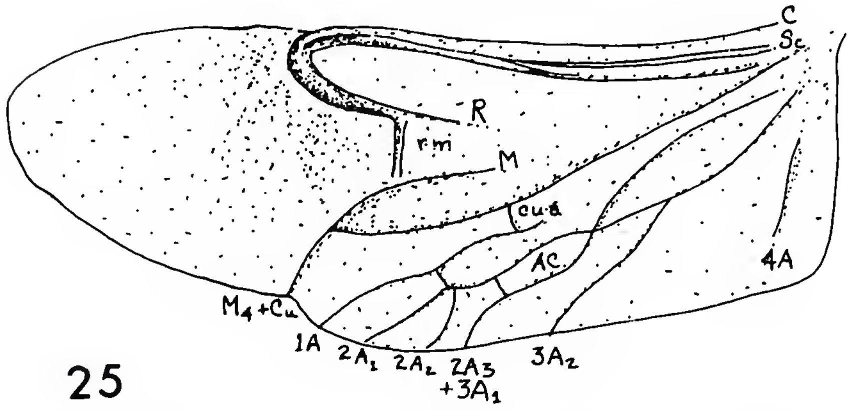

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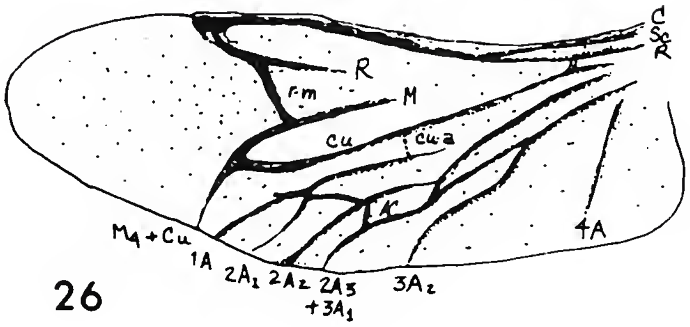
Figs. 22–25. Fig. 22. *Lara avara,* wing; *rc-v* = radial cross-vein. (From Hinton, 1940, Fig. 1.) Fig. 23. *Omotonus notabilis,* wing. Venation is essentially similar in *Hydrethus, Potamogethes,* and *Potamophilinus.* (From Delève, 1963, Fig. 28.) Fig. 24. *Stetholus elongatus,* wing. Vein $3A_1$ joins 2A before it divides. Fig. 25. *Potamocares burgeoni,* wing. (From Delève, 1963, Fig. 31. In the caption to Delève's figures, this one is labeled *Hydrethus proximus,* but his discussion on p. 445 makes it evident that his Figs. 30 and 31 were inadvertently reversed. The venation of *Hydrethus* is essentially like that shown in Fig. 23.)



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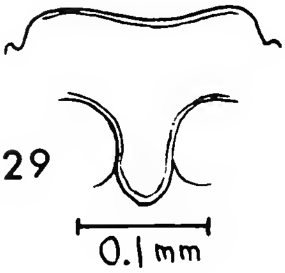

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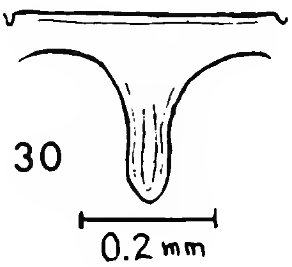

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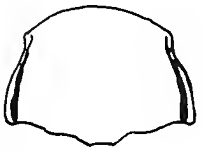

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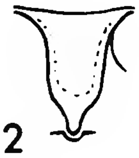

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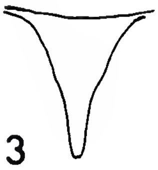

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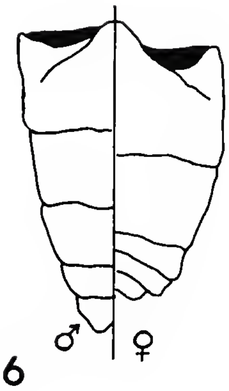
Figs. 26–35. Fig. 26. *Potamophilus acuminatus,* wing. The venation of *Parapotamophilus* n. g. is approximately the same as this. (From Hinton, 1940, Fig. 2.) Fig. 27. *Ovolara australis,* antenna. Fig. 28. *Hydora obsoleta,* antenna. Fig. 29. *Ovolara australis,* prosternum. Fig. 30. *Hydora picea,* prosternum. Fig. 31. *Potamocares jeanneli,* pronotum. (From Hinton, 1937, Fig. 19.) Fig. 32. *Omotonus notabilis,* prosternum. (From Delève, 1963, Fig. 7.) Fig. 33. *Potamogethes major,* prosternum. (From Delève, 1963, Fig. 14.) Fig. 34. *Omotonus notabilis,* aedeagus; *bp* = basal piece. (From Delève, 1963, Fig. 2.) Fig. 35. *Potamophilinus foveicollis,* aedeagus. (From Bollow, 1938, Fig. 26c.)

19a. Elytral apices not conspicuously divergent or acute; aedeagus with penis and parameres fused basally, subparallel, both somewhat expanded in apical third (Figs. 38, 40, 44–47) . . . . (New Guinea) (1 sp.) *Parapotamophilus* new genus

Hispaniolara, new genus
(Figs. 6, 17, 49–57)

Form.—Very elongate, slender, subparallel; subcylindrical (Fig. 6). *Vestiture.*—Clothed with very short and inconspicuous but dense hairs.



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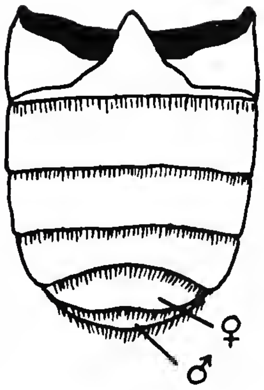

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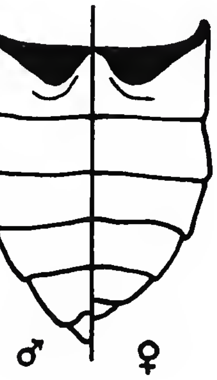

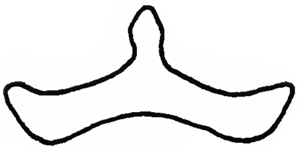

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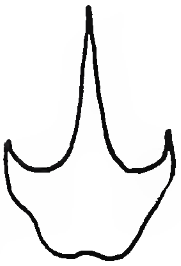

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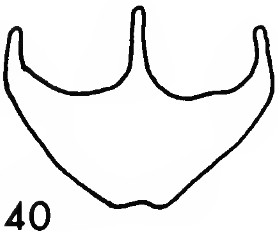

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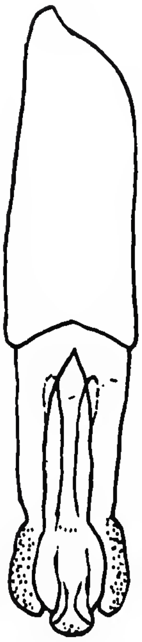

Figs. 36–45. Fig. 36. *Potamophilinus foveicollis,* abdomen. (From Bollow, 1938, Fig. 24.) Fig. 37. *Potamophilus acuminatus,* abdomen. (From Bollow, 1938, Fig. 42.) Fig. 38. *Parapotamophilus gressitti* n. sp., abdomen. Fig. 39. *Potamophilus acuminatus,* male, abdominal sternite 6. (From Bollow, 1938, Fig. 43.) Fig. 40. *Parapotamophilus gressitti* n. sp., male, abdominal sternite 6. Fig. 41. *Potamophilinus foveicollis,* male, abdominal sternite 6. (From Bollow, 1938, Fig. 25.) Figs. 42, 43. *Potamophilus acuminatus,* aedeagus, lateral and dorsal aspects. (From Bollow, 1938, Fig. 44.) Figs. 44, 45. *Parapotamophilus gressitti* n. sp., aedeagus, lateral and dorsal aspects.

Head.—Not capable of being retracted into thorax beyond eyes. Antenna (Fig. 49) 11-segmented, rather short and compact; basal segment longest, slightly curved, apically inflated, with posterior surface fitting snugly over eye and bordered by long, decurved setae that fit over eye; segment 2 subglobular and also bordered by long setae matching curvature of eye; segments 3–11 forming a rather compact club. Mandible (Fig. 50) with 1 subacute subapical and 2 subacute apical teeth; outer basal angle with a digitiform lobe; molar process well-developed and bearing transverse ridges; prostheca membranous but bordered mesally with a pectinate row of rather short setae. Maxilla (Fig. 51) with palp 4-segmented and stipes with a well-developed palpifer; galea and lacinia separate and densely spinose. Labium (Fig. 52) with palp 3-segmented; prementum with palpiger; ligula expanded laterally; mentum and submentum transverse.

Pronotum.—Basal angles acute; with a subapical transverse groove; without longitudinal sulci or carinae; margined laterally.

Elytra.—Striate and punctate; without accessory striae and without carinae.

Hind wing.—(Fig. 17) Without radial cross-vein; with a closed anal cell; veins $2A_1$ and $2A_2$ fused; 1A incomplete or discontinuous between cross-vein cu-a and wing margin.

Prosternum.—(Fig. 53) Very short in front of anterior coxae; process long, without median longitudinal carina.

Mesosternum transverse, with a narrow groove for reception of prosternal process; this groove expanded posteriorly.

Metasternum subquadrate, ratio of length to width at least 2:3; with a median longitudinal impressed line.

Abdomen.—Sternite 1 longest, 2 noticeably shorter than 1 but longer than 3, 3 slightly longer than 4, 4 and 5 subequal, 6 small and largely obscured by hairs from 5. Sternites 1–3 with posterior margins straight, those of 4 straight in male but broadly emarginate in female, that of 5 convex but with a narrow apical notch or emargination, those of 6 rather broadly and distinctly emarginate in male (Fig. 54) but narrowly and feebly emarginate in female. Spiracles of segments 4 and 5 greatly enlarged and directed posteriorly.

Legs with front coxae transverse and trochantin distinctly visible; front and middle legs with femora very compressed in anteroposterior plane and expanded dorsoventrally, with middle femur greatly elongated (longer than body width across humeri). Front and middle legs, when extended at right angles to body axis, can fit rather tightly together, but are widely separated from hind legs. Claws without teeth.

Male genitalia (Figs. 55, 56) slender and elongate, with basal piece well-developed and much longer than parameres; penis much longer than parameres.

Female genitalia (Fig. 57) with relatively elongate coxites and styli.

Etymology.—The generic name is feminine and is derived from Hispaniola, the island on which it occurs, combined with *Lara,* the type-genus of the subfamily Larinae.

Type-species.—*Hispaniolara farri* Brown, new species, which is described below.

Hispaniolara farri, new species

(Figs. 6, 17, 49–57)

Holotype male.—(Fig. 6) Body about 3 times as long as wide; widest at apical fourth of elytra and across elytral humeri. Length 6.75 mm; width 2.1 mm.

Coloration.—Dorsum dark brown to black, elytra slightly lighter than head and pronotum. Golden pubescence of occipital portion of head and most of body may confer a lighter cast when seen from certain angles. Venter somewhat lighter than dorsum, especially on metasternum. Cuticle feebly shining.

Head.—Width across eyes 1.3 mm. Occipital region rounded and slightly swollen; frons shallowly excavated on each side near antennal base; anterior margin of frons feebly bisinuate; anterior margin of clypeus broadly convex, with the angles broadly rounded. Labrum densely covered with erect golden hairs, anterior margin shallowly and arcuately emarginate at middle, with angles broadly rounded. Antenna as figured (Fig. 49), not reaching base of pronotum. Mandible as in Fig. 50. Maxilla (Fig. 51) with palp dark, short, and stout; segments 2 and 3 apically expanded; segment 4 a little longer than wide and obliquely truncate, the apical sensory surface being shallowly concave, oval in outline, and lighter in color. Labium (Fig. 52) with ligula densely covered with pale, stiff hairs, those on the lateral lobes being recurved; palp short and stout, with segment 3 rather dark except at flattened apical sensory surface.

Pronotum broadest at base (1.8 mm), 1.2 mm long, tapering arcuately from base, almost to apex; slightly flared at apex, which is 1.2 mm wide. Anterior margin feebly arcuate; posterior margin bisinuate on each side. Transverse impression medially at apical fourth and laterally at apical eighth, forming an anterior collar that conforms to contours of occipital portion of head. With shallow excavations laterally in basal quarter, and with very feeble median longitudinal impression from base to transverse impression; on each side with a feeble prescutellar impression which extends anterolaterally.

Elytra more than 4 times as long as pronotum (5.5 mm:1.2 mm); broadest across humeri and near apical fourth. Sides subparallel, slightly constricted near middle where hind femora fit against sides; apices independently rounded and slightly divergent. Lateral margins smooth and feebly explanate toward apices. Humeri slightly gibbous. Elytral intervals essentially flat. Sutural intervals narrow at base, gradually widening in basal third. Strial punctures round to subquadrate, becoming feebler and shallower apically so that on apical sixth they have virtually disappeared.

Hind wing with venation as figured (Fig. 17).

Scutellum slightly broader than long (0.30 mm:0.25 mm), almost flat, and with vestiture like that of elytra.

Venter with prosternum and abdominal sternite 6 as figured (Figs. 53, 54).

Legs long and slender; front femur 2.0 mm, tibia 2.0 mm; middle femur 2.5–2.6 mm, tibia 2.25 mm; hind femur 1.8 mm, tibia 1.6 mm; each tarsus 1.25 mm. Front and middle femora blade-like. Middle tibia glabrous except for narrow longitudinal band of tomentum on mesal margin.

Genitalia as figured (Figs. 55, 56). Aedeagus 1.5 mm long, 0.17 mm wide, subparallel; penis slightly shorter than basal piece and fully twice as long as parameres, expanded beyond parameres to width of basal piece, with exposed portion decurved and tapering to a subacute apex.

Female externally similar to male except as follows: pronotum slightly narrower at base (1.7 mm); abdomen with sternite 5 broader and less convex, and sternite 6 with posterior margin narrowly and feebly emarginate at middle. Genitalia as figured (Fig. 57).

Types.—Holotype-male, DOMINICAN REPUBLIC: Dist. La Vega: mountain stream w. Jayaco, elev. 1170 m, 10/X/1971, Harley Brown, deposited in Stovall Museum of Science and History, Norman, Oklahoma. Allotype, same data as type, deposited with holotype; genitalia on slide Hifa-FG1. Paratype: male, DOMINICAN REPUBLIC: Dist. La Vega: Rio Lo Candango w. Bonao, elev. 1025 m, 10/X/1971, Harley Brown, dissected and with parts mounted on slides Hifa-Ag1, Hifa-An1, Hifa-Av1, Hifa-W1, deposited with holotype. One larva with same data as paratype, deposited with holotype; to be described elsewhere.

Etymology.—The species is named in honor of Dr. Thomas H. Farr, who served the Institute of Jamaica long and well, and was gracious host to many a visiting biologist.

Discussion.—*Hispaniolara* is proportionately the slimmest or lankiest member of the Larinae, bearing slight resemblance to the rather chunky little *Phanocerus,* the only other member of the subfamily known from Hispaniola. Geographically, the next closest larine neighbor is *Hexanchorus caraibus,* 600 miles away on Guadeloupe. In both structure and habits, *Hispaniolara* is much more like *Hexanchorus* than like *Phanocerus,* although *Hexanchorus* is also much smaller and relatively broader than the new genus. Both *Hexanchorus* and *Phanocerus* differ from *Hispaniolara* in lacking an anal cell in the hind wing. In size, *Hispaniolara* is comparable to *Lara, Disersus, Pseudodisersus,* and *Potamophilops,* but our western montane *Lara* is strikingly different from the 4 neotropical genera in both habits and structure. Adults of *Lara* are not even aquatic, whereas I have observed *Hispaniolara* and *Potamophilops* in shallow, fast water, apparently employing the remarkable respiratory mechanics described by Stride (1955) for their African cousin, *Potamodytes.* The presence of an accessory elytral stria will serve to separate *Lara* from the 4 neotropical genera. Although *Hispaniolara* bears a superficial resemblance to *Disersus,* it differs in having a transverse pronotal impression, differently formed antennae, and much longer middle femora. *Hispaniolara* appears to be closest to *Potamophilops* and *Pseudodisersus,* though it differs from them in pronotal and elytral contour, shape of middle tibiae, details of wing venation, and in having unusually long middle femora. Both male and female genitalia are distinctive and somewhat intermediate in form between those of *Hexanchorus* and *Potamophilops.*

The larva of *Hispaniolara,* which is clearly different from all other known larine larvae of the New World, will be described elsewhere. In many respects, it resembles larvae of such elmine genera as *Stenelmis* and *Neocylloepus.*

Ovolara, new genus
(Figs. 9, 20, 27, 29, 58)

Form.—Ovate, convex.

Vestiture.—Entire surface rather densely covered with short, mostly decumbent hairs.

Head.—Rounded, capable of being retracted within thorax to eyes; deflected so as to be barely visible from above. Width of head capsule across eyes subequal to width of pronotum at apex. Antenna (Fig. 27) short, not reaching beyond middle of pronotum; 11-segmented, inserted at front margin of eye; segment 1 longest and fitting over surface of eye, segment 2 ovoid, segments 3–11 gradually enlarging to form a rather compact club; segments 6–10 broader than long. Mandible with 2 or 3 sharp, chisel-like apical teeth, an ear-like outer lateral lobe, and a prominent, hemispheric, medially directed basal lobe that apparently serves a molar function; prostheca broad and membranous but with spinose apex. Maxilla with palp 4-segmented; stipes with well-developed palpifer; cardo well-sclerotized and with a deep notch on outer margin; galea and lacinia densely spinose, lacinia at apex with several rows of decurved spines. Clypeus transverse and distinct. Labrum transverse, with apical margin densely spinose, angles rounded. Labium with palps short and 3-segmented; prementum with palpigers; ligula expanded laterally and densely spinose; both mentum and submentum transverse.

Pronotum.—Broader than long; with basal margin bisinuate, basal angles acute, anterior margin arcuate, lateral margins feebly sinuate near base, then broadly arcuate to apex; with sublateral longitudinal carinae in basal fifth; without transverse impressions; disk rather evenly convex except for a feeble median elevation at base which becomes a feeble impression near middle; surface rather finely punctate.

Scutellum.—Relatively small, about as wide as long, with rounded sides; very feebly raised.

Elytra.—Much broader across humeri than base of pronotum; widest at or near humeri, which are rather prominent; twice as long as wide and about 3.5 times as long as pronotum. With an accessory stria between sutural and second stria in basal fifth. Strial punctures relatively large and distinct, most of the striae extending to margin. Intervals rather flat, none being elevated to form carinae. Margins broadly arcuate to apex; elytral apices conjointly rounded.

Hind wing.—Without radial cross-vein or closed anal cell; with veins 1A, $2A_1$, $2A_2$ rather well-developed; cross-vein cu-a present (Fig. 20).

Prosternum.—Anterior margin produced beneath head; length between anterior margin and procoxal cavity greater than breadth of prosternal process; process medially carinate, subacute at apex and relatively broad between procoxae (Fig. 29).

Mesosternum.—Short and transverse, with a deep, median, V-shaped excavation in anterior ⅔ to accommodate prosternal process.

Metasternum.—Transverse, twice as wide as long; with a median longitudinal groove; each side broadly convex.

Abdomen.—Tapering arcuately from base to rounded apex; width at base more than ¾ of length; 5 visible segments (only females seen); segments 1 and 5 longest and subequal, 2 perceptibly shorter than 1, 3 sightly shorter than 2, and 4 perceptibly shorter than 3; all segments broadly convex; punctation similar to that of metasternum.

Legs.—Relatively short and stout; femora not flattened or bladelike; femur of front leg grooved on anteroventral surface for reception of tibia; femora of middle and hind legs grooved thus on posterior surface; claws without teeth.

Genitalia.—(Only females seen) Both coxites and styli relatively slender and elongate (Fig. 58).

Etymology.—The generic name *Ovolara* is feminine and is derived from a combination of the Latin word *ovum,* referring to the egg-like shape of the body, and *Lara,* the type-genus of the subfamily Larinae.

Type-species.—*Lutrochus australis* King (1865, p. 159).

Discussion.—Although originally described in the genus *Lutrochus* Erichson, which is not even a member of the family Elmidae, and later moved to *Hydrethus* Fairmaire, *Ovolara* would key to *Hydora* Broun in the key provided by Hinton (1940), and is probably closest to that genus. Members of both genera are much smaller in size than most members of the subfamily, and approximate the dimensions of such neotropical forms as *Hexanchorus* and *Phanocerus*. *Ovolara* differs from *Hydora* in being more robust and ovoid in shape, in having a much more clavate antenna, the prosternum produced anteriorly, and different wing venation (e.g., veins $2A_1$ and $2A_2$

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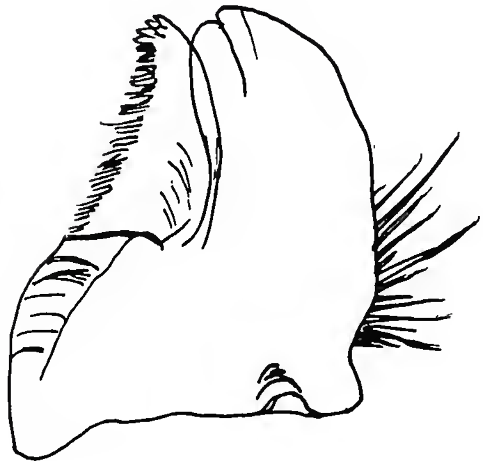

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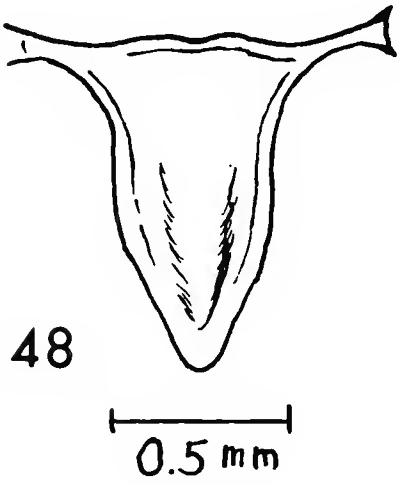

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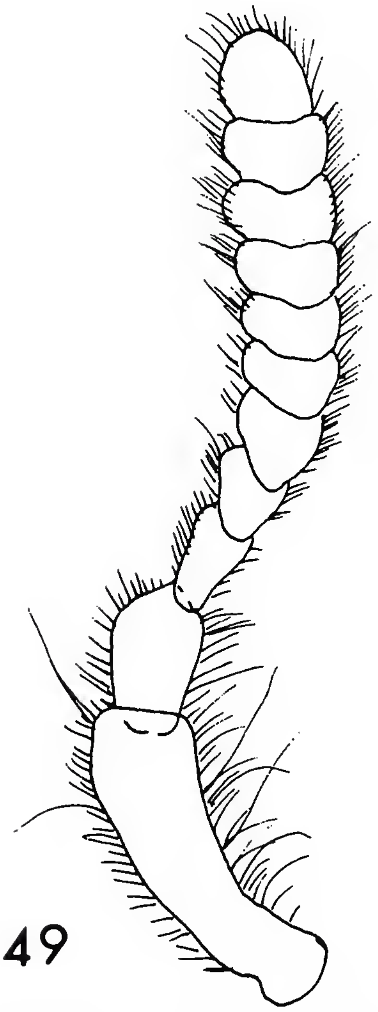

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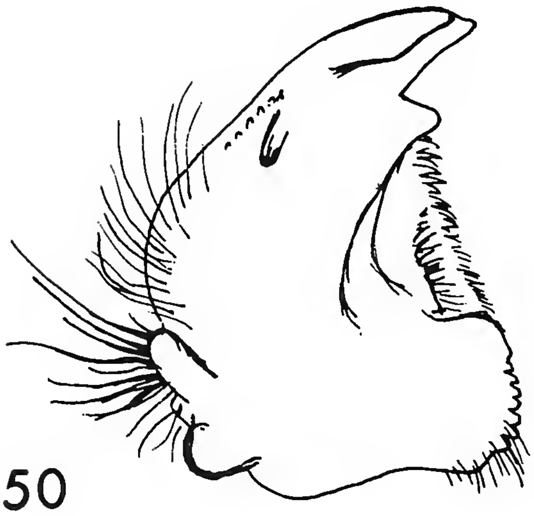

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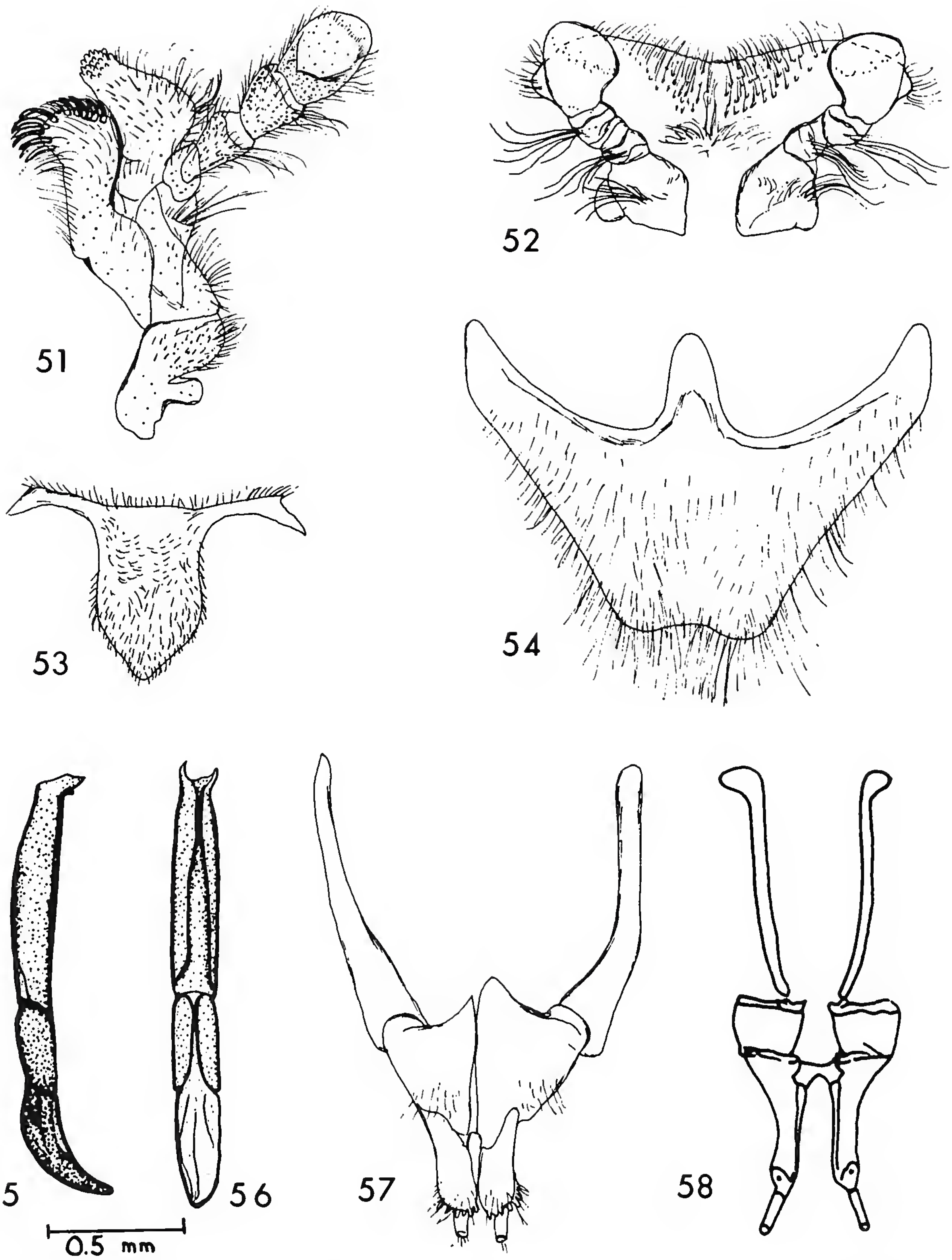
Figs. 46–50. Fig. 46. *Parapotamophilus gressitti* n. sp., female genitalia. (From Satô, 1973, Fig. 10.) Fig. 47. *Parapotamophilus gressitti* n. sp., mandible. Fig. 48. *Parapotamophilus gressitti* n. sp., prosternum. Fig. 49. *Hispaniolara farri* n. sp., male, antenna. Fig. 50. *Hispaniolara farri* n. sp., male, mandible.



Figs. 51–58. Fig. 51. *Hispaniolara farri* n. sp., male, maxilla. Fig. 52. *Hispaniolara farri* n. sp., male, labium. Fig. 53. *Hispaniolara farri* n. sp., male, prosternum. Fig. 54. *Hispaniolara farri* n. sp., male, sixth abdominal sternite. Fig. 55. *Hispaniolara farri* n. sp., male genitalia (aedeagus), lateral aspect. Fig. 56. *Hispaniolara farri* n. sp., aedeagus, dorsal aspect. Fig. 57. *Hispaniolara farri* n. sp., female genitalia. Fig. 58. *Ovolara australis* (King), female genitalia.

are both present and distinct and cross-vein cu-a is present, whereas in *Hydora* $2A_1$ and $2A_2$ are represented by a single vein and cu-a is lacking). From *Stetholus,* the only other genus of Larinae known from Australia besides *Hydora* and *Ovolara,* it differs in being much smaller, ovate rather than elongate and subparallel, in having the pronotum with sublateral carinae at base, the prosternum produced beneath head and rather long anterior to coxae, and more clavate antennae. Judging from the body contour and leg structure, I would surmise that the habits and ecology of *Ovolara* would approximate those of *Phanocerus,* which is essentially riparian, rather than those of such aquatics as *Hispaniolara, Potamophilops,* and *Potamodytes* (cf. Stride, 1955).

Another species assigned to *Ovolara* is *Hydrethus leai* Carter 1926.

Parapotamophilus, new genus
(Figs. 38, 40, 44–48)

Form.—Elongate, subcylindrical; broadest near humeri, tapering gradually toward elytral apex.

Vestiture.—Surface rather densely covered with short, inconspicuous hairs.

Head.—Retractile within thorax to eyes; width of head capsule across eyes only slightly greater than width of pronotum at apex. Antenna 11-segmented, short, not reaching beyond middle of pronotum; inserted at front margin of eye; segment 1 longest, apically tumid, extending less than half way over surface of eye; segment 2 ovoid, longer than broad; segments 3–11 enlarging to form a rather compact club; segments 4–10 broader than long. Mandible (Fig. 47) strong, with subacute apical and blunt medial or subapical tooth; outer margin in basal half bearing rather long, suberect setae; with a prominent, rounded, medially-directed basal lobe that presumably serves a molar function; prostheca membranous but with a pectinate median border of erect hairs on spines. Maxillary palp 4-segmented with apical segment flared into a shallow cup directed anteriorly; stipes with well-developed palpifer; cardo well-sclerotized; galea and lacinia separate and subequal, each densely spinose at apex. Clypeus transverse, less than half as long as labrum. Labrum transverse, with anterior angles expanded and rounded, and covered by a dense brush of curved setae; anterior margin bisinuate and densely covered with very short, suberect setae. Labium with palps short and 3-segmented, the apical segment somewhat flattened in anteroposterior plane; prementum with palpigers; ligula expanded laterally and rather densely setose; both mentum and submentum transverse; gula slightly elongate, longer than combined submentum and mentum.

Pronotum.—Slightly broader than long; broadest near base; basal margin bisinuate; basal angles bidentate; anterior margin subtruncate; lateral margin arcuate from sub-basal tooth anteriorly, but slightly sinuate near apex; without longitudinal carinae or sulci and without transverse grooves or impressions; on each side with a shallow lateral excavation or impression near base and another near apex, and with a small, shallow prescutellar impression.

Scutellum.—Slightly longer than wide; triangular with all sides rounded; very feebly convex.

Elytra.—Much broader across humeri than base of pronotum; widest at humeri and in basal third; more than twice as long as broad and more than 3 times as long as pronotum. Humeri prominent. With an accessory stria between sutural and second stria in basal fifth. Strial punctures distinct but partially obscured by pubescence. Intervals rather flat, none being elevated to form carinae. Lateral margins subparallel in basal third, then sinuate at edge of first abdominal sternite where hind femora may be appressed to sides; feebly explanate. Elytral apices slightly divergent and independently rounded.

Hind wing.—Venation essentially like that of *Potamophilus* (Fig. 26); without radial cross-vein; with closed anal cell; with separate veins 1A, $2A_1$, and $2A_2$; vein $3A_1$ joining 2A at proximal margin of anal cell.

Prosternum.—Anterior margin not produced; length from anterior margin to procoxal cavity very short; prosternal process subequal in width to diameter of eye and twice as long as wide, raised medially and along anterolateral margins, tapering from basal third to subacute apex (Fig. 48).

Mesosternum.—Short and transverse, completely divided medially by excavation to accommodate prosternal process.

Metasternum.—Transverse, about twice as wide as long; broadly convex on each side of median longitudinal groove.

Abdomen.—With 5 visible sternites in female, 6 in male, tapering posteriorly from apex of sternite 2; segment 1 longest, 2–4 progressively shorter, 5 subequal to 4; male with posterior margin of segment 5 arcuately emarginate, that of segment 6 narrowly emarginate (Figs. 38, 40).

Legs.—Relatively long and slender; front and middle legs with femora and tibiae slightly flattened; femora not grooved for reception of tibiae; claws without teeth.

Genitalia.—Male with aedeagus elongate, ca. 4 times longer than wide, sides subparallel; penis and basal piece subequal in length; penis slightly longer than parameres, inflated and complex at apex, consisting of 2 dissimilar portions or lobes: a broader ventral one which is spoon-shaped, subapical, with its ventral surface concave, and a smaller apical portion which is reflexed dorsally and deeply excavated laterally to accommodate apices of parameres; parameres fused at base, with apices expanded into lateral cushions (Figs. 44, 45). Female genitalia with coxites short and stout; styli short and less than one-fourth as wide as coxite at apex; struts rather short and stout, expanded at both ends (Fig. 46).

Etymology.—The generic name *Parapotamophilus* is masculine and is formed by adding the prefix *para* (Greek word meaning *near*) to the generic name *Potamophilus* (Greek for "river-lover").

Type-species.—*Parapotamophilus gressitti,* new species, which is described below.

Discussion.—*Parapotamophilus* n. g. is probably closest to *Potamophilus,* whose geographic range extends from the East Indies to Europe and which it greatly resembles, the general appearance and wing venation being almost identical. It differs from *Potamophilus* in mandibular structure, having 2 blunt rather than 3 sharp teeth, in having the abdomen tapering rather than abruptly rounded, in having the elytral apices rounded rather than acute, and most importantly in the form of the male genitalia and the associated abdominal sternite 6. In *Potamophilus* the penis and parameres taper to rather slender apices, and are separate; the basal piece tapers from apex to base; sternite 6 is very short and broad with a stout median anterior process and a very broadly emarginate posterior margin (Fig. 39). In *Parapotamophilus* the penis and parameres are subparallel with bluntly lobate apices, and are fused at the base; the basal piece is long and subcylindrical; sternite 6 is proportionately longer and narrower, with a slender anterior median process and a narrowly emarginate posterior margin (Fig. 40). *Parapotamophilus* is also quite similar to *Potamophilinus* in general appearance and dimensions, and the latter genus is well represented in Southeast Asia and the East Indies. *Potamophilinus* differs from the new genus in wing venation (veins $2A_1$ and $2A_2$ are combined rather than separate), abdominal structure (sternites 1 and 2 are much longer than the remaining segments as in Fig. 36), and genitalia; sternite 6 of the male is rather like that of the new genus but much longer, the anterior median process being exaggerated (Fig. 61); the aedeagus is also somewhat like that of *Parapotamophilus* but with the penis and parameres separate, abruptly arched at base, very long and slender, and less complex at apex (Fig. 35).

Parapotamophilus gressitti, new species
(Figs. 38, 40, 44–48)

Potamophilus papuanus (Carter). Satô, 1973, *Pacific Insects* 15(3/4): 468, figs. 9–10.

Holotype male.—Length 6.7 mm; width 2.4 mm. Widest across elytral humeri.

Coloration.—Dorsum dark brown to black, feebly shining. Venter mostly dark brown to black and more conspicuously pubescent than dorsum; metasternum and coxae somewhat lighter; abdominal sternite 6, the median portion of 5, and posterior margin of 4 at middle testaceous. Legs reddish to dark brown.

Head.—Width across eyes 1.3 mm. Vertex feebly convex. Antennae with segments 1 and 2 lighter than 3–11. Clypeus 6 times wider than long, with anterior margin straight. Labrum about twice as wide as long, with apical half paler. Mandible as figured (Fig. 47). Maxillary palp subequal in length to antennal segments 1+2, with apical segment dark brown. Labial palp subequal in length to apical segment of maxillary palp, not visible from above; apical segment brown, with apex convex. Submentum and gula covered with rather long golden hairs.

Pronotum.—Length 1.5 mm; greatest width 1.7 mm in basal half, basal angles feebly bidentate, not acute. Lateral sub-basal excavation with anterior margin bordered by hairs which form a feeble oblique ridge or brow (very inconspicuous on the holotype, but quite noticeable on some paratypes). Surface smooth, finely punctate; pubescence inconspicuous.

Prosternum.—As shown in Fig. 48.

Elytra.—Length 5.4 mm; width 2.4 mm across humeri.

Abdomen.—As shown in Figs. 38 and 40.

Legs.—Front femur 1.6 mm, tibia 1.7 mm, tarsus exclusive of claws 1.1 mm. Middle femur 1.8 mm, tibia 1.95 mm, tarsus 1.0 mm. Hind femur 1.7 mm, tibia 1.7 mm, tarsus 1.0 mm. Middle tibia at inner apex with a small, blunt spur, which appears to be a secondary sexual character. Middle leg differs from front and hind legs in having tibia and tarsus more flattened and less pubescent. Otherwise, legs are devoid of noticeable spines or unusual features.

Aedeagus.—Length 2.25 mm; greatest width (basal piece) 0.4 mm. Parameres with lateral apical cushions bilobate and occupying distal third (Figs. 44, 45).

Female.—Slightly larger than male; length 6.75 mm, width 2.5 mm. Abdomen with segment 6 withdrawn beneath 5; segment 5 with posterior margin narrowly emarginate at middle. Middle tibia at inner apex without spur. Otherwise similar to male. Genitalia as illustrated in Fig. 46.

Etymology.—The species is named in honor of Dr. Judson Linsley Gressitt, who collected the type-series and who has contributed so much to our knowledge of phytophagous beetles of New Guinea.

Types.—Holotype male: NEW GUINEA: N.E., Wonenara, 6°40′S, 145°55′E, 1450 m, light trap, 14/VI/66, J. L. Gressitt; deposited in Bernice P. Bishop Museum, Honolulu, Hawaii. Allotype: same data as holotype, deposited with holotype. Paratypes: 50 with same data as types; 28, same except Gressitt & Wilkes.

Discussion.—*Stetholus papuanus* Carter was described from 7 specimens taken by C. T. McNamara at 1300 ft. on Mt. Lamington, Northeast Papua (Carter, 1930). This species was transferred to *Potamophilus* by Hinton

(1935, p. 173). The specimens upon which I base the description of the new genus *Parapotamophilus* and the species *P. gressitti* were examined by Satô (1973) and assigned by him to *Potamophilus papuanus* (Carter). My initial reason for assuming that *gressitti* is distinct from *papuanus* was that Carter described the pronotum thus: ". . . the posterior angles bidentate, formed by a deep subcircular excision, each tooth acute . . . ." His figure of *papuanus* (Fig. 13) agrees with this description, showing two acute and prominent teeth. In *gressitti* the posterior angles are feebly and inconspicuously bidentate, the teeth not acute, and the excision could hardly be said to form the bidentate condition since both teeth occur at or near the posterolateral border of the excision. Examination of one of Carter's syntypes, kindly sent to me by Dr. C. M. F. vön Hayek of the British Museum (Natural History), bears out the accuracy of Carter's description and illustration. Fortunately, this syntype happened to be a male. Although the apices of both penis and parameres are missing, the structure of the aedeagus (Figs. 59, 60) is typical of *Potamophilus,* rather than *Parapotamophilus*. I might add that it was Satô's figure of the aedeagus of what he thought to be *P. papuanus* that led me to suspect that the specimens he examined represented a new genus, since the aedeagal structure was so different from that of other species of *Potamophilus*.

Pseudodisersus, new genus
(Figs. 5, 61–64)

Form.—Oblong.

Vestiture.—Covered with fine, dense pubescence above and below and on legs.

Pronotum.—(Figs. 5, 61) Transverse; narrowed anteriorly; with a deep, anterior, transverse impression and a distinct, median, longitudinal impression extending from base to anterior transverse impression; sides narrowly margined; posterior angles bidentate; posterior margin raised medially.

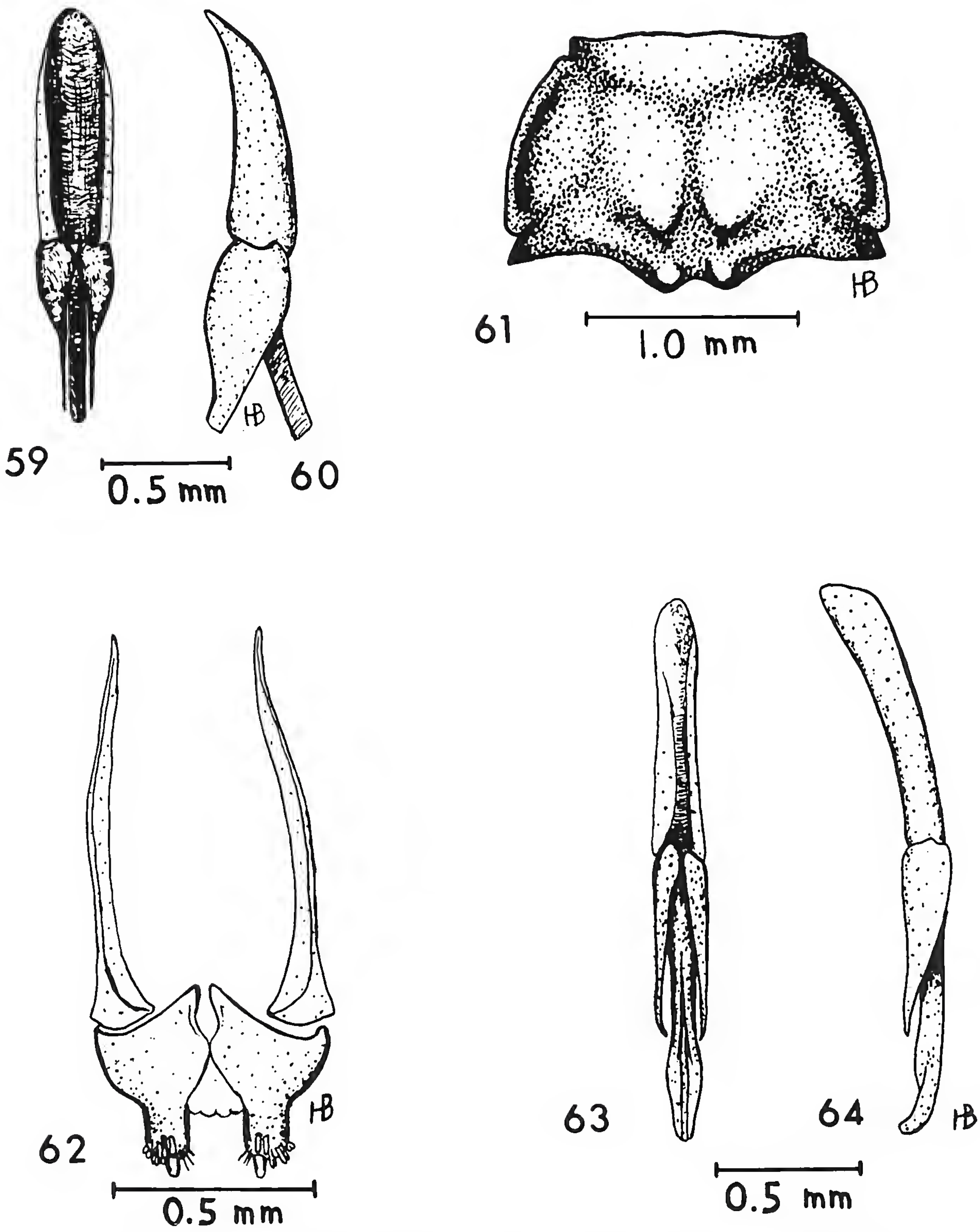
Elytra.—Long and narrow; slightly broader across humeri than pronotum; tapering from humeri; acute and slightly divergent at apices; without accessory striae; intervals only slightly raised, none carinate.

Hind wings.—Venation like that figured for *Disersus* (Fig. 16); without radial cross-vein; with closed anal cell; vein 1A interrupted between cross-vein cu-a and wing margin; veins $2A_1$ and $2A_2$ fused; vein $3A_1$ joining $2A_3$ on posterior margin of anal cell slightly distal to base of cell.

Prosternum short in front of coxae; with anterior margin reflected; process very broadly triangular and shallowly excavated, rounded at apex.

Mesosternum transverse, with deep subcircular excavation to accommodate prosternal process extending to posterior margin.

Metasternum divided by a narrow, median, longitudinal groove; disk broadly and rather shallowly excavated on each side of midline.



Figs. 59–64. Figs. 59, 60. *Potamophilus papuanus*, aedeagus in dorsal and lateral aspects, drawn from syntype in British Museum (Natural History). Apices of penis and parameres apparently broken off. Figs. 61–64. *Pseudodisersus coquereli* n. sp. Fig. 61. Pronotum, dorsal aspect; Fig. 62. Female genitalia; Figs. 63–64. Aedeagus in dorsal and lateral aspects.

Abdomen with only 5 visible segments in both sexes; segments 1–4 progressively shorter; tapering from posterior margin of segment 2 to narrow apex; segment 1 on each side with a longitudinal carina extending from mesal anterior margin of coxal cavity to apical (posterior) third, feebly excavated between carinae.

Legs very compressed and flattened; hind legs shortest and least flattened; tarsal claws without basal teeth.

Genitalia.—Aedeagus of male (Figs. 63, 64) long and slender; basal piece long and well-developed; penis long and slender; parameres not fused, long and slender but shorter than penis, acute at apex. Female genitalia (Fig. 62) with both coxites and styli short; coxites broad at base; struts long and slender.

Etymology.—The generic name is masculine and combines the prefix *pseudo,* meaning false, with *Disersus,* the genus from which it is being extracted.

Type-species.—*Pseudodisersus coquereli,* new species, which is described below.

Pseudodisersus coquereli, new species
(Figs. 61–64)

Size.—Length 6.4–6.8 mm; width 2.1–2.4 mm.

Coloration.—Body dark reddish brown, darker on head and thorax; antennae testaceous to brown.

Head.—Smooth, rounded, without noticeable impressions; finely punctate and pubescent. Antennae short, subequal in length to width of head across eyes; pubescent. Clypeus short and transverse, 6 times broader than long; anterior margin straight, bordered by a row of curved, eyelash-like setae. Labrum transverse, 3 times broader than long; angles rounded; anterior margin bordered by a fringe of pale hairs. Mandible not prominent, with only 1 apical tooth visible in pinned specimens. Maxillary palp pubescent, rather inconspicuous; segment 4 subequal in length to segment 3 but darker in color, with sensory apex diagonal, subcircular, and flattened or feebly concave. Labium with long, pale hairs arising from mentum, prementum, and subapical segment of palp; palp with distal segment dark, compressed, and similar in size to sensory apex of maxillary palp. Gula slightly transverse, narrower than mentum, subequal to postmentum, with all 4 margins emarginate.

Pronotum.—(Fig. 61) Length 1.3–1.5 mm; width 1.95–2.20 mm. Median longitudinal impression bordered on each side by a rounded, slightly diagonal prominence extending from basal quarter to apical quarter. On each side, between this prominence and the lateral margin with another rounded longitudinal prominence parallelling the lateral margin. Also on each side, posterior to submedian prominence and parallelling posterior margin, with a low transverse ridge culminating submedially in a conspicuous, dorsally projecting, digitiform prominence just anterior to scutellum. Anterior margin collar-like, feebly bisinuate; posterior margin bisinuate on each side; on each side with posterior angle acute and depressed, sub-basal tooth raised and forming posterior end of lateral marginal flange; sides converging arcuately from sub-basal tooth to apical collar, in apical tenth parallel; anterior angles rectangular.

Scutellum triangular, elongate, raised posteriorly.

Elytra more than 2 times longer than wide (5.5:2.4 mm); humeri not very prominent.

Legs pubescent except middle tibia and distal half of outer surface of hind tibia, which are glabrous. Measurements: front femur 1.7 mm, tibia 1.9 mm, tarsus except claw 1.25 mm; middle femur 2.0 mm, tibia 1.75 mm, tarsus 1.25 mm; hind femur 1.9 mm, tibia 1.65 mm, tarsus 1.15 mm.

Male genitalia as figured (Figs. 63, 64); penis subequal in length to basal piece, slightly expanded and laterally flanged beyond tips of parameres, apex feebly decurved and bluntly rounded; parameres two-thirds as long as penis, tapering from base to acute apex, curved feebly inward at apex.

Female.—Like male, but with metasternum and abdominal segment 1 more shallowly excavated, and with abdominal segment 5 rounded at apex. Last abdominal tergite also with apex rounded, instead of acute as in male. Genitalia (Fig. 62) with each coxite bearing about 8 apical or subapical, erect, blunt, spinose setae in addition to a few, short, ordinary setae.

Habitat.—Though Coquérel (1851) states that Goudot's specimens were close to water on moist rocks in the middle of a fast-flowing river along with adults of *Hexanchorus cordillierae* (Guérin) 1843, I would suspect from the morphology of those I have examined that adults of *Pseudodisersus coquereli* n. sp. are typically submerged in fast, shallow water as described by Stride (1955) for *Potamodytes tuberosus*.

Types.—Holotype: male, COLOMBIA, Sharp Coll., 1905-313. Allotype female: COLOMBIA, Bogotá, Sharp Coll., 1905-313. Paratypes: 5 with same data as holotype; 4, COLOMBIA without further data (2 from H. E. Hinton Coll. but not collected by him); 1, Andes. Location of types: Holotype, allotype, and 8 paratypes in British Museum (Natural History), 2 paratypes in Stovall Museum of Science and History, Norman, Okla.

Etymology.—The species is named for Dr. Jean Charles Coquérel, whose description enabled me to determine that the specimens he had examined represented a new genus.

Discussion.—When Sharp (1882) erected the genus *Disersus* for *D. longipennis* Sharp 1882, he noted that *Potamophilus goudotii* Guérin 1843 also belonged to his new genus, but did not mention *Potamophilus cacicus* Coquérel 1851. Sharp was primarily concerned with separating these neotropical species from the European *Potamophilus,* and concentrated upon ventral characters such as prosternal and mesosternal configuration. Following suit in employing ventral characters, Grouvelle (1896) transferred *P. cacicus* to *Disersus* and created 3 new genera, *Potamophilops, Potamophilinus,* and *Potamodytes.* Zaitzev (1910) and Blackwelder (1944) continued to list *lon-*

gipennis, goudotii, and *cacicus* as members of the genus *Disersus.* Hinton (1940) presumably had not examined specimens of *goudotii* when he prepared his key, for he made no mention of this species although the key character he used to distinguish *Disersus* (absence of an anterior, transverse, pronotal impression) would exclude *goudotii* from the genus. Apparently Hinton also failed to notice that Coquérel (1851) employed this character in his key to separate *goudotii* from *cacicus.* It was this feature of Coquérel's key that alerted me to the fact that *goudotii* might require the creation of a new genus.

Pseudodisersus n. g. differs from *Disersus, Lara, Hydora,* and *Phanocerus* in having the pronotum with a distinct transverse impression in the anterior third and bidentate posterior angles. From *Hexanchorus, Hispaniolara,* and *Potamophilops* it differs in having a deep, median, longitudinal pronotal impression. In size, shape, and general aspect, *Pseudodisersus* most resembles *Potamophilops* from central Brazil. The genitalia are distinctive, but probably closest to those of *Disersus.*

Guérin (1843) described *Potamophilus goudotii* from specimens collected by Justin Goudot from the Rio Chipalo in New Grenada during September and October of 1842 and deposited, I presume, in the Paris Museum. Coquérel (1851) apparently redescribed the species from the same material. I have not seen these specimens, nor have I been able to determine just where the Rio Chipalo is located. From Sharp (1882) and Blackwelder (1944), I gather that it is in Colombia, in some mountainous region. Fortunately, the British Museum (Natural History) has a number of specimens from the Sharp Collection identified as members of this species, and it is upon this material that I have based my descriptions. Since Coquérel's description indicates that Goudot's specimens were larger than those I have seen (7 mm long, 2.5 mm wide as compared with 6.4–6.8 mm long and 2.1–2.4 mm wide), and apparently differ from my description in details concerning the pronotum, I presume that they represent a different species of *Pseudodisersus,* and it is appropriate that I describe the new one. If future comparison of the two series indicates that they represent a single species, the type-species of *Pseudodisersus* will become *P. goudotii* (Guérin) 1843 instead of *P. coquereli* Brown. If the descriptions are accurate, *goudotii* (Fig. 5) differs from *coquereli* (Fig. 61) in having the pronotum with posterior angles acute and raised and the median longitudinal impression with elevated edges, as well as in being larger as mentioned above.

I have collected several larvae in mountain streams near Bogotá, Colombia, which are probably those of *Pseudodisersus.* They will be described elsewhere. The larva from Bolivia tentatively attributed to *Disersus* by Hinton (1940) in his key to larval elmids probably represents *Pseudodisersus* instead.

The creation of this new genus necessitates a few changes in the definition or diagnosis of the genus *Disersus*; that given below is from Sharp (1882), with features added which differentiate this from related genera.

Disersus Sharp 1882
(Figs. 4, 16)

Diagnosis.—Body elongate, clothed with short, dense pubescence. Labrum very broad, wider than clypeus. Antennae widely separated at base, 11-segmented, with basal segment elongate, segment 2 simple, almost transverse, 3–11 subequal. Anterior coxae very widely separated. Prosternum subtriangular, extremely short in front of coxae. Mesocoxae also widely separated. Mesosternum with large, deep excavation to accommodate prosternal process extending to metasternal border. Legs long; anterior femora especially elongate; tibiae compressed. Pronotum transverse, narrowed anteriorly; without anterior, transverse impression; posterior angles simple and acute; posterior margin not raised. Scutellum not raised. Elytra with humeri not prominent and not much broader than base of pronotum; without accessory striae; divergent and acute at apex. Hind wings (Fig. 16) without radial cross-vein; with closed anal cell; vein 1A interrupted between cross-vein cu-a and wing margin; veins $2A_1$ and $2A_2$ fused; vein $3A_1$ joining $2A_3$ on posterior margin of anal cell distal to base of cell. Abdomen with 5 visible segments; segments 1–4 progressively shorter. Male genitalia very elongate and slender; basal piece longer than penis; penis longer than parameres. Female genitalia with coxites short and broad; styli short.

Acknowledgments

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NEW SPECIES OF NORTH AMERICAN *HYDROPORUS*, *NIGER-TENEBROSUS* GROUP (COLEOPTERA: DYTISCIDAE)

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The information presented here is part of a doctoral dissertation entitled "A revision of the *niger-tenebrosus* group of *Hydroporus* (Coleoptera: Dytiscidae)," completed in 1969. As with many such theses, the likelihood of seeing it published in the entirety becomes more remote as time goes by. Therefore I welcome the opportunity to publish at least the most critical portion as a tribute to Hugh Leech.

When I was an enthusiastic collector of water beetles as a student at North Dakota State University, Hugh Leech was one of my idols. I was positively impressed with the quality of his published work and can still recall the sort of trepidation with which I composed my first letter to him. Better still, I can recall the thrill of receiving his prompt reply, and being amazed at the length of it. I can now well appreciate the amount of time he must have spent in responding to an unknown amateur. That was the first of many such letters over the years, and no matter what my questions were, or what specimens I might send or request, or what literature I might need, the response from Hugh Leech was always the same: prompt, complete, and unfailingly encouraging. Several years have passed since then, and I am, hopefully, slightly further along as a taxonomist, but Hugh remains a very special person to me. Rarely is one privileged to work contemporaneously in the same research area with a person as universally respected as Hugh, and I am grateful to have had the opportunity. I dedicate this paper to him, for without his encouragement and help, it might never have been initiated.

Fall (1923) wrote the first revision of the *niger-tenebrosus* group which is the only complete treatment of that group. Much of the difficulty encountered by Fall in separating species still exists; examination of male genitalia has alleviated the problems somewhat, but the group remains probably the most difficult among all of the North American Dytiscidae. The *niger-tenebrosus* group is one of 4 groups proposed by Fall (1923) for North American members of the genus *Hydroporus* Clairville. Sharp (1882), in his monograph on the Dytiscidae of the world, split *Hydroporus* into 8 groups, and Fall modified Sharp's system for the North American species. The other 3 groups of North American *Hydroporus* are: the *pulcher-undulatus* group, *oblitus* group, and *vilis* group. Members of the *niger-tenebrosus* group are nearctic, palearctic, or holarctic in distribution. Most New World species are found in Canada and the northern United States with a few species ranging south to Florida, Texas, and Arizona. One species is reported from northern Mexico.

Larson (1975) published an excellent work on the Dytiscidae of Alberta, in which he dealt with those species of the *niger-tenebrosus* group occurring in that province. Larson described 3 new species, *H. hockingi, H. criniticoxis* and *H. carri.*

Type-material included herein has been deposited with the following institutions or individuals (abbreviations listed are used in the text): California Academy of Sciences (CAS); Frank Young, Indiana University (FNY); J. R. Zimmermann, New Mexico State University (JRZ); Museum of Comparative Zoology, Harvard University (MCZ); Robert Gordon (RDG); North Carolina State University (NCS); Ohio University (OU); Field Museum of Natural History (FM); Cornell University (CU); American Museum of Natural History (AMNH); University of Idaho (UID); U.S. National Museum of Natural History (USNM). The number of paratypes examined from each locality is listed in front of each new locality.

Hydroporus boreus, new species
(Figs. 1, 2)

Holotype male.—Length 4.85 mm, width 2.10 mm. Form obovate, widest posteriad to middle of elytra (Fig. 1). Head yellowish rufous with faint traces of two triangular spots between the eyes; palpus and undersurface of head yellowish rufous; antenna yellowish rufous, last four segments dark apically. Pronotum yellowish rufous. Elytron light brown. Undersurface and legs yellowish rufous.

Head alutaceous; punctures fine, separated by twice their diameter.

Pronotum faintly alutaceous; fine punctures on disc separated by twice their diameter, punctures becoming nearly contiguous laterally and posteriorly; equal in width to base of elytra; hind angle recurved; lateral margin narrow, slightly wider than an anterior protarsal claw; pubescence fine, almost lacking.

Elytron with alutaceous sculpture nearly absent, strongly shining; coarsely and densely punctured, punctures much larger than pronotal punctures, separated by less than their diameter; pubescence fine and sparse; lateral margin ascending in basal third.

Metasternal wing and plate and first two abdominal sterna with large coarse punctures. Metacoxal process truncate at apex. Pro- and mesotarsi narrowly dilated, three-fourths as wide as tibia, basal segment largest, second and third segments progressively smaller. Protarsal claws equal, ante-

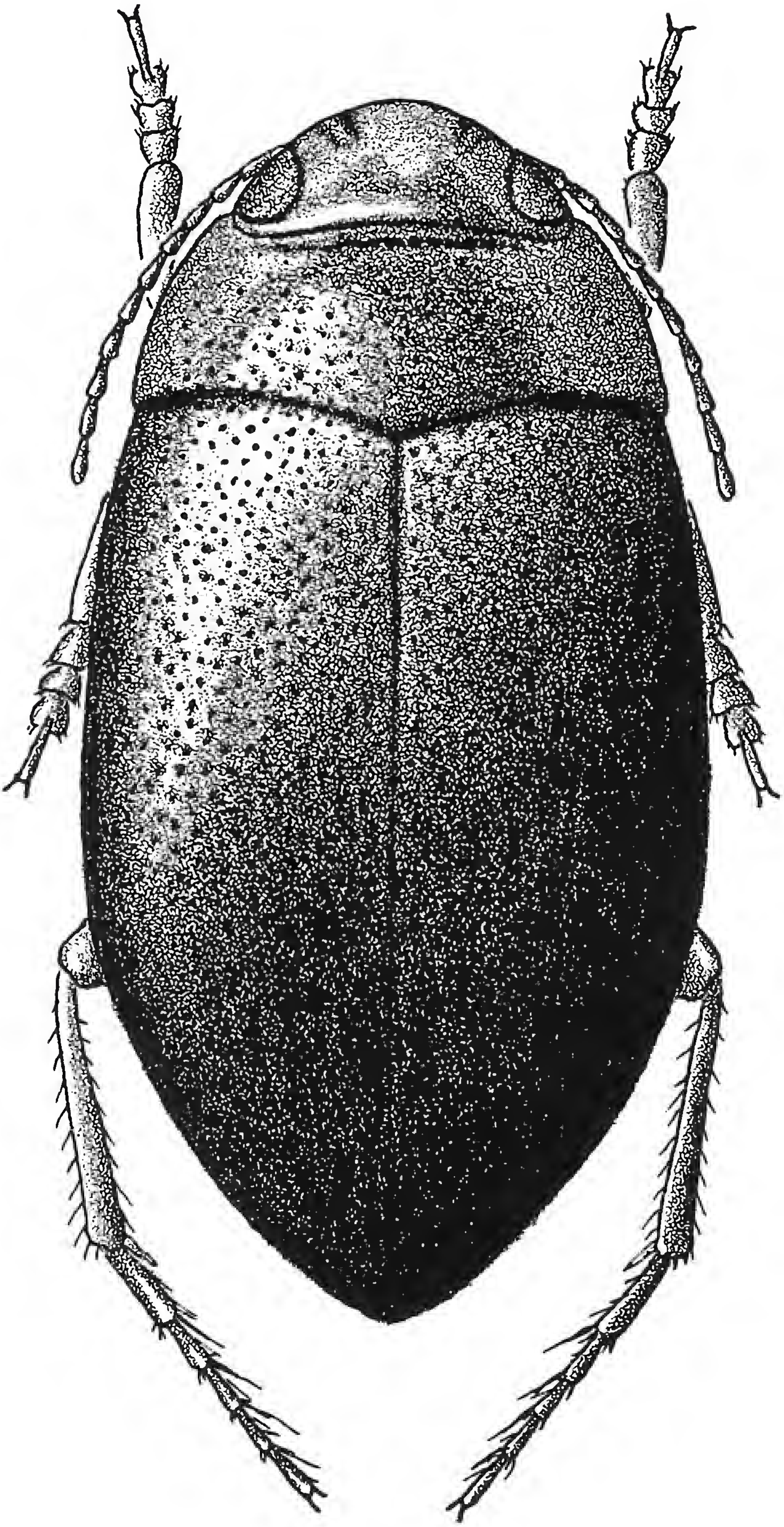

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Fig. 1. Habitus. *Hydroporus boreus,* n. sp.

rior claw just perceptibly thicker, claws half the length of last tarsal segment. Aedeagus tapered from base to apex, the tip curved downward (Fig. 2).

Allotype.—Length 4.00 mm, width 1.90 mm. Similar to holotype except dorsal surface dull, elytron definitely alutaceous with punctures much smaller than male. Pro- and mesotarsi dot dilated; protarsal claw simple.

Variation.—Length varies from 3.90 to 5.00 mm. The females average slightly smaller than the males. In some specimens the pronotum appears narrower than the elytra at the base, and the sides of the pronotum are not as arcuately rounded as in more typical specimens.

Holotype.—Aklavik, N.W.T. (Northwest Territories), July 28, 1932, Lot 308, collected by Owen Bryant (CAS).

Allotype.—60–75 mi. N of Rampart House, Alas. (Alaska), 23.6.12, J. M. Jessup (USNM).

Paratypes.—Total 21, 5 same data as for holotype (CAS). 10, Aklavik, N.W.T. (Northwest Territories), Aug. 13, 1932, Lot 319, collected by Owen Bryant (CAS). 4, Aklavik, N.W.T., Aug. 20, 1930, Lot 108 (CAS) (USNM). 2, Umiat, Alaska, 5-VI-47, collected by K. L. Knight (USNM).

Comparative notes.—This species does not resemble any other in the *niger-tenebrosus* group. As the groups are now defined it must fall here by virtue of the truncate metacoxal process, but it most resembles some members of the *pulcher-undulatus* group. Of the members of the *niger-tenebrosus* group it most nearly resembles *dentellus,* but it is distinguished by the obovate shape, coarse elytral punctures of the male, and the protarsal claws equal in length in the male.

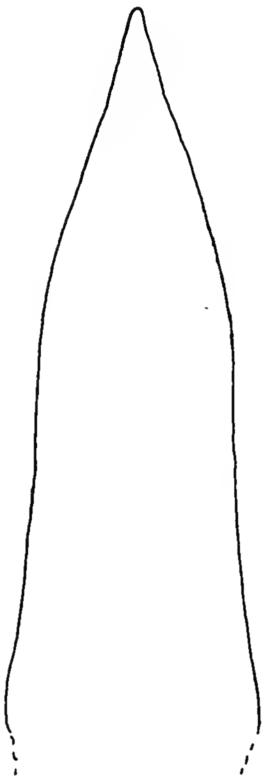
The specific name refers to the northern distribution of this species.

Hydroporus leechi, new species
(Fig. 3)

Holotype male.—Length 5.50 mm, width 2.90 mm. Form elongate-oval, widest at middle of elytra, sides nearly parallel in basal one-half of elytra. Head piceous with a narrow, rufous, basal border; palpus fuscous, apical segment piceous; undersurface of head reddish yellow; antennal segments dark brown apically, reddish yellow basally. Pronotum black, lateral border rufopiceous; legs, sides of abdominal sterna and apex of last abdominal sternum rufous.

Head alutaceous, punctures fine, separated by less than to 4 times their diameter.

Pronotum alutaceous; disc densely punctured, punctures separated by their diameter or slightly more, coarser marginal punctures contiguous or nearly so, forming longitudinal wrinkles near lateral margins; equal in width to base of elytra; hind angle abrupt, a right angle; lateral margin narrow, about the width of a protarsal claw; pubescence fine, sparse.



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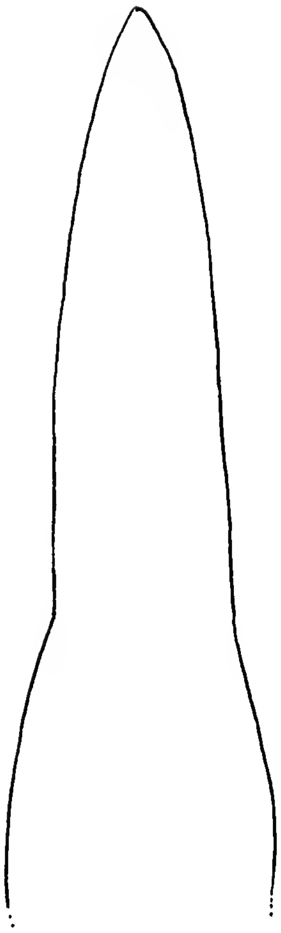

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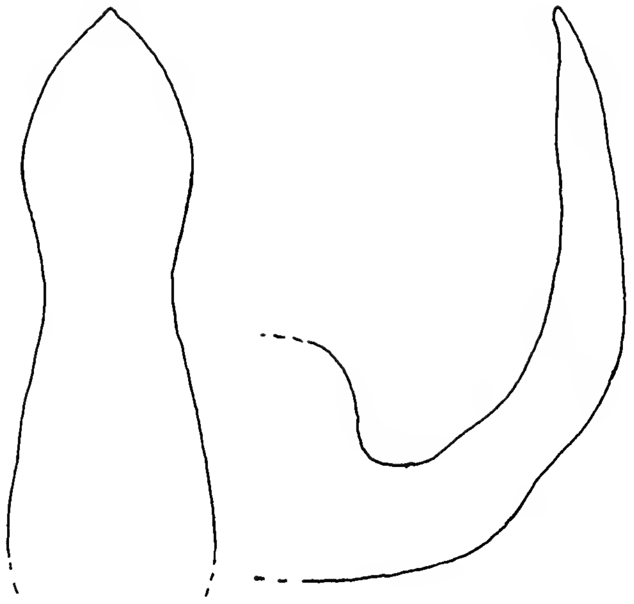

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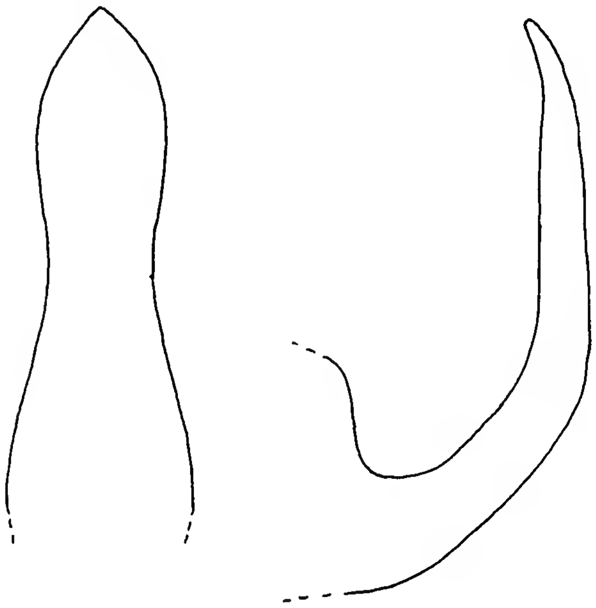

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Figs. 2–5. Male genitalia of *Hydroporus* spp. Fig. 2, *H. boreus* (dorsal view). Fig. 3, *H. leechi* (dorsal view). Fig. 4, *H. signatus youngi* (dorsal, ventral views). Fig. 5, *H. signatus signatus* (dorsal, ventral views).

Elytron not as strongly alutaceous as pronotum, shining; punctures finer than on disc of pronotum, separated by their diameter or less; pubescence fine, longer and denser than on pronotum; lateral margin broadly ascending in basal one-third.

Metasternal wing and plate strongly alutaceous, indistinctly punctured; abdominal sterna coarsely and densely punctured, especially so laterally. Metacoxal process truncate at apex. Pro- and mesotarsi strongly dilated, slightly wider than tibia, second protarsal segment widest, rounded. Protarsal claw elongate, equal in length, not sinuate, slightly longer than last tarsal segment. Aedeagus long, slender, tapering to a point, side slightly sinuate (Fig. 3).

Allotype.—Female not known.

Variation.—The type series does not vary except for length 5.35–5.50 mm and width 2.80–2.90 mm.

Holotype.—San Mateo Co., California, Edgemar district of Pacifica, 4.6 mi. south of San Francisco Co. line; permanent pond E side Skyline Blvd., 9-X-1967, Hugh B. Leech (CAS).

Paratypes.—Total 3. 2, UNITED STATES: California: same data as for holotype (CAS) (USNM); 1, San Mateo Co., California, Skyline Pd., III-16-51, D. Rentz (CAS).

Comparative notes.—This species keys best to *columbianus* Fall in Fall's (1923) key to species. The male protarsal claw is as long or longer than the last protarsal segment, and the punctures of the metasternal wing nearly invisible in *leechi*. The male protarsal claw is ½ or less the length of the last protarsal segment, and the punctures of the metasternal wing are distinct in *columbianus*.

The specific name is in recognition of Hugh Leech's life-long contributions to water beetle systematics.

Hydroporus signatus youngi, new subspecies
(Figs. 4, 6)

Holotype male.—Length 4.15 mm, width 2.40 mm. Form oval, widest at middle of elytra. Head rufous with traces of two dark triangular spots between the eyes; palpus and undersurface of head rufous, last segment of maxillary palpus piceous apically; antenna piceous, first two segments testaceous. Pronotum piceous, rufopiceous laterally. Elytron piceous, humeral angle paler, traces of posterior marginal and subapical pale spot present. Undersurface black; legs rufous; third through fifth abdominal sterna rufous at sides, sixth sternum rufous at apex and sides.

Head alutaceous; punctures fine, separated by twice their diameter.

Pronotum alutaceous; punctures on disc separated by twice their diameter, coarser marginal punctures nearly contiguous; equal in width to base of elytra; hind angle abrupt, slightly recurved; lateral margin moderate, one and a half times as wide as an anterior protarsal claw; pubescence fine, very sparse.

Elytron alutaceous, feebly shining; densely punctured, punctures slightly smaller than discal pronotal punctures, separated by their diameter; pubescence fine, denser on apical third; lateral margin straight from base to apex.

Metasternal wing and plate and first two abdominal sterna coarsely punctured. Metacoxal process truncate at apex. Pro- and mesotarsi moderately dilated, as wide as tibia, segments equal in width. Protarsal claws equal, both claws sharply bent at base, nearly parallel to tip, sinuate on inner margin, as long as last tarsal segment. Aedeagus slightly constricted at middle, anterior portion bulbous, apical projection very short (Fig. 4).

Allotype.—Length 3.80 mm, width 2.00 mm. Similar to holotype except dorsal surface dull, elytron strongly alutaceous and minutely punctate; pro- and mesotarsi not dilated, protarsal claw simple.

Variation.—Length varies from 3.90 to 4.20 mm in the male; 3.85 to 4.15 mm in the female. The markings on the elytra are more distinct in some individuals than in others. A series from Scott's Pond at Bloomington, Indiana, are lighter in color than normal and has elytral markings more distinct.

Holotype.—Beltsville, Maryland, 8-VII-1961, P. J. Spangler, USNM (72156).

Allotype.—Same data as for holotype (USNM).

Paratypes.—Total 219. UNITED STATES: ALABAMA: Mobile, VI-5-27, Darlington (MCZ); Mobile Co., Loding (MCZ); Novulicla?, VI-16-1931, H. P. Loding; Camp Rucker, Ozark, 31-XII-1942, J. G. Franclemont (FNY); Tumblin Gap (USNM), District of Columbia: Piney Branch, 2-5-05, DH Clemons collector (USNM): WASHINGTON, Coll. Hubbard and Schwarz (USNM). FLORIDA: Liberty County, 5.3 mi. S Bristol, VI-II-54, S Brown-F N Young (FNY). GEORGIA: Decatur County, Flatwoods, 2.7 mi. NE Faceville, VI-II-54, S Brown-F Young (FNY); Floyd County, Cave Spring, IX-4-49, F N Young (FNY); Fulton County, Fort McPherson in Atlanta, III-31-43, F N Young (FNY); Hart County, Nuberg, IX-I-1943 (FNY); Rabun Co., July (CAS). INDIANA: Brown Co., IV-21-56, J. R. Zimmerman (JRZ); Monroe Co., Bloomington, IV-26-56, V-11-56, V-12-56, V-17-56, V-22-56, VI-25-56, VII-1-56, VII-30-56, IX-8-56, X-5-56, X-11-56, XI-13-56, XII-3-56, X-11-55, X-18-55, J. R. Zimmerman (JRZ); Monroe Co., Hilltop Pond, I-29-50, F N Young (FNY); Monroe County, Scott's Pond at Bloomington, X-II-49, VII-2-50, II-24-51, IV-8-51, II-11-52, IV-17-52, V-3-52, VI-1-52, F N Young (FNY); Noble Co., X-26-56, J. R. Zimmerman (JRZ). MARYLAND: Beltsville, 8-VII-1961, P. J. Spangler (USNM); Beltsville, Goldfish Pd., 9-V-1965, Robert Gordon (RDG); Friendship, 24-IV-1965, 8-V-1965, Robert Gordon (RDG); Garrett Co., Deep Creek L., 13-VI-1965, Robert Gordon (RDG); Marlboro, U. of Md. Tob. Fm., 25-V-1965, 29-VI-1965, Robert Gordon (RDG); C&O Lock at Plummer's Isl., VI-29-1960, VII-5-1960, IX-1-1960, P. J. Spangler (USNM); Potomac R., 16-V-1965, Robert Gordon (RDG); Rosehaven, 27-III-1965, 7-VIII-1965, Robert Gordon (RDG). MISSOURI: Ashland, V-8-1955, P. J. Spangler (USNM); Columbia, VIII-6-1953, P. J. Spangler (USNM); 5 mi. S Columbia, VIII-20-1953, M. C. Grabau (USNM); Maramec Spring, St. Hiway 8, VII-21-1958, P. J. Spangler (USNM). NEW JERSEY: Camden Co., VI-16-29, J. W. Green (CAS); Lakehurst, 9-1-01 (USNM); Lakehurst, V-2-27 (MCZ). NORTH CAROLINA: N.C. (MCZ); Raleigh, 9-March-02, F. Sherman Jr. (NCS); Raleigh, 29-April-03, C. S. Brimley (NCS); Swain Co., Bryson City, 8 mi. SW, V-18-57, J. R. Zimmerman (JRZ). OHIO: Athens Co., 15-VI-1960, 15-VII-1960, J. Stanley (OU); Armitage, Athens Co., VI-7-1951, P. J. Spangler (USNM); Athens Airport, Athens Co., 5-16-1950, 5-21-1951, 5-22-1951, 5-23-1951, VI-3-1951, Paul J. Spangler (USNM); Champaign Co., Cedar Run, July 24, 1964, J. L. Williams (USNM); 10-21-50, Jackson, Jackson Co., P. J. Spangler (USNM); 11-5-50, 5 mi. W of Chillicothe, Ross Co., P. J. Spangler (USNM). PENNSYLVANIA: Annville, Water Works, 6-VI-1965, Robert Gordon (RDG); Stony Creek, Lebanon Co., VI-22-1953, P. J. Spangler (USNM). SOUTH CAROLINA: Clemson College, IV-22-1928, 24 Nov. 1929, 12 Jun. 1930, 15 Mch. 1931, 24 Mch. 1931, D. Dunavan coll. (USNM); Rocky Bottom, Pickens Co., 14 May 1931, 20 Sept. 1931, D. Dunavan coll. (USNM); Walhalla, 24 Mch. 1929, D. Dunavan coll. (USNM); Windsor, 25 Nov. 1933, David Dunavan (USNM). TENNESSEE: Bluegrass, 31-X-40, G. Keener (CAS). VIRGINIA: Mt. Vernon, Fairfax Co., VIII-1-1919, E. Shoemaker collector (USNM); Fredskbg., 7-73, 9-93, 3-19-99, 3-30-99, 9-2-00 (USNM); Giles County, pond near Mt. Lake, VII-22-1959 (FNY); Ivy, June 1933, F. E. Winters (CAS); Beaver Pond Mt. Lake, 22-VIII-41, A. C. Cole (CAS); Warm Springs, 10-6 (USNM); Washington, 15-V-1965, Robert Gordon (RDG). WEST VIRGINIA: Swimming Pool, Droop Mt., June 9, 1933 (FNY); Smoke Hole, Pendleton Co., Aug. 7–30, J. G. Needham (FM) (CU); Ripley, 6-25-1930, P N Musgrave (FM) (CU).

Comparative notes.—A comparison of the male genitalia (Figs. 4, 5) is necessary to separate *youngi* from typical *signatus* Mannerheim (to which it will go in Fall's key 1923) with certainty, but the two can usually be distinguished when seen in series. *H. youngi* is larger and the punctures on the pronotal disc and elytra are much more dense, the metasternal plate is coarsely punctured and nearly equal to the metasternal wing in this respect, while nominate *signatus* has the punctures of the metasternal plate distinctly smaller than on the metasternal wing. Color differs considerably in typical

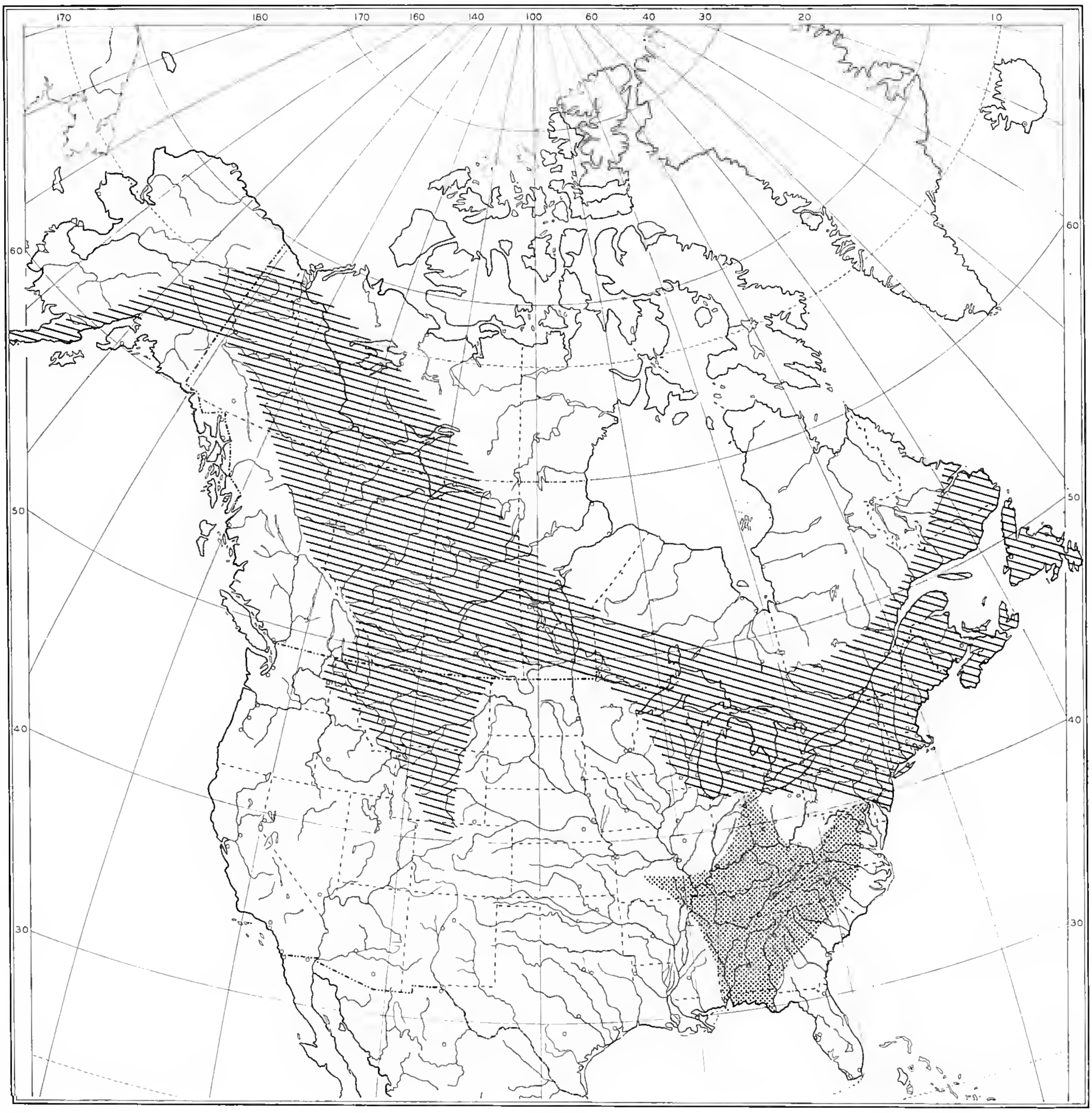

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Fig. 6. Distribution of *H. signatus signatus* (lined area) and *H. signatus youngi* (dotted area).

examples of the two subspecies. *H. signatus* has the head usually a uniform piceous, whereas *youngi* has either a plain rufous head or more typically with two dark triangular spots between the eyes. The elytron in *youngi* is much darker than *signatus* and the form is more regularly oval. The nominate form and *youngi* intergrade in New Jersey and Indiana (Fig. 6).

The specific epithet is a genitive of the surname of Frank Young, to whom I dedicate this subspecies in recognition of his contributions to water beetle taxonomy.

Hydroporus simplex, new species
(Fig. 7)

Holotype male.—Length 5.25 mm, width 2.80 mm. Form elongate oval, widest at middle of elytra. Head piceous with pale clypeal margin and pale posterior transverse band; palpus and entire undersurface of head rufous; antenna rufous; segments piceous in apical third. Pronotum black, paler laterally. Elytron brown. Undersurface black except abdomen rufous, legs rufous.

Head alutaceous; punctures fine, separated by one or two times their diameter.

Pronotum alutaceous; fine punctures on disc separated by twice their diameter, punctures becoming coarser laterally, nearly contiguous; equal in width to base of elytra; hind angle abrupt; lateral margin wide, two and one-half times as wide as an anterior protarsal claw; pubescence fine, sparse.

Elytron alutaceous, shining; finely and densely punctured, punctures equal in size to basal pronotal punctures, separated by less than their diameter; pubescence fine, sparse; lateral margin ascending in basal third.

Metasternal wing and plate and first two abdominal sterna coarsely punctured. Metacoxal process just perceptibly protruding at apex. Protarsus slightly dilated, much narrower than tibia, third segment narrower than first and second, parallel sided; mesotarsus not dilated. Protarsal claws unequal, anterior claw slightly shorter, thickened, claws half the length of the last tarsal segment. Aedeagus parallel sided, narrowing to a blunt point in apical fourth (Fig. 7).

Allotype.—Length 5.00 mm, width 2.80 mm. Similar to holotype except for the equal and unmodified protarsal claws.

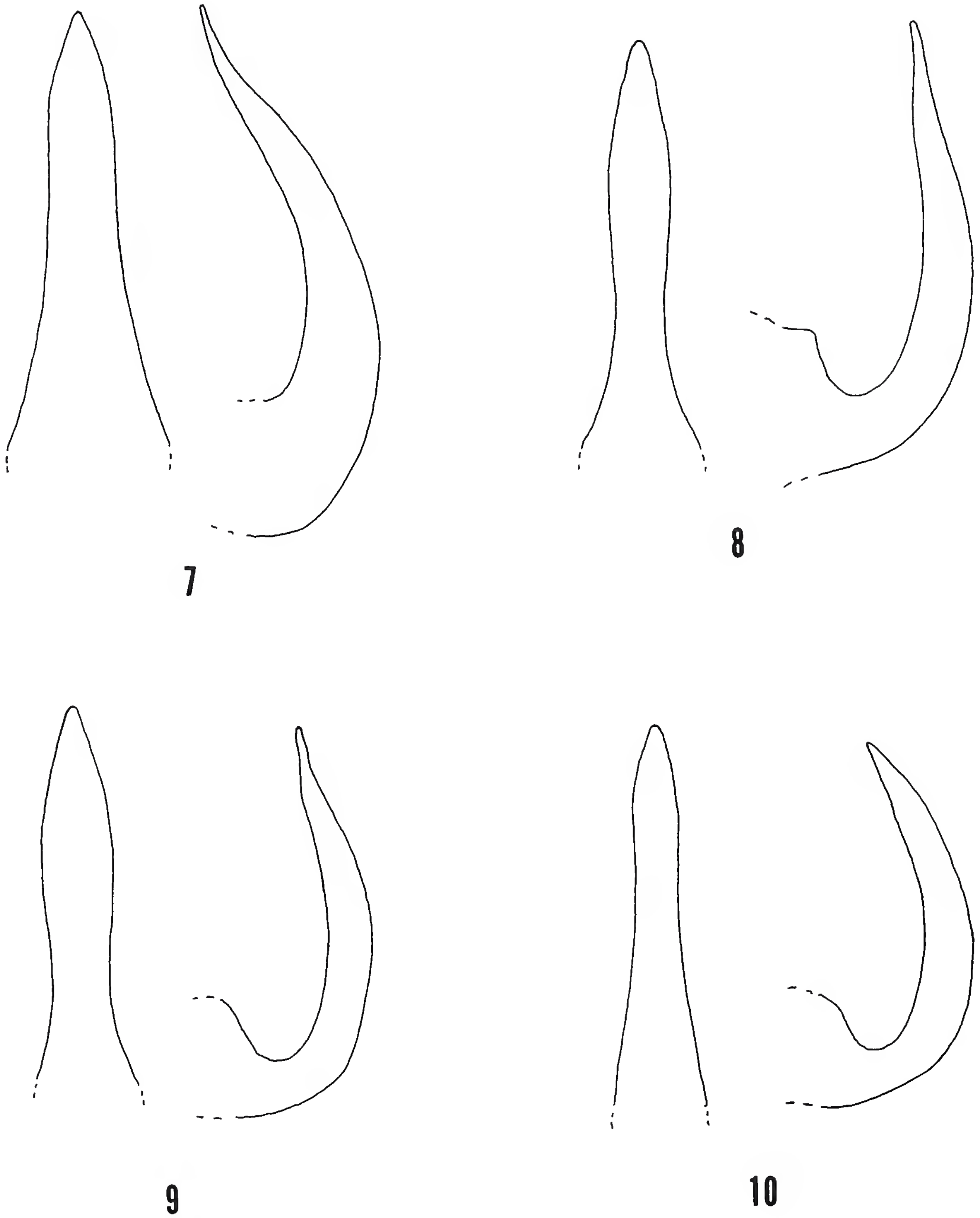
Variation.—No apparent variation is evident in the short type series. A single aberrant female has only two tarsal segments on the left protarsus with normal claws appearing on the second segment.

Holotype.—Pinecrest, Tuolumne Co. (California), 13-VII-1948, collected by P. H. Arnaud (CAS).

Allotype.—Same data as for holotype (CAS).

Paratypes.—Total 8. Same data as for holotype (CAS) (USNM).

Comparative notes.—Males of this species can be separated easily from males of other species in the same size range by the very narrow protarsus. It is closest to *subpubescens* LeConte and *columbianus* Fall, both of which have the protarsus as wide or wider than the tibia. Females can be separated from *columbianus* by size, which averages nearly 1 mm less than *columbianus*. Females of *subpubescens* are dull dorsally while females of *simplex* are as shiny as the male. If the rufous abdomen proves to be a constant character, it will easily separate this species from all other western members of the group. If this species is restricted to California and bordering states,



Figs. 7–10. Male genitalia of *Hydroporus* spp. Fig. 7, *H. simplex* (dorsal, ventral views). Fig. 8, *H. utahensis* (dorsal, ventral views). Fig. 9, *H. hirsutus* (dorsal, ventral views). Fig. 10, *H. californicus* (dorsal, ventral views).

as may well be the case, *subpubescens* is the only species with which it may be confused.

The specific epithet refers to the lack of any outstanding morphological characteristic in this species.

Hydroporus utahensis, new species
(Fig. 8)

Holotype male.—Length 4.50 mm, width 2.50 mm. Form elongate-oval, widest at middle of elytra. Head rufopiceous with a pale posterior transverse band; gena black, rest of undersurface of head rufous; antenna rufopiceous, first two segments rufous. Pronotum rufopiceous becoming rufous laterally. Elytron slightly paler than pronotum. Undersurface black; legs rufous; faint rufous spot present on lateral margin of the third abdominal sternum.

Head alutaceous; punctures fine, separated by one and one-half times their diameter.

Pronotum alutaceous; fine punctures on disc separated by twice their diameter, coarser and nearly contiguous laterally and posteriorly; equal in width to base of elytra; hind angle abrupt; lateral margin wide, three to four times as wide as an anterior protarsal claw; pubescence fine, very sparse. Elytron alutaceous, shining; densely and evenly punctured, punctures smaller than basal punctures of pronotum, separated by their diameter; pubescence fine, sparse; lateral margin slightly ascending in basal third.

Metasternal wing and plate and first two abdominal sterna coarsely punctured. Metacoxal process slightly angulate at apex. Pro- and mesotarsi slightly dilated, narrower than tibia, segments one and two subequal in width, third segment slightly narrower. Protarsal claws equal, unmodified, half the length of last tarsal segment. Aedeagus long, slender, with a constriction in basal third, tapering gradually to a rounded tip (Fig. 8).

Allotype.—Length 4.35 mm, width 2.30 mm. Similar to holotype except dorsal surface slightly more alutaceous; punctures of elytron smaller, less distinct; pro- and mesotarsi not dilated; protarsal claw simple.

Variation.—One male in the type series is only 4.35 mm long, the rest are as for the holotype. The metacoxal process is flat in some specimens and perceptibly angulate in others. One male in the series is strongly alutaceous and dull in appearance.

Holotype.—Utah Lake East Side (Utah), No. 196 Exp., 7-6-41 NE, Elv. 4000 W, collected by H. P. Chandler (CAS).

Allotype.—Utah Lake East Side (Utah), No. 192 Exp., 7-6-41 NE, Elv. 4000 SW, collected by H. P. Chandler (CAS).

Paratypes.—Total 5. Same data as for holotype (CAS) (USNM).

Comparative notes.—This species resembles *despectus* Sharp and *hirtellus* LeConte. The broad constriction of the aedeagus in the basal third is a characteristic not shared by either *despectus* or *rusticus,* both of which have that portion of the aedeagus either not constricted, or with a feeble constriction occupying the basal two-thirds. The lateral margin of the pronotum is wider in *utahensis* than any of the related species. The punctures of the pronotum and elytra are fine in *utahensis,* much finer than those of *despectus,* the gena is piceous or at least considerably darker than the submentum of *utahensis,* whereas the gena and submentum are the same color in *despectus.* The form of *utahensis* is more elongate than that of *hirtellus* and the elytral punctures, while nearly as fine as in *hirtellus,* are not nearly as dense. *H. similaris* Fall may also be confused with this species, but *similaris* males have the anterior protarsal claw distinctly shorter than the posterior.

The species name refers to the state in which the material was collected.

Hydroporus hirsutus, new species
(Fig. 9)

Holotype male.—Length 3.90 mm, width 1.90 mm. Form elongate, nearly parallel sided, widest at middle of elytra. Head piceous with clypeal margin and posterior transverse band rufous; last segment of maxillary palpus and gena piceous, rest of undersurface of head rufous; antenna rufopiceous, first two segments rufous. Pronotum piceous becoming rufopiceous laterally. Elytron brown. Undersurface black; legs rufous.

Head alutaceous; punctures moderately coarse, separated by one or one and one-half times their diameter.

Pronotum alutaceous; moderately coarse punctures on disc separated by twice their diameter, nearly contiguous posteriorly and laterally; equal in width to base of elytra; hind angle abrupt; lateral margin moderate, one and one-half times as wide as an anterior protarsal claw; pubescence fine, sparse.

Elytron slightly alutaceous, strongly shining; coarsely and evenly punctured, punctures larger than those on pronotum, separated by their diameter; pubescence fine, quite dense, particularly so laterally and posteriorly; lateral margin very slightly ascending in basal third.

Metasternal plate finely punctured; metasternal wing and first two abdominal sterna coarsely punctured. Metacoxal process angulate at apex. Pro- and mesotarsi narrowly dilated, not as wide as tibia, segments one and two equal, third segment smaller. Anterior protarsal claw slightly shorter than posterior, protarsal claw half the length of last tarsal segment. Aedeagus constricted in basal third, gradually narrowing to a blunt point in apical third (Fig. 9).

Allotype.—Length 4.00 mm, width 1.90 mm. Similar to holotype except alutaceous sculpture more evident on elytron; pro- and mesotarsi not dilated; protarsal claws equal in length.

Variation.—A few specimens in the series are slightly more alutaceous than the holotype. The degree of pubescence varies slightly but this is probably the result of handling the specimens.

Holotype.—Mt. Goethe, Fresno Co., Calif. (California), 9-VII-1952, 12,600 ft. elev., collected by Peter Raven (CAS).

Allotype.—Same data as for holotype (CAS).

Paratypes.—Total 14. Same data as for holotype (CAS) (USNM).

Comparative notes.—This species most nearly resembles *pervicinus* Fall and *californicus,* new species. It can be separated from *pervicinus* by the piceous last segment of the maxillary palpus and by the much finer punctation of the metasternal plate. The male protarsal claws are nearly equal, whereas in *pervicinus* the anterior protarsal claw is much shorter than the posterior. *H. hirsutus,* new species, can be separated from *californicus* by the narrow, elongate shape and much denser pubescence, both dorsally and ventrally.

The type series was taken at an altitude of 12,600 feet, and the species may possibly be restricted to high elevations. The specimens are unusually pubescent, in this respect resembling some of our small arctic species.

The specific epithet refers to the unusually distinctive pubescence.

Hydroporus californicus, new species
(Fig. 10)

Holotype male.—Length 3.85 mm, width 2.00 mm. Form oval, widest anteriad to middle of elytra. Head piceous with posterior transverse rufous band; gena and last segment of maxillary palpus piceous, rest of undersurface of head rufous; antenna piceous, first two segments rufous. Pronotum piceous becoming rufopiceous laterally. Elytron brown. Undersurface black, legs rufous.

Head alutaceous; punctures fine, separated by twice their diameter.

Pronotum alutaceous; moderately coarse punctures on disc separated by twice their diameter, coarser and nearly contiguous laterally and posteriorly; equal in width to base of elytra; hind angle abrupt, slightly recurved; lateral margin twice as wide as an anterior protarsal claw; pubescence fine, very sparse.

Elytron alutaceous, shining, evenly punctured, punctures larger than on pronotum, separated by their diameter; pubescence fine, very sparse; lateral margin ascending slightly in basal third.

Metasternal plate finely punctured; metasternal wing and first two abdominal sterna coarsely punctured. Metacoxal process slightly angulate at apex. Pro- and mesotarsi slightly dilated, narrower than tibia, segments one and two equal, third segment slightly narrower. Protarsal claws nearly equal in length, anterior claw just perceptibly shorter, claws half the length of last tarsal segment. Aedeagus narrow, feebly constricted medially, enlarged apically before tapering to a blunt point (Fig. 10).

Allotype.—Length 3.8 mm, width 2.00 mm. Identical to holotype in all respects except that the pro- and mesotarsi are not dilated.

Variation.—The degree to which the metacoxal process is produced varies from just perceptibly angulate to definitely so.

Holotype.—Mono Co., Cal. (California), round pond on ridge S of Leavitt Mdw., 13-VII-1963, collected by H. B. Leech (CAS).

Allotype.—Same data as for holotype (CAS).

Paratypes.—Total 22, 21, same data as for holotype; 1, California, Mendocino Co. Univ. Cal. Range Exp. Sta., pond by deerpen, about 4 mi. NE of Hopland, 30-VI-1963, collected by H. B. Leech (CAS) (USNM).

Comparative notes.—This species is closest to *hirtellus* LeConte in appearance. In series it averages obviously smaller than *hirtellus*. The elytral punctures are coarser and not as dense. The punctation of the metacoxal plate in *hirtellus* is coarse, not appreciably different than the punctures of the metasternal wing and first two abdominal sterna. In *californicus* the punctation of the metacoxal plate is fine, much finer than metasternal wing or first two abdominal sterna. *H. californicus* may also be confused with *hirsutus,* new species, but see comparative notes under *hirsutus*.

The species name refers to the state in which the type material was collected.

Hydroporus fatigus, new species
(Fig. 11)

Holotype male.—Length 4.25 mm, width 2.25 mm. Form elongate oval, widest at middle of elytra. Head rufopiceous with pale posterior transverse band; palpus rufous, terminal segments darker; undersurface of head rufous with gena darker; antenna rufopiceous, first two segments rufous. Pronotum piceous, becoming paler laterally. Elytron brownish piceous, humeral angle paler; undersurface black; legs rufous with femora darker medially. Third and fourth abdominal sterna rufous laterally.

Head alutaceous; punctures fine, separated by twice their diameter.

Pronotum alutaceous; fine punctures on disc separated by two or three times their diameter, punctures slightly larger at margins, separated by their diameter; equal in width to base of elytra; hind angle abrupt; lateral margin wide, twice as wide as an anterior protarsal claw; pubescence fine, sparse.

Elytron alutaceous, shining; moderately coarsely punctured throughout, punctures slightly larger than basal pronotal punctures, separated by their diameter; pubescence fine, sparse; lateral margins slightly ascending in basal third.

Metasternal wing and plate and first two abdominal sterna coarsely punctured. Metacoxal process strongly angulate at apex. Protarsus slightly dilated, narrower than tibia, segments equal in width; mesotarsus not dilated. Protarsal claws equal, anterior claw slightly thickened, claws less than half the length of last tarsal segment. Aedeagus narrow, pinched at basal third, narrowing to a blunt point apically (Fig. 11).

Allotype.—Length 4.20 mm, width 2.00 mm. Similar to holotype in all respects except that the color of the abdomen is entirely rufous; protarsus not dilated, protarsal claws simple.

Variation.—Size ranges from 3.90 to 4.30 mm in length, 1.90 to 2.10 mm in width. The rufous abdomen of the allotype female is not constant for all specimens. The color of the abdomen varies from rufous to black. An occasional specimen lacks the distinctive pale humeral angle.

Holotype.—Abbotsford, B.C. (British Columbia), roadside ditch, 14-IX-45, collected by Hugh B. Leech (CAS).

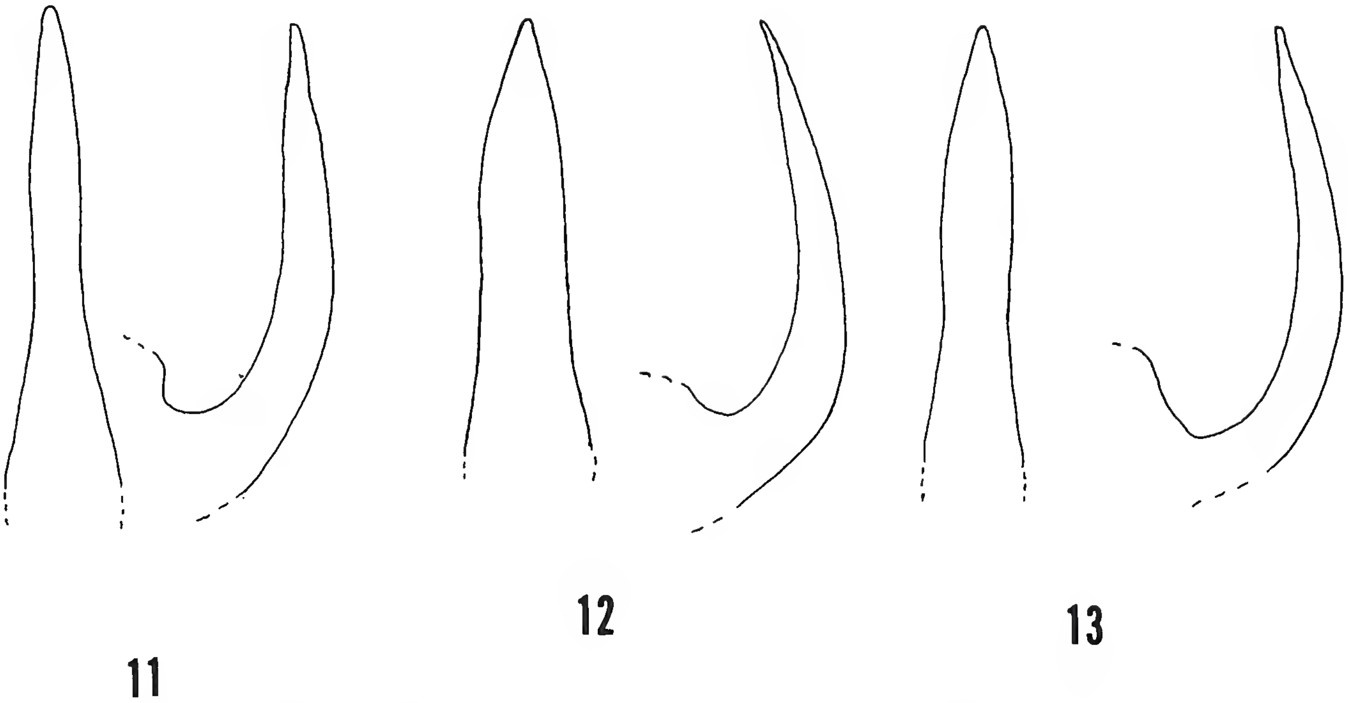
Allotype.—Abbotsford, B.C., 29-V-40, collected by H. B. Leech (CAS).

Paratypes.—Total 67. CANADA: BRITISH COLUMBIA: Abbotsford, 29-V-40, 14-IX-45, H. B. Leech (CAS); Salmon River, Glenemma, 15-VII-49, H. B. Leech collector (CAS); Fraz. Val., J. D. Sherman collection (USNM); Lac-le-Jeune, Kamloops, 23-V-1933, A. C. Thrupp (CAS); Tranquille Lake, near Kamloops, 27-VIII-1939, G. J. Spencer (CAS); Langley, 26-I-1935, 17-IV-35, 23-VI-35, K. Graham (CAS); Lumby, 19-IX-1937, 16-IX-1939, 25-II-1943, 25-IX-1943, 8-IX-1944, H. B. Leech (CAS); Metlakatla, Rev. Keene collection (USNM); Salmon Arm, 22-VIII-1929, 2-IX-1929, 7-X-33, 5-IX-37, Hugh B. Leech (CAS); Vancouver, 29-III-30, VI-11-30, 5-IX-1932, Hugh B. Leech (CAS); Wynndel, 25-VII-47, G. S. Smith (CAS).

UNITED STATES: MONTANA: 2 mi. W Corvallis, Ravalli Co., V-20-1952, A. A. Hubert. OREGON: Corvallis, J. D. Sherman collection (USNM); Corvallis, 20-V-1938, Hugh B. Leech (CAS); Crescent, Klamath Co., 10-IX-1950, Malkin & Thatcher (FM); Ft. Klamath, Klamath Co., 13-VIII-1950 (FM); Curry Co., VI-12-1954, R. K. Benjamin (USNM). WASHINGTON: Chase Lake, 25-VII-1954, B. Malkin (FM); Mason Co., Cushman, VI-22-1919, F M Gaige (FNY); Shohomish R., 5-23-92 (USNM).

Comparative notes.—This species is grouped with *similaris* Fall and *longiusculus* Gemminger and Harold by the strongly angulate apex of the metacoxal process. *H. longiusculus* is slightly smaller, flattened dorsoventrally, and has the elytral punctures much finer than *fatigus*. The elytra of *longiusculus* are yellowish brown while the elytra of *fatigus* are usually nearly piceous. *H. similaris* males can immediately be separated from *fatigus* males by the short anterior protarsal claw. The females are difficult to separate, but *fatigus* characteristically has a distinct pale yellowish humeral angle which *similaris* lacks.

The specific epithet refers to the amount of effort "fatigue" expended before this species was finally segregated from *similaris*.



Figs. 11–13. Male genitalia of *Hydroporus* spp. Fig. 11, *H. fatigus* (dorsal, ventral views). Fig. 12, *H. elusivus* (dorsal, ventral views). Fig. 13, *H. spangleri* (dorsal, ventral views).

Hydroporus elusivus, new species
(Fig. 12)

Holotype male.—Length 3.40 mm, width 1.80 mm. Form elongate oval, widest anterior to middle of elytra. Head rufopiceous, slightly paler on clypeal margin; palpus and entire undersurface of head rufous; antenna rufopiceous, first two segments rufous. Pronotum rufopiceous becoming paler laterally. Elytron brown. Undersurface rufopiceous; legs rufous; third through sixth abdominal sterna rufous laterally.

Head alutaceous; punctures fine, separated by twice their diameter.

Pronotum alutaceous; fine punctures on disc widely separated, punctures becoming coarser laterally, separated by less than their diameter; equal in width to base of elytra; hind angle abrupt; lateral margin wide, three times as wide as an anterior protarsal claw; pubescence fine, very sparse.

Elytron alutaceous, shining; coarsely punctured, punctures subequal in size to basal pronotal punctures, separated by slightly less than their diameter; pubescence fine, very sparse; lateral margin slightly ascending in basal third.

Metasternal wing and plate and first two abdominal sterna coarsely punctured. Metacoxal process truncate at apex. Pro- and mesotarsi slightly dilated, almost as in female, narrower than tibia, segments equal in width. Protarsal claws equal, anterior claw slightly thickened, claws half the length of last tarsal segment. Aedeagus tapering from base to apex, ending in a blunt point (Fig. 12).

Allotype.—Length 3.60 mm, width 1.90 mm. Similar to holotype except dorsal surface more alutaceous. Pro- and mesotarsi slightly narrower than male, protarsal claws simple.

Variation.—No apparent variation is evident in the short type series.

Holotype.—Rumney, N.H. (New Hampshire), IV-22-1926, collected by P. J. Darlington (MCZ).

Allotype.—Same data as for holotype (MCZ).

Paratypes.—Total 2. Same data as for holotype (MCZ) (USNM).

Comparative notes.—This species most nearly resembles *tartaricus* LeConte from which it may be separated by the spacing of the elytral punctures. The punctures are much closer together in *elusivus,* and the male protarsus is much narrower than in *tartaricus.* The specific epithet refers to the apparent scarcity of this species which I have seen from a single locality.

Hydroporus spangleri, new species
(Fig. 13)

Holotype male.—Length 3.40 mm, width 1.80 mm. Form obovate, widest posterior to middle of elytra. Head piceous with a pale posterior transverse band; palpus and entire undersurface of head rufous; antenna rufopiceous, first two segments rufous. Pronotum piceous becoming paler laterally. Elytron brown. Undersurface black; legs rufous; third abdominal sternum with rufous spot laterally.

Head alutaceous; punctures fine, separated by one or two times their diameter.

Pronotum alutaceous; fine punctures on disc unevenly spaced, punctures becoming coarser laterally, separated by less than their diameter; equal in width to base of elytra; hind angle slightly rounded; lateral margin narrow, less than twice as wide as an anterior protarsal claw; pubescence fine, very sparse.

Elytron alutaceous, shining; coarsely and evenly punctured, punctures equal in size to basal pronotal punctures, separated by less than their diameter; pubescence fine, sparse on disc, becoming more dense laterally and posteriorly; lateral margin slightly ascending in basal third.

Metasternal wing and plate and first two abdominal sterna coarsely punctured. Metacoxal process angulate at apex. Pro- and mesotarsi slightly dilated, narrower than tibia, segments two and three equal in width, third segment narrower. Protarsal claws equal, unmodified, claws half the length of last tarsal segment. Aedeagus with sides nearly parallel, tapering to a point in apical third (Fig. 13).

Variation.—The two males in the type series show no apparent variation.

Holotype.—Lambs Canyon nr. S (Salt) Lake City (Utah), VI-30-1949, collected by G. K. Todd (USNM 72155).

Allotype.—No female available for study.

Paratype.—Total 1. Same data as for holotype (USNM).

Comparative notes.—H. spangleri most nearly resembles *occidentalis* to which it keys in Fall (1923). The elytron is much more coarsely and densely punctate than *occidentalis,* and the male genitalia of *spangleri* have the aedeagus very slender and obviously constricted medially, while the aedeagus of *occidentalis* is comparatively broader and not constricted, or if constricted, then feebly and broadly so. The holotype and a single paratype are the only specimens seen to date. The specific epithet is a genitive of the surname of Paul Spangler, to whom I am indebted for much help and encouragement in studies of water beetles.

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NOTES ON THE NATURAL HISTORY OF *SPANGLEROGYRUS ALBIVENTRIS* FOLKERTS, WITH A NEW DISTRIBUTION RECORD (COLEOPTERA: GYRINIDAE)

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The whirligig beetle *Spanglerogyrus albiventris* Folkerts (Coleoptera: Gyrinidae) was originally described from a series of 11 specimens taken from undercut banks of large streams at two localities in the Red Hills region of southwestern Alabama (Folkerts, 1979) and was reported to be uncommon at those sites. The species was placed in a separate subfamily because of its unique structure. Our interest in this small, aberrant gyrinid prompted a trip to the type-locality in April 1980 and resulted in the following report on its natural history. These observations may be helpful in future studies of gyrinid phylogeny and origin.

New Locality Record and Specimens

An intensive search of the type-locality near Peterman, Monroe County, yielded only 2 specimens of *Spanglerogyrus albiventris,* a female collected 11 April and a male on 17 April. Unusually heavy spring rains before and during our stay caused considerable flooding of streams in the area and we associated this with the low number of specimens taken. However, on 19 April at a nearby locality in Conecuh County (13 km E. Evergreen) we discovered a concentration of members of this species and took a series of 85 specimens (26 ♂♂, 59 ♀♀) in about an hour of collecting.

This collection indicates that *S. albiventris* can be locally much more abundant than originally thought. The collection site represents the first record for the species in Conecuh County; it lies between and south of the two previously recorded sites and is within the presumed range figured by Folkerts (1979).

Cursory examinations of sex ratios in members of other gyrinid genera demonstrate that the high proportion of females to males is a common condition within the family.

Habitat

The large series of *S. albiventris* was collected midday at a shaded stream 8–12 m wide, with steep, mossy banks; surrounding soil is sandy and the creek has a sand and gravel bottom. This is like the habitat described by Folkerts for the type-locality, but at this new site most of the beetles were concentrated near the mouths of two small tributaries (1–2 m wide) and up along the margins of one of them for more than 50 m; beyond that there were few suitable microhabitats, i.e. small undercuts and hollowed-out pockets in the bank. Highest concentrations were taken at the points of land at the confluence of the small creeks and main stream even though suitable microhabitats seemed equally distributed elsewhere along the margin of the large stream. Beetles were fewer in number and occurred in smaller isolated clusters as we sampled up the small creeks and fewer along the edge of the larger stream as we worked upstream and downstream from the mouths of the smaller ones. The absence of similar small tributaries at the type-locality might explain the low abundance at that site.

Our observations on the concentration of *S. albiventris* indicate that the presence of small tributaries to larger streams is probably an important factor in the maintenance of local populations of the species. We believe the larval habitat may be up the small streams rather than along the margins of the large ones. We did not find larvae, nor do we know when they are present. A few of the females examined contained 1–3 eggs, although most had none, suggesting that the eggs recently had been deposited.

We collected the beetles by wading in the stream and closely examining the margins where small shaded excavations of 5–10 cm in the bank or spaces among root tangles provided shelter from the current. *Spanglerogyrus* members usually were seen swimming rapidly on the water surface in these situations, singly or in clusters of up to 12 individuals depending on the size of the hollow or pocket. They were captured with a dipnet brought up to the surface from below. After being disturbed by the net, beetles not caught soon reappeared at the same spot.

The easy visual detection of specimens at this site, contrary to the observation by Folkerts, may have been due to the higher than normal water level; most of the larger shelflike undercut banks were submerged, thus forcing the beetles higher to more exposed habitats. On the other hand, relatively open microhabitats may be preferred. The species is apparently diurnal; activity in captive specimens decreases at night. The unpigmented venter, which may help to avoid visual detection from below by predators such as small fish, would be of particular advantage to a surface-dweller in open areas during the day. By comparison, species of *Gyretes,* which have a dark colored venter, are most often found under deep, shelflike banks where illumination is low.

Small body size may allow clusters of *S. albiventris* to utilize smaller spaces unsuitable for larger gyrinids and thereby allow them to avoid competition with the other species along the same stream bank. We collected *Gyretes* sp. at this locality in places similar and adjacent to those of *S.*

albiventris, but usually in larger, deeper pockets in the bank where *S. albiventris* rarely was found. *Dineutus discolor* Aubé also was taken nearby, in wide open areas, usually protected from strong current behind log-jams.

Behavior

We were able to observe the activity of *S. albiventris* both in the field and in captivity and to compare its behavior to that of members of three other gyrinid genera. In addition to the unusual jumping behavior described by Folkerts (1979), we noted some peculiarities not seen in other gyrinids. When associated with ecologic and structural features, these characters may be of help in understanding the position of *Spanglerogyrus* in the phylogeny and origin of the Gyrinidae.

Swimming.—The characteristic gyrating motion of gyrinids on the water surface is noticeably jerky and more rapid in *S. albiventris,* probably due to the comparatively small body size. The flat ventral surface of the body makes the beetle float like a bubble on the surface tension, having most of its body mass above water. Most larger gyrinids are convex ventrally and have relatively greater body mass below water level.

The single female taken 11 April was kept alive in a glass jar and closely observed for several days. The jar, 5 cm in diameter and 10 cm deep, contained water 5 cm deep and some emergent roots and pine needles from the stream. Swimming normally the beetle pursued a circular path 1–2 cm in diameter and made 2–4 revolutions per second. The beetle swam clockwise for an average of 4–12 revolutions, then reversed abruptly and swam counterclockwise for as many revolutions. This pattern was broken occasionally when the beetle would spin out in an exploratory manner, usually returning to the same spot to resume circling.

Diving.—Diving beneath the water surface, an evasive tactic often seen in other larger gyrinids, was observed also in *S. albiventris.* The small size, convex body form, and light build of these beetles appear to make them more bouyant; the captive specimens swam vigorously to remain submerged and soon bobbed back to the surface to resume gyrating. Members of *S. albiventris* made no attempt to cling to a root in order to stay submerged as is common in other gyrinids (Hatch, 1925a). The individuals observed seldom dived and appeared to do so only when highly agitated. In the field, specimens swam in wide zigzag paths and scattered when we approached, but dived only when directly disturbed. They dispersed temporarily along the stream margin but did not stray far from the pocket which they happened to be inhabiting; because of their comparative frailty it is possible that these beetles have a greater risk of being swept downstream by the current.

Feeding.—*Spanglerogyrus albiventris* is apparently a general surface scavenger and predator as are other members of the family; the gyrating habit aids the beetles in finding food particles. Bread crumbs dropped on the water were drawn inward by the circling of the beetle and were eaten as the beetle continued to swim. Group feeding on larger pieces of food was observed when we placed 15 beetles (from the series collected 19 April) in a jar and offered them some baetid mayflies. Several beetles surrounded and chewed at a floating mayfly while holding it with their front legs. One specimen of *S. albiventris* that had died in captivity was partially eaten by the others.

Some specimens preserved in alcohol immediately after collecting were dissected and gut contents were examined. Small fragments of dark colored insect (probably dipteran) exoskeleton were found.

Resting.—After feeding, the beetles swam to an emergent stem or root, or side of the glass jar, and climbed upward, then immediately turned around and rested with the head downward just above the water line. This habit and position probably facilitate rapid re-entry to the water. We were not able to observe *S. albiventris* at rest in the field (other than floating motionless on the water surface), but members of *Gyrinus, Gyretes* and *Dineutus* spp. were observed resting on emergent roots or in moss along the stream banks; the head-down position was rarely assumed, and does not seem to be characteristic of these genera.

Walking.—The long and relatively unmodified middle and hind tarsi of *S. albiventris* allow these beetles to be more agile out of water than members of other gyrinid groups. Captive specimens were observed walking steadily up stems and rootlets and across the glass surface of their container, and are capable of turning around on narrow stems such as pine needles. When walking the ventral surface is elevated, with only the tips of the tarsi contacting the substrate. All legs are used in walking, in the manner of cursorial insects.

On several occasions we saw a beetle reach the top of a stem and attempt to take flight, hit the side of the jar and fall to the water to resume swimming. The beetles spread their wings and took flight without jumping off the stem. The jumping behavior described by Folkerts (1979) is apparently used as a method of escape; we observed it only when beetles were caught in the net or placed on the ground.

Members of *Dineutus* often cling to floating leaves or emergent stems but rarely leave the water completely (Folkerts and Donovan, 1973) and we observed them doing so only under highly crowded captive conditions; the beetles that climbed available stems did so clumsily and often fell back into the water.

Members of stream-dwelling species of *Gyrinus* and *Gyretes* frequently climb up stems and twigs to rest and do so with proficiency (Folkerts and Donovan, 1973). The climbing is accomplished, however, by pushing with the short, flattened middle and hing legs and pulling with the long forelegs;

the body is not elevated above the substrate. We observed members of *Gyretes iricolor* burrowing through moss on the banks of the streams, but neither this nor any of the above modes of terrestrial locomotion approach the actual walking of *S. albiventris*.

Unique Structural Features

Spanglerogyrus, which represents a monotypic subfamily, has many structural characters not present in members of other gyrinid taxa. Some of these may be considered highly derived, while others are plesiotypic, being present in other members of the Adephaga but not in other gyrinids. For comparison, *Gyrinus, Dineutus,* and *Gyretes* spp. plus representatives of some tropical genera were briefly examined; these genera represent each of the 3 tribes of the subfamily Gyrininae. Some important characters of *Spanglerogyrus* not previously recognized are noted.

An obvious difference in members of *Spanglerogyrus* is the lack of ventral excavations to receive the legs when folded. Distinct, trough-like excavations, particularly for the forelegs, are present in all members of the Gyrininae; members of Spanglerogyrinae have a nearly flat ventral surface. The shape of the dorsum in lateral view is also not as streamlined as in other gyrinids. These features of the general body form seem more typical of terrestrial beetles, and are probably associated with the walking behavior. The anterior coxal cavities, however, are like the type described by Bell (1966) for other Hydradephaga.

The mesosternum has an unusual shape and form: the posterior process between the mesocoxae comes to a narrow point, and the mesocoxae are nearly contiguous. In gyrinines this process is broadly bilobed (with a median emargination at the apex) and widely separates the mesocoxae. The anterior median carina in members of *Spanglerogyrus* is also absent in gyrinines. Since this mesosternal form is also distinct from that of other adephagans, it is considered here as an apotypic feature of *Spanglerogyrus,* but this is uncertain; further comparative studies in this area are needed.

The form of the metasternum is also radically different; it is relatively long and evenly transverse, whereas in gyrinines it is constricted and arcuate between the mesocoxae and the anteriorly expanded metacoxal plates. A distinct transverse sulcus on the metasternum, a character absent or weakly developed in other Hydradephaga (Bell, 1966), is present in *Spanglerogyrus* members. The metacoxal plates in *Spanglerogyrus* members are shorter and truncate anteriorly, and the femoral excavations are narrow and are oriented laterally rather than ventrally. These characters seem more carabid-like and are considered primitive.

The middle and hind legs in *Spanglerogyrus* members are modified for swimming differently than those of gyrinines, but seem to be equally efficient structures in both groups. In the gyrinines the tibiae and tarsi are shortened and flattened for swimming; in spanglerogyrines the tibiae have become greatly modified, while the tarsi, though equipped with long natatory hairs, have remained relatively unmodified. The long-fringed, oarlike, dorsal extensions of the tibiae in members of *Spanglerogyrus* are not known in any other aquatic beetles and must be considered as highly derived structures. The front tibiae, on the other hand, possess a primitive feature in having a distinct apical spur. Gyrinines possess at most a tuft of setae, but no protibial spurs. The front tarsi of male *Spanglerogyrus* are not strongly dilated and possess relatively few adhesive hairs, another feature considered less derived (Brinck, 1977).

In addition to the dorsal and ventral eyes being narrowly separated in spanglerogyrines, the dorsal eye is much larger than the ventral one; in gyrinines the reverse is true or the two eyes are roughly equal in size. In the hypothesized descent of the Gyrinidae, single compound eyes became divided as an adaptation for surface swimming, then the bridge between them widened as the dorsal eye moved upward. Extant *Spanglerogyrus* members possess the intermediate, less derived condition.

The apical visible abdominal sternum in spanglerogyrines is divided medially into two overlapping lobes, whereas gyrinines have an entire, broadly rounded or pointed abdominal apex. In both gyrinid subfamilies, this apical sclerite is the 8th sternum; the homologous sclerite in other known adephagans, usually also divided, is reduced and hidden beneath the 7th sternum, which is the apical visible sternum in these groups. An exposed and divided 8th sternum, a character unique to *S. albiventris,* might be considered a specialized (derived) feature. However, reduction, retraction and fusion of sclerites are generally considered to be derived states, while a more complex, unmodified condition implies an ancestral form. It seems more probable that the exposed, divided 8th sternum in *S. albiventris* is a plesiotypic character, retained since the origin of the gyrinid line.

The whiplike setae on the outer apical angle of the elytra are also unique structures. There are two equal adjacent setae on each elytron; they appear as single setae in dried specimens unless teased apart. In a surface-swimming beetle of small size they may be functional in keeping the water from covering the abdominal apex by breaking up the meniscus of surface tension around that region. Some gyrinines possess sharp spines along the apical margin of the elytra; these do not seem homologous to the setae in spanglerogyrines and probably have a protective function. We consider the elytral setae in *S. albiventris* to be a specialized apotypic feature because of their apparent functional nature, but it is possible that these setae are homologous to the tactile setae of the elytra in Carabidae. There are numerous tactile setae on the clypeus of *S. albiventris*; these are not typical of other known Hydradephaga. The presence of these setae and the other carabid-like features in *Spanglerogyrus* members suggests a terrestrial origin of the Gyrinidae independent from other Hydradephaga, as was postulated by Bell (1966).

The presence of a setose median lobe in the male genitalia of *Spanglerogyrus* members is an unusual feature; median lobes in other gyrinids have no setae or accessory structures (Tranda, 1972). Although setose genitalia are generally considered a primitive feature, these short, retorse setae seem to be a specialized feature of male *Spanglerogyrus*. Also, the median lobe is not dorsoventrally flattened as in members of Gyrininae. The relatively reduced number of setae on the parameres also suggests an apotypic condition.

Conclusions

Many of the characters that give members of *Spanglerogyrus* their uniqueness seem to be related to small size, which is considered here as an apotypic character among the Gyrinidae. The extreme reduction in size is probably the result of specialization for a niche not occupied by other sympatric gyrinid species. We think the ability to walk and the associated physical features have been retained in *Spanglerogyrus* members because of the need for greater agility in a surface-swimming beetle with a smaller body size, which would be more vulnerable to sudden changes in its stream margin habitat. At the same time, spanglerogyrines have acquired natatory appendages (the oarlike meso-and metatibiae) equal in efficiency to the modified legs in other gyrinids.

The large dorsal eye which is not widely separated from the ventral eye, though considered a primitive condition, would also be advantageous for a small-sized surface swimmer. If *Spanglerogyrus* beetles live in small microhabitats close to the stream bank and are diurnal, as our observations suggest, a large, laterally oriented dorsal eye would be more useful than a smaller eye with a more dorsal orientation, as it would be easier for the beetles to orient themselves in a small semi-enclosed area while swimming and feeding.

We agree with Folkerts (1979) that the *Spanglerogyrus* taxon represents an early offshoot of the ancestral gyrinid line, but we do not think that the genus can truly be referred to as "primitive." Many of the apotypic characters of the genus (oarlike tibiae, whiplike elytral setae, form of the mesosternum, retorse setae of the median lobe, resting habit and jumping behavior) are not found in other known gyrinids and are not likely to have been features possessed by an early ancestral gyrinid. Although members of *Spanglerogyrus* do have plesiotypic structural and behavioral features that might be expected in an ancestral gyrinid, with its many other derived features it would not represent an example of the ancestral gyrinid form. We therefore suggest the unusual taxon *Spanglerogyrus* represents the plesion of Gyrinidae in terms of branching sequence, but has since acquired many autapotypic features.

The relatively primitive features of spanglerogyrines within Gyrinidae, however, may be useful in determining the origin of the Gyrinidae among the Adephaga. The walking behavior, setose clypeus, metasternal form, and structure of the hind coxae are more carabid-like than dytiscoid, supporting the view of Bell (1966) that the Gyrinidae arose directly from a terrestrial adephagan form, rather than an aquatic one. The male genitalia of gyrinids have characters that are generally considered to be plesiotypic, i.e. the dorsoventrally flattened, symmetrical, trilobed condition (Tranda, 1972). Asymmetry and reduction of the parameres are characteristic of caraboids, haliplids, and dytiscids, indicating that these groups are more closely related to each other than any of them are related to the Gyrinidae. This is contrary to the view of Hatch (1925b) and Crowson (1955), who have placed gyrinids near the Dytiscidae.

The complex of plesiotypic characters in *S. albiventris* implies a very early origin in adephagan evolution. We feel that the gyrinid line arose from a carabid-like terrestrial ancestor which gave rise to two main lines, the modern caraboids and the gyrinids. The dytiscoids and haliplids were perhaps a later offshoot of the caraboid line. In this proposed phylogeny, the Gyrinidae would be removed from the ''Glabricornia'' as defined by Bell (1966) and would become an earlier branch from primitive adephagan stock. An early common ancestor of modern Adephaga could have been similar to the one hypothesized for Bell's Glabricornia, but probably had male genitalia of the symmetrical, trilobed type, and an exposed and divided 8th abdominal sternum.

These ideas will be tested as more information is gathered from detailed studies of other aspects of life histories and internal structures. The discovery of the larva of *Spanglerogyrus* will be of great interest, in that it will provide another set of character states with which to analyze adephagan relationships.

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A DISTRIBUTIONAL SURVEY OF THE WORLD GENERA OF AQUATIC DRYOPOID BEETLES (COLEOPTERA: DRYOPIDAE, ELMIDAE, AND PSEPHENIDAE *SENS. LAT.*)

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Since dryopoid beetles are so widely distributed, are commonly present throughout the year, and are often highly diagnostic of water quality, they are gaining increased attention. This is especially true in the United States because of legal requirements for environmental assessment. The Nearctic fauna is reasonably well known (Brown 1975, 1976), although a number of species await description. Not surprisingly, the European members of the group are even better known, but it is no simple matter to learn what lives where, even in Europe. The world picture is infinitely more discouraging: the literature is scattered and difficult to track down. The most recent attempt at a comprehensive catalog or checklist is well over half a century old (Junk and Schenkling 1910, 1914). Blackwelder's supplements to Leng (1920) and his checklist for the rest of this hemisphere (1944) with its extensive bibliography (1957) are of tremendous help, but a large portion of our present taxa have been described subsequent to his work. Hinton, who contributed most to our knowledge of Neotropical dryopoids, died before achieving his goal of monographing the South American elmids. I know of no one on the scene today who is familiar with that diverse fauna, much less the dryopoids of the world. Delève would have been the logical person to monograph the Ethiopian elmids and dryopids, but he, too, died before accomplishing such a task. My own collecting has been limited to western Europe, South America, Central America, and the West Indies, in addition to the United States, and I confess to but a superficial acquaintance with the riffle beetles of these regions. My knowledge of the dryopoids of Australia, Asia, Africa, etc. is derived almost exclusively from such literature as I have been able to assemble. This paper is a summary of what I have gleaned. It could save others a great deal of time and effort. If readers note omissions or errors, I should greatly appreciate their kindness in informing me of such.

Taxonomic history poses problems for those who wish to organize or list taxa, and the history of dryopoids is perhaps more confusing than most. Since details will soon appear in forthcoming sections of the *Catalog of the*

Coleoptera of America North of Mexico (Brown, in press), I shall present here only what is necessary for the reader to use the major literature. For much of its history, most of the group was treated under the family name Parnidae, which later became Dryopidae. The psephenids have held family status for over a century, though some authors have considered them but a subfamily of Dryopidae as recently as 1939. Nor is the composition of the family Psephenidae settled at present: each of the groups treated here as subfamilies is placed in a separate family by such workers as Bertrand (1972). To make matters even worse, the members of two of these subfamilies (Eubrianacinae and Eubriinae) are put by Arnett (1963) and Bertrand (1972) in another *superfamily,* the Dascilloidea. They are not original or unique in this. Bertrand also treated elmids as but a subfamily within the Dryopidae, and retained *Lutrochus* in this family, whereas virtually everyone else accords the elmids family status and most have followed Hinton (1939) in transferring *Lutrochus* to the Limnichidae. It now appears that *Lutrochus* merits a family of its own, but I shall not deal with that issue here. As for the elmids, many authors in recent years had been employing the family name Elminthidae for them until Steyskal (1975) clarified the proper derivation as Elmidae.

At the generic level, considerable confusion stems from the fact that, for a long time, many species of *Helichus* were placed in the genus *Dryops,* whereas many *Dryops* were called *Parnus*. However, some *Helichus* were also described as *Parnus,* and four genera (*Parygrus, Pachyparnus, Pomatinus* and *Potaminus*) were created for portions of the present genus *Helichus*. Somewhat comparable mix-ups occurred between the Palaearctic genera *Elmis* and *Limnius,* and members of many genera around the world were originally assigned to one or the other of these two. Until quite recently, those species now in the genus *Limnius* were called *Lat(h)elmis,* members of the genus *Oulimnius* being placed in *Limnius*.

To minimize confusion, I am omitting synonyms from the distribution tables. For the benefit of readers who wish to reconcile these tables with previous lists, however, I am listing major synonyms, etc. in Table 5.

Eventually, I expect to publish a world checklist of species, but that is beyond the scope of this survey. The present paper is intended to provide an overview of the distribution of those genera which have been described to date. Additional genera are in the offing. I am in the process of describing several new Neotropical genera of elmids and dryopids, and am either describing or planning to describe larvae representing 2 new genera of eubriine psephenids (or eubriids)—one from Central America and one from India. Thus, although the tables are presumably up to date, they are far from complete. The numbers of species will also change, of course. Most of my new species in process of or awaiting description are Neotropical and Nearc-

Table 1. Distribution of species of Dryopidae.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Ahaggaria Bollow 1938	0	0	0	3	0	0	3
Ceradryops Hinton 1937	0	0	0	0	1	0	1
Drylichus Heller 1916	0	0	0	0	0	1	1
Dryops Olivier 1791	2	20	30	19	1	0	72
Elmomorphus Sharp 1888	0	0	1	0	11	1	13
Elmoparnus Sharp 1882	0	6	0	0	0	0	6
Geoparnus Besuchet 1978	0	0	0	0	1	0	1
Helichus Erichson 1847	9	18	10	5	20	0	62
Malaiseianus Bollow 1940	0	0	0	0	1	0	1
Onopelmus Spangler 1980	0	1	0	0	0	0	1
Oreoparnus Delève 1965	0	0	0	2	0	0	2
Pelonomus Erichson 1847	1	10	0	0	0	0	11
Phallodryops Delève 1963	0	0	0	1	0	0	1
Protoparnus Sharp 1883	0	1	0	0	0	3	4
Rapnus Grouvelle 1899	0	0	0	3	0	0	3
Sostea Pascoe 1860	0	4	1	1	43	0	49
Sosteamorphus Hinton 1936	0	1	0	0	0	0	1
Strina Redtenbacher 1867	0	0	0	4	0	0	4
TOTAL GENERA	3	8	4	8	7	3	18
TOTAL SPECIES	12	61	42	38	78	5	234

tic, but we may expect many more from China, Australia, and numerous other regions. Certainly South America will still yield many.

The tables list for each genus the number of species known from the various zoogeographic realms. For the most part, this is quite satisfactory, but problems arise with species whose distribution straddles a boundary. Instead of complicating tabulation by listing such species in both realms, I have simply attempted to assign them to what I think to be the more appropriate realm. In brief, the regions included in the realms, with a summary of their dryopoids, are as follows:

NEARCTIC (North America from the Mexican highlands northward): dryopids—3 genera with 12 species; elmids—1 genus with 2 species of Larinae plus 24 genera with 84 species of Elminae; psephenids—1 species of Eubrianacinae, 1 genus with 7 species of Psepheninae, and 4 genera with 8 species of Eubriinae.

NEOTROPICAL (Mexican lowlands, Central America, West Indies and South America): dryopids—8 genera with 61 species; elmids—6 genera with 20 species of Larinae plus 30 genera with 295 species of Elminae; psephenids—1 species of Eubrianacinae, 4 genera with 17 species of Psepheninae, and 5 genera with 19 species of Eubriinae.

PALAEARCTIC (Eurasia south to the Himalayas, Afghanistan, Iran, etc., and Africa north of the Sahara Desert): dryopids—4 genera with 42 species; elmids—3 genera with 5 species of Larinae plus 24 genera with 137 species of Elminae; psephenids—2 genera with 11 species of Eubrianacinae, 2 genera with 5 species of Psepheninae, 1 species of Psephenoidinae, and 5 genera with 7 species of Eubriinae. Of the 24 species of psephenids, only one (*Eubria palustris*) occurs north or west of China, the remaining 23 occurring in China and Japan and having their affinities primarily with the Oriental fauna. Surprisingly, however, a fossil species of *Eubrianax* has been reported from France.

ETHIOPIAN (Africa including and below the Sahara Desert plus Madagascar): dryopids—8 genera with 38 species; elmids—6 genera with 53 species of Larinae plus 25 genera with 265 species of Elminae; psephenids—1 genus with 6 species of Eubrianacinae, 1 species of Psephenoidinae, and 1 genus with 4 species of Eubriinae.

ORIENTAL (Asia south of the Himalayas, southern China, Taiwan, the Philippines, Indochina, Sri Lanka, the Malay Archipelago and Indonesia): dryopids—7 genera with 78 species; elmids—3 genera with 13 species of Larinae plus 18 genera with 130 species of Elminae; psephenids—17 species of *Eubrianax,* 2 genera with 2 species of Psepheninae, 5 species of *Psephenoides,* and 5 genera with 11 species of Eubriinae.

AUSTRALIAN (Australia, Tasmania, New Zealand, New Guinea and related islands): dryopids—3 genera with 5 species, none of which are in Australia itself; elmids—7 genera with 14 species of Larinae plus 7 genera

Table 2. Distribution of species of Elmidae: Larinae.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Disersus Sharp 1882	0	3	0	0	0	0	3
Dryopomorphus Hinton 1936	0	0	2	0	1	0	3
Hexanchorus Sharp 1882	0	7	0	0	0	0	7
Hispaniolara Brown 1981	0	1	0	0	0	0	1
Hydora Broun 1882	0	0	0	0	0	7	7
Hydrethus Fairmaire 1889	0	0	0	4	0	0	4
Lara LeConte 1852	2	0	0	0	0	0	2
Omotonus Delève 1963	0	0	0	5	0	0	5
Ovolara Brown 1981	0	0	0	0	0	2	2
Phanocerus Sharp 1882	0	7	0	0	0	0	7
Parapotamophilus Brown 1981	0	0	0	0	0	1	1
Potamocares Grouvelle 1920	0	0	0	4	0	0	4
Potamodytes Grouvelle 1896	0	0	2	35	0	0	37
Potamogethes Delève 1963	0	0	0	4	0	0	4
Potamolatres Delève 1963	0	0	0	1	0	0	1
Potamophilinus Grouvelle 1896	0	0	0	0	10	1	11
Potamophilops Grouvelle 1896	0	1	0	0	0	0	1
Potamophilus Germar 1811	0	0	1	0	2	2	5
Pseudodisersus Brown 1981	0	1	0	0	0	0	1
Stetholus Carter & Zeck 1929	0	0	0	0	0	1	1
TOTAL GENERA	1	6	3	6	3	7	20
TOTAL SPECIES	2	20	5	53	13	14	107

Table 3. Distribution of species of Elmidae: Elminae.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Ampumixis Sanderson 1954	1	0	0	0	0	0	1
Ancyronyx Erichson 1847	1	0	0	0	0	0	1
Aspidelmis Delève 1954	0	0	0	5	0	0	5
Atractelmis Chandler 1954	1	0	0	0	0	0	1
Austrolimnius Carter & Zeck 1929	0	18	0	0	0	52	70
Cephalolimnius Delève 1973	0	0	0	0	1	0	1
Cleptelmis Sanderson 1954	2	0	1	0	0	0	3
Coxelmis Carter & Zeck 1929	0	0	0	0	0	3	3
Ctenelmis Delève 1964	0	0	0	8	0	0	8
Cylloepus Erichson 1847	1	50	0	0	0	0	51
Dubiraphia Sanderson 1954	9	0	0	0	0	0	9
Dupophilus Mulsant & Rey 1872	0	0	1	0	0	0	1
Elmidolia Fairmaire 1897	0	0	0	6	0	0	6
Elmis Latreille 1798	0	0	13	0	0	0	13
"*Elmis*" (Not true *Elmis* but not yet assigned to proper genera)	0	11	0	0	0	0	11
Elpidelmis Delève 1964	0	0	0	2	0	0	2
Elsianus Sharp 1882	3	32	0	0	0	0	35
Epodelmis Hinton 1973	0	1	0	0	0	0	1
Esolus Mulsant & Rey 1872	0	0	11	0	1	0	12
Eumicrodinodes Delève 1965	0	0	0	3	0	0	3
Exolimnius Delève 1954	0	0	0	2	0	0	2

Table 3. Continued.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Gonielmis Sanderson 1954	1	0	0	0	0	0	1
Graphelmis Delève 1968	0	0	1	0	11	1	13
Grouvellinus Champion 1923	0	0	6	0	16	0	22
Gyrelmis Hinton 1940	0	12	0	0	0	0	12
Haplelmis Delève 1964	0	0	0	1	0	0	1
Hedyselmis Hinton 1976	0	0	0	0	1	0	1
Helminthocaris Grouvelle 1906	0	0	0	8	0	0	8
Helminthopsis Grouvelle 1906	0	0	0	35	0	0	35
Heterelmis Sharp 1882	3	13	0	0	0	0	16
Heterlimnius Hinton 1935	2	0	0	0	0	0	2
Hexacylloepus Hinton 1940	1	21	0	0	0	0	22
Hintonelmis Spangler 1966	0	10	0	0	0	0	10
Holcelmis Hinton 1973	0	2	0	0	0	0	2
Huleechius Brown 1981	1	1	0	0	0	0	2
Ilamelmis Delève 1973	0	0	0	0	3	0	3
Kingolus Carter & Zeck 1929	0	0	0	0	0	11	11
Lathridelmis Delève 1965	0	0	0	1	0	0	1
Leielmis Delève 1964	0	0	0	1	0	0	1
Leptelmis Sharp 1888	0	0	2	8	10	0	20
Limnius Illiger 1802	0	0	13	0	0	0	13
Lobelmis Fairmaire 1898	0	0	0	7	0	0	7

Table 3. Continued.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Ludyella Reitter 1899	0	0	1	0	0	0	1
Macrelmis Motschulsky 1859	0	14	0	0	0	0	14
Macronychoides Champion 1923	0	0	0	0	1	0	1
Macronychus Mueller 1806	1	0	1	0	2	0	4
Microcylloepus Hinton 1935	4	21	0	0	0	0	25
Microdinodes Grouvelle 1906	0	0	0	42	0	0	42
Narpus Casey 1893	3	0	0	0	0	0	3
Neocylloepus Brown 1970	1	6	0	0	0	0	7
Neoelmis Musgrave 1935	1	45	0	0	0	0	46
Neolimnius Hinton 1939	0	1	0	0	0	0	1
Neoriohelmis Nomura 1958	0	0	2	0	0	0	2
Nomuraelmis Satô 1964	0	0	1	0	0	0	1
Normandia Pic 1900	0	0	4	0	0	0	4
Notelmis Hinton 1941	0	2	0	0	0	0	2
Notriolus Carter & Zeck 1929	0	0	0	0	0	16	16
Onychelmis Hinton 1941	0	2	0	0	0	0	2
Oolimnius Hinton 1939	0	1	0	0	0	0	1
Optioservus Sanderson 1954	13	0	9	0	0	0	22
Ordobrevia Sanderson 1953	1	0	4	0	8	0	13
Oulimnius Des Gozis 1886	2	0	7	0	0	0	9
Pachyelmis Fairmaire 1898	0	0	0	33	0	0	33

Table 3. Continued.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Paramacronychus Nomura 1958	0	0	1	0	1	0	2
Peloriolus Delève 1964	0	0	7	0	0	7	7
Phanoceroides Hinton 1939	0	1	0	0	0	0	1
Pilielmis Hinton 1971	0	6	0	0	0	0	6
Podelmis Hinton 1941	0	0	0	0	7	0	7
Portelmis Sanderson 1953	0	2	0	0	0	0	2
Promoresia Sanderson 1954	2	0	0	0	0	0	2
Protelmis Grouvelle 1911	0	0	0	3	0	0	3
Pseudamophilus Bollow 1940	0	0	1	0	0	0	1
Pseudancyronyx Bertrand & Steffan 1963	0	0	0	12	0	0	12
Pseudelmidolia Delève 1963	0	0	0	28	0	0	28
Pseudomacronychus Grouvelle 1906	0	0	0	11	0	0	11
Rhizelmis Chandler 1954	1	0	0	0	0	0	1
Riolus Mulsant & Rey 1872	0	0	7	0	0	0	7
Simsonia Carter & Zeck 1929	0	0	0	0	0	16	16
Sphragidelmis Delève 1964	0	0	0	3	0	0	3
Stegoelmis Hinton 1939	0	3	0	0	0	0	3
Stenelmis Dufour 1835	27	0	36	36	45	2	146
Stenelmoides Grouvelle 1908	0	5	0	0	0	0	5
Stethelmis Hinton 1945	0	2	0	0	0	0	2
Taprobanelmis Delève 1973	0	0	0	0	1	0	1

Table 3. Continued.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Tolmerelmis Hinton 1972	0	1	0	0	0	0	1
Tolriolus Hinton 1940	0	1	0	0	0	0	1
Trachelminthopsis Delève 1965	0	0	0	1	0	0	1
Troglelmis Jeannel 1950	0	0	0	1	0	0	1
Tropidelmis Delève 1964	0	0	0	1	0	0	1
Tyletelmis Hinton 1972	0	1	0	0	0	0	1
Uralohelmis Roubal 1940	0	0	1	0	0	0	1
Urumaelmis Satô 1965	0	0	1	0	1	0	2
Vietelmis Delève 1968	0	0	0	0	1	0	1
Xenelmis Hinton 1936	0	9	0	0	0	0	9
Xenelmoides Hinton 1936	0	1	0	0	0	0	1
Zaitzevia Champion 1923	2	0	10	0	8	0	20
Zaitzeviaria Nomura 1961	0	0	3	0	13	0	16
TOTAL GENERA	24	30	24	25	18	7	96
TOTAL SPECIES	84	295	137	265	130	101	1,012
TOTAL ELMID GENERA	25	36	27	31	21	14	116
TOTAL ELMID SPECIES	86	315	142	318	143	115	1,123

with 101 species of Elminae; psephenids—2 genera with 7 species of Eubriinae.

Distribution maps, though not feasible for this paper, would bring out features not evident from the tables. For example, maps would show that the dryopoid fauna of the West Indies is obviously derived from South and Central America. There is virtually no overlap between Cuba and Florida, or any indication of transport to Cuba by drift from the mouth of the Mississippi River. Hinton (1965) makes this point quite effectively.

Table 4. Distribution of species of Psephenidae.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
			Eubrianacinae				
Eubrianax Kiesenwetter 1874	1	1	10	6	17	0	35
Microeubrianax Pic 1954	0	0	1	0	0	0	1
			Psepheninae				
Mataeopsephus Waterhouse 1876	0	0	4	0	1	0	5
Pheneps Darlington 1936	0	5	0	0	0	0	5
Psephenops Grouvelle 1898	0	5	0	0	0	0	5
Psephenus Haldeman 1853	7	6	0	0	1	0	14
Sinopsephenus Nakane 1964	0	0	1	0	0	0	1
Xexanchorinus Grouvelle 1898	0	1	0	0	0	0	1
			Psephenoidinae				
Afropsephenoides Basilewsky 1959	0	0	0	1	0	0	1
Psephenoides Gahan 1914	0	0	1	0	5	0	6
			Eubriinae				
Acneus Horn 1880	4	0	0	0	0	0	4
Afroeubria Villiers 1961	0	0	0	4	0	0	4
Alabameubria Brown 1980	1	0	0	0	0	0	1
Cneoglossa Guérin 1843	0	8	0	0	0	0	8
Cophaesthetus Waterhouse 1880	0	0	0	0	1	0	1
Dicranopselaphus Guérin 1861	1	5	0	0	0	0	6
Drupeubria Nakane 1952	0	0	1	0	0	0	1

Table 4. Continued.

Genera	Nearctic	Neotropical	Palaearctic	Ethiopian	Oriental	Australian	Total
Ectopria LeConte 1853	2	4	0	0	2?	1?	9
Eubria Germar 1818	0	0	1	0	2	0	3
Grammeubria Kiesenwetter 1874	0	0	3	0	4	0	7
Homoeogenus Waterhouse 1880	0	0	1	0	0	0	1
Schinostethus Waterhouse 1880	0	0	1	0	2	0	3
Sclerocyphon Blackburn 1892	0	0	0	0	0	7	7
Tychepsephus Waterhouse 1876	0	1	0	0	0	0	1
TOTAL GENERA	6	9	10	3	9	2	24
TOTAL SPECIES	16	36	24	11	35	8	130

In scanning the tables, I am impressed with the fact that most of the genera are endemic, or confined to one realm. This fact, too, would be much more conspicuous if distribution maps were included for each species. Of the 159 genera, not one can be considered truly cosmopolitan. Most nearly cosmopolitan is the dryopid *Helichus,* with the elmid *Stenelmis* a close runner-up. The only psephenid in the running would be *Eubrianax.* One conclusion I draw from the extensive endemism and the failure of any species, or even any genus, to become cosmopolitan, is that dryopoid beetles are unlikely to become of major economic importance as pests.

The only instance of successful intercontinental hitchhiking by a dryopoid that I know about is *Dryops viennensis,* a European species which has become established along the St. Lawrence River of eastern Canada. Undoubtedly there are other transplants not yet detected or reported, but if they were pests they would probably have been noticed.

I have mentioned above the difficulty posed by species whose geographic ranges straddle boundaries between adjacent realms, and suggested that distribution maps for each species would serve to clarify the situation. Perhaps a bit of discussion is in order. Among the Larinae I do not list *Phanocerus* as Nearctic, although one of the widely-distributed Neotropical species extends into Texas. Among the Elminae, *Xenelmis* occurs in Arizona, and the number of Nearctic species would be increased for such genera as *Cylloepus, Heterelmis, Hexacylloepus* and *Neoelmis* if I included

Table 5. Sources of confusion: synonyms, homonyms, and genera of other families which have been listed as dryopoids.

Afropsephenium Paulian 1946—not a psephenid, or even a dryopoid
Alloparnus Broun 1893 = *Protoparnus*
Aptyktophallus Steffen 1957 = *Normandia*
Awadoronus Kono 1934 = *Zaitzevia*
Betelmis Matsumura 1916 = *Mataeopsephus* (Psephenidae)
Chelonarium Fabricius 1801—Chelonariidae, a dryopoid family
Drupeus Lewis 1895—Ptilodactylidae, another dryopoid family
Dryopidius Grouvelle 1896 = *Elmomorphus*
Dryopomorphus Hinton 1936—shifted to Elmidae: Larinae
Dryops Leach 1817 = *Helichus*
Eurea LeConte 1853 = *Ectopria*
Eurypalpus LeConte 1852 = *Psephenus*
Fluvicola DeKay 1844 = *Psephenus*
Freyiella Bollow 1938 = *Potamophilinus*
Furcipalpus Guerin 1861 = *Dicranopselaphus*
Gridelliana Bollow 1939 = *Potamodytes*
Grouvelleus Zaitzev 1908 = *Grouvellinus*
Helminthopsoides Delève 1954 = *Elmidolia*
Helmis Bedel 1878 = *Elmis*
Lareynia DuVal 1859 = *Elmis*
Lat(h)elmis Reitter 1883 = *Limnius*
Limnius Erichson 1847 = *Oulimnius*
Lutrochus Erichson 1847—Limnichidae or Lutrochidae, other dryopoid families
Macroeubria Pic 1916—Ptilodactylidae, another dryopoid family
Mataeopsephenus Zaitzev 1908 = *Mataeopsephus*
Microdes Motschulsky 1859 = *Grouvellinus*
Neosolus Carter & Zeck 1929 = *Austrolimnius*
Oberonus Casey 1893 = *Pelonomus*
Pachycephala Broun 1881 = *Hydora*
Pachyparnus Fairmaire 1888 = *Helichus*
Parnida Broun 1880 = *Protoparnus*
Parnoides Kuwert 1900 = *Pelonomus*
Parnus Fabricius 1792 = *Dryops*
Parygrus Erichson 1847 = *Helichus*
Philhydrus Duftschmidt 1805 = *Elmis*
Placonycha Horn 1880 = *Eubrianax*
Pomatinus Sturm 1853 = *Helichus*
Potaminus Lacordaire 1854 = *Helichus*
Pseudochelonarium Mequignon 1935—Chelonariidae, another dryopoid family
Spineubria Nakane 1952—Ptilodactylidae, another dryopoid family
Stenelsianus Hinton 1934 = *Stenelmoides*
Tychepsephenus Zaitzev 1908 = *Tychepsephus*
Udorius Broun 1882 = *Hydora*
Ulimnius Grouvelle 1896 = *Oulimnius*

Mexican species that extend across the border. These genera, together with *Elsianus* and *Neocylloepus,* are really Neotropical, and it seems a bit inappropriate to list them as Nearctic at all. This is also the case for a number of genera that are really Oriental, but which extend up into eastern China and Japan and thus qualify as Palaearctic. I have already pointed out the psephenids in this category; examples of elmids are *Dryopomorphus, Gra-Phelmis, Grouvellinus, Leptelmis, Ordobrevia, Zaitzevia,* and *Zaitzeviaria,* none of which range westward into Europe. Of these, *Ordobrevia* and *Zaitzevia* extend, instead, across into western North America, as do *Cleptelmis* and *Optioservus.* In the case of *Optioservus,* and perhaps *Cleptelmis* as well, movement across the Bering Strait land bridge was probably from Nearctic to Palaearctic rather than the reverse, since *Optioservus* is widely distributed across North America and represented by 13 species, whereas in the Old World it seems confined to Japan. For *Ordobrevia* and *Zaitzevia,* on the other hand, the migration was almost certainly from the Old World to the New. Some relationships of this sort can, of course, be surmised from the tables. The 2 ''Palaearctic'' species of *Potamodytes,* as one might suspect, are escapees from the Ethiopian realm, one into Egypt, the other into the Arabian Peninsula.

The absence of dryopids from the continent of Australia is noteworthy. It suggests that the family did not arise until after the geological isolation of that land mass. Equally interesting to me is the only major generic linkage between Australia and any other realm—the elmid genus *Austrolimnius.* It is well represented in both Australia and South America. Furthermore, one of the species from southern Australia is more closely related to a couple of species in Chile than to any of its fellow Australian species (Hinton, 1965, 1968). When one takes into account the fact that these beetles are very intolerant of environmental diversity, that they disperse very slowly and are unlikely to be transported by accident, this situation presents very cogent evidence of the ancient connection between these two continents. While discussing *Austrolimnius,* I might add that Hinton (1971) stated that it was the dominant elmid genus of New Guinea as well as Australia, but none of the species from New Guinea has yet been described.

In my association with them for over 20 years, I have noted the greater diversity of riffle beetles in tropical streams as compared with streams in temperate zones, and the reduction in variety as one ascends higher among the mountains. Near the snow line, at least in our Rockies and the Mexican sierras, there is but a single species left. When assembling data for the tables presented here, at first I took for granted that the greater numbers of Neotropical genera and species than Nearctic ones, for example, reflected this same principle. Perhaps they do, but the evidence is not as overwhelming as I initially thought. In the case of the Neotropical taxa, one cannot tell from the tables what proportion represent temperate rather than tropical climates. Essentially everything from Chile would be from temperate zones, and a disproportionate portion of Brazilian specimens described thus far have come from the southernmost regions, which are not genuinely tropical. Again, maps would help resolve the issue. Unfortunately, however, all too many species are known only from the original description, with no more precise locality data than "Brazil" or "Argentina."

One thing shown clearly by the tables is the large number of genera represented by only one species. In this category are 7 of the 18 dryopid genera, 6 of 20 Larinae, 29 of 96 Elminae, and 9 of the 25 psephenids, for a total of 51 out of 159 genera—approximately one-third.

This impresses me as a very high proportion. So far as I can judge, it does not simply reflect a tendency on the part of dryopoid taxonomists to be splitters, although it is possible that this plays a minor role. It is also probable that additional species will be described for some of these genera, but I think the proportion of genera represented by unique species will remain quite high. Undoubtedly, at least some of these are relicts—the last survivors of groups formerly more widespread and diverse. Although a few of them are widely distributed, e.g. *Ancyronyx* and *Dupophilus,* most of them are apparently confined to rather small areas and restricted habitats. Some may be extinct by the end of this century. They will not receive the attention given the dodo or the passenger pigeon, but we riffle beetle buffs will mourn their loss as well as the loss of the delightful habitat that sustained them.

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NOTES ON NOMENCLATURE AND CLASSIFICATION OF *HYDROPORUS* SUBGENERA WITH THE DESCRIPTION OF A NEW GENUS OF HYDROPORINI (COLEOPTERA: DYTISCIDAE)[1]

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Nearctic species of *Hydroporus* Clairville were last revised by Fall (1923). He considered *Oreodytes* Seidlitz and *Deronectes* Sharp to be subgenera of *Hydroporus*. His subgenus *Hydroporus* had four species groups: *niger-tenebrosus* (=subgenus *Hydroporus*) (48 nearctic species); *pulcher-undulatus* (50 species); *oblitus* (9 species); and *vilis* (17 species).

Subsequent American workers have treated nearctic species on a regional basis and in various ways. For example, Hatch (1953), dealing with the fauna of northwestern America, referred *Deronectes* species (*sensu* Fall) to the subgenus *Potamonectes* Zimmermann, put *Oreodytes quadrimaculatus* Horn in the subgenus *Deronectes* and put the *vilis, oblitus* and *pulcher-undulatus* group species in the subgenus *Heterosternus* Zimmermann. Young (1954), working on Florida water beetles, referred the *pulcher-undulatus* species to *Sternoporus* (=*Heterosternus,* preoccupied) and the *niger-tenebrosus* species to *Hydroporus* (*s. str.*). Leech and Chandler (1956) and Anderson (1962), working on California and Utah species respectively, accepted *Oreodytes* and *Deronectes* as genera. Larson (1975), dealing with the Alberta fauna, felt that the various species groups of *Hydroporus* probably deserved subgeneric status but treated all species under *Hydroporus* (including *Deronectes* and *Oreodytes*) because the groups were inadequately defined. Zimmerman and Smith (1975) partially revised nearctic *Deronectes* and treated it as a genus, but added that *Hydroporus* was a heterogeneous assemblage of species and that there were significant differences between the species groups within it.

Hydroporus has been a dumping ground for unrelated groups of species and this is especially true of the *pulcher-undulatus* species group (*sensu* Fall) which consists of approximately 50 species. There are three species groups within the *pulcher-undulatus* group that we feel require subgeneric or generic status: *pilatei-triangularis* group (2 species); *pulcher* group (13 species); and *undulatus* group (about 35 species). All three are probably limited to the Nearctic Region.

Use of subgenera seems especially warranted within *Hydroporus*. Opinions vary concerning desirability of using subgeneric names. Misuse (overuse) of them in the past has contributed to a great deal of nomenclatural confusion.

We have elected to use subgeneric names in certain situations for several reasons. (1) *Hydroporus* is a large, diverse genus and there are a number of distinct lineages within it that are more closely related to each other than any single group is to an excluded group. Although subgeneric differences are not of the same magnitude as generic differences, many subgenera are still readily recognized in the field (even by nonspecialists). (2) In speciose genera, such as *Hydroporus,* subgeneric designations allow specialists to conveniently refer to specific parts of a genus. (3) Although informal species group names may sometimes be just as convenient, subgeneric names are already available.

Here we discuss nomenclatural problems of *Hydroporus,* especially as they pertain to the *pulcher-undulatus* group (*sensu* Fall); describe a new genus of Hydroporini, and review species assigned to it.

Nomenclature

There has been considerable confusion over the authorship of the genus *Hydroporus*. Most authors have cited either Clairville or Schellenberg or both. Helvetische Entomologie was published anonomously in 2 volumes (1798 and 1806). The section dealing with aquatic Adephaga appears in volume 2. The volumes are arranged with one page in German and the facing page in French. According to Andrews (1939), Clairville only translated Schellenberg's work. However, according to Méquignon (1940), Clairville wrote both volumes and Schellenberg only did the illustrations. Méquignon's evidence is rather persuasive, especially where it concerns segments of the prefaces of volumes 1 and 2. Furthermore Schellenberg died in 1806. Therefore, based on evidence available to us we believe that Clairville should be recognized as author of *Hydroporus*.

There have been numerous type designations, summarized by Leech (1948), that are invalid for various reasons: *Dytiscus depressus* Fabricus and *Dytiscus duodecimpunctatus* Fabricius (not originally included species); *Dytiscus parvulus* Linnaeus (species inquirendum); and *Dytiscus palustris* (on Clairville's list as *Dytiscus sexpustulatus*; Fabricius, however, the synonym wasn't noted in the type designation).

The type of *Hydroporus* is *Hyphidrus pubescens* Gyllenhal, designated by

Guignot (1946). Zaitzev (1953) designated *Dytiscus erythrocephalus* Linnaeus as the type of *Hydroporus,* but Guignot's designation has priority.

The genus *Hydroporus* has been variously divided into a number of subgenera. Des Gozis (1914) described *Suphrodytes* as a monotypic subgenus to include *Hydroporus dorsalis* Fabricius and this is still accepted by most workers. Zimmermann (1919) described the subgenus *Heterosternus* basing the separation of this group from *Hydroporus* (*s. str.*) on the shape of the medially produced postmetacoxal process, the prosternal process, and the vittate or fasciate color pattern. His group of 37 species, although composed primarily of nearctic *pulcher-undulatus* species (*sensu* Fall), also included species now assigned to the *vilis* and *oblitus* species groups (*sensu* Fall) and the palearctic *Hydroporus picicornis.* Although Zimmermann didn't designate a genotype, the figure of the metacoxal process characteristic of *Heterosternus* was that of *Hydroporus concinnus* LeConte (=*wickhami* Zaitzev).

There have been several type designations for *Heterosternus.* Leech (1950) designated *Hydroporus concinnus* LeConte as the type of *Heterosternus* stating correctly that the designation of Guignot (1945) wasn't valid. However, Guignot (1942) stated (concerning Zimmermann's description of *Heterosternus*), ''Il désigne donc ainsi implicitement, mais formellement, l'espéce *concinnus* LeC. comme le type du nouveau sous-genre.'' This is a valid type designation according to article 69 (a) iii. Finally Guignot definitively designated the type again in 1949.

Falkenström in 1930 described *Sternoporus* as another new subgenus, within *Hydroporus.* Although without formal designation, he used *Hydroporus longicornis* Sharp as a standard of comparison and it seems obvious that this should be considered the type.

Guignot (1931, 1942) incorrectly stated that Falkenström designated *H. longicornis* as the type of *Sternoporus.* This is a valid type designation according to Article 69(a)iii. Guignot (1931) also put *Sternoporus* in synonymy with *Heterosternus* Zimmermann. He then described a new subgenus, *Neoporus,* with *Hydroporus hebes* Fall as the type-species. His major diagnostic character was the medially produced metacoxal process which was straight-edged on each side, not sinuate.

Strand (1935) recognized that *Heterosternus* Zimmermann was a homonym and proposed the name *Heterosternuta.* Falkenström (1938) stated that because *Heterosternuta* Strand was feminine and Strand hadn't redefined the subgenus when he proposed the name that a new name was necessary and he therefore proposed *Heterostethus.* Subgeneric names do not have to agree in gender with their species and name changes do not require a redefinition, so *Heterostethus* was unnecessary.

Guignot (1942) pointed out that *Heterosternuta* also wasn't necessary because the name *Sternoporus* Falkenström (1930) was available. Brinck

(1943), apparently unaware of Guignot's 1942 paper, realized that *Heterostethus* Falkenström was itself a homonym and suggested retaining *Heterosternuta* with *Hydroporus concinnus* LeConte as the type, but this was not necessary at this time because *Sternoporus* Falkenström had priority as Guignot had already synonymized *Sternoporus* and *Heterosternus*.

In 1945, Guignot created the subgenus *Hydroporinus* (type *Hydroporus neglectus* Sturm) and he also synonymized *Neoporus* Guignot with *Sternoporus* Falkenström. He then created the subgenus *Circinoporus* with *Hydroporus cimicoides* Fall as the type. This indicates Guignot didn't understand how closely related *Hydroporus cimicoides* was to *H. hebes* Fall, Guignot's type for *Neoporus*. In fact, Young (1954) indicates that *H. hebes* may intergrade with both *H. cimicoides* and *H. lobatus*. Although Guignot didn't give a formal definition of *Circinoporus,* he did indicate diagnostic characters in a key.

In 1947 Guignot included five more species in *Hydroporinus*. One of these was *H. longicornis,* the type of *Sternoporus*. Although *Sternoporus* had priority over *Hydroporinus,* Guignot continued to use the name *Hydroporinus* for this group (including the type of *Sternoporus*) but he also continued to apply the name *Sternoporus* to some nearctic species.

Later Guignot (1949) acknowledged this mistake. He then took *Heterosternuta* out of synonymy with *Sternoporus*; *Neoporus* out of synonymy with *Sternoporus*; synonymized *Hydroporinus* with *Sternoporus* and described a new subgenus, *Hydroporidius* (type *Melanarius* Sturm). Therefore, he recognized seven subgenera within *Hydroporus*: *Hydroporus* Schellenberg (type *pubescens* Gyllenhal); *Hydroporidius* Guignot (type *melanarius* Sturm); *Sternoporus* Falkenström (type *longicornis* Sharp); *Suphrodytes* Des Gozis (type *dorsalis* Fabricius); *Neoporus* Guignot (type *hebes* Fall); *Circinoporus* Guignot (type *cimicoides* Sharp) and *Heterosternuta* Strand (type *concinnus* LeConte).

Palearctic workers have generally continued to use at least the first four of these subgenera (see, for example, Franciscolo, 1979; Freude et al, 1971; Zaitzev, 1953), and Zaitzev (1953) also used *Hydroporinus* as including *longicornis*. Galewski (1971) however, used none of the subgenera. Nearctic workers have generally ignored these groups although the name *Sternoporus* has been applied to Fall's *pulcher-undulatus* group (see Young, 1954).

The net effect of Guignot (1949) was to isolate the *pulcher-undulatus* species (*sensu* Fall) in the last three subgenera (*Neoporus, Circinoporus* and *Heterosternuta*), because he separated *Sternoporus* and *Heterosternuta*. *Neoporus* contained *H. superiorus, uniformis, hebes* and *consimilis*; *Circinoporus* was monotypic with *cimicoides*; and *Heterosternuta* contained the remaining species.

We are synonymyzing *Circinoporus* and *Neoporus*. These two subgeneric names are obviously synonyms when respective types are considered as we discussed above. Furthermore we are moving all species within *Heterosternuta,* except the 13 *pulcher* group species, to *Neoporus.*

The *pulcher* group species, in this sense, constitute the subgenus *Heterosternuta* (which has been revised, Matta and Wolfe, 1981). These species form a monophyletic unit and deserve subgeneric rank. One other European work has a direct bearing on taxonomy of nearctic groups. Franciscolo (1979) described a new monotypic genus of Hydroporini, *Sanfilippodytes,* from a cave in Mexico. The type-species, *S. sbordonii* Franciscolo, has reduced eyes, is depigmented and the prosternal process does not reach the metasternal process. Genitalia and the metacoxal process structure strongly suggest that *Sanfilippodytes* may be congeneric with other nearctic *vilis* group species currently included in *Hydroporus.* The relationship between *vilis* group species and *Sanfilippodytes* needs to be studied carefully.

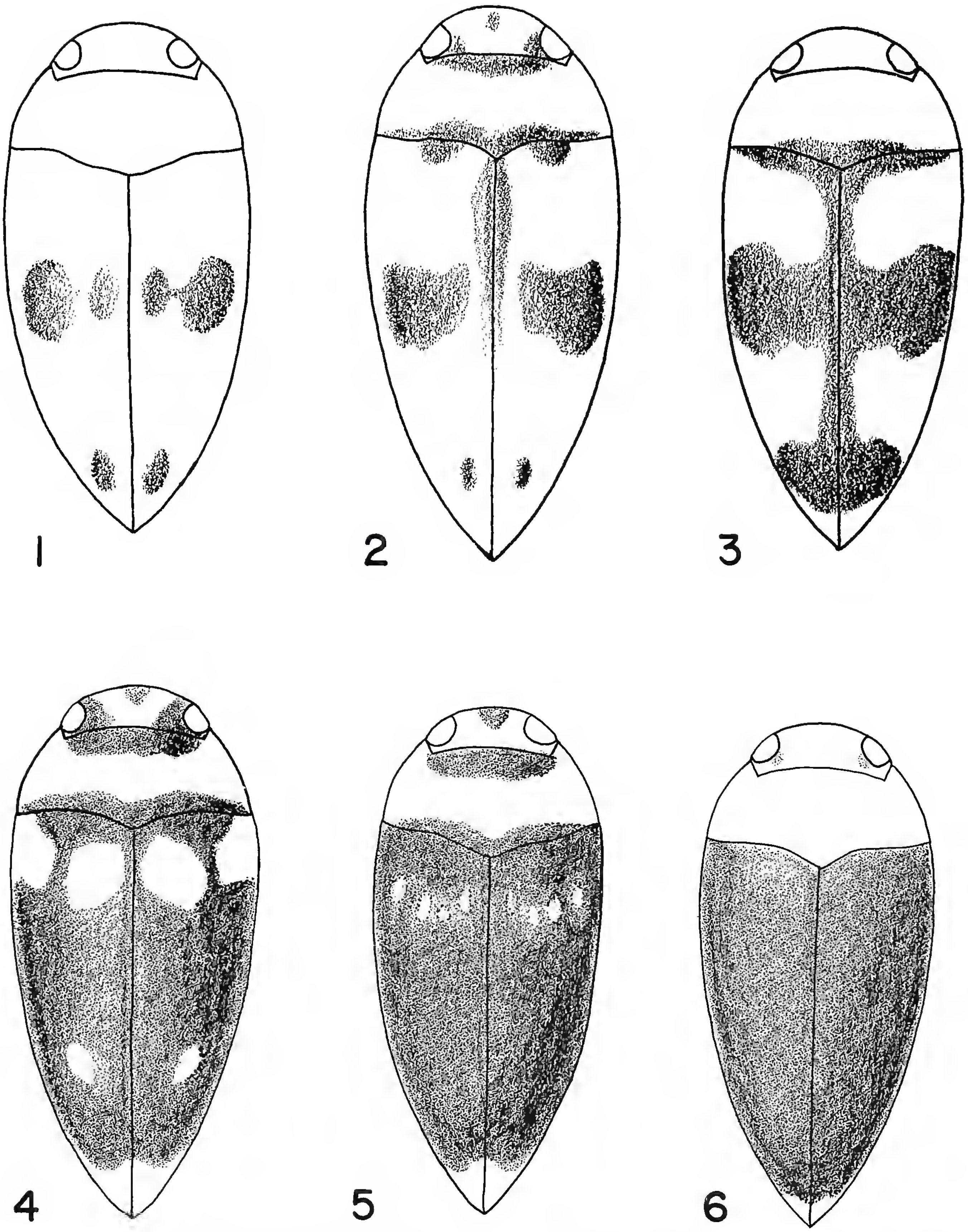
The following list summarizes our concept of subgeneric status within *Hydroporus*:

Hydroporus Clairville 1806. Type *Hyphidrus pubescens* Gyllenhal by subsequent designation, Guignot (1942).
  S. G. *Suphrodytes* Des Gozis 1914. Type *H. dorsalis* Fabricius by monotypy.
  S. G. *Heterosternuta* Strand 1935. Type *H. concinnus* LeConte (=*wickhami* Zaitzev) by subsequent designation, Guignot (1942).
    nec Heterosternus Zimmermann (1919),
    nec Heterostethus Falkenström (1938).
  S. G. *Sternoporus* Falkenström 1930. Type *H. longicornis* Sharp by subsequent designation, Guignot (1931).
    Hydroporinus Guignot 1945. Type *H. neglectus* Sturm by original designation.
  S. G. *Neoporus* Guignot 1931. Type *H. hebes* Fall by original designation.
    Circinoporus Guignot 1945. Type *H. cimicoides* Sharp by original designation.
  S. G. *Hydroporidius* Guignot 1949. Type *H. melanarius* Sturm by original designation.

Balfour-Browne (1940) also recognized *Graptodytes* Seidlitz, *Stictonectes* Brinck, and *Scarodytes* Des Gozis as subgenera of *Hydroporus.* However, more recent palearctic workers recognize those three taxa and *Metaporus* Guignot and *Porhydrus* Guignot as distinct genera.

Falloporus, new genus

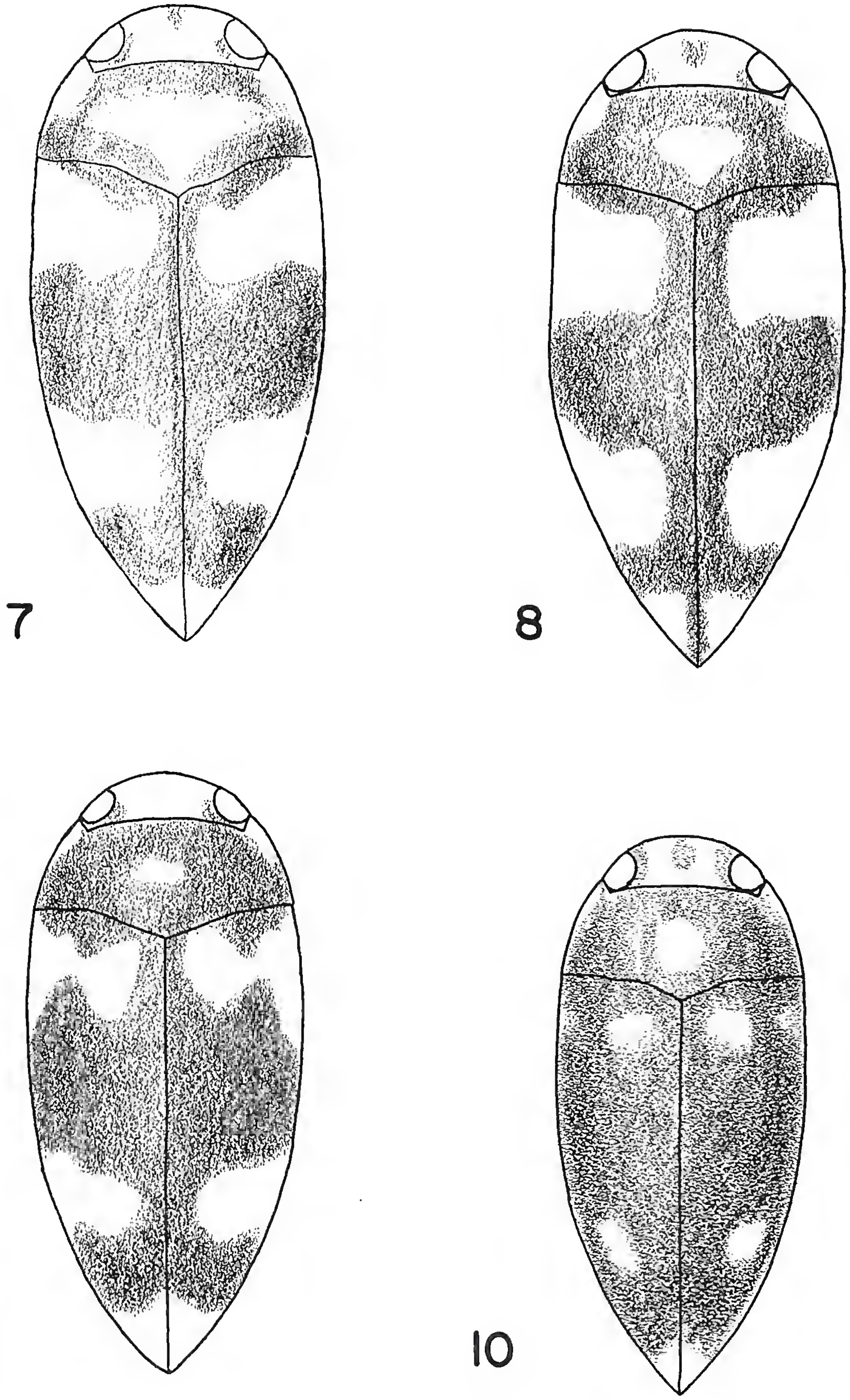
Diagnosis.—Among nearctic hydroporine groups, *Falloporus* is immediately recognizable by its enlarged fourth or fourth and fifth antennal segments (Figs. 14–21), protarsal cupule (Fig. 32), and subapical setae of the



Figs. 1–6. *F. triangularis*: Fig. 1. Scott Co., TN. Fig. 2. Blount Co., TN. Fig. 3. Van Buren Co., TN. Figs. 4–6. Baldwin Co., AL.

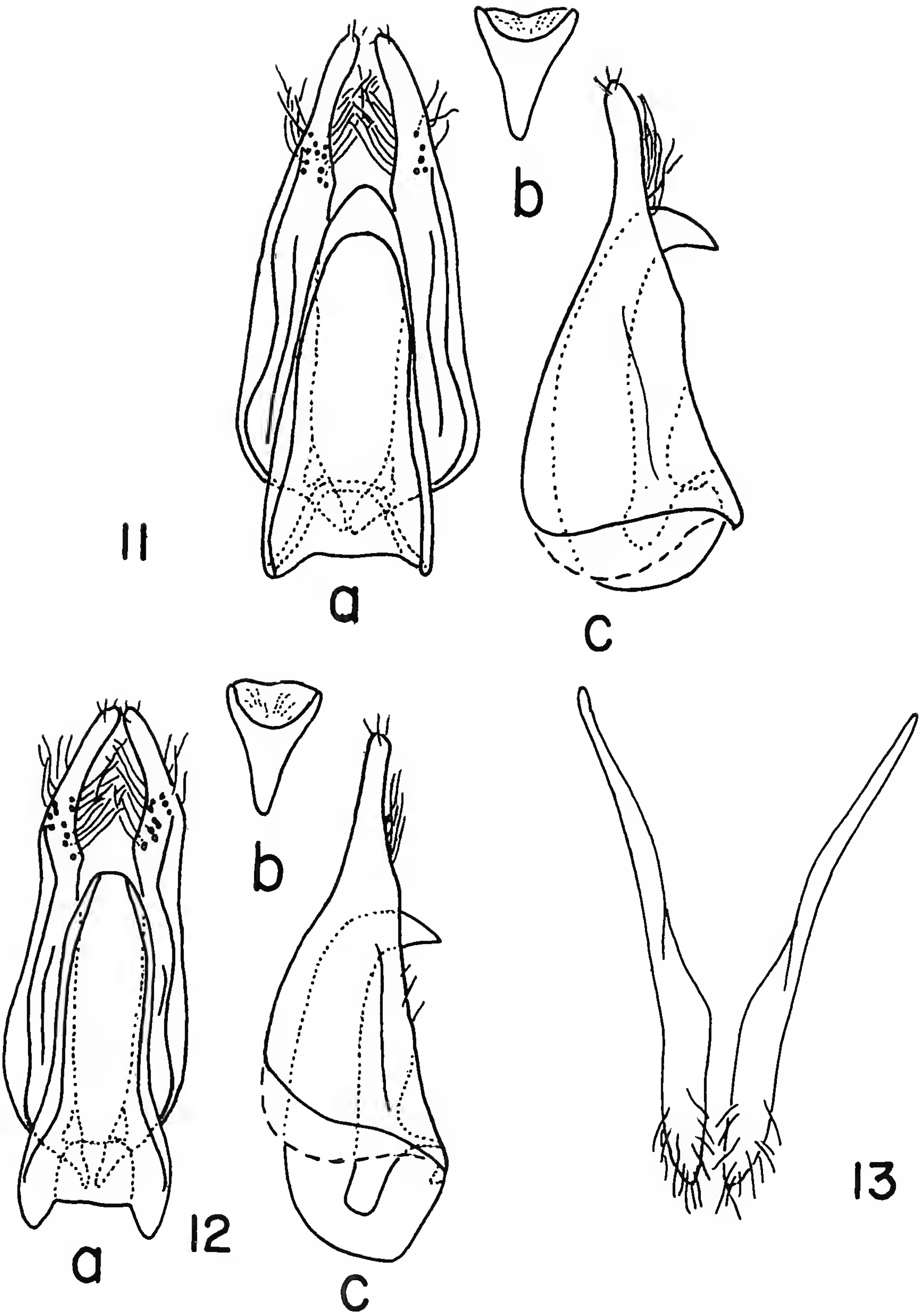
parameres (Figs. 11–12). In addition, the metasternal process does not touch the mesosternum (Fig. 27), there are no pronotal stria, and the prosternum is declivitous, but not at all protuberant (Fig. 27).

Description.—Form elongate oval (length twice width); sides subparallel,



Figs. 7–10. *F. pilatei*: Fig. 7. Gilchrist Co., FL. Figs. 8–9. Lauderdale Co., TN. Fig. 10. Miller Co., GA.

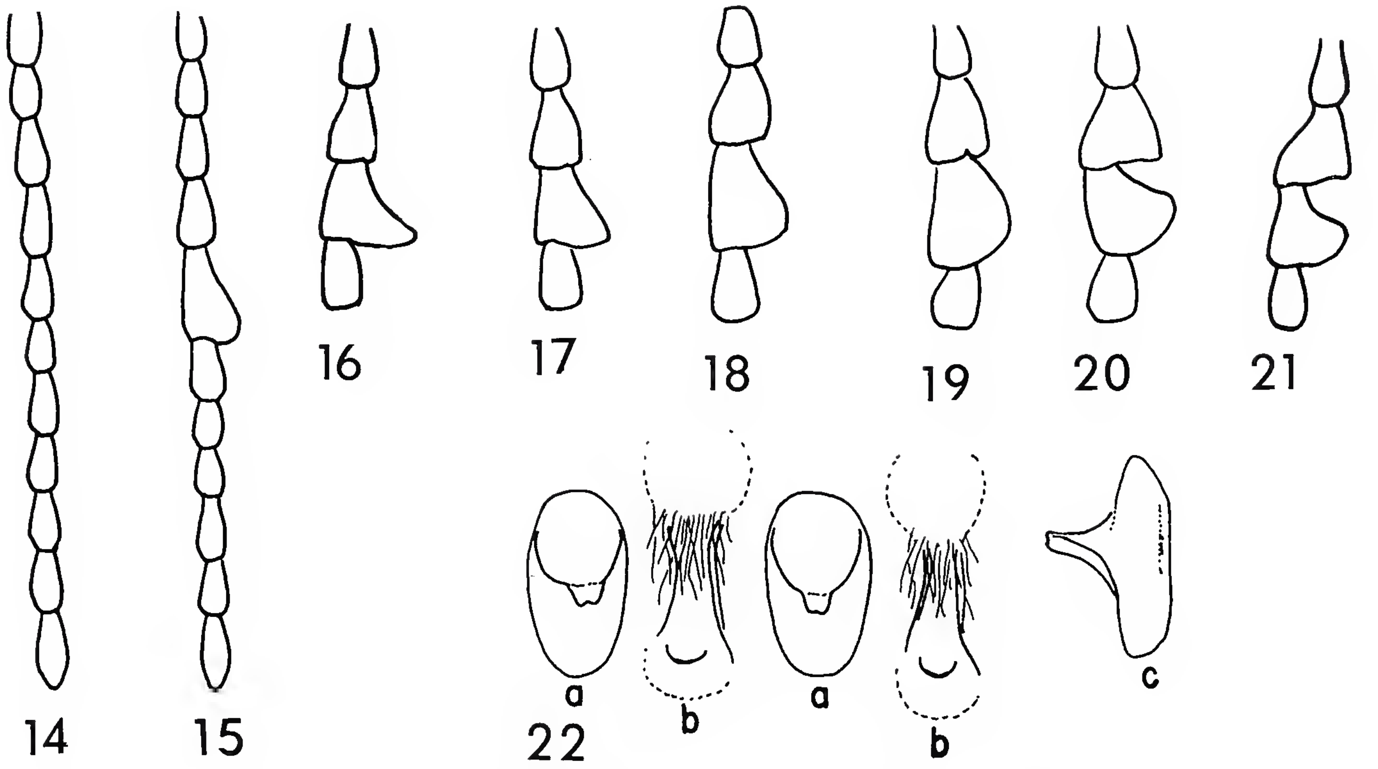
pronotum and elytra continuous; rather depressed. Color variable with dark fascia which vary from small spots to complete coalescence (Figs. 1–10). Surface shining, but with microreticulation; entire dorsal and ventral surface, palps, antennae and metafemora densely covered with "button-like"



Figs. 11–13. Fig. 11. *F. pilatei*. a. dorsal view of aedeagus and parmeres. b. apical (posterior) view of deflected tip of aedeagus. c. lateral view of aedeagus and parameres. Fig. 12. *F. triangularis*. a. dorsal view of aedeagus and parmeres. b. apical (posterior) view of deflected tip of aedeagus. c. lateral view of aedeagus and parameres. Fig. 13. *F. triangularis* ovipositor.

sensilla (Figs. 29–31). Scattered large setigerous punctures separated by three times their width (Figs. 29–30).

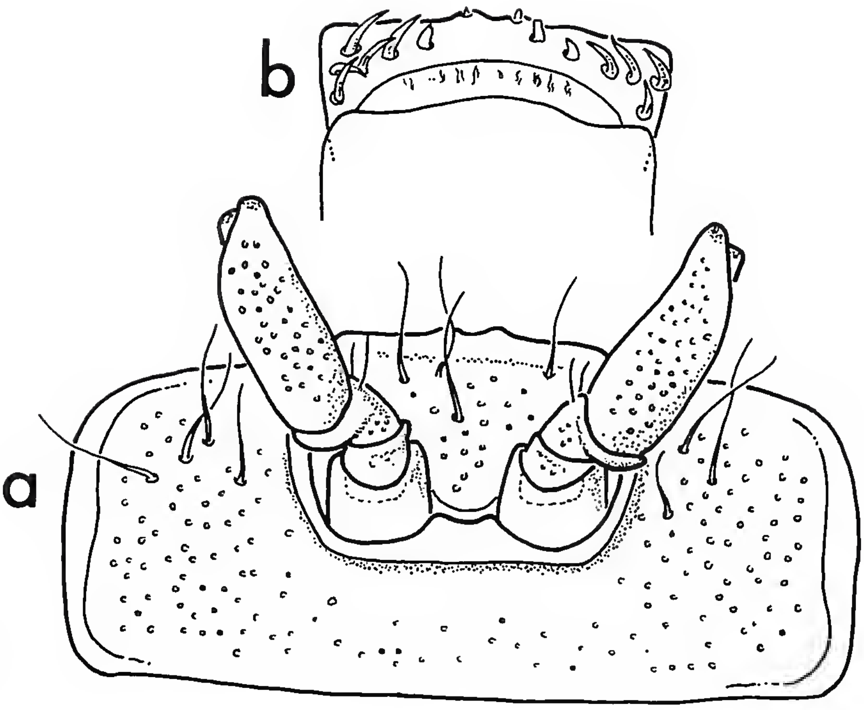
Head broadest at posterior portion of eye; front and back margin of eye shallowly emarginate. A series of coarse punctures at anteromedial corner



Figs. 14–22. Figs. 14–19. *F. triangularis*. 14. Female antenna. 15. Male antenna, Benton Co., TN. 16–19. Male antenna (segments 3–6). 16. Sauk Co., WI. 17. Lincoln Co., MS. 18. Blount Co., TN. 19. Macon Co., AL. Figs. 20–21. *F. pilatei,* male antenna (segments 3–6). 20. Macon Co., GA. 21. Miller Co., GA. Fig. 22. *F. triangularis*. Inner view of sclerotized lobes of proventriculus. a. oval, toothed outer lobe. b. inner valve-like ciliate lobe. c. side view of outer lobe showing medially projecting tooth.

of eye. Clypeus not thickened, slightly margined laterally; labrum emarginate, with dense golden setae medially. Mandibles with reduced medial teeth, no medial fringe of setae (Figs. 24–25). Maxillary palps four segmented; last segment distinctly emarginate apically, its length approximately equal to the basal three segments combined. Ligula subtriangular in ventral view, micropunctate with a few sparse slender setae (Fig. 23a); a row of stout spines along dorsal anterior edge (Fig. 23b). Mentum strongly lobed anteriorly, lobes rounded, not arcuate; medial portion between labial palps produced (Fig. 23b). Labial palpus four segmented, last segment distinctly notched. Antennae with fourth or fourth and fifth segments variably broadened (Figs. 14–21).

Pronotum slightly more than 2 times broader than long, very narrowly margined, lateral bead about 10–15% width of second antennal segment. Pronotum without posterior lateral stria, anterior lateral angles produced and subacute, posterior lateral angles rather sharp. A small pore-like opening present at each ventral anterolateral corner of pronotum. Prosternum declivitous but not at all protuberant or rugose (Fig. 27). Prosternal process lanceolate, widely margined laterally, distinctly longitudinally convex medially; apex moderately acute; extending between mesocoxae and fitting in



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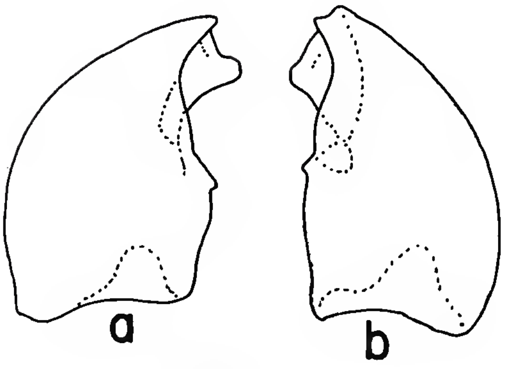

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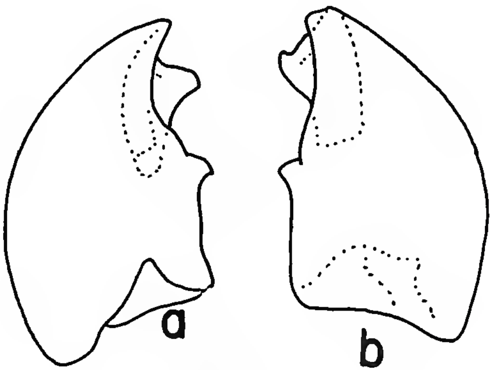

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Figs. 23–25. Fig. 23. *F. pilatei.* a. Ligula and mentum, ventral view (250×). b. Apical-dorsal edge of ligula showing arrangement of spines (250×). Figs. 24–25. Ventral view of mandibles (a, right mandible; b, left mandible). 24. *F. triangularis.* 25. *F. pilatei.*

metasternal sulcus. Mesosternum and metasternum distinctly separated (Fig. 27). Metafurca rather well developed (Fig. 26). Proventriculus of hydroporine type: outer lobes oval, with transverse teeth; inner lobes valve-like and ciliate (Fig. 22).

Scutellum concealed. Elytra widest in basal third, edges often parallel in basal third; in side view straight, not ascending at base; epipleura gradually narrowing posteriorly; epipleural width at anterior edge of second abdominal sternite about 40% its basal width; no humeral carina on epipleura; no inner ligula. Metasternum with a deep longitudinal sulcus medially for 50–75% of its length (Fig. 27). Anterior and posterior edges of metacoxal plate subparallel;

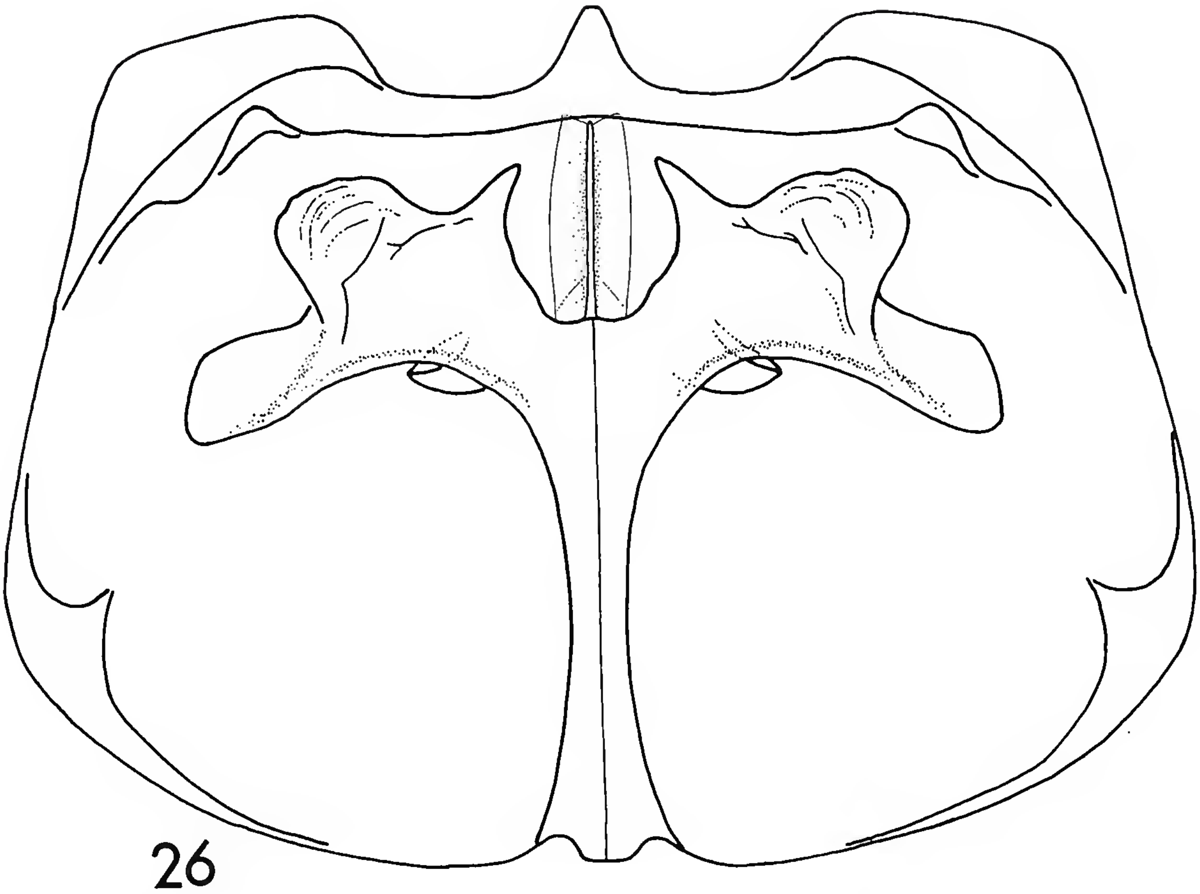


Fig. 26. *F. pilatei,* metafurca.

metacoxal lines extending anteriorly to metasternum, almost parallel (not diverging anteriorly). Posterior metacoxal process posterolaterally produced, covering base of hind trochanters, concave on each side of middle; medially produced, metacoxal cavities totally separate (Fig. 28). Metafemoral base not touching metacoxal process. Metafemur appearing somewhat shining but evenly covered with modified sensilla (micropunctate), with barely perceptible sparse median line of setigerous punctures; posterodorsal edge carinate.

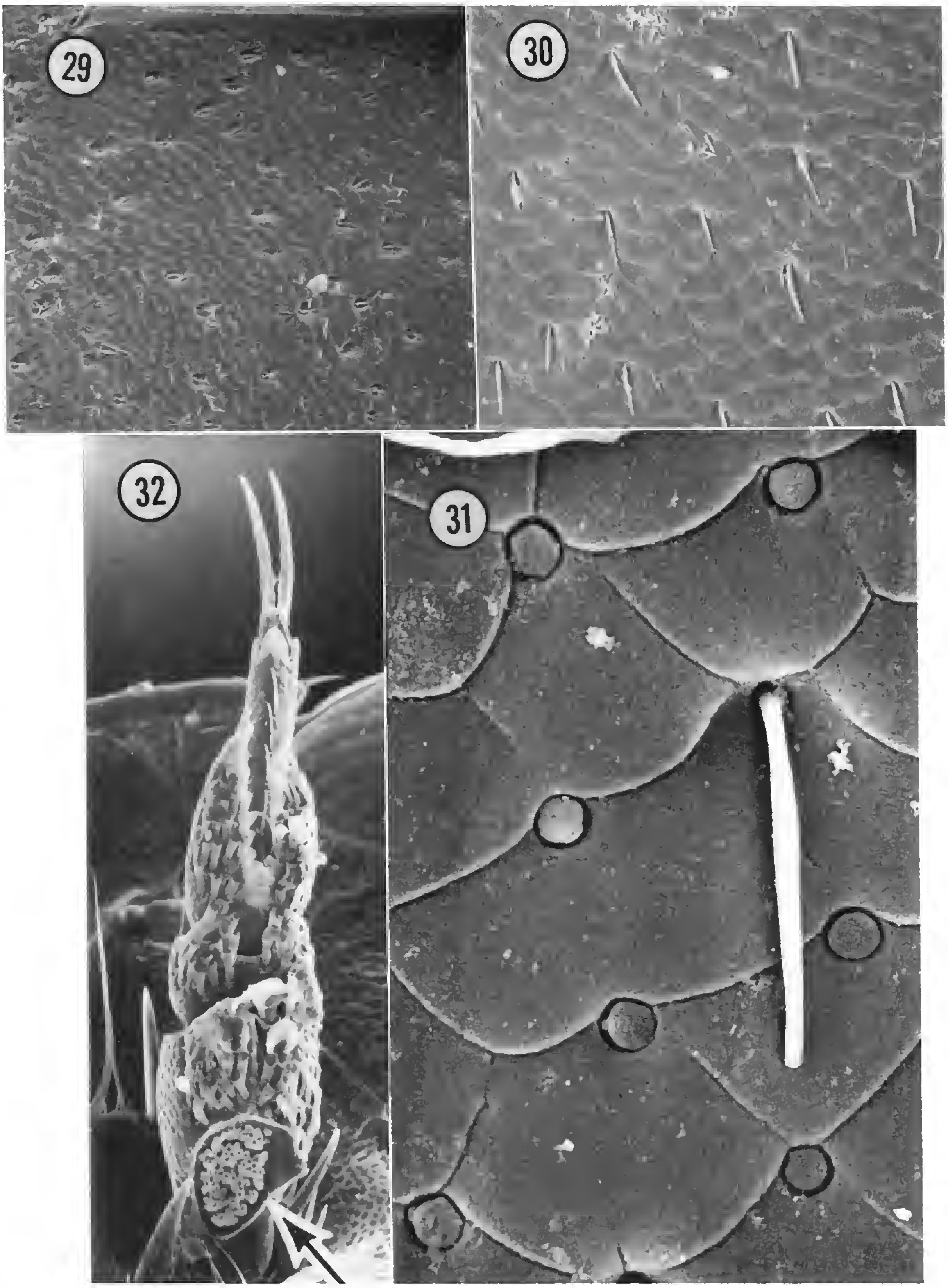
Protarsus and mesotarsus pseudotetramerous. Male protarsus slightly broadened with cupule containing many foliate sensillae (Fig. 32). Anterior male protarsal claw not modified; evenly curved and tapered from base to apex. Parameres broadest at base, strongly tapered towards apices with long subapical setae; aedeagus strongly ventrally deflected and subacute apically (Figs. 11–12). Ovipositors (Fig. 13) with anteriorly extended strut, valvifer absent.

Type-species.—Hydroporus triangularis Fall (1917:170).

Etymology.—This genus is named in honor of Henry C. Fall. He made many significant contributions to knowledge of North American water beetles.

Gender.—Masculine.

Figs. 27–28. Fig. 27. *F. triangularis*. Metasternal process and prosternum, pro- and mesocoxae removed. Note sulcate metasternum; metasternum not attaining mesosternum; and non-protuberant prosternum (100×). Fig. 28. *F. triangularis*. Metacoxal apex (200×).



Figs. 29–32. *F. triangularis*. Fig. 29. Metacoxa (115×). Fig. 30. Elytron (115×). Fig. 31. Elytron (2000×). Fig. 32. Protarsus with basal cupule (arrow) (160×).

Taxonomic Notes

Subgeneric status was first considered for *Falloporus*. This might seem more consistent since *Heterosternuta* and *Neoporus* are kept as subgenera and they are substantially larger groups (13 and 35 species respectively). However, based on mesosternum-metasternum relationships, subgeneric status within *Hydroporus* is untenable because *Falloporus* is more closely

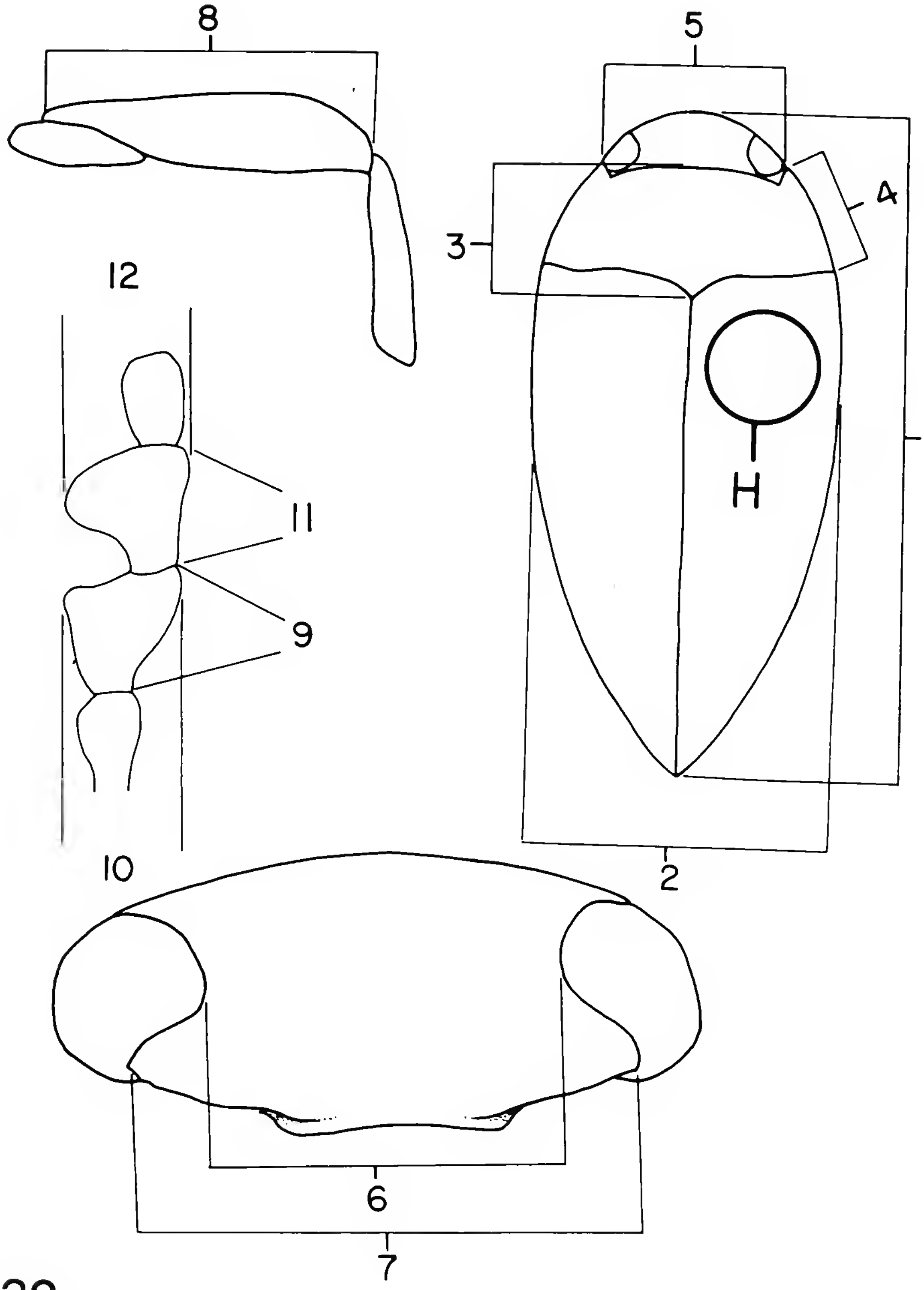


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Fig. 33. 1–12 indicate measurements made for phenetic analysis. Area H encloses area from which SEM photographs were taken (see Figs. 30–31).

related to other genera in Hydroporini. Each of these more closely related groups (excluded from *Hydroporus*) justifiably deserves generic status and *Falloporus* is at least as distinct from each of them as they are from each other.

Among Hydroporini, we have examined all species of *Heterosternuta* and *Neoporus* and the mesosternum and mestasternum always contact each other

Table 1. List of OTUs with locality and identification data.

OTU	Group	Sex	Species	Locality
1	1	M	P	Miller Co., GA
2	1	F	P	Miller Co., GA
3	2	F	P	Lawrence Co., MS
4	3	M	T	Tapallosa Co., AL
5	4	M	P?	Macon Co., AL
6	4	F	P?	Macon Co., AL
7	5	M	P	Baldwin Co., AL
8	5	F	P	Baldwin Co., AL
9	6	F	P	Houston Co., AL
10	7	M	T	Escambia Co., AL
11	8	M	T	Logan Co., KY
12	8	F	T	Logan Co., KY
13	9	M	P	Lauderdale Co., TN
14	9	F	P	Lauderdale Co., TN
15	10	M	P	Dorchester Co., SC
16	10	F	P	Dorchester Co., SC
17	11	F	P	Haywood Co., TN
18	12	M	P	Gilchrist Co., FL
19	12	F	P	Gilchrist Co., FL
20	13	M	P	Montgomery Co., AL
21	13	F	P	Montgomery Co., AL
22	14	F	T	Bay Co., FL
23	15	F	P	Alachua Co., FL
24	16	F	P	Jackson Co., FL
25	17	M	P	Levy Co., FL
26	18	F	P	Bleckely Co., GA
27	19	M	P	Baker Co., GA
28	20	F	P	Caddo Par., LA
29	21	F	P?	Smith Co., TX
30	22	F	P	Nacogdoches Co., TX
31	23	M	P	Arkansas
32	23	F	P	Arkansas
33	24	M	P	Robeson Co., NC
34	25	F	T	Indiana, PA
35	26	M	T	E. Cont., MO
36	27	F	P	Jackson Co., MO
37	28	M	T	Boone Co., MO
38	29	M	T	Scioto Co., OH
39	30	M	T	Scott Co., TN
40	31	M	T	Benton Co., TN
41	32	M	T	White Co., TN
42	33	M	T	Stewart Co., TN
43	33	F	T	Stewart Co., TN
44	34	M	T	Bledsoe Co., TN
45	34	F	T	Bledsoe Co., TN
46	35	M	T	Baldwin Co., AL
47	35	F	T	Baldwin Co., AL

Table 1. Continued.

OTU	Group	Sex	Species	Locality
48	36	M	T	Van Buren Co., TN
49	36	F	T	Van Buren Co., TN
50	37	M	T	Lincoln Co., MS
51	37	F	T	Lincoln Co., MS
52	38	M	T?	Blount Co., TN
53	38	F	T?	Blount Co., TN
54	39	M	T	Sauk Co., WI
55	39	F	T	Sauk Co., WI

ventromedially. Sharp (1882) and Balfour-Browne (1940) have shown that the mesosternum and mestasternum contact in *Hydroporus s. str., Laccornis* Des Gozis, *Oreodytes, Graptodytes, Stictonectes, Scarodytes, Porhydrus,* and *Metaporus.* Fall (1923) and Zimmerman and Smith (1975) have shown that a few nearctic *Deronectes* have contacting segments. Non-contacting segments are known in *Paroster* Sharp, *Antiporus* Sharp, *Nectrosoma* M'Leay, *Megaporus* Brinck, *Hygrotus* Stephens, and most *Deronectes* (Sharp 1882). We also found the non-contacting conditions in *Peschetius* Guignot and *Falloporus.*

A detailed discussion of hydroporine phylogeny is the subject of another paper (in preparation), however, it can briefly be stated that there is strong evidence that non-contact between the mesosternum and metasternum is an apotypic condition. This indicates *Falloporus* does not belong in *Hydroporus*; instead, it shares a more recent common ancestor with other Hydroporini genera. Since *Falloporus* is at least as distinct as other nearctic and palearctic genera, we have elected to raise it to generic status. *Falloporus* is probably most closely related to *Hygrotus* or *Deronectes.*

Phenetics

Extreme variation in color pattern and antennal modification suggested the possibility of one highly variable species rather than two distinct species. Therefore, a cluster cluster, ordination, and discriminant analysis were performed on specimens of both presumed species of *Falloporus.*

All available specimens of *Falloporus* have been examined and at least a representative sample of specimens from each collection, but usually the entire collection, were measured for 14 characters. Measured characters used are depicted in Fig. 33: 1; total length (TL), 2; total width (TW), 3; median pronotal length (MPL), 4; lateral pronotal length (LPL), 5; head width (HW), 6; interoccular distance (ID), 7; frons width (FW), 8; femur length (FL), 9; width of 4th antennal segment (4W), 10; length of 4th antennal segment (4L), 11; width of 5th antennal segment (5W), 12; length of 5th

Table 2. Average of each OTU for measured variables. N = sample size. See text for other abbreviations.

OTU	TL	TW	MPL	LPL	HW	ID	FW	FL	4W	4L	5W	5L	PC	EC
1	76.80	34.63	31.25	27.90	41.34	24.09	31.38	30.50	5.44	6.74	5.13	5.32	4.75	6.50
2	78.10	36.30	31.46	32.72	43.78	24.94	32.40	31.50	3.00	4.64	3.00	3.80	5.60	6.10
3	78.50	37.10	31.00	27.50	42.00	25.50	32.50	31.50	2.90	5.00	2.85	3.90	1.75	5.25
4	66.00	32.00	30.00	23.50	37.00	24.00	30.20	26.00	3.10	4.00	4.10	5.00	1.00	5.00
5	77.64	33.21	31.26	27.88	42.88	26.81	34.15	29.88	4.57	4.91	5.66	7.27	3.00	5.44
6	78.17	36.33	30.67	27.67	42.33	27.67	34.67	29.83	3.00	4.37	3.10	4.10	2.00	5.17
7	78.17	36.50	31.33	27.67	41.67	25.73	33.33	30.00	4.33	5.80	5.67	6.07	2.00	6.33
8	77.59	36.21	31.09	28.55	42.00	26.20	32.91	29.91	3.01	5.31	3.04	4.43	1.77	10.54
9	81.00	36.00	33.00	29.00	45.00	25.00	32.00	31.20	3.00	4.00	3.00	5.00	3.50	6.00
10	73.00	36.30	31.00	27.00	41.00	26.50	33.00	29.00	4.00	9.00	6.00	6.10	1.00	5.50
11	69.00	39.00	31.00	25.00	40.00	25.00	32.00	27.00	4.00	3.80	6.00	4.90	1.00	5.00
12	68.00	33.75	30.00	28.25	39.00	25.00	31.50	26.25	2.25	5.00	2.15	4.25	1.00	4.25
13	78.00	35.93	31.67	28.33	41.83	24.43	31.33	30.67	6.00	6.00	5.33	5.17	5.50	6.67
14	83.50	38.00	35.00	30.00	44.00	25.00	33.00	33.00	3.00	4.50	3.00	3.80	4.50	5.00
15	78.00	36.00	31.00	29.00	41.00	24.00	31.00	31.00	6.20	6.80	6.00	5.00	5.00	6.00
16	80.67	37.43	32.33	29.33	42.67	25.33	32.67	31.67	3.23	4.60	2.93	3.70	6.17	5.83
17	84.00	38.00	34.00	30.00	44.00	25.00	34.00	32.60	3.00	4.50	3.00	3.50	6.50	5.50
18	80.50	36.50	27.00	29.50	44.50	28.50	35.10	31.25	5.05	4.75	6.45	8.00	1.75	5.50
19	85.00	38.00	33.00	31.00	45.00	26.00	33.80	33.00	3.00	5.00	3.00	4.00	6.00	10.00
20	84.00	40.00	33.00	31.00	44.00	26.00	35.00	33.00	5.80	6.00	5.20	6.00	3.00	5.50
21	82.00	38.00	32.00	29.00	44.00	26.00	35.00	32.00	3.00	4.80	3.00	4.00	6.50	7.00
22	71.50	35.00	30.00	27.00	39.00	25.00	32.00	28.00	2.30	5.00	2.80	3.50	1.00	11.00
23	84.00	40.00	33.00	30.50	46.00	26.00	34.00	33.00	3.00	5.00	3.00	4.50	6.00	9.50
24	85.00	39.00	34.00	30.00	44.50	27.00	34.00	33.00	3.00	5.00	3.00	4.00	5.00	6.00
25	81.50	37.00	34.00	30.00	44.00	26.00	34.00	33.00	6.00	8.00	5.50	5.00	5.50	11.00
26	81.00	38.00	31.00	29.00	43.00	25.00	32.00	31.00	3.00	5.00	3.00	4.00	5.00	5.50
27	75.00	36.00	24.00	26.00	41.00	24.00	32.00	30.00	5.00	6.00	4.80	5.00	4.00	5.50
28	79.00	37.00	32.00	28.00	43.00	25.00	33.00	31.00	3.00	5.00	3.00	4.00	4.00	5.50
29	79.00	37.00	32.00	29.00	43.00	27.00	34.00	30.00	2.50	5.00	3.00	4.00	1.50	5.00

Table 2. Continued.

OTU	TL	TW	MPL	LPL	HW	ID	FW	FL	4W	4L	5W	5L	PC	EC
30	85.00	39.00	33.00	30.00	45.00	25.50	34.00	32.00	3.00	4.50	3.00	4.00	5.00	5.00
31	81.00	37.25	31.50	29.50	43.50	24.50	32.00	31.50	5.75	6.00	5.50	5.75	6.75	6.25
32	80.00	37.00	32.00	28.00	42.00	25.00	33.00	31.00	3.00	5.00	3.00	3.80	7.50	6.00
33	80.00	36.00	33.00	29.00	44.00	26.00	32.80	30.00	5.50	7.00	5.50	5.00	5.00	10.00
34	73.00	36.00	31.00	28.00	41.00	25.00	33.00	29.00	2.00	5.00	2.30	4.00	1.00	4.00
35	75.00	35.00	21.00	28.00	40.00	26.00	31.00	28.00	3.00	6.00	6.50	4.50	1.00	4.00
36	80.00	37.00	32.00	28.00	44.00	27.00	33.00	31.00	2.50	4.00	3.00	4.00	2.00	4.00
37	77.00	36.00	32.00	29.00	41.00	26.00	32.00	28.00	3.50	4.00	8.00	6.00	1.00	5.00
38	69.00	34.00	30.50	27.00	39.50	26.00	31.50	26.00	4.50	5.25	4.30	5.00	1.00	3.50
39	75.00	36.00	32.00	29.00	41.00	26.00	34.00	29.00	3.50	4.80	5.00	6.00	1.00	1.00
40	68.00	32.50	29.00	25.00	37.00	25.00	30.00	26.00	3.00	4.00	4.60	6.00	1.00	4.00
41	76.00	38.00	32.00	29.00	42.00	28.00	35.00	31.00	2.00	4.00	3.00	4.00	1.00	3.00
42	69.80	33.00	30.00	27.00	39.00	25.00	31.00	28.00	3.20	3.80	5.50	6.50	1.00	3.00
43	72.00	35.00	32.00	27.00	41.00	27.00	34.00	29.00	2.80	4.00	2.80	4.00	1.00	1.00
44	71.00	34.00	30.00	26.00	40.00	27.00	33.00	26.50	4.00	4.00	4.50	7.00	1.00	3.00
45	70.00	33.60	29.00	26.00	39.00	25.00	32.00	26.00	2.00	4.00	2.80	4.00	1.00	3.00
46	71.00	33.79	29.43	25.71	39.14	25.07	30.71	27.29	3.91	4.73	5.84	6.31	1.00	11.93
47	71.00	34.25	29.50	27.00	39.50	25.75	32.00	28.00	2.90	4.55	3.00	4.30	1.00	55.50
48	73.71	34.50	29.75	27.44	40.63	26.79	32.63	28.19	3.18	4.23	4.48	5.94	1.00	2.63
49	74.00	35.00	30.50	27.50	41.00	27.50	32.50	27.75	2.55	4.25	3.00	4.15	1.00	3.25
50	72.50	35.00	31.00	28.00	40.50	25.50	31.50	29.00	3.50	4.15	5.10	6.00	1.00	3.50
51	73.38	34.75	30.25	28.00	39.88	25.63	32.00	29.00	2.72	4.13	2.95	4.07	1.00	3.13
52	78.33	38.00	33.33	29.33	44.33	27.83	34.50	30.33	4.03	4.67	5.60	6.83	1.33	2.17
53	81.00	37.50	33.00	29.00	45.00	38.00	35.00	30.50	3.00	5.00	3.50	4.50	2.00	4.00
54	78.00	36.00	31.50	29.00	40.75	25.50	33.00	30.00	3.30	4.00	7.45	6.75	1.00	6.00
55	74.00	36.00	30.00	28.00	41.00	26.00	33.00	30.00	3.00	4.10	3.00	4.00	1.00	6.50

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Fig. 34. Dendrogram resulting from cluster analysis. Squares are *F. triangularis,* circles are *F. pilatei*; open figures are females, closed figures males.

antennal segment (5L). Degree of pronotal color (PC) and elytral color (EC) were also numerically coded. Male 4th and 5th antennal segment shape was also recorded but since both males and females were used in the analysis these characters were not used. Each collection was divided by sex because of the sexual dimorphism exhibited by members of *Falloporus* and all members of a single sex from one collection made up an OTU. A total of 39 collections produced 55 OTUs and these are listed in Table 1 with their collection localities. Before clustering and ordination were performed, the 39 collections were identified as *pilatei, triangularis,* or 'intermediate.' Our identifications were based primarily on the characters presented by Fall (1923) for distinguishing the two species.

Values for each variable in each OTU were averaged and these data are reported in Table 2. These values were used to calculate a similarity coefficient matrix. The Canberra metric (Lance and Williams, 1967) was chosen because it is not affected by the entire range of characters in the data set, but only reflects those groups being compared (Sneath and Sokal, 1973). This was thought desirable because of the presence of characters exhibiting extreme sexual dimorphism. The similarity matrix was subjected to both cluster analysis (group average) and ordination (PCORD technique) in order to examine the relationships between the OTUs. Neither cluster analysis nor ordination is preferred for the study of population variation and when both are used additional insight is gained into the relationship between the OTUs.

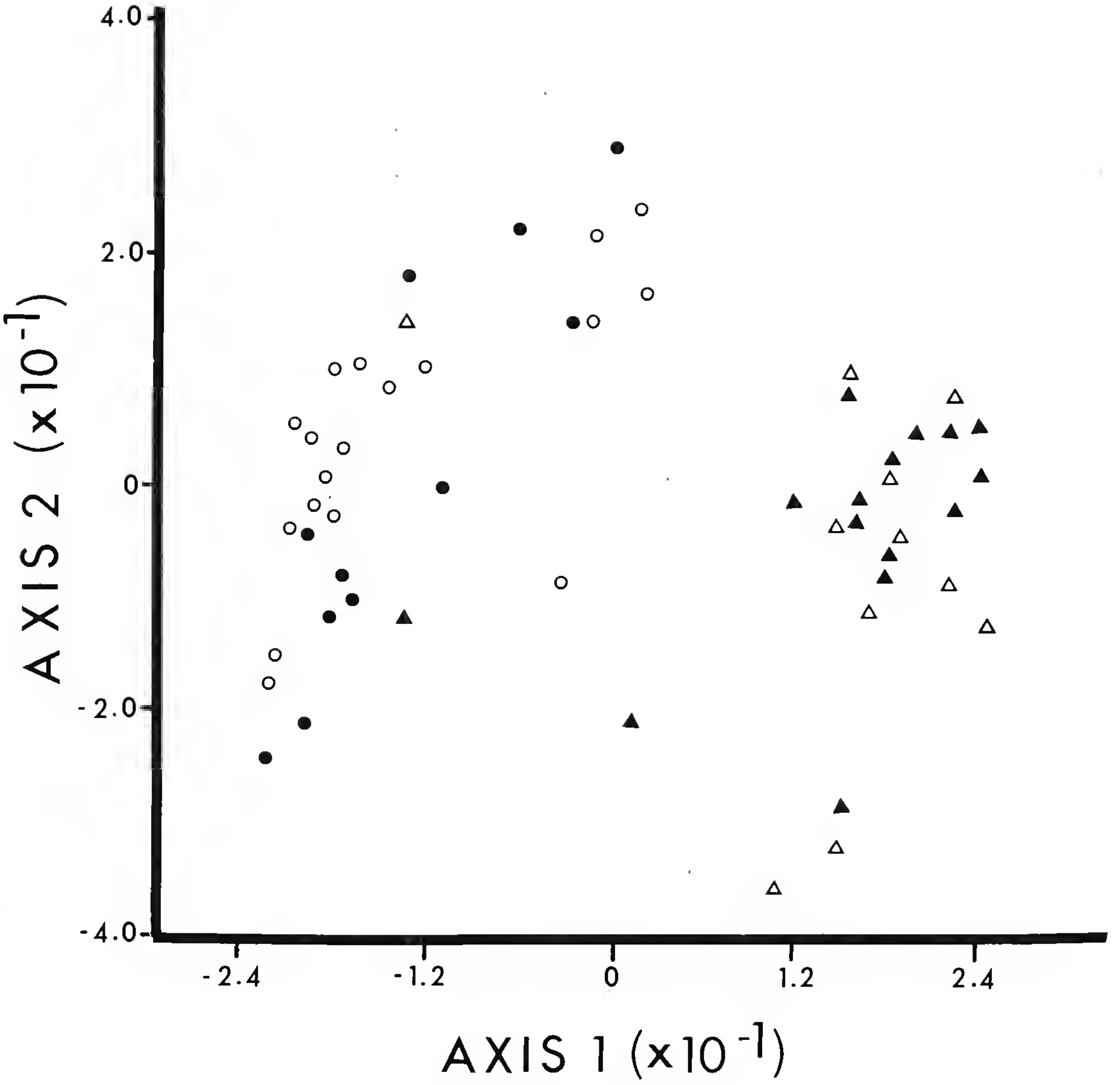

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Fig. 35. Ordination of 55 OTUs on the first two principal coordinates. Triangles are *F. triangularis*, circles are *F. pilatei*; open figures are females, closed figures males.

The result of the cluster analysis is presented in Fig. 34. The primary grouping (at similarity level 0.874) is of the two putative phena. Within these two major phena, OTUs are grouped into clusters of males and females. A single OTU (53), *triangularis* female from Blount Co., TN, was misclassified by the cluster analysis. Males from the same collection (52) were correctly classified.

This result supports the two species concept. Alternative results (e.g. three major clusters with the 'intermediates' clustering by themselves or severe mixing of the previously designated *pilatei* and *triangularis* OTUs in the same cluster) would have supported the single species concept.

A principal coordinate analysis was performed on the similarity matrix and an ordination of the OTUs on the first two coordinates is shown in Fig. 35. The efficiency of the coordinates decreases rapidly because of the sexual dimorphism exhibited by members of *Falloporus*. The first two coordinates

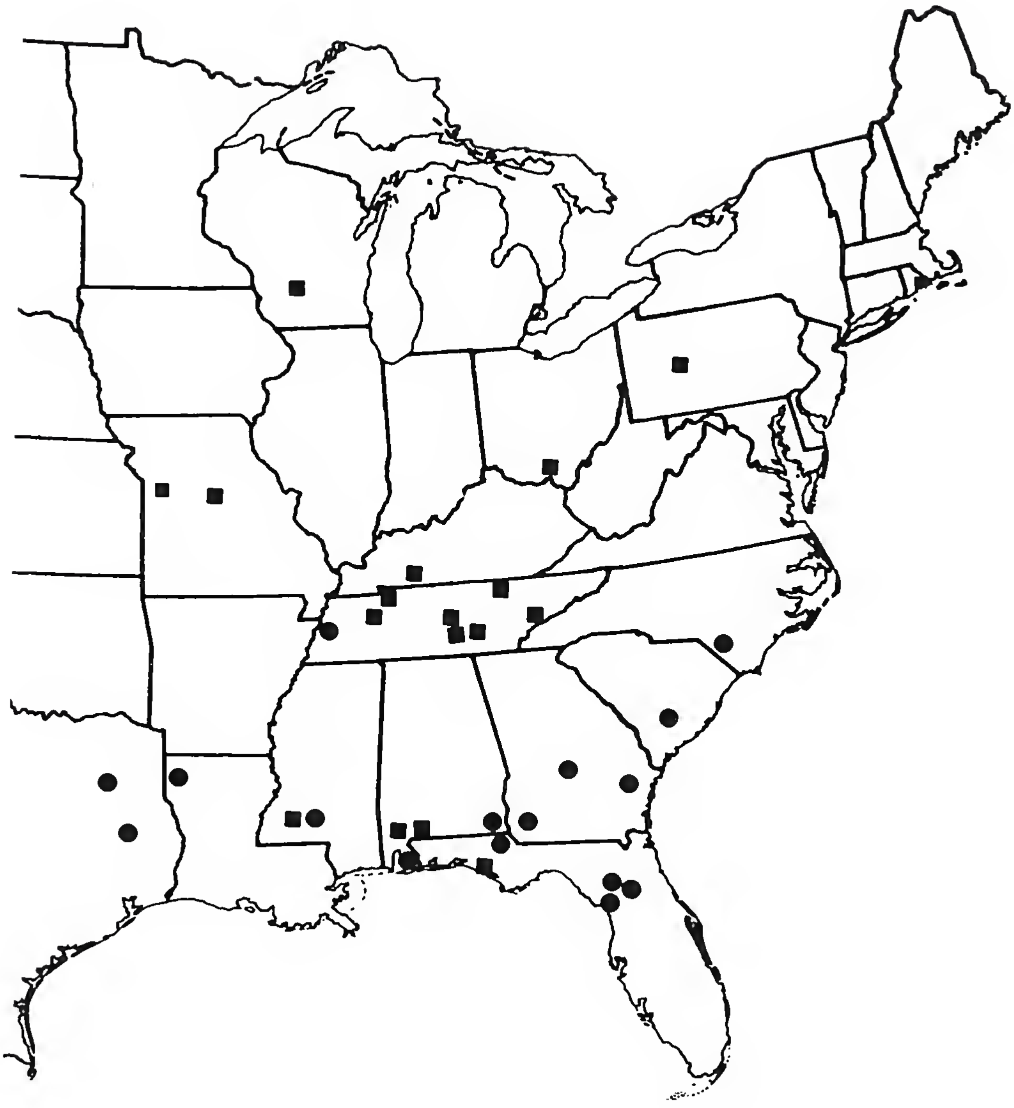

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Fig. 36. Distribution of *F. triangularis* (squares) and *F. pilatei* (circles).

(28.138 and 19.397) explain 47.5% of the variance in the similarity matrix. The pattern in Fig. 35 indicates that the primary separation of species occurs along the first axis with some minor separation along the second axis.

An examination of the loading matrix indicates that length (TL), width of the 4th antennal segment (4W), and pronotal color (PC) load heavily on the first coordinate while both 4th and 5th antennal segment width (4W and 5W) load heavily on the second coordinate.

The ordination produced an interesting grouping of *pilatei* OTUs (centroid; Axis I = 0.0, Axis II = +2.0). These collections are all from the southern coastal plain, but not all collections from this area are included in the grouping. These collections appear to be specimens of *pilatei* which have unusually reduced pronotal coloration. The collections which we had *a priori* identified as 'intermediate' did not fall in the area between the two phena as would have been expected if they represented true intermediate forms. They were rather uniformly distributed within each major grouping.

Two OTUs (52 and 53) which we identified as *triangularis* fell into the *pilatei* group; one of these (53) was misclassified by cluster analysis. Reexamination revealed that pronotal coloration is about as in members of *triangularis,* but length and width of the fourth and fifth antennal segments are slightly larger than would be expected in *triangularis*. These OTUs (males and females from the same collection) may represent hybrids between the two species or may simply be extreme examples of *Falloporus triangularis*.

Discriminant analysis indicated that the most reliable characters for separating the two species were size, antennal width, and antennal length (although there was some overlap in these characters). Pronotal coloration, which we have found to be a fairly reliable character for separating species of *Falloporus* and which was also important in both clustering and ordination, was not heavily weighted in the discriminant analysis. This was probably due to high interpopulation variation within each species. Although discriminant analysis did not emphasize pronotal coloration, classification by these techniques indicated 2 phena and in this respect was still in close agreement with the results of the cluster and ordination analysis. There were several exceptions. According to discriminant analysis, OTU's 5 and 6 (originally identified as 7 male and 3 female *pilatei*) were a mixture of both species or possibly represented an intermediate population. OTU 52 which was misclassified by ordination analysis and OTU 53 which was misclassified by both cluster and ordination analyses, were both classified correctly by discriminant analysis.

All three analyses indicate that there are two distinct phena and we conclude that the statistical evidence does not support synonomization at this time. Furthermore, the phena appear to prefer different habitats. *Falloporus triangularis* is more common in streams with undercut banks and is usually found in upland situations. *Falloporus pilatei* usually occurs in sluggish swampy rivers or streams or in adjacent pools, and occasionally in dangling roots of shrubs in swamps. It is typically found on the coastal plain.

A Key to *Falloporus* Species

1. Fourth and fifth male antennal segments broadened (Figs. 20–21); pronotum more broadly infuscate (Figs. 7–10) .... *pilatei*
   Only fifth male antennal segment distinctly modified (Figs. 14–19); pronotum less broadly infuscate (Figs. 1–6) .... *triangularis*

Falloporus triangularis (Fall) **NEW COMBINATION**

Hydroporus triangularis Fall, 1917:170.

Diagnosis.—This species is distinguished from *Falloporus pilatei* by the lack of modification of the 4th antennal segment of males (Figs. 14–19) and by the less infuscate head and pronotum (Figs. 1–6). In dorsal view the aedeagal apex of *triangularis* is slightly more truncate than that of *pilatei* (Figs. 11a and 12a).

Description.—Males—Size (N = 51), length = 3.80 (3.39 to 4.26); width = 1.82 (1.64 to 2.05); L/W = 2.09. Form elongate oval, tapered posteriorly, widest at middle or just anterior; pronotum and elytra continuous. Lateral edges of pronotum gradually curved inward toward anterior angles, bead extremely fine, not broadened anteriorly; much narrower than second antennal segment. Prosternum declivitous (Fig. 27), not angularly protuberant. Prosternal process lanceolate, bluntly pointed, clypeus not thickened, metasternum sulcate (Fig. 27). Fifth antennal segment variable but distinctly broadened apically, usually appearing somewhat triangular.

Color pattern variable but almost always maculate (Figs. 1–6). Head usually uniformly yellowish orange, sometimes variably infuscate bordering eyes. Pronotum usually uniformly light yellowish orange, sometimes with narrow infuscation along anterior and posterior edge. Elytral pattern with variable light and dark fascia; sutural stripe usually vague, but sometimes distinct or completely lacking; extending along basal edge to varying degrees to form basal infuscation which is seldom connected to middle dark fascia. Middle and apical dark fascia often extending from suture to lateral margin and usually not connected to each other. The middle fascia is sometimes isolated from the sutural stripe and narrower than usual, sometimes even broken into two isolated spots. Apical fascia also sometimes greatly reduced. Apices of elytra yellowish. Venter yellowish orange.

Microreticulation evident; dorsal and ventral surfaces usually densely micropunctate (Figs. 29–31). Punctation of head extremely fine and dense; coarser punctures in shallow depressions at anteromedial corners of eyes. Pronotal punctation extremely fine and dense, coarser punctures along anterior edge and scattered across disc; coarser punctures in discal area separated by two to three times their width. Elytral punctures approximately as coarse as coarser pronotal discal punctures, separated by two to three times their width (Fig. 30); vague discal longitudinal series of denser punctures evident. Metacoxa and metasternum with scattered punctures, coarsest on metasternum, microreticulation evident (Fig. 29).

Anterior protarsi not appreciably broadened, with distinct circular cupules at basal end of first segment (Fig. 32). Aedeagus with ventral portion deflected apically, much shorter than parameres; parameres with long subapical setae (Fig. 12).

Females—Size (n = 43), length = 3.92 (3.44 to 4.26); width = 1.87 (1.67 to 2.00); L/W = 2.09. Similar to male. Antennae not modified. Ovipositor as in Fig. 13.

Type locality.—Sauk City, Wisconsin.

Type data.—Fall (1917) states that his description of *triangularis* was based on four males and six females from Sauk City, Wisconsin. These were supposed to have been collected for Mr. J. D. Sherman by Mr. W. S. Marshall. There is a series of four specimens of *triangularis* (two males and two females) in the H. C. Fall collection at the Museum of Comparative Zoology, Harvard University. All bear collection labels for Sauk City, Wisconsin. Additionally one has the date represented as VIII—9.

One male, which we have designated as the lectotype, bears labels as follows: (1) Sauk City, Wisconsin; (2) a male symbol; (3) TYPE *triangularis* (*triangularis* is handwritten); (4) M.C.Z. type 23962; (5) H. C. FALL COLLECTION; (6) Handwritten Lectotype label with GWW in the lower left corner. The other three specimens have been designated paralectotypes and handwritten paralectotype labels (with GWW in the lower left corner) have been affixed to the pins.

Range.—This species ranges from Wisconsin to the southern Gulf coastal plain (Fig. 36).

Habitat.—This is a lotic species, preferring undercut banks of clear water streams. Teneral specimens were collected in August. The gut contents of one of the specimens which we dissected contained a ceratopogonid pupa.

Falloporus pilatei (Fall) **NEW COMBINATION**

Hydroporus pilatei Fall, 1917:170.

Diagnosis.—Distinguished from *triangularis* by enlarged 4th antennal segment (Figs. 20–21) and generally darker coloration of the head and pronotum (Figs. 7–10). In dorsal view, the aedeagus of *pilatei* is slightly more apically tapered than that of *triangularis* (Figs. 11a and 12a).

Description.—Males—Size (N = 31); length = 4.02 (3.79 to 4.31); width = 1.81 (1.65 to 2.05); L/W = 2.22. Prosternum, body form and most morphological characters as in *triangularis* except 4th and 5th antennal segments modified, appearing triangular (Figs. 20–21).

Coloration darker than *triangularis* (Figs. 7–10). Head infuscate around eyes. Pronotum broadly infuscate. Discal area appearing lighter. Elytra with light and dark fascia; sutural stripe distinct, extending along basal edge to form basal fascia. Middle dark fascia broad, extending from sutural stripe to the lateral margin, often connected to basal dark fascia, thus breaking the basal yellowish fascia into two isolated spots. Apical dark fascia connected to sutural stripe, sometimes expanded so light fascia between it and middle dark fascia are reduced to restricted lateral spots. Apices of elytra yellowish. Ventral surface orange.

Protarsi not appreciably broadened, with circular cupule at the base of the tarsal segment. Anterior protarsal claw not modified; aedeagus and parameres as in Fig. 11.

Females—Size (N = 38); length = 4.08 (3.67 to 4.36); width = 1.89 (1.69

to 2.05); L/W = 2.15. Similar to males, antennal segments unmodified; ovipositor very similar to that of *trinagularis*.

Type locality.—Winnfield, Louisiana.

Type data.—Fall's 1917 description of *pilatei* was based on a unique male from Winnfield, Louisiana, collected by Mr. G. R. Pilate. The specimen bears the following labels: (1) Winnfield VI-17 La.; (2) TYPE *pilatei* (*pilatei* is handwritten); (3) M.C.Z. Type 23944; (4) H. C. FALL COLLECTION; (5) *Hydroporus pilatei* Fall (handwritten); (6) a handwritten lectotype label with GWW in the lower left corner. The speciment is very teneral.

Range.—Gulf and Atlantic coasts from North Carolina to Texas and north to Tennessee (Fig. 36).

Habitat.—Unlike *triangularis* this species appears to prefer swampier habitats and sluggish streams. Specimens have been collected from dangling roots of marginal shrubs and from submerged vegetation on gently sloping banks. Teneral specimens were collected in June and October.

Summary

Clairville is recognized as the author of *Hydroporus* and the correct type-species is *Hyphidrus pubescens* designated by Guignot (1946). Within Fall's *pulcher-undulatus* group: *Circinoporus* is designated a synonym of *Neoporus*; *Heterosternuta* is recognized as the valid name for *pulcher* group species (type *H. concinnus* = *H. wickhami*); and the name *Neoporus* is applied to all other species except *pilatei* and *triangularis*. A new genus, *Falloporus,* is described for *pilatei* and *triangularis* because these species are phylogenetically out of place in *Hydroporus*. The primary evidence for removal from *Hydroporus* is that the mesosternum and metasternum contact each other in all species groups and subgenera of *Hydroporus,* but do not contact in *Falloporus*. Non-contacting segments is considered apotypic and this indicates *Falloporus* has a more recent common ancestor with other Hydroporini genera than it does with *Hydroporus*.

It was initially suspected that *pilatei* and *triangularis* were actually a single variable species; however, a phenetic analysis (cluster, ordination and discriminant analysis) distinguished two phena. All but one specimen from suspected hybrid zones and all specimens that were *a priori* considered intermediate in appearance were readily classified into two phena by the analysis. Statistical evidence can never prove there are, in fact, two species; however, here it is of sufficient strength that synonymizing *pilatei* and *triangularis* would be unwise.

Falloporus keys to couplet 15 in Leech and Chandler's (1956) Dytiscidae key and may be separated using the following interpolation:

15. Prosternal process not protuberant (Fig. 27); male with fourth or fourth and fifth antennal segments enlarged (Figs. 14–21); male protarsal cupule present (Fig. 32); length greater than 3.3 mm . . . . *Falloporus*

Prosternal process usually protuberant (if not protuberant then length less than 3.3 mm); male with fourth and fifth antennal segments not enlarged and protarsal cupule absent 15a

15a. Hind angles of pronotum rectangular or obtuse. .... (in part) *Hydroporus*

Hind angles of pronotum acute .... (in part) *Deronectes*

Acknowledgments

Hugh Leech's taxonomic and nomenclatural Dytiscidae studies have provided a solid basis for this and other studies. Mr. W. Steiner (Smithsonian Institution) and Drs. F. N. Young (Indiana University), G. Folkerts (Auburn University), W. Hilsenhoff (University of Wisconsin) and P. J. Spangler (Smithsonian Institution) generously loaned specimens. Mr. N. Stone (Museum of Comparative Zoology, Harvard University) arranged for type specimen loans from the H. C. Fall Collection. Technical work involved with specimen preparation for scanning electron microscope use was provided by Ms. Mary Jacque Mann and Mrs. Susan Braden. Dr. Spangler also allowed extensive use of his personal library of Dytiscidae literature. Mr. R. E. Roughley (University of Alberta) and Drs. F. C. Thompson (USDA, Smithsonian Institution) and T. Erwin (Smithsonian Institution) reviewed the manuscript and provided critical, but always helpful and constructive, suggestions.

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Footnote

[1] Portions of this work were completed during graduate study at the University of Tennessee and during a postdoctoral fellowship at the Smithsonian Institution.

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A REVISION OF THE SUBGENUS *HETEROSTERNUTA* STRAND OF *HYDROPORUS* CLAIRVILLE (COLEOPTERA: DYTISCIDAE)[1]

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The nearctic species of the genus *Hydroporus* Clairville were last revised by Fall (1923). Since Fall's 1923 revision there have been several regional treatments (Young, 1954; Leech and Chandler, 1955; Gordon, 1965; Larson, 1975) and several new species have been described in the nearctic fauna. Also, Gordon has revised the *niger-tenebrosus* group (1969). Despite these studies, much remains to be done, including the clarification of species variation in several groups. The description of the larval forms and the development of life history data for most species is still to be completed.

The members of the holarctic genus *Hydroporus* are widespread and occupy a variety of aquatic habitats. They are commonly encountered at the margins of lakes and rivers, are occasionally present in large numbers in woodland pools, are frequently taken from springs, seepage areas, and occasionally from the faster flowing waters of small streams. Several species (*oblitus* group) have been taken from wells and caves.

We believe that the species allied with *pulcher* form a morphologically and ecologically related group which is sufficiently distinct to warrant subgeneric status. Wolfe and Matta (1981) have reviewed the generic and subgeneric synonomies within *Hydroporus* (with the emphasis on names applicable to Fall's (1923) *pulcher-undulatus* group). In that paper Strand's subgenus *Heterosternuta* is recognized for those species which have been known as the *pulcher* group (*sensu* Fall). Here the subgenus and its species are redescribed and a key is provided. Figures of adult color patterns, genitalia and scanning electron micrographs are provided for each species.

Materials and Methods

Extensive collecting for specimens in this subgenus was conducted in the eastern United States and the mid-south to add to the museum material available and to determine habitat preferences. Specimens were collected along margins of streams with a sturdy round or triangular framed dip net.

The most productive areas were gravelly stream margins and isolated gravel bottomed pools of water in drying stream beds. Specimens were found in streams with a substrate of bedrock in the fissures and cracks where gravel and algae accumulated. They are extremely abundant in suitable habitats and occasionally we have collected hundreds of specimens along a few feet of stream margin. Repeated vigorous scraping was often necessary and frequently more specimens were collected after the area had been thoroughly disturbed than in the initial stages of collecting.

Specimens were preserved in 80% alcohol which was changed after several hours. Dissection of genitalia was performed under a binocular microscope with jewelers forceps or a slightly hooked minutin. All drawings were done with an ocular grid and camera lucida.

It is important to observe the structure of the genitalia in alcohol as well as after they are dried and mounted on points. This is expecially true for *Hydroporus laetus* Leech and *H. ouachitus* Matta and Wolfe. When wet the thin bifid tips of the aedeagus bend gently inward; however, when dry the tips flex out (Figs. 36c, 36e). All drawings in this paper are from wet specimens unless otherwise indicated. The cleft bisecting the tip of the aedeagus is often obscured in dorsal view and is best observed ventrally.

Specimens were borrowed from several individuals and museums and we would like to thank the following people for aid in obtaining specimens: Dr. G. A. Schuster (State Biological Survey of Kansas), Dr. L. L. Pechuman (Cornell University), Dr. David Larson (Memorial University of Newfoundland), Dr. Alés Smetana (Biosystematics Research Institute, Canadian National Collection), Dr. K. C. Kim (Forest Entomological Museum, Penn State University), Dr. William Hilsenhoff (University of Wisconsin), Mr. P. Severance (University of Connecticut), Dr. Paul Spangler (National Museum of Natural History), Dr. Frank Young (Indiana University), Dr. W. Brigham (Illinois Natural History Survey) and Dr. L. Herman (American Museum of Natural History). Type material from the H. C. Fall collection was generously loaned from the Museum of Comparative Zoology (Harvard University) and we thank Ms. M. M. Pearce for her assistance. We also wish to thank Mr. Nicholas Stone (Museum of Comparative Zoology) for searching through the LeConte collection for specimens of *H. oppositus*.

We especially appreciate Mr. R. E. Roughley's critical review of the manuscript. His suggestions for change and addition have increased the usefulness of this work.

Technical work involving specimen preparation and scanning electron microscope use was provided by Ms. Mary Jacque Mann and Mrs. Susan Braden.

Subgenus *Heterosternuta* Strand

Diagnosis.—The species of *Heterosternuta* are narrow, elongate oval, brightly maculate species and all possess a distinctly apically bifid aedeagus.

All but two species (*wickhami* and *oppositus*) have at least a portion of the dorsal surface of the aedeagus sclerotized.

Redescription.—Form elongate-oval (almost always twice as long as broad); pronotum and elytra continuous in outline; shining, usually brightly maculate. Head broadest at posterior edge of eye. Front and back margin of eye very shallowly emarginate. A series of coarser punctures by anterior medial edge of eye. Clypeus not thickened; labrum distinctly emarginate, emargination with dense golden cilia. Maxilla four segmented; ultimate segment apically emarginate and approximately equal in length to basal three segments. Labial palpus four segmented; ultimate segment about equal to the combined lengths of second and third segments. Ligula roughly triangular, with a row of short spines along the anterior edge; mentum strongly lobed anteriorly on each side, produced between the labial palps. Antennae usually filiform (median segments expanded in *diversicornis*).

Pronotum broadest at base; basal width a little more than two times the midlength. Lateral bead distinct, approximately equal to width of second antennal segment. Posterolateral pronotal stria not present. Anterolateral corners of pronotum produced, bluntly pointed, posterolateral angles sharp. Prosternum distinctly declivitous (Figs. 41–45); declivity transversely ridged or rugose (Figs. 46, 47); anterior portion sometimes with dense stiff setae. Prosternal process lanceolate; strongly margined laterally; with definite medial ridge; bluntly pointed, apex extending between mesocoxae and touching metasternum.

Elytra widest in basal third or at middle, gradually tapered posteriorly; occasionally basal margins subparallel. In lateral view side margin straight, not ascending at base. Epipleura gradually narrowing, but more strongly, evenly constricted at level of second sternite.

Metasternum sulcate, shallowly in some species. Anterior and posterior edges of metacoxal plates subparallel. Metacoxal lines extending anteriorly to metasternum as thin carinate lines; lines a little divergent anteriorly. Metacoxal process laterally produced, covering base of hind trochanters; medially produced and sinuate on each side, apex recessed.

Metafemora shining, with definite medial line of setatious punctures. Anterior protarsi of male broadened; anterior protarsal claws modified. Usually more strongly bent basally and more sinuate on the inner edge than the posterior claw.

Genitalia symmetrical with parameres broadest at base; tapered posteriorly; aedeagus always deeply bifid.

Type-species.—*Hydroporus wickhami* Zaitzev (=*H. concinnus* LeConte) (Guignot, 1942).

Distribution.—The subgenus, as now defined, is restricted to North America, with most species found east of 97 degrees west longitude.

Taxonomic notes.—There are many species of *Hydroporus* in addition to the members of *Heterosternuta* which are found at the margins of streams; however, none has the aedeagus split dorsoventrally. In our experience species most frequently collected at stream margins and easily confused with the *Heterosternuta* are *H. stratiopunctatus, H. vitiosus* and *H. blanchardi.* Dark specimens of *H. blanchardi* are easily confused with the dark forms of *H. oppositus* but may be distinguished by the absence of prosternal bristles. *H. vitiosus* was originally grouped with the *pulcher-wickhami* group by Fall (1923) but Leech (1949) pointed out the aedeagus is not bifid and *vitiosus* is not a member of this group. *H. vitiosus* may be separated from the *Heterosternuta* on the basis of external characters by the combination of the dark ventral surface and the lack of modified prosternal setae. *H. stratiopunctatus* may be easily separated from all other species by the alternating of deeply impressed elytral punctures and rather fine punctures.

Diagnostic characters.—A brief consolidated overview of diagnostic characters is presented to facilitate use of the key, especially for the non-taxonomic specialist.

Coloration.—The color of the head ranges from yellowish to orangish. Head color differences have only been used to help separate *ohionis* Fall (orangish) from *jenniferae* Wolfe and Matta (yellowish).

The most common pronotal color pattern in *Heterosternuta* consists of an anterior infuscation (usually evenly extended along the entire anterior edge) and a separate, more restricted and variable posterior infuscation. The anterior infuscation is somewhat reduced in *cocheconis* Fall and *diversicornis* Sharp and most reduced in *ouachitus* Matta and Wolfe. In three species (*jeanneae* Wolf and Matta, *sulphurius* Matta and Wolfe and *laetus* Leech) the pronotum is uniformly reddish-brown.

Elytral coloration may only be used to conclusively identify one species, *jeanneae*. In that species there is a large dark sub-medial elytral fascia (Fig. 8). Most other species possess two dark and three light fascia; however, interconnections between dark fascia sometimes obscure the distinctly fasciate appearance (*e.g.* compare Figs. 17–19).

Metasterna, metacoxa and abdominal sterna are usually orangish or yellowish. However, in *oppositus* and *wickhami* ventral coloration tends to be dark blackish-red with medial portions of metacoxae and abdominal sterna usually reddish. The degree of infuscation is more pronounced in *wickhami* than *oppositus*.

Microsculpture.—The reticulation pattern is very conservative, usually appearing as a pentagonal mesh. However, punctation can be a valuable supplement in identification. In *Heterosternuta,* elytral and metacoxal punctures vary from fine and dense (Figs. 48, 61 *pulcher*) to very coarse and sparse (Figs. 59, 70 *folkertsi*). The differences between some species are subtle while differences between others are so extreme that knowledge of that difference can completely eliminate confusion. For example, the metacoxal punctation of *pulcher* is so fine it should not be confused with coarsely punctate species like *cocheconis, folkertsi,* or *ouachitus* (Figs. 52, 59, 50). Differences in elytral punctation are usually similarly useful.

Head.—There are few morphological head characters important in species identification. The clypeus is not thickened and there is a series of coarse punctures at the anterior corner of each eye in all *Heterosternuta.* Antennae are always filiform; however, the broadened medial antennal segments (5 through 8, segment 6 twice as broad as 11) of male *H. diversicornis* (Fig. 25) affords ready identification of that species.

Pronotum.—Pronotal morphology and shape is not generally useful. The pronotal margin is distinctive in *H. oppositus* specimens from the southern portion of its range (southern Virginia and Tennessee), because it is subtly sinuate anteriolaterally.

Prosternum.—The prosternum is always angularly declivitous (Figs. 42–45). The declivity is less pronounced in some species but this variation is too subtle to be useful.

The declivitous portion of the prosternum is ridged (Figs. 46, 47). In most species the ridges are irregular (rugose) (Fig. 46) but in four species (*wickhami, oppositus, diversicornis,* and *jeanneae*) the ridges are transverse and regularly placed (Fig. 47). The characters associated with the declivitous area are consistent but minute.

The most useful, readily observable prosternal character involves the degree of modification of setae on the base of the prosternum, just anterior to the procoxae. In some species prosternal setae are sparse and slender (Fig. 42); in other species prosternal setae are elongate, stiff and thickened (Figs. 43–45). Modified setae are present in *diversicornis, jeanneae, wickhami, oppositus, jenniferae* and *ohionis*; however, the modified setae are less developed in the last two species.

Elytra.—In a few species (*ouachitus, alleghenianus* Matta and Wolfe and *cocheconis*) the basal, lateral, outer edge of each elytron is very slightly concave for about ⅓ its length.

Metacoxae.—Metacoxal characters are not of use in most species; however, there is a distinct pubescence (Figs. 40–41) restricted to the internal lamina on one species, *diversicornis.*

→

Figs. 1–13. Figs. 1, 2. *H. folkertsi,* Jefferson Co., AL. Figs. 3, 4. *H. jenniferae,* Trousdale Co., TN. 5. *H. sulphurius,* Benton Co., AR. Fig. 6. *H. ohionis,* Clarke Co., KY. Fig. 7. *H. ohionis,* Dearborne Co., IN. Fig. 8. *H. jeanneae,* Trousdale Co., TN. Fig. 9. *H. alleghenianus,* Morgan Co., TN. Figs. 10, 11. *H. alleghenianus,* Stewart Co., TN. Fig. 12. *H. ouachitus,* Polk Co., AR. Fig. 13. *H. diversicornis,* Blanco Co., TX.

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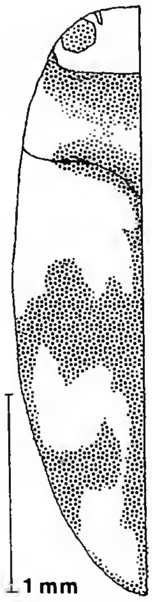

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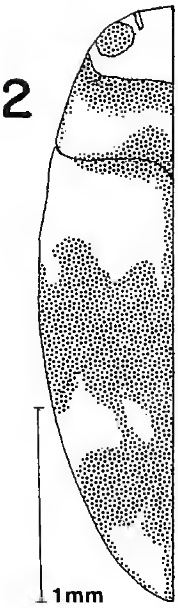

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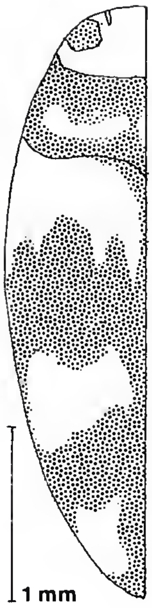

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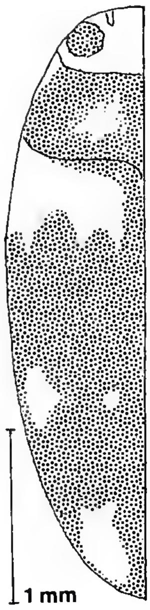

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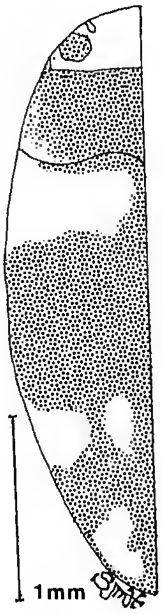

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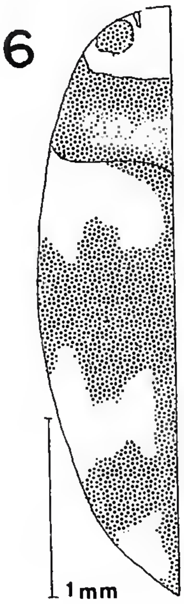

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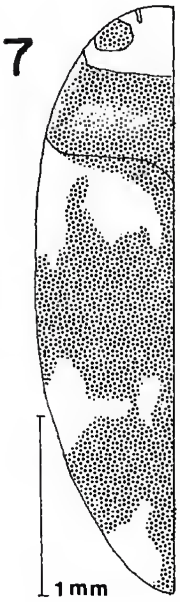

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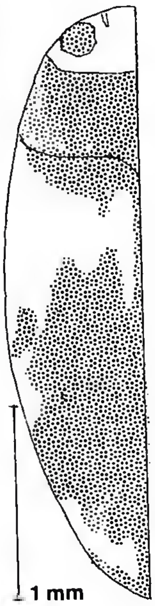

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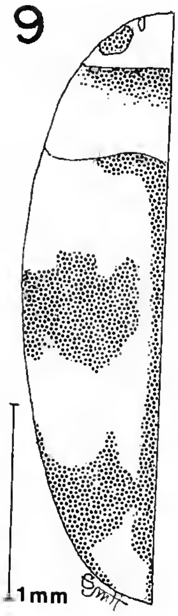

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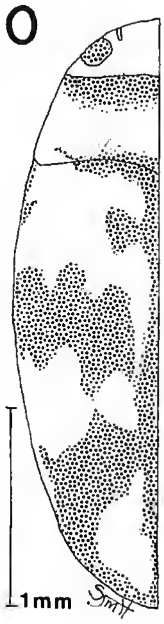

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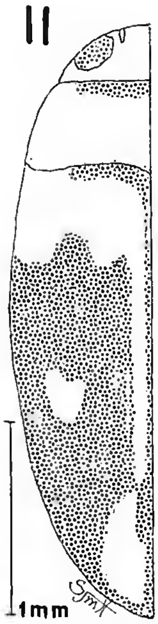

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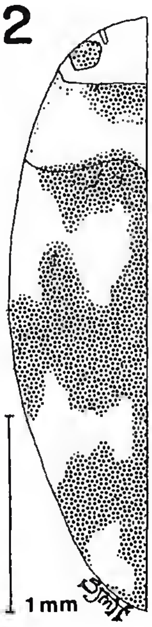

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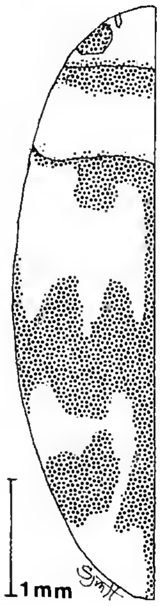

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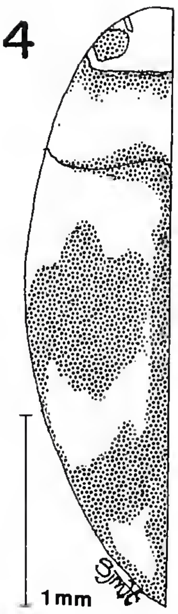

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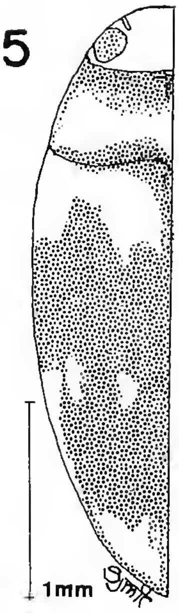

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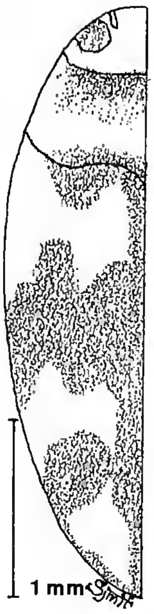

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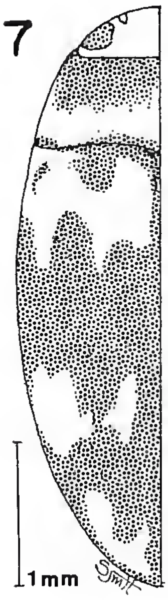

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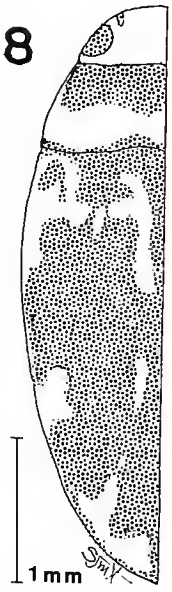

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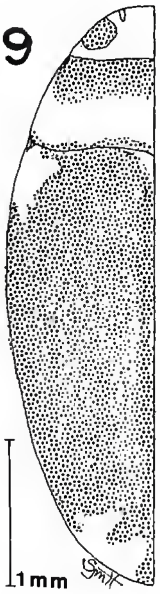

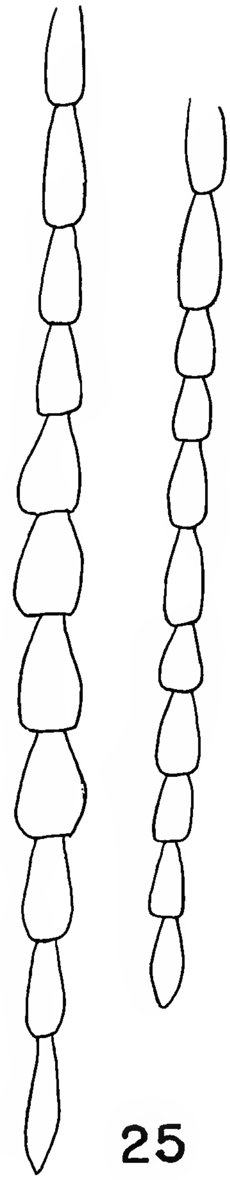

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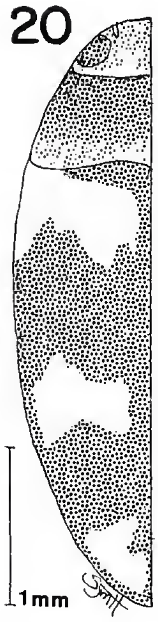

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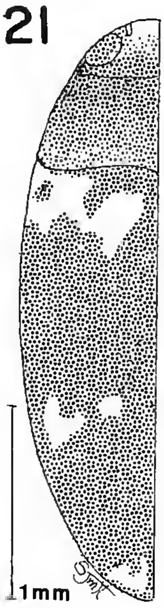

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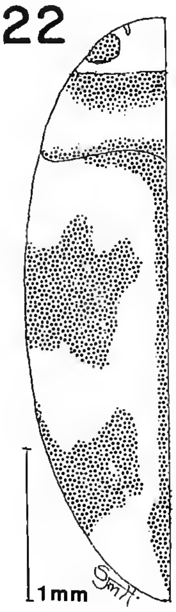

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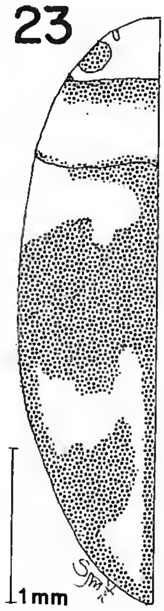

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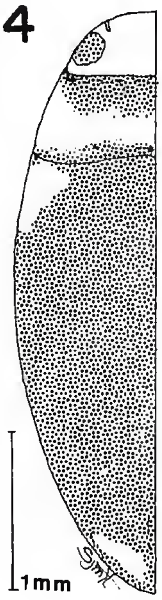


Legs.—Leg morphology is very uniform and not of use in species identification. Secondary sexual characteristics of the protarsus and protarsal claw are discussed below.

Genitalia.—The aedeagus apex is always deeply bifid and this is especially evident in ventral view (Figs. 26–38). In some species there is a distinct subapical ventral projection evident in lateral view (Figs. 30–33, 35); in other species this projection is reduced and appears more as an angular prominence (Figs. 34, 36–38). The subapical ventral projection is absent in four species (Figs. 26–29).

The dorsal aedeagal surface is completely membranous only in *oppositus* and *wickhami*. In all other species at least a portion of the dorsal surface is sclerotized. In most species there is a small sclerotized cross bridge in the posterior dorsal portion of the aedeagus (Figs. 28, 30–37) but in *diversicornis* the entire dorsal surface is sclerotized (Fig. 29).

Length.—Total length is so variable that it is only helpful in separating the smallest species, *alleghenianus,* from other *Heterosternuta.*

Secondary sexual characters.—In some species males are shinier than females. In most *Heterosternuta* the protarsi are broadened and the anterior protarsal claw is more strongly bent basally and at least vaguely sinuate on the inner side. Protarsal modifications are least pronounced in *folkertsi* and *cocheconis* and most pronounced in *jeanneae* (Fig. 39f) and some *oppositus* (from southern Virginia and Tennessee).

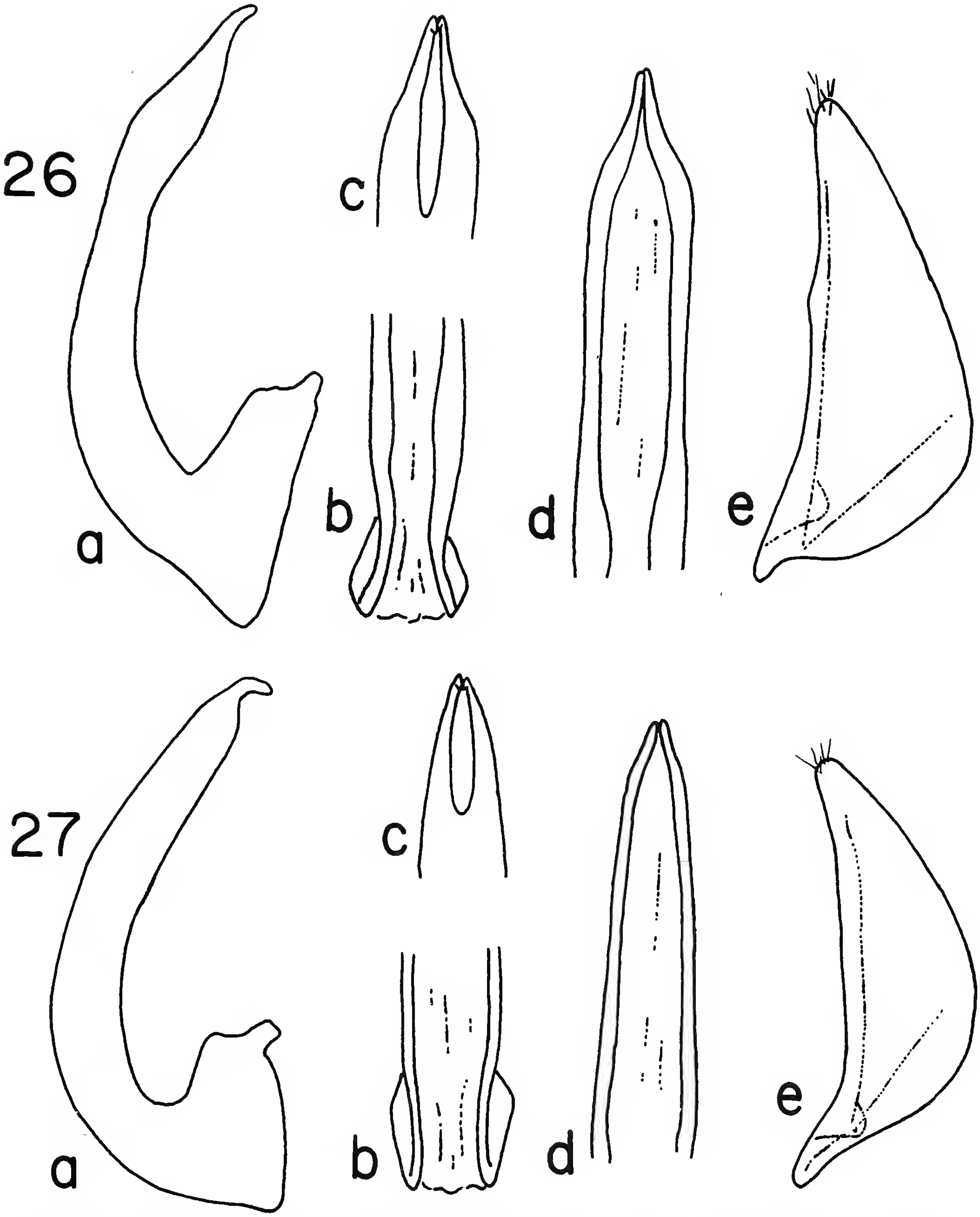
The modified antennal segments in *diversicornis* were discussed above. Additionally, the pubescence of the metacoxae of *diversicornis* is denser in males (Fig. 40) than in females (Fig. 41).

A Key to the Species of Subgenus *Heterosternuta* Strand

1. Prosternum with dense tufts of thickened setae anterior to the coxae (Figs. 43–44) 2
   Without modified prosternal setae (Fig. 42) 7
2. With the area between the coxal lines densely pubescent (Figs. 40–41); male with middle antennal segments (5–8) broadened and flattened, 6th segment twice as broad as 11th) (Fig. 24) .... *diversicornis*

←

Figs. 14–25. Fig. 14. *H. cocheconis,* Cambria Co., TN. Fig. 15. *H. cocheconis,* Tolland Co., CT. Fig. 16. *H. wickhami,* Bledsoe Co., TN. Fig. 17. *H. oppositus* Grundy Co., TN. Fig. 18. *H. oppositus,* Frederick Co., VA. Fig. 19. *H. oppositus,* Benton Co., VT. Fig. 20. *H. laetus,* Trimble Co., KY; Fig. 21. *H. laetus,* Macon Co., TN; Fig. 22. *H. pulcher,* Ross Co., OH. Fig. 23. *H. pulcher,* DeKalb Co., TN. Fig. 24. *H. pulcher,* E. Varick, NY. Fig. 25. *H. diversicornis,* antennae (male right, female left).



Figs. 26, 27. Fig. 26. *H. oppositus*. Fig. 27. *H. wickhami*. a, aedeagus, lateral view; b, posterodorsal view (note absence of sclerotized cross bridge, see Fig. 28); c, ventral apex; d, dorsal view; e, paramere, lateral view.

→

Figs. 28–29. Fig. 28. *H. jeanneae*; a, lateral view of aedeagus (arrow indicates posterolateral pustules); b, posterodorsal view (arrow indicates sclerotized cross bridge); c, ventral apical view of aedeagus; d, dorsal view of aedeagus; e, paramere, lateral view. Fig. 29. *H.*

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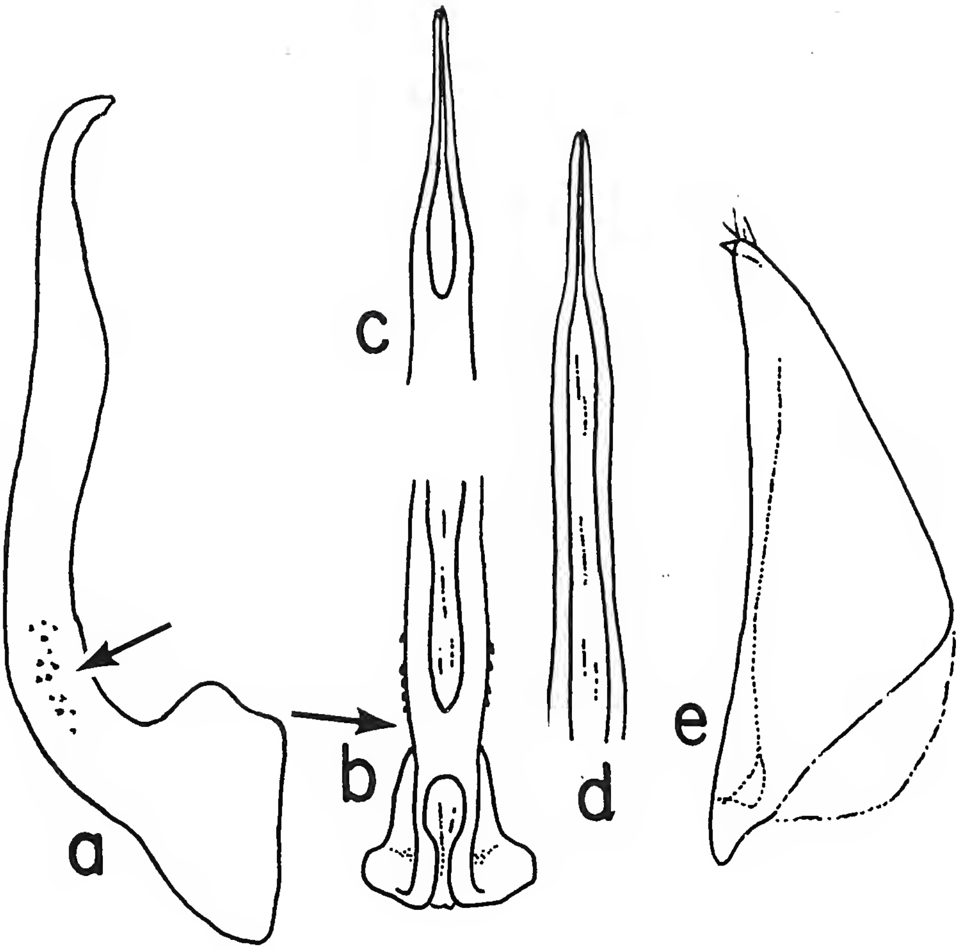

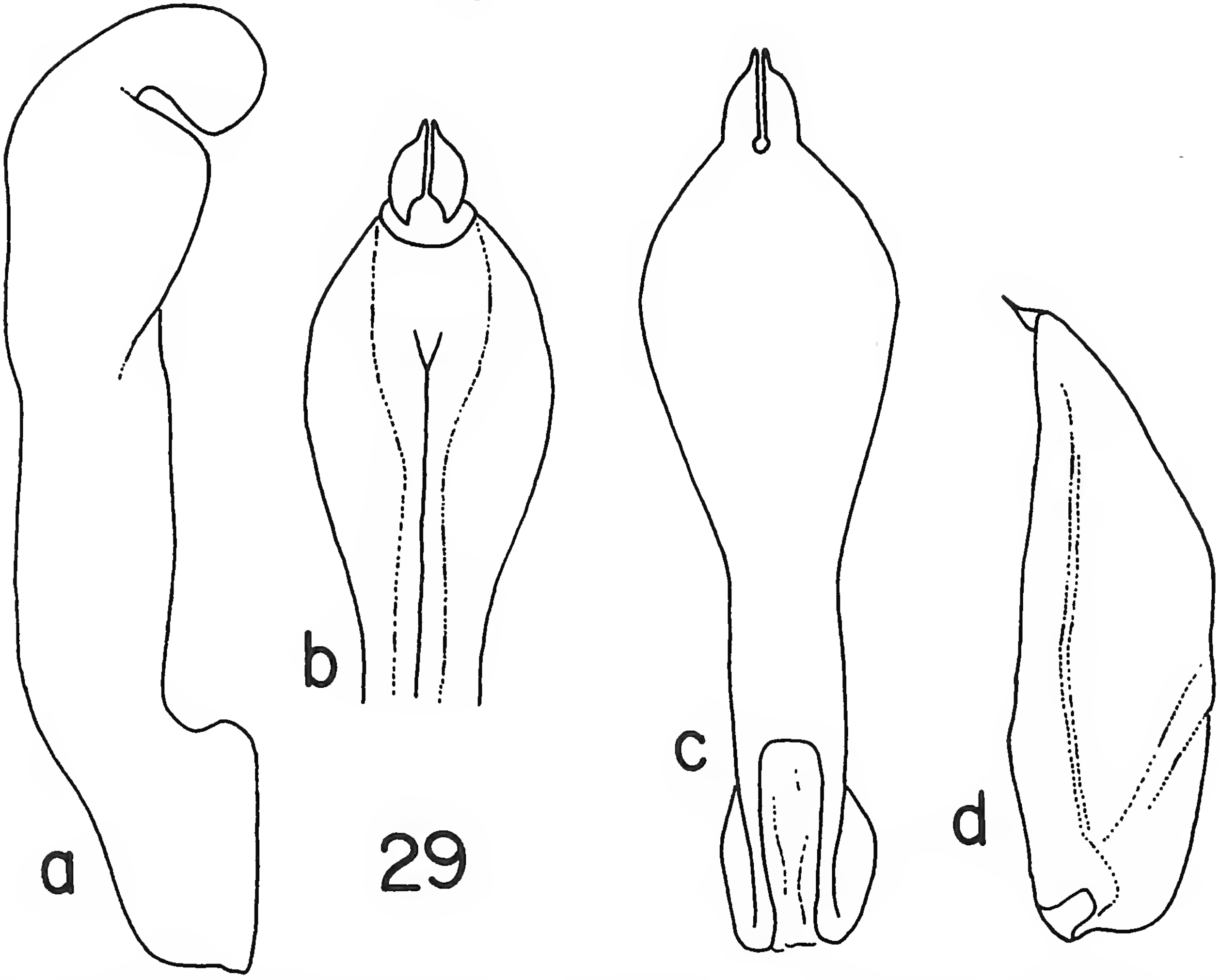

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diversicornis; a, aedeagus, lateral view; b, aedeagus, ventral apical view; c, aedeagus, dorsal view; d, paramere, lateral view.

The area between the coxal lines not pubescent; male with middle antennal segments (5–8) not broadened (6th segment equal or slightly wider than 11th) 3

3. Pronotum uniformly reddish-brown; elytron with a pale basal fascia and a long posterior dark brown fascia (Fig. 8). Aedeagus posterolaterally with minute denticles (Fig. 28a); apex elongate, gently tapering .... *jeanneae*

Pronotum with some pale fascia; elytron not as above, usually with 2 dark and 3 light fascia 4

4. Aedeagus with a posterior sclerotized bridge (Fig. 28b); metacoxal punctation coarse (Figs. 57–58); ventral surface yellowish or orangish 5

Aedeagus without a posterior sclerotized bridge (Figs. 26–27); metacoxal punctation finer (Figs. 54–55); usually with extensive darkening of the ventral surface, at least laterally 6

5. Length 3.3 mm or less; head more orangish or reddish; aedeagus as in Fig. 32 .... *ohionis*

Length usually greater than 3.3 mm; head rather yellowish; adeagus as in Fig. 31 .... *jenniferae*

6. Ventrally more blackish, elytral (Fig. 62) and metacoxal (Fig. 54) punctation just perceptibly finer. Best separated from *oppositus* by the shape of the aedeagus (Fig. 27a) which is more distinctly deflected ventrally at the apex .... *wickhami*

Ventral surface reddish, at least medially; elytral (Fig. 63) and metacoxal (Fig. 55) punctation a little coarser; aedeagus (Fig. 26a) more elongate, not as distinctly deflected at apex .. *oppositus*

7. Length less than 3.1 mm, usually less than 3.0 mm; aedeagus with a distinct ventral projection (Fig. 30a) .... *alleghenianus*

Length usually greater than 3.1 mm, if less than 3.1 mm and aedeagus with a ventral projection then pronotum completely infuscate 8

8. Pronotum uniformly reddish brown (Figs. 5, 20–21) or with yellow markings reduced to very small spots 9

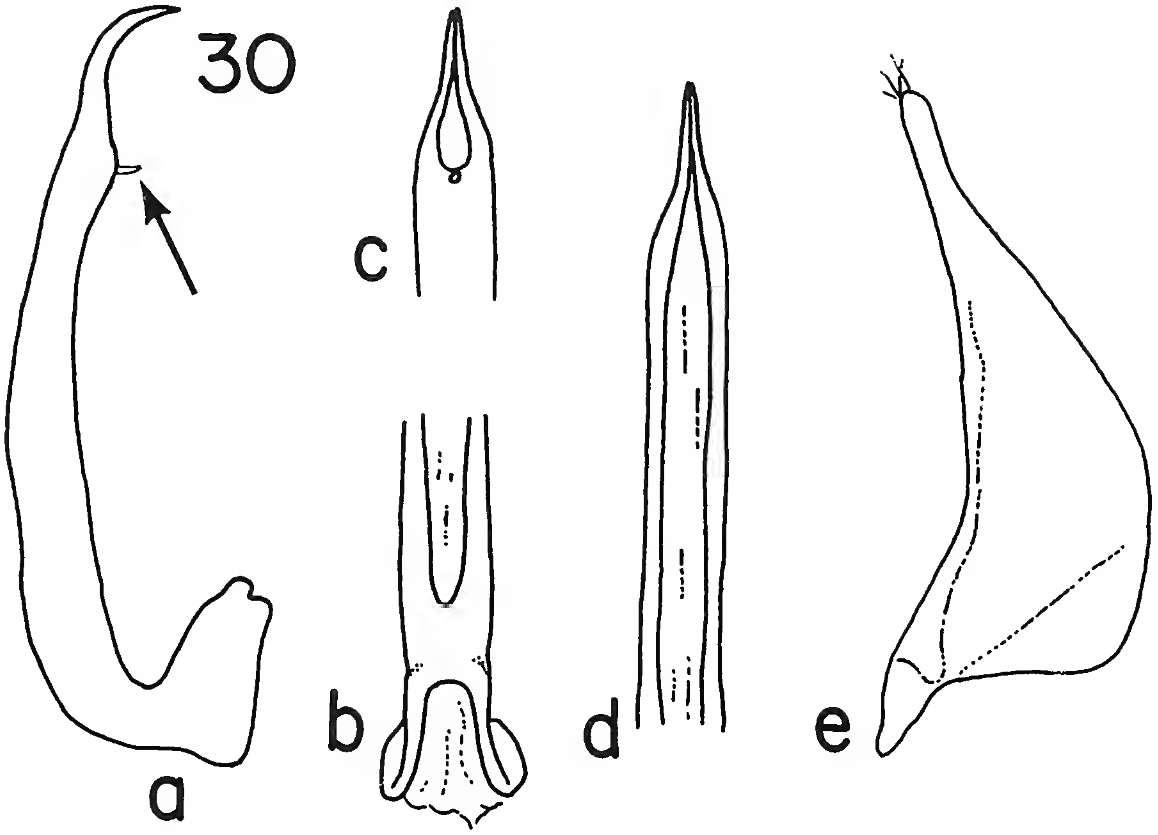
Pronotum with transverse anterior and posterior infuscation, disc yellow (Figs. 9–13) 10

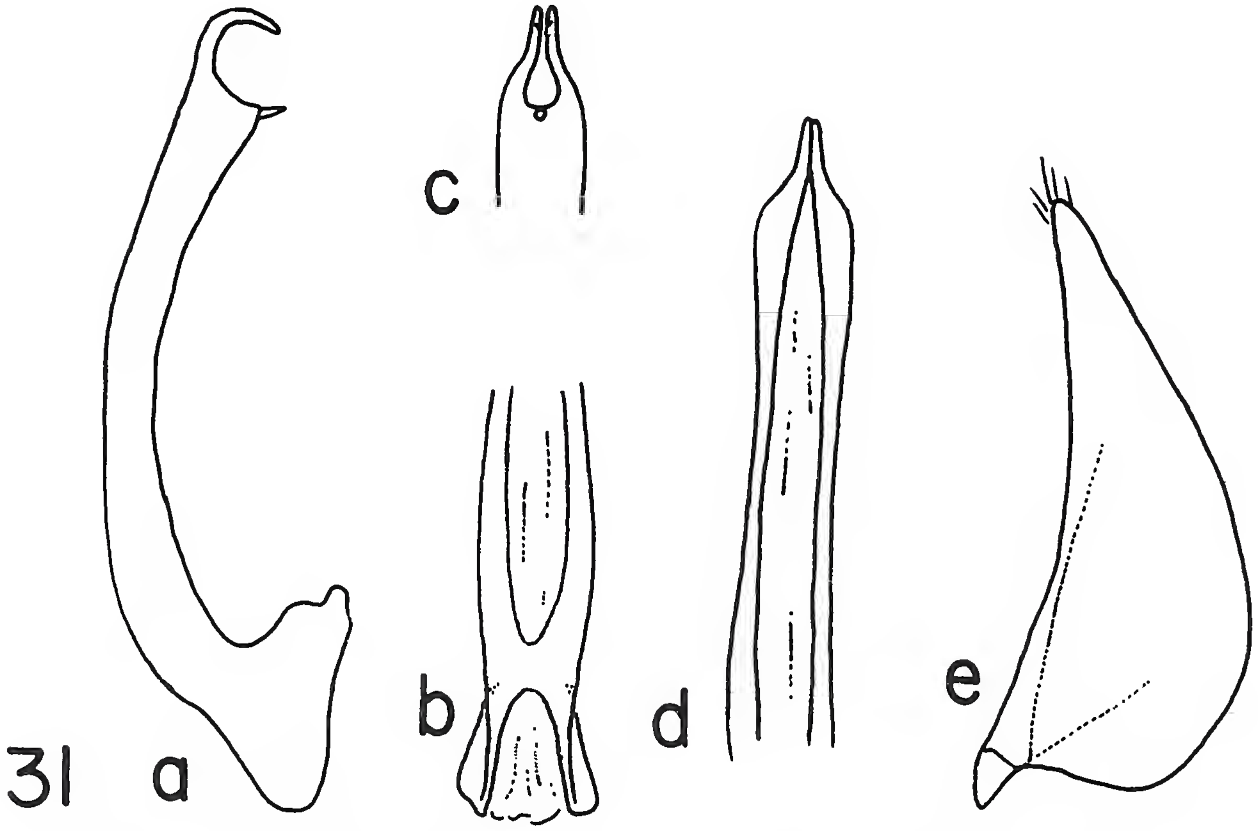
9. Aedeagus apex extremely acute in dorsal view, with a distinct ventral projection (Fig. 30) .... *sulphurius*

Aedeagus apex not very acute in dorsal view, without a ventral projection (Fig. 36) .... *laetus*

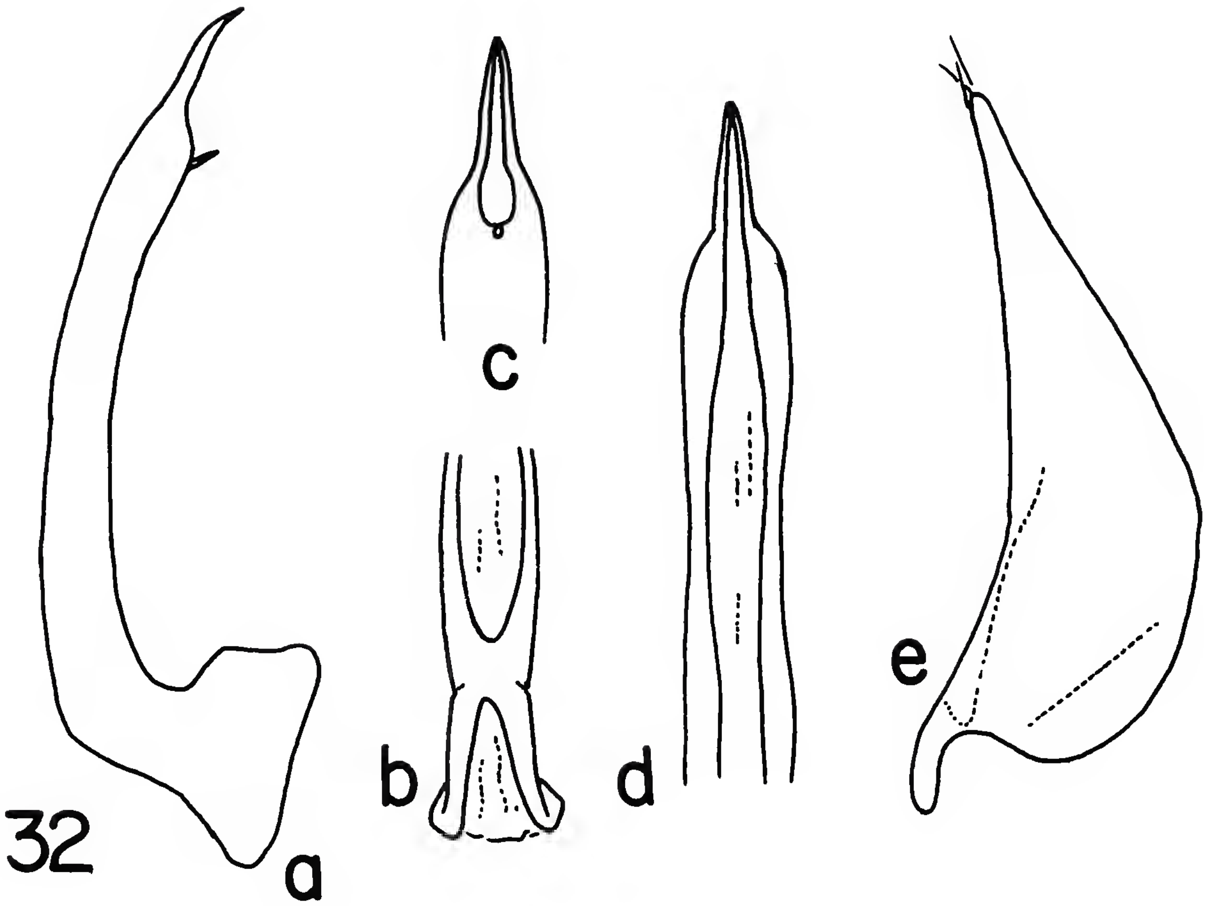
10. Metacoxal punctation very distinctly fine and dense (Fig. 48); aedeagus broadly flattened at apex (Fig. 38) .... *pulcher*

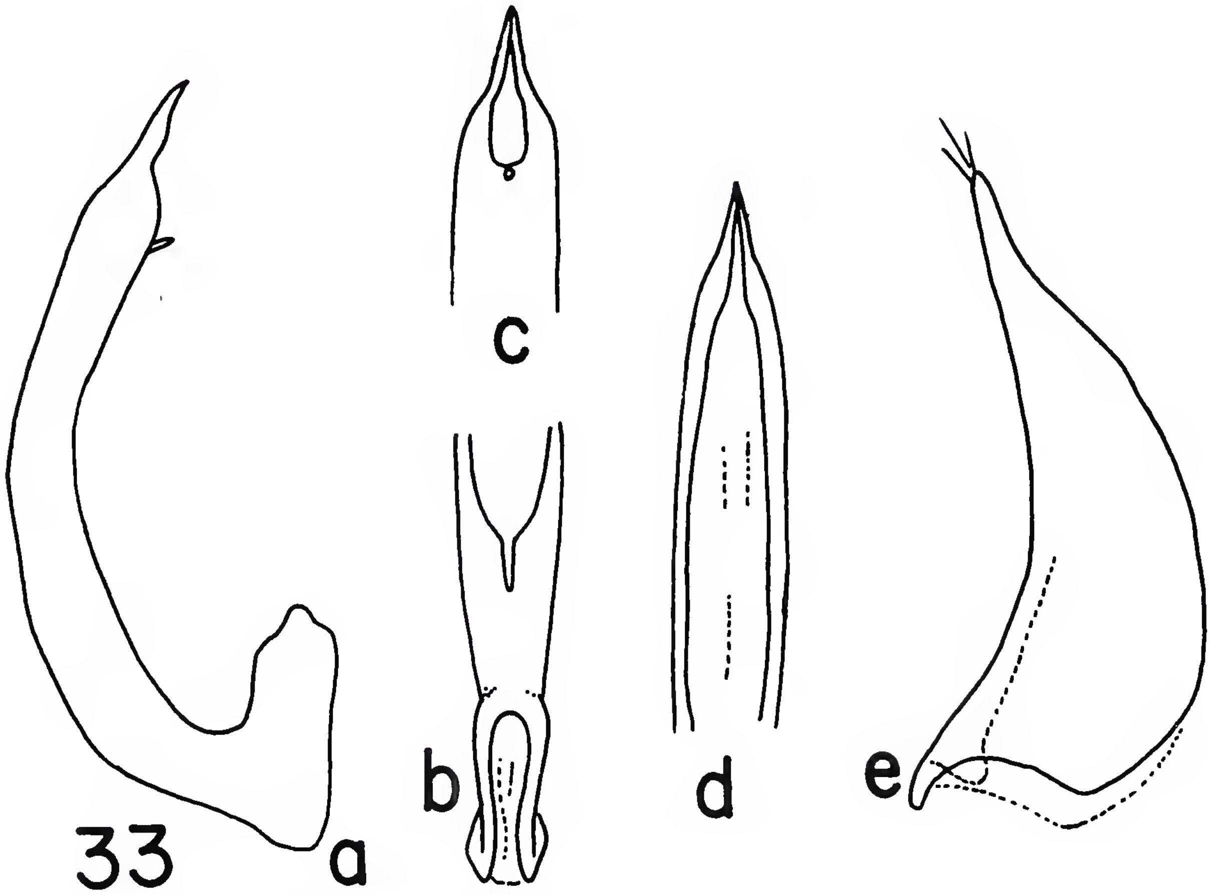
Metacoxa more coarsely punctate (Figs. 50, 52, 59), not appearing smooth 11



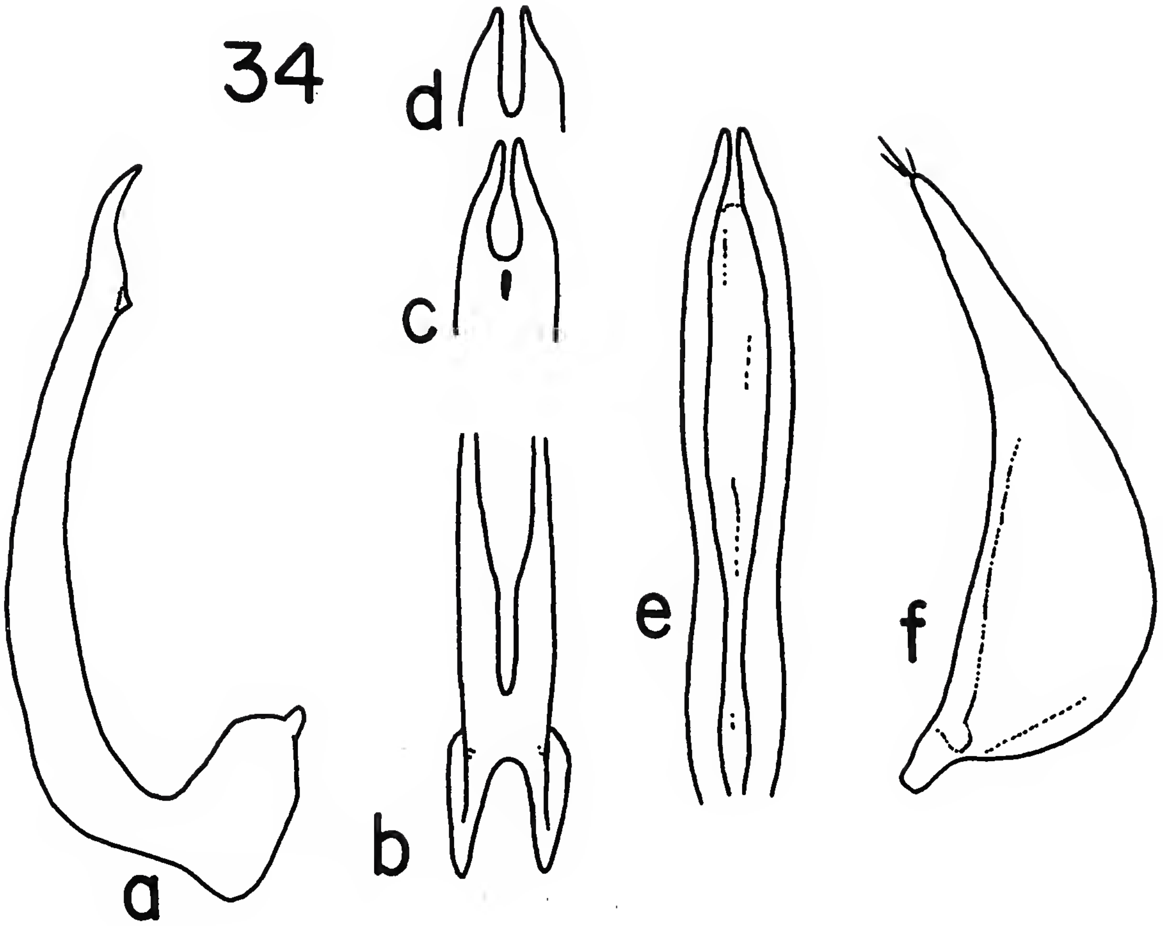


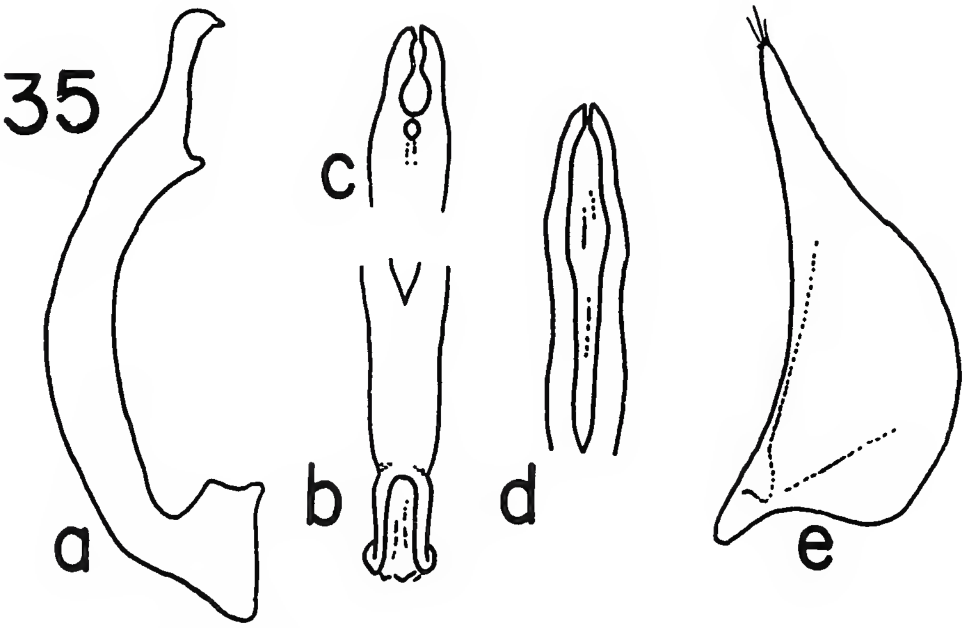
Figs. 30, 31. Fig. 30. *H. sulphurius*. Fig. 31. *H. jenniferae*. a, aedeagus, lateral view (arrow indicates ventral subapical prong); b, aedeagus, posterodorsal view; c, aedeagus, ventral apical view; d, aedeagus, dorsal view; e, paramere, lateral view.





Figs. 32, 33. Fig. 32. *H. ohionis*. Fig. 33. *H. folkertsi*. a, aedeagus, lateral view; b, aedeagus, posterodorsal view; c, aedeagus, ventral apical view; d, aedeagus, dorsal view; e, paramere, lateral view.





Figs. 34–35. Fig. 34. *H. cocheconis*; a, aedeagus, lateral; b, aedeagus, posterodorsal; c, d, aedeagus, ventral apical (bifurcate tips showing variation); e, aedeagus, dorsal; f, paramere, lateral. Fig. 35. *H. alleghenianus*; a, aedeagus, lateral (arrow indicates ventral subapical prong); b, aedeagus, posterodorsal; c, aedeagus, ventral apical; d, aedeagus, dorsal; e, paramere, lateral.

11. Aedeagus as in Fig. 34; size variable but usually greater than 3.3 mm; northeastern U.S. and Canada .... *cocheconis*
    Aedeagus not as above; size usually less than 3.3 mm; not in northeastern U.S. 12
12. Aedeagus as in Fig. 33; presently known from Alabama .... *folkertsi*
    Aedeagus as in Fig. 37; presently known from the Ozark province .... *ouachitus*

Hydroporus alleghenianus Matta and Wolfe

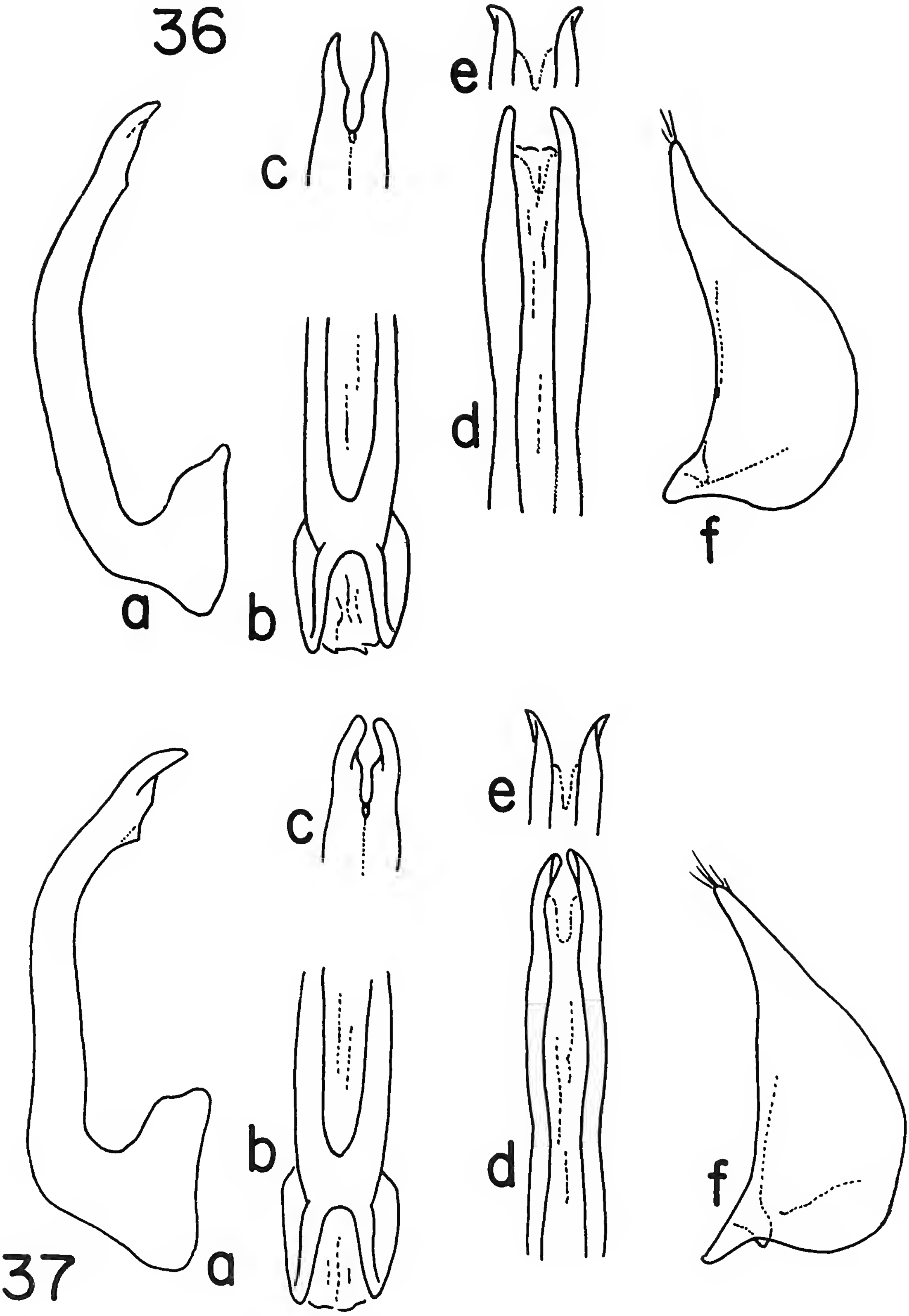
Hydroporus alleghenianus Matta and Wolfe 1979:291.

This is the smallest species in the *pulcher* group with an average size of less than 3 mm. Small specimens of several species approach this size, but may always be separated on the basis of the male genitalia. The species is quite uniform in size throughout its range; however, some specimens from the western portions of its range have the medial and apical fascia broadly coalesced.

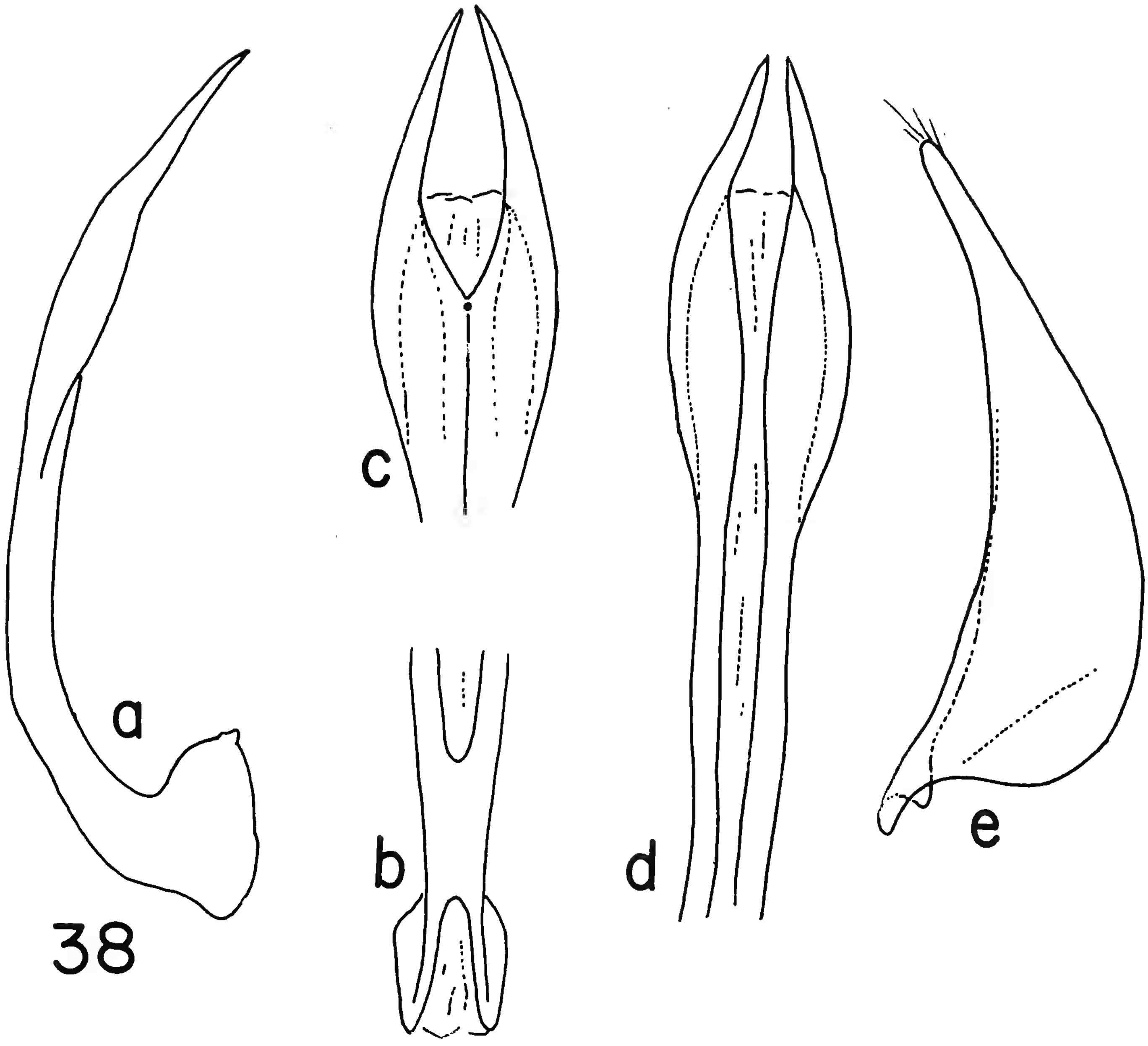
Description.—Length 2.6 to 3.1 mm; width 1.2 to 1.5 mm. Form elongate oval, sides of elytra subparallel, widest at middle, elytra and pronotum almost continuous in outline, however basal lateral elytral edges very slightly concave. Lateral margins of pronotum evenly rounded inward toward the anterior angles, lateral bead distinct, gradually broader anteriorly, at maximum width a little less than the width of the second antennal segment. Prosternal prominence angular, not protuberant, file area rugose, prosternal process lanceolate, bluntly pointed, modified prosternal setae absent.

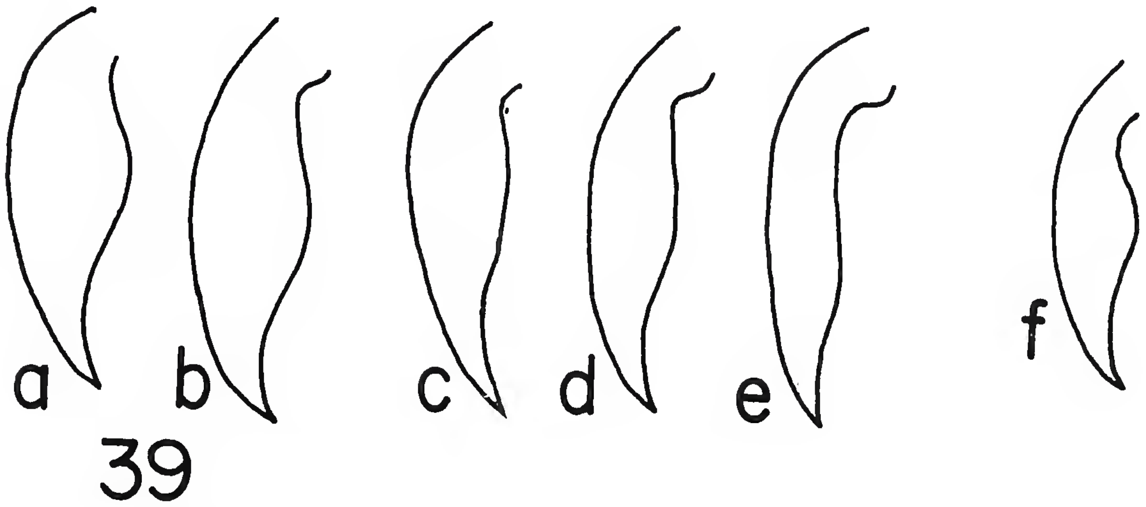
Rather shining dorsally, a little alutaceous. Head pale yellow; pronotum with broad blackish band along anterior margin, basal infuscation very narrow, sometimes scarcely evident, discal and lateral areas pale yellow. Elytra with yellow and brownish-black fascia (Figs. 9–11). Sutural stripe usually distinct and extending narrowly laterally up to one half the basal width. Medial fascia broad, undulating, sometimes isolated from the sutural stripe; basal and medial fascia not connected. Apical fascia smaller, also occasionally isolated from the sutural stripe, apical and medial fascia usually separate; however, some specimens have broadly coalesced apical and medial fascia, usually isolated from the sutural stripe.

Dorsal surface with evident microreticulation. Head randomly, finely punctate, punctures usually separated by 1 to 3 times puncture width; finer anteriorly, densest in shallow depressions. Pronotal punctures a little coarser, usually separated by 1 to 2 times puncture width, somewhat denser paralleling the anterior margin. Elytral punctation fine, somewhat sparse, punctures separated by about 2 puncture widths (Fig. 65). Ventrally metacoxal punctures coarse, somewhat sparse (Fig. 49). Metasternal punctures

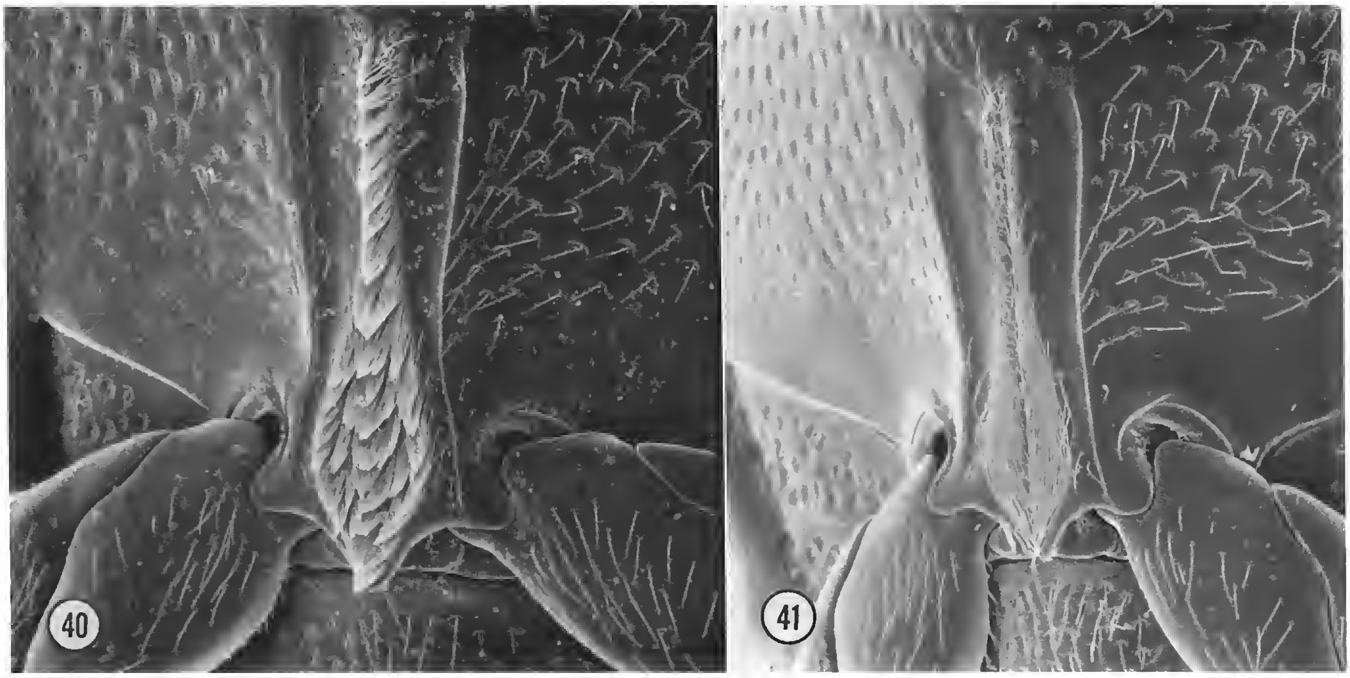


Figs. 36, 37. Fig. 36. *H. laetus*. Fig. 37. *H. ouachitus*. a, aedeagus, lateral; b, aedeagus, posterodorsal; c, aedeagus, ventral apical; d, aedeagus, dorsal (wet); e, aedeagus, dorsal apex (dry); f, paramere, lateral.





Figs. 38–39. Fig. 38. *H. pulcher*; a, aedeagus, lateral view; b, aedeagus, posterodorsal; c, aedeagus, ventral apical; d, aedeagus, dorsal; e, paramere, lateral. Fig. 39. a–e, *H. oppositus*; anterior protarsal claw of male; a, Grundy Co., TN; b, Grainger Co., TN; c, Frederick Co., VA; d, Belfrage, PA; e, Benton Co., VT; f, *H. jeanneae,* Trousdale Co., TN.



Figs. 40, 41. *H. diversicornis* metacoxae (96×). Fig. 40. Male; Fig. 41. Female.

a little coarser, finer medially. Abdominal sternum 1 and anterior half on sternum 2 coarser, rest of abdomen finer.

Male protarsi and anterior protarsal claw scarcely modified. Aedeagus with subapical ventral projection peg-like (Fig. 34).

Females are similar to males. No external sexual characters are evident.

Larvae.—Unknown.

Type data.—The holotype and allotype are from Bath Co., VA, collected by J. F. Matta on VIII-9-73. They are deposited in the collection of J. F. Matta but have NMNH type number 75967.

Range.—Indiana, Ohio, Illinois, Virginia, Kentucky, North Carolina, Tennessee (Fig. 74).

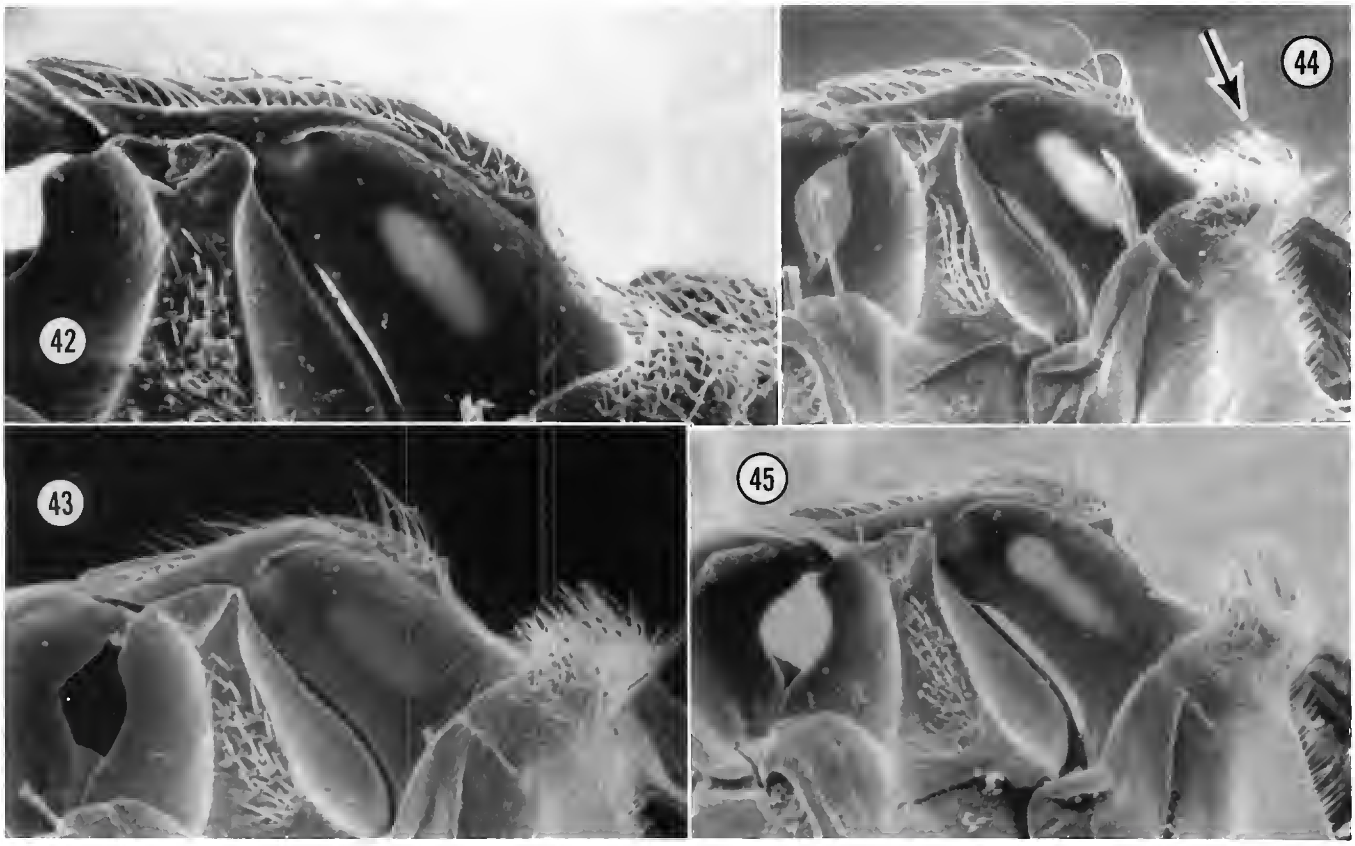
Natural history.—Teneral specimens were collected in August. This species is found in marginal pools of streams with pebble substrate and leaf litter. Large collections have been obtained from very small (possibly intermittent) streams. While some specimens have been collected from the stream itself most were found in small coves or isolated pockets of water less than 0.5 meters wide.

Hydroporus cocheconis Fall

Hydroporus cocheconis Fall 1917:171.

This species may be separated from other *Heterosternuta* by the absence of prosternal setae, the coarse punctation of the ventral surface (Fig. 52) and the distribution (northeastern U.S. and Canada).

Description.—Length 3.0 to 3.7 mm; width 1.4 to 1.8 mm. Form elongate oval, widest at middle; elytra almost parallel sided for the basal half, very



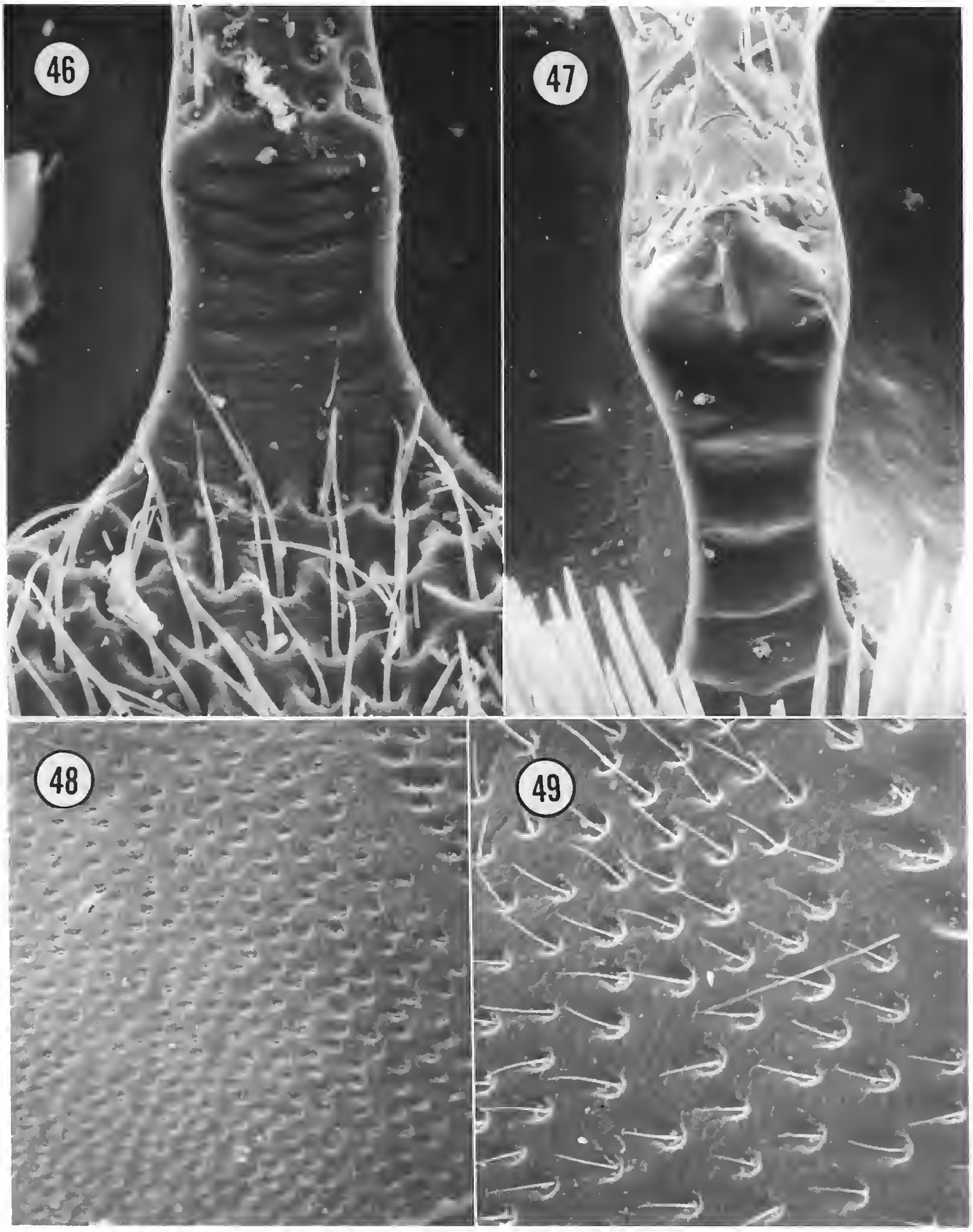
Figs. 42–45. Prosternum and prosternal process, legs and head removed. Fig. 42. *H. pulcher* (180×). Fig. 43. *H. ohionis* (114×). Fig. 44. *H. jenniferae* (123×) (arrow points to prosternal bristles). Fig. 45. *H. wickhami* (132×).

slightly concave in basal third; edges of elytron and pronotum continuous in outline. Lateral margins of pronotum evenly rounded toward anterior angle and with well defined lateral bead which widens anteriorly; at widest point about the width of fourth antennal segment. Prosternal prominence angular but not distinctly protuberant, file not pronounced; modified prosternal setae absent; prosternal process broadly lanceolate, blunt at tip.

Strongly shining dorsally, head pale yellow with light brown mottling which is darkest posterior to eyes. Antennae brown with the last segment infuscate. Pronotum with an even broad dark band on the anterior margin which does not extend to the side margins. Elytra (Figs. 14, 15) with sutural stripe distinct. Middle and apical spots narrowly connected to each other and broadly connected to the sutural stripe. Ventral surface yellow-brown, legs slightly darker.

Dorsal surface with reticulation fine and weak, especially on the elytra. Punctation of head very fine; pronotal and elytral (Fig. 64) punctation larger, punctures separated by as much as a puncture width (Fig. 64). Ventral punctation coarser; metasternal and metacoxal punctures quite large and separated by less than ½ a puncture width (Fig. 52). Abdominal sternum 1 and anterior portion of 2 coarsely punctate; rest of abdomen finely punctate.

Male protarsi slightly broader than female, with anterior protarsal claw



Figs. 46–49. Fig. 46. *H. ouachitus,* rugose prosternal declivity (400×). Fig. 47. *H. jeanneae,* transversely ridged prosternal declivity (384×). Fig. 48. *H. pulcher,* metacoxal punctation (150×). Fig. 49. *H. alleghenianus,* metacoxal punctation.

bent at base and slightly broadened on inner margin. Aedeagus and parameres as in Fig. 34.

Variation.—Specimens from Connecticut are smaller than average and are strongly marked with the darker markings appearing almost black.

Larvae.—Unknown.

Type data.—Fall (1917) never designated a holotype but stated that he had a series of specimens from the Cocheco River at Farmington, New

Hampshire, which were taken in July and August. The type series is in the MCZ and there are 8 specimens collected in July and August 1900 and 1 specimen collected in August 1902.

One male bears a type label with the number 23919; however, the genitalia of this specimen are apparently lost. Since there has never been a published type designation we have designated another male specimen as the lectotype and all other syntypes as paralectotypes.

Range.—The northeast; Quebec, New Hampshire, Vermont, New York and Connecticut (Fig. 75).

Natural history.—This species is typically found at gravelly margins of smaller streams in areas protected from the current, or in overhanging vegetation.

Hydroporus diversicornis Sharp

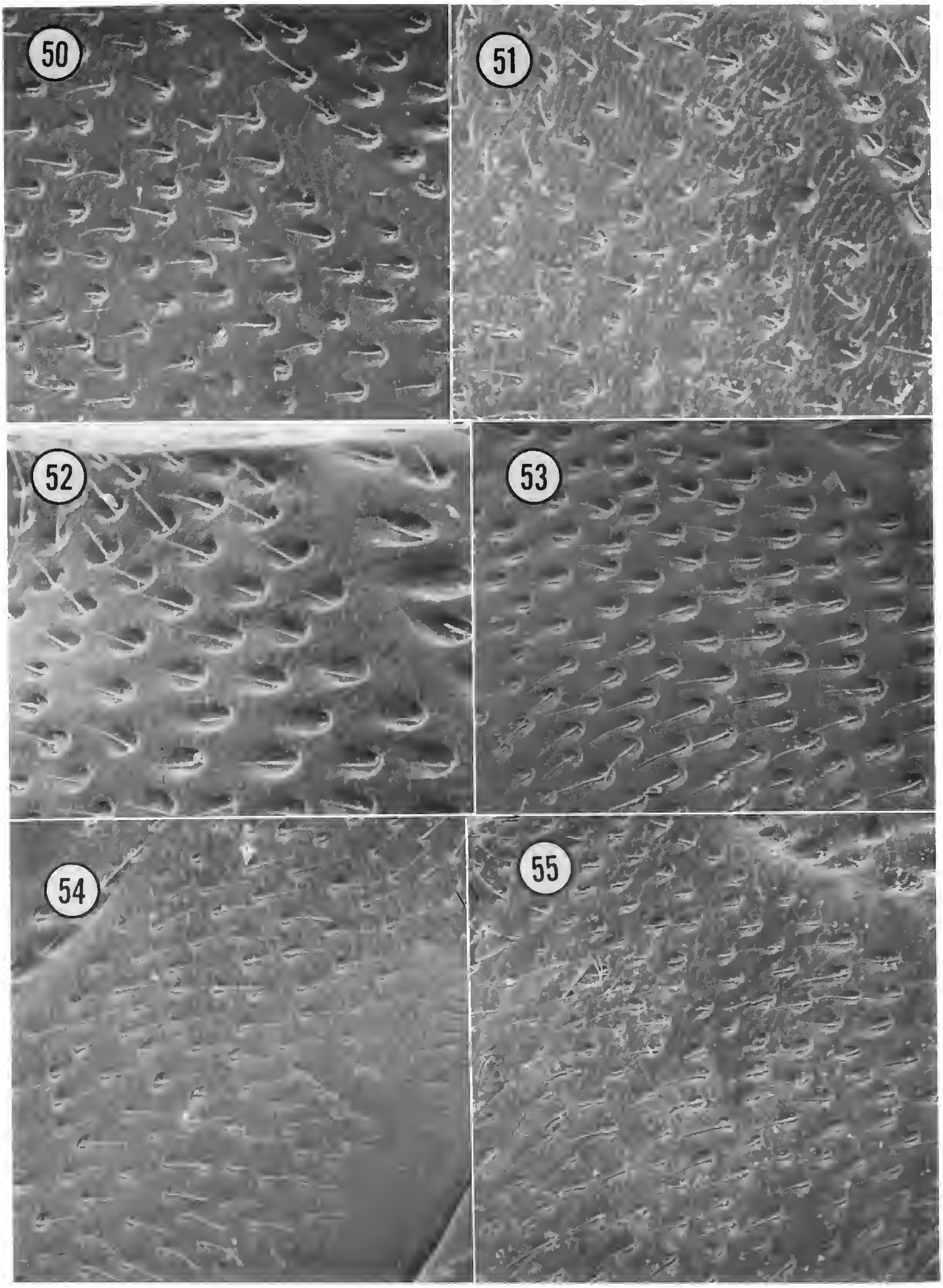
Hydroporus diversicornis Sharp 1882:437.

This is the most easily recognized of all of *Heterosternuta* because of the densely pubescent area (Figs. 40, 41) between the coxal lines in both sexes and the modified male antennae (Fig. 25). It also has dense, modified prosternal setae. This species has not previously been included in the *pulcher* group but is included in the subgenus on the basis of the following characteristics: 1; the length to width ratio is 2.0 in most specimens; 2; the unmodified clypeus; 3; the aedeagus is highly modified and atypical of the subgenus but is split at the tip; 4; finally prosternal bristles are present and this character has been found only within this subgenus.

Description.—Length 4.2 to 4.6 mm; width 2.15 to 2.3 mm. Form elongate oval, elytra parallel sided in basal half; elytra and pronotum continuous in outline, pronotal margin evenly curved towards anterior angles; with a flattened lateral bead which gradually widens anteriorly; at widest point about equal to width of last antennal segment. Modified prosternal setae distinct; prosternal process protuberant; with a distinct anterior file; process lanceolate posterior to procoxae.

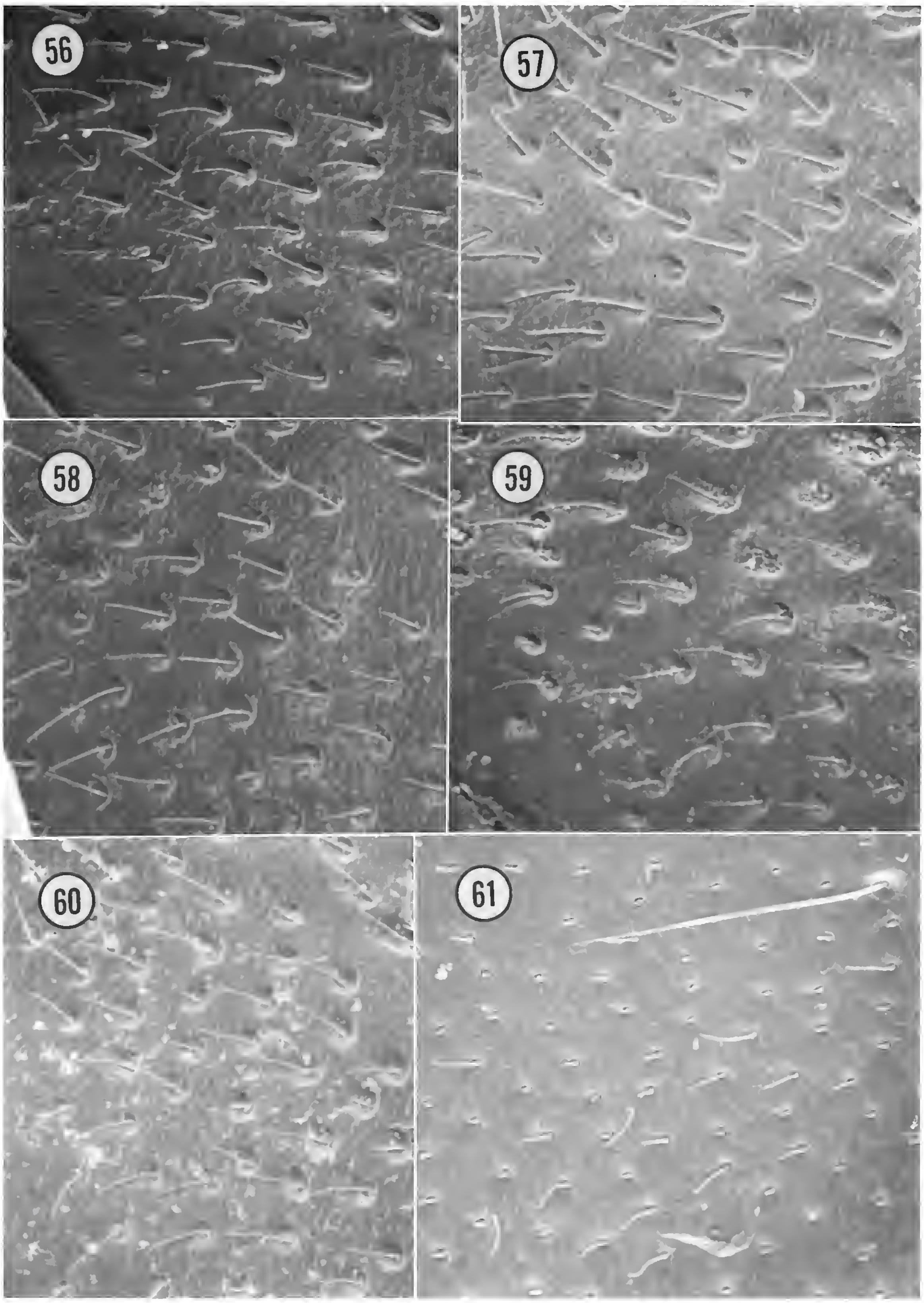
Strongly shining dorsally. Head, including antennae, and pronotum rufotestaceous; pronotum with an infuscation on the anterior margin which extends no more than ½ of the distance to the lateral margin. Posterior margin with a narrow brown border. Elytra flavotestaceous with brown markings. Sutural stripe reduced to a narrow dark line bordering the suture. Dark markings consisting of a strongly undulating medial fascia which reaches the suture, a postmedain spot and postapical fascia which is usually connected along the suture to the medial fascia. Ventral surface rufotestaceous, somewhat lighter on the abdominal sterna.

Dorsal surface finely alutaceous, markedly so on the pronotum. Punctures



Figs. 50–55. Metacoxal punctation. Fig. 50. *H. ouachitus* (150×). Fig. 51. *H. laetus* (150×). Fig. 52. *H. cocheconis* (150×). Fig. 53. *H. diversicornis* (150×). Fig. 54. *H. wickhami* (150×). Fig. 55. *H. oppositus* (123×).

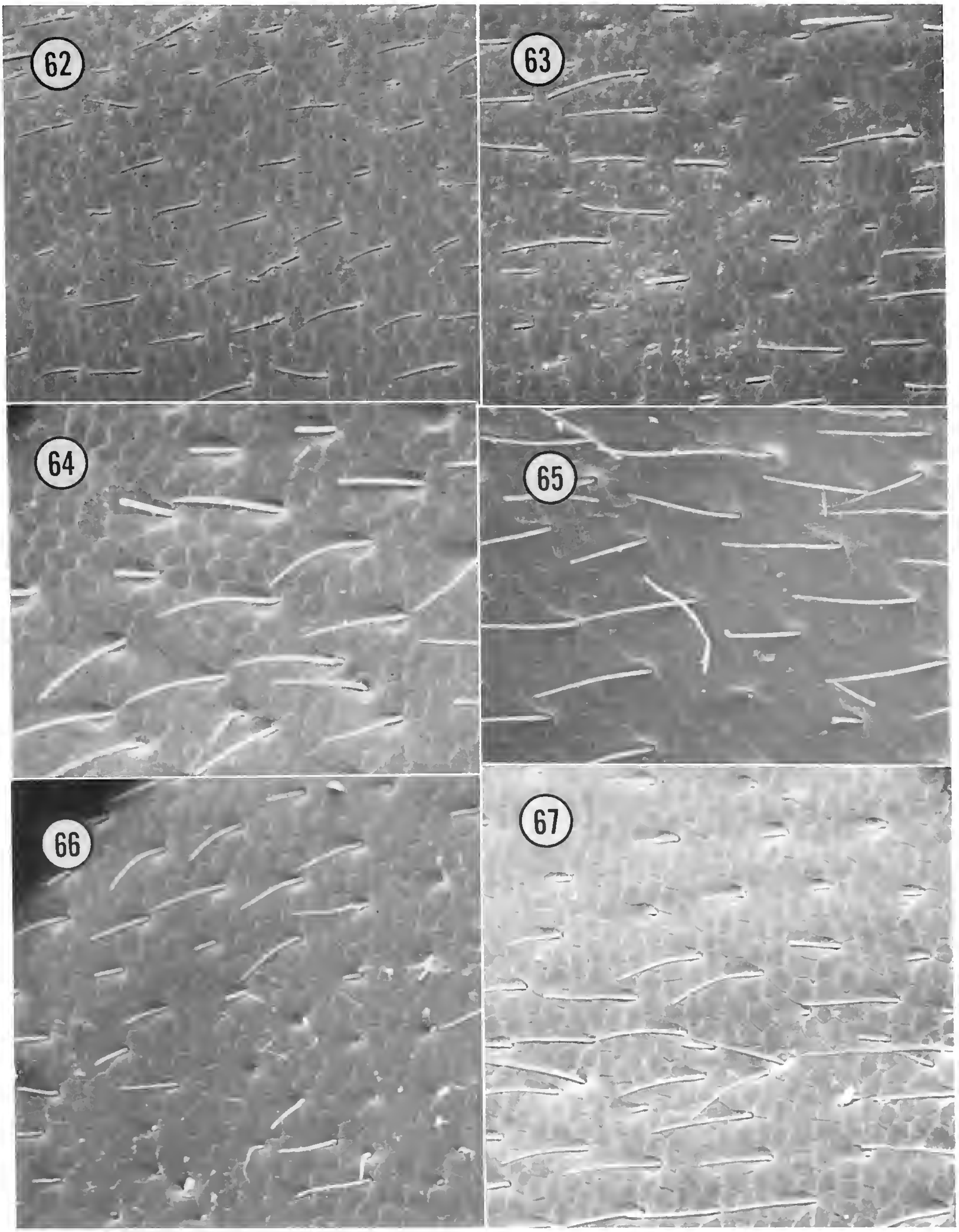
of head fine and sparse; pronotal punctation coarser and denser, punctures separated by up to 1 puncture width. Punctation of elytra (Fig. 72) about the same size as pronotal punctation but more densely applied; separated by ½ a puncture width or less. Ventral surface with punctures of metaster-



Figs. 56–61. Metacoxal punctation. Fig. 56. *H. sulphurius* (150×). Fig. 57. *H. jenniferae* (150×). Fig. 58. *H. ohionis* (150×). Fig. 59. *H. folkertsi* (150×). Fig. 60. *H. jeanneae* (150×). Fig. 61. Elytral punctation, *H. pulcher* (350×).

num and metacoxae (Fig. 53) about the size of pronotal punctures; separated by 1½ to 2 puncture widths. Abdominal punctures finer. The space between the coxal lines is covered with a dense pile of white hairs.

Male protarsi broadened; anterior protarsal claw shorter and slightly thicker than posterior claw. Male with middle antennal segments (Fig. 25)

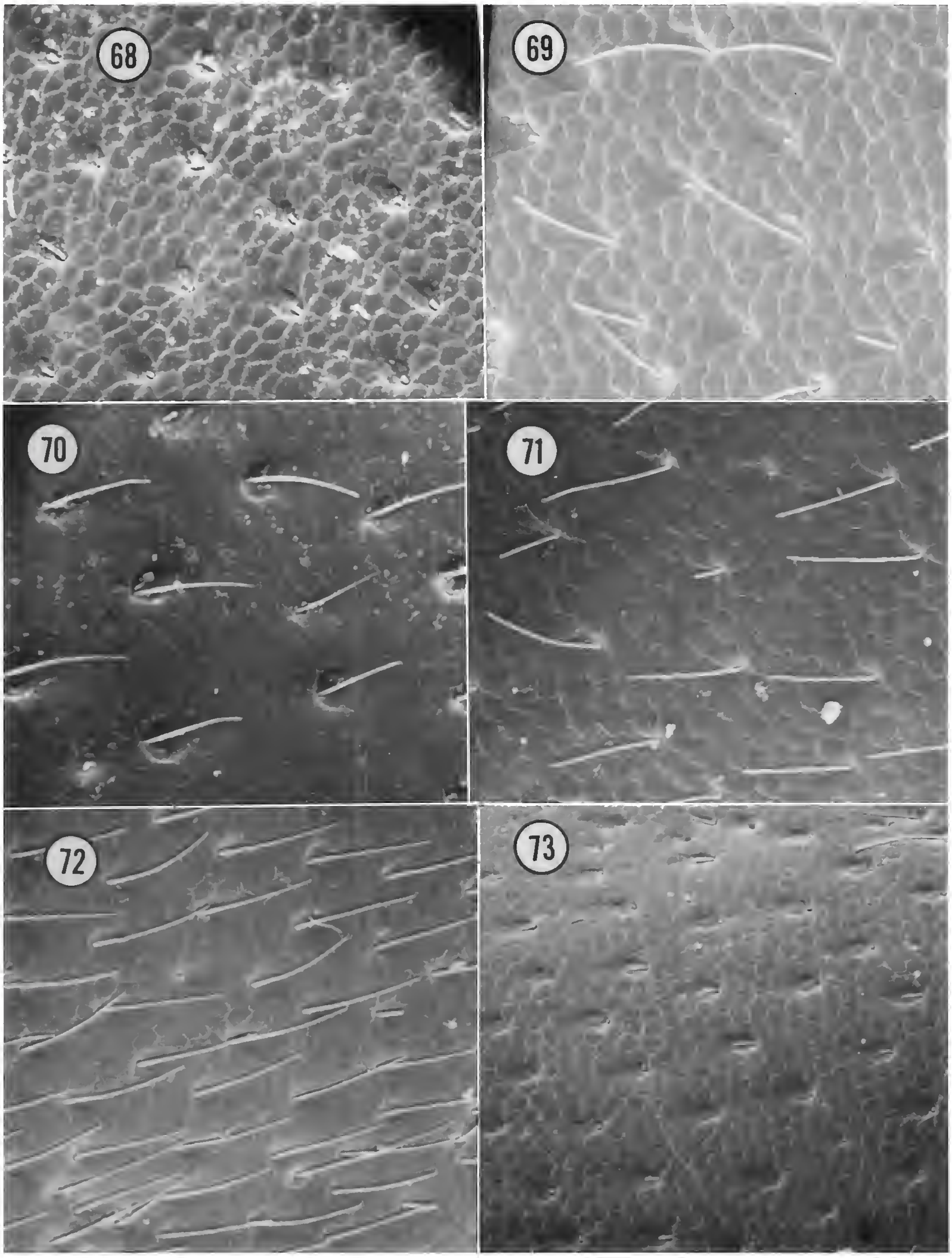


Figs. 62–67. Elytral punctation. Fig. 62. *H. wickhami* (308×). Fig. 63. *H. oppositus* (308×). Fig. 64. *H. cocheconis* (350×). Fig. 65. *H. alleghenianus* (350×). Fig. 66. *H. ouachitus* (350×). Fig. 67. *H. laetus* (350×).

broadened and flattened. Aedeagus decidedly aberrant; fully sclerotized dorsally and ventrally (Fig. 29).

Female similar to male except there is no protarsal or antennal modification and the pubescent area between the coxal lines is less dense.

Larvae.—Unknown.



Figs. 68–73. Elytral punctation. Fig. 68. *H. jenniferae* (400×). Fig. 69. *H. ohionis* (400×). Fig. 70. *H. folkertsi* (350×). Fig. 71. *H. sulphurius* (350×). Fig. 72. *H. diversicornis* (350×). Fig. 73. *H. jeanneae* (350×).

Type data.—The specimens on which Sharp based his description are presumably deposited at the British Museum of Natural History; however, we have not examined them.

Range.—Texas, Oklahoma and Kansas (Fig. 76).

Natural history.—We have collected this species from overhanging grassy banks beside flowing portions of streams in Texas. Occasional specimens have been reported from temporary ponds in Kansas.

Hydroporus folkertsi Wolfe and Matta

Hydroporus folkertsi Wolfe and Matta 1979:175.

The unusually elongate narrow form and very coarse punctation (Figs. 59, 69) distinguish this species. The aedeagus is similar to that of *ohionis* but that species has modified prosternal setae.

Description.—Length 3.0 to 3.4 mm; width 1.4 to 1.7 mm. Form quite elongate oval, very narrow, widest at middle. Lateral edges of pronotum evenly rounded toward the anterior angles, lateral bead distinct. Modified prosternal setae not present; prosternal prominence angulate but reduced; prosternal process lanceolate posterior to procoxae.

Rather strongly shining dorsally; head entirely pale yellow. Antennae pale yellow with articles 8 to 11 becoming gradually infuscate. Pronotum with even broad brownish infuscation along the anterior margin, posterior infuscation restricted to the middle third with the anterior edge undulating; discal and lateral areas yellow. Elytra (Figs. 1, 2) with sutural stripe distinct and extending one third of the length of the elytral base. Middle and apical fascia not connected, usually connected to the sutural stripe. Ventral surface entirely yellowish.

Dorsal surface with perceptible reticulation, somewhat effaced on elytra. Punctation of head sparse and fine, denser on vertex between eyes, sparser anteriorly, densest in shallow depressions at antero-lateral corners of eyes. Pronotum with narrow area of denser punctures parallel to anterior margin, discal punctures slightly coarser, coarsest punctures along posterior edge in infuscation. Elytra (Fig. 69) with coarse and sparse punctures, somewhat less coarse laterally and apically; a vague lengthwise series of finer punctures evident in discal area and adjacent to suture. Ventrally metacoxae very coarsely and sparsely punctured (Fig. 59), metasternal punctures finer medially. Abdominal sterna finely punctate except sternum 1 and the anterior portion of 2.

Male protarsi scarcely broadened; anterior protarsal claw strongly bent at base, otherwise scarcely modified. Aedeagus with distinct narrow subapical projection located ventrally (Fig. 33).

Female with anterior protarsal claw gradually and evenly tapered and curved; female not otherwise discernible from male on the basis of external characters.

Larvae.–Unknown.

Type data.—The holotype and allotype are from a woodland stream 1.5 mi. N. of Praco on Co. Rd. 81, 18 Dec. 1977, collected by Jennifer, Jeanne

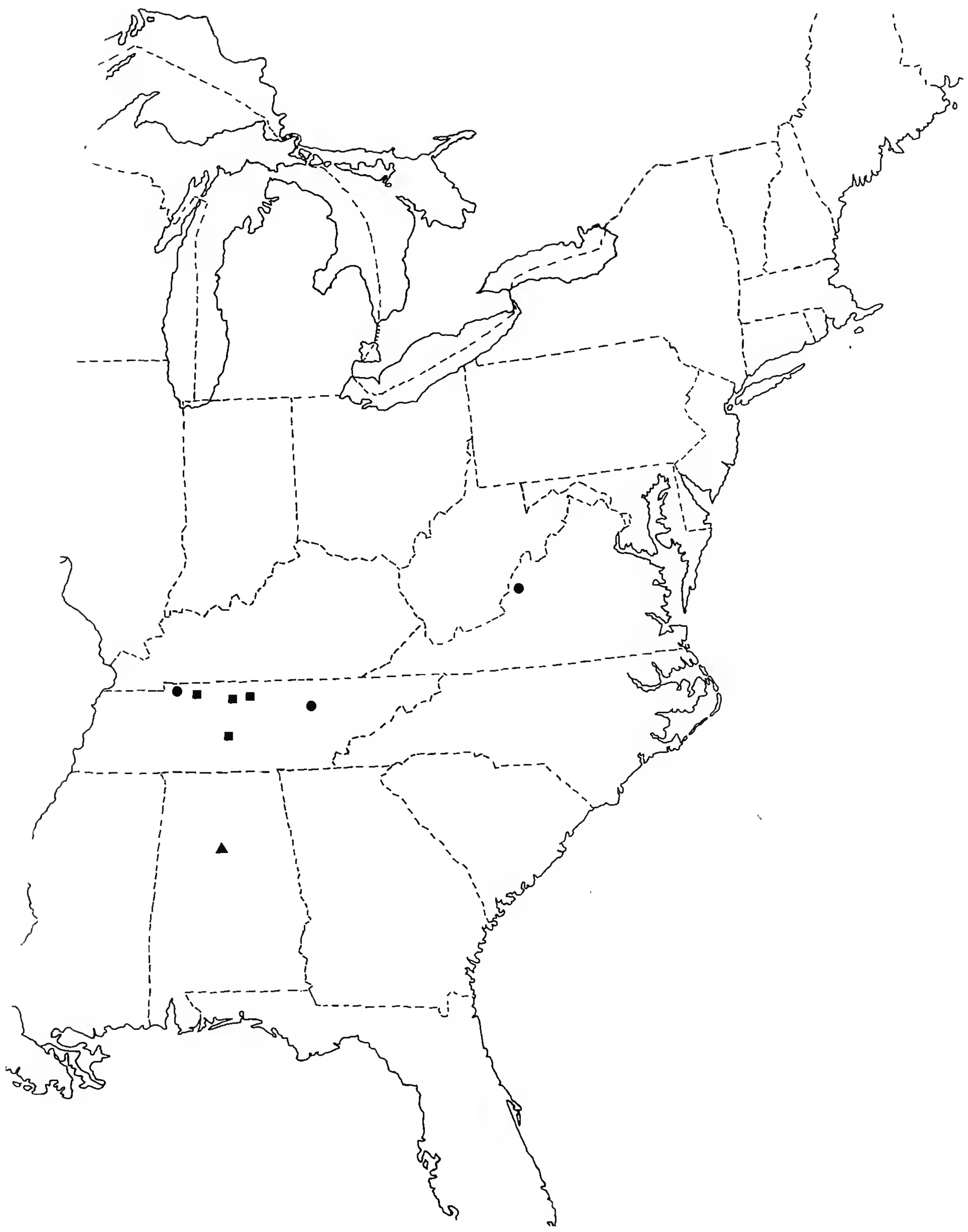


Fig. 74. *H. alleghaneanus* ●; *H. jeanneae* ■; *H. folkertsi* ▲.

and G. W. Wolfe. The primary types are in the NMNH with type number 75500.

Range.—Known only from the type locality in Jefferson Co., Alabama (Fig. 74).

Natural history.—The type locality is a small woodland stream (3 to 8 feet wide) with a gravel rock and rubble bottom. All specimens were taken along the margin in overhanging grass and leaves. Both of the existing collections were made in January.

Hydroporus jeanneae Wolfe and Matta

Hydroporus jeanneae Wolfe and Matta 1979:174.

This species is quite easily distinguished by its unique elytral pattern which consists of a pale basal fascia and a large submedial dark brown fascia (Fig. 8). The combination of a uniformly reddish brown pronotum (Fig. 8) and the presence of prosternal setae is also a distinctive combination. The only other species which have a concolorous pronotum, *H. laetus* and *H. sulphurius*, lack prosternal setae and are also easily separated by aedeagus morphology.

Description.—Length 3.1 to 3.5 mm; width 1.6 to 1.8 mm; form evenly elongate oval, widest at middle, pronotum and elytra continuous in outline. Lateral margins of pronotum evenly rounded toward the anterior angles, lateral bead distinct and at maximum width about equal to the width of the second antennal segment. Modified prosternal setae distinct and dense; prosternal prominence distinctly angulate and somewhat produced; file composed of regularly placed transverse ridges (Fig. 47). Prosternal process lanceolate posterior to procoxae.

Not strongly shining dorsally; head light brownish yellow and vaguely infuscate on each side of head between eyes and at occiput. Antennae light reddish yellow with eleventh segment infuscate. Pronotum entirely dark reddish-brown, slightly darker anteriorly. Elytra (Fig. 8) with one large dark fascia in posterior half, pale yellow band across basal third and apical sixth; pale markings also evident in lateral areas of the discal fascia. Dark brownish sutural stripe extending from apex to base of elytra then laterally along the base to two thirds the width, expanding at middle of base. Ventral surface orange.

Dorsal surface with perceptible microreticulation. Punctation on head sparse and fine, denser on vertex between eyes, finer anteriorly, densest in shallow depressions at antero-lateral corners of eyes. Pronotal punctation finer medially, elytral punctation coarser (Fig. 73), with a vague lengthwise series of discal punctures on elytra. Ventral punctation (Fig. 60) coarser than dorsal punctation, rather dense; punctation of abdominal sternum 1 and anterior portion of sternum 2 very coarse, posterior portion of 2 and 3 through 5 finer.

Protarsi broadened; anterior protarsal claw strongly sinuate internally. The aedeagus is distinct (Fig. 28); it possesses posterolateral denticles and is deeply cleft.

Female similar to the male but slightly more alutaceous. Anterior tarsi

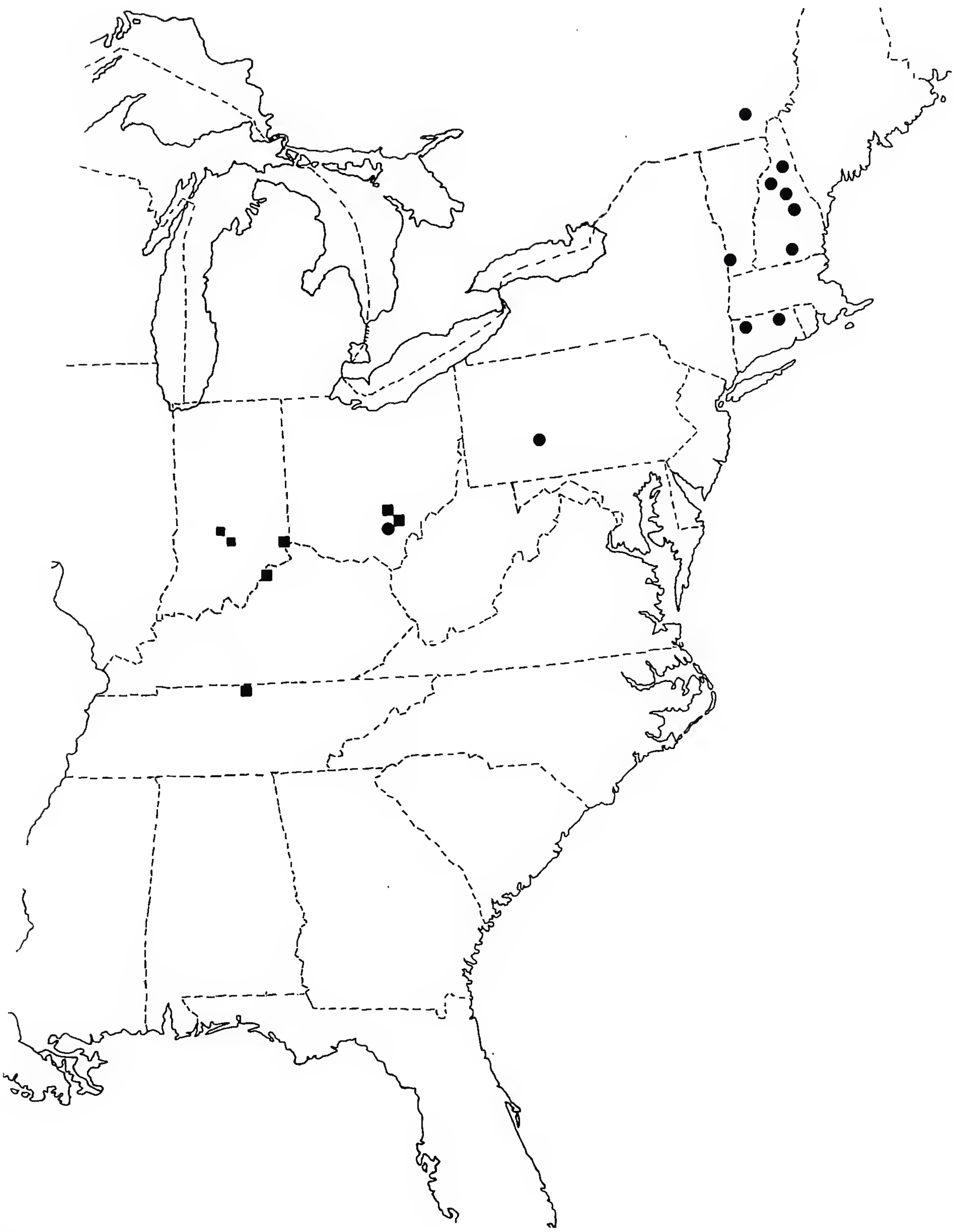


Fig. 75. *H. cocheconis* ●; *H. laetus* ■.

narrower and anterior protarsal claw evenly curved and tapering. The abdominal sterna are more infuscate.

Larvae.—Unknown.

Type data.—The holotype and allotype are from Trousdale Co., TN, 1 mi. N. Barthelia on Hwy 231–10, 20 June 1977, and were collected by G. W. Wolfe and Jennifer and Jeanne Wolfe. The primary types are deposited in the NMNH with type number 75499.

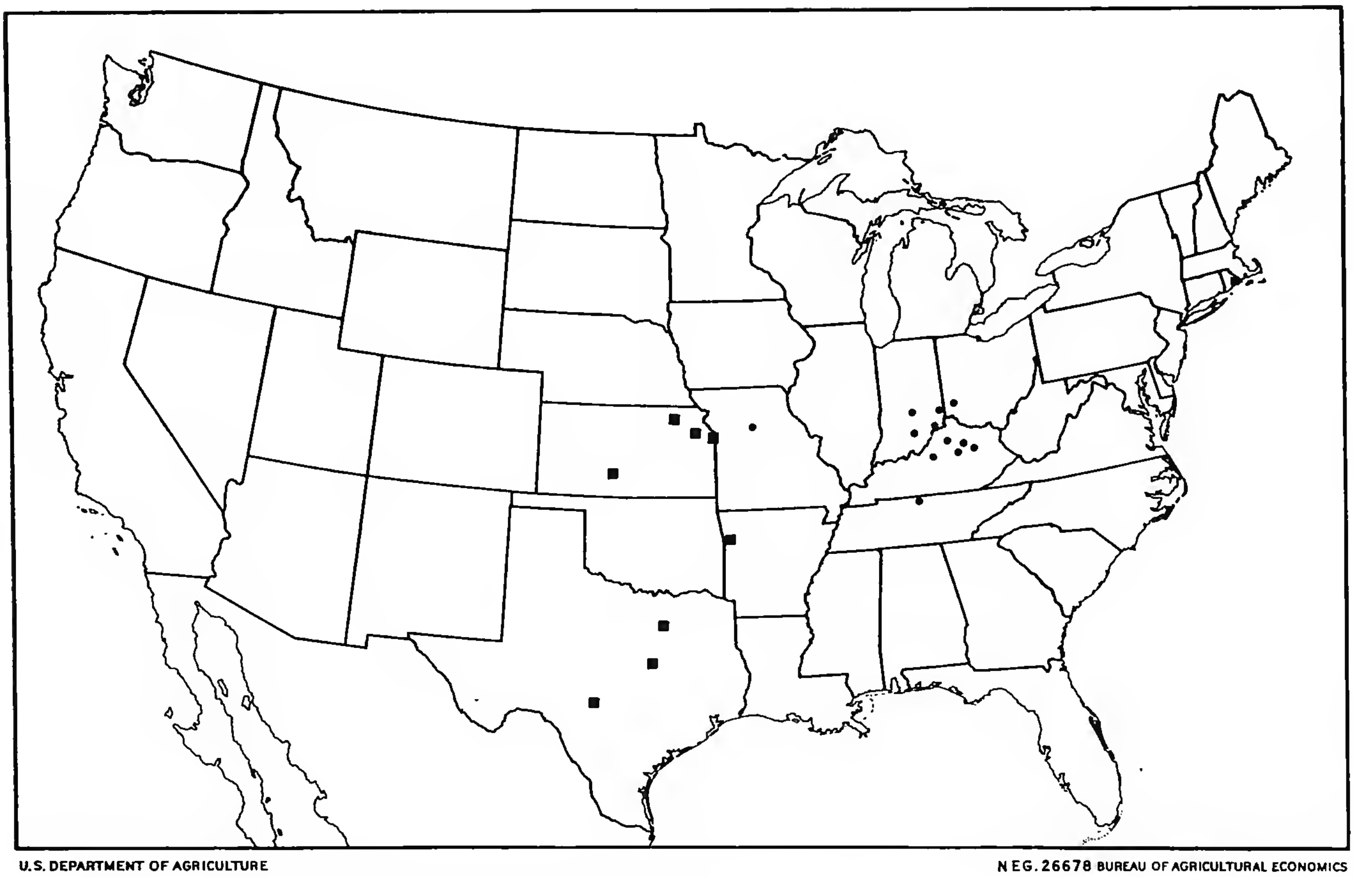


Fig. 76. *H. diversicornis* ■; *H. ohionis* ●.

Range.—This species has been collected only in central Tennessee (Fig. 74).

Natural history.—Hydroporus jeanneae prefers gravelly margins of streams and the fissures in large barely submerged slabs of bedrock. Leaves and algae were usually present.

Hydroporus jenniferae Wolfe and Matta

Hydroporus jenniferae Wolfe and Matta 1979:171.

This species is most closely related to *H. folkertsi* and *H. ohionis* but averages slightly larger and has a paler head than *ohionis* and is not as coarsely punctate as *folkertsi*. The apex of the aedeagus of *jenniferae* is ventrally deflected; appearing hook-shaped in lateral view.

Description.—Length 3.0 to 3.7 mm; width 1.4 to 1.7 mm; form evenly oval, widest at middle; pronotum and elytra continuous in outline. Lateral margins of pronotum evenly rounded toward the anterior angles; lateral bead distinct and at maximum width about equal to the width of the second antennal segment. Modified prosternal setae present but sparse. Prosternal prominence evidently angulate but not distinctly protuberant, prosternal file present rugose; prosternal process lanceolate posterior to procoxae, tip bluntly pointed.

Not strongly shining dorsally. Head pale yellow; vaguely infuscate at

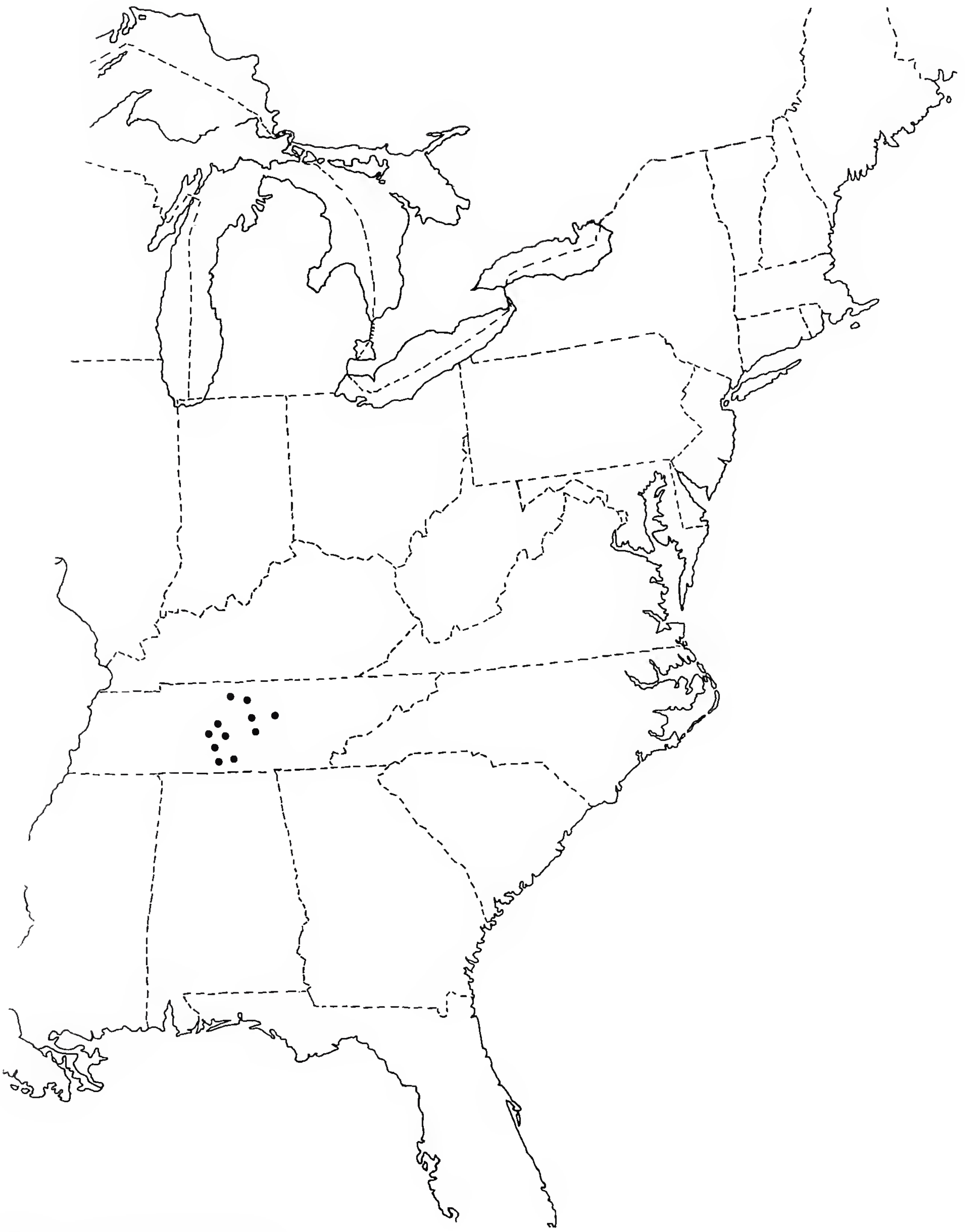


Fig. 77. *H. jenniferae* ●.

vertex, antennae pale yellowish with 11th segment infuscate. Pronotum with an evenly broad black band along anterior edge. Posterior margin of pronotum with a black band of variable width, narrower on each side, expanding in undulating fashion and often coalescing with the anterior band. Paler isolated areas of the pronotum reddish yellow. Elytra (Figs. 3, 4) with distinct brownish black and yellow fascia. Sutural stripe distinct and extending along half the elytral base. Middle fascia large, indented in an undulating fashion; variable in extent. The middle fascia may be reduced and isolated

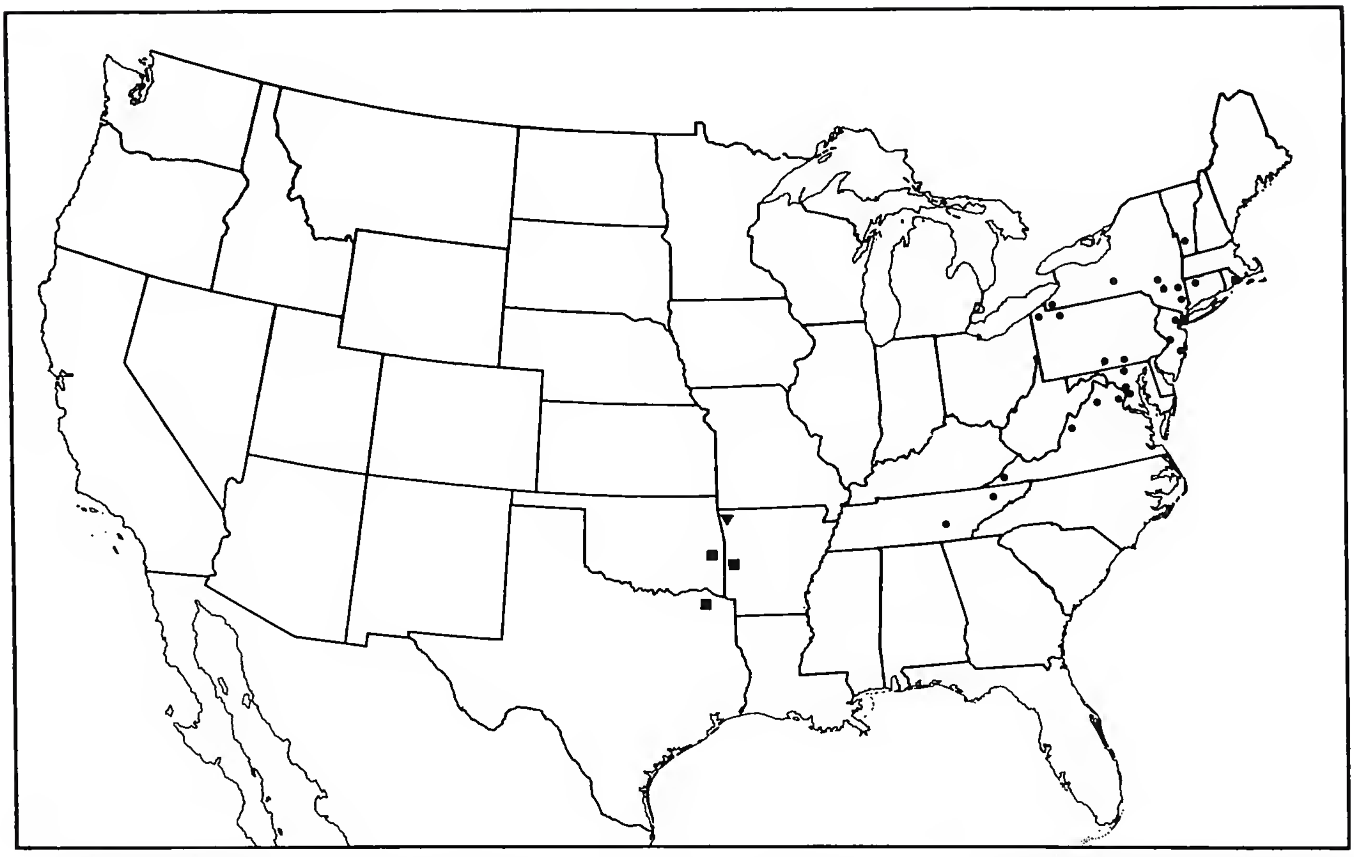


Fig. 78. *H. oppositus* ●; *H. sulphurius* ▼; *H. ouachitus* ■.

from the sutural stripe and the smaller apical fascia or it may be broadly connected to both. Ventral surface primarily reddish-yellow with mesosternum, lateral edges of metasternum, metacoxae and abdominal sterna variably infuscate.

Dorsal surface perceptibly reticulate; punctation of head fine and sparse, densest on vertex between eyes, sparser and finer anteriorly, densest in shallow depressions at antero-medial corners of eyes. Pronotum with a line of coarser and denser punctures parallel to anterior margin, discally punctures sparser and finer. The posterior prototal areas with punctures coarser and more or less restricted to the posterior infuscations.

Elytral punctation fine and sparse (Fig. 68), coarsest discally and finer laterally and apically. A very poorly defined lengthwise series of denser punctures is discernible in the discal area of each elytron. Ventrally metacoxa rather coarsely punctate (Fig. 57), metasternum even more so; medial punctures finer on both metacoxa and metasternum. Abdominal punctures coarser on sternum 1 and anterior portion of 2; posteriorly finer.

Protarsi of male relatively short and broad, anterior claw strongly bent at base and slightly sinuate internally. Aedeagus ventrally deflected at apex; appearing hook-shaped, with thin subapical ventral projection (Fig. 31).

Female similar to the male but slightly longer and broader. The anterior protarsal claw evenly curved and tapering. Abdominal sterna usually more infuscate.

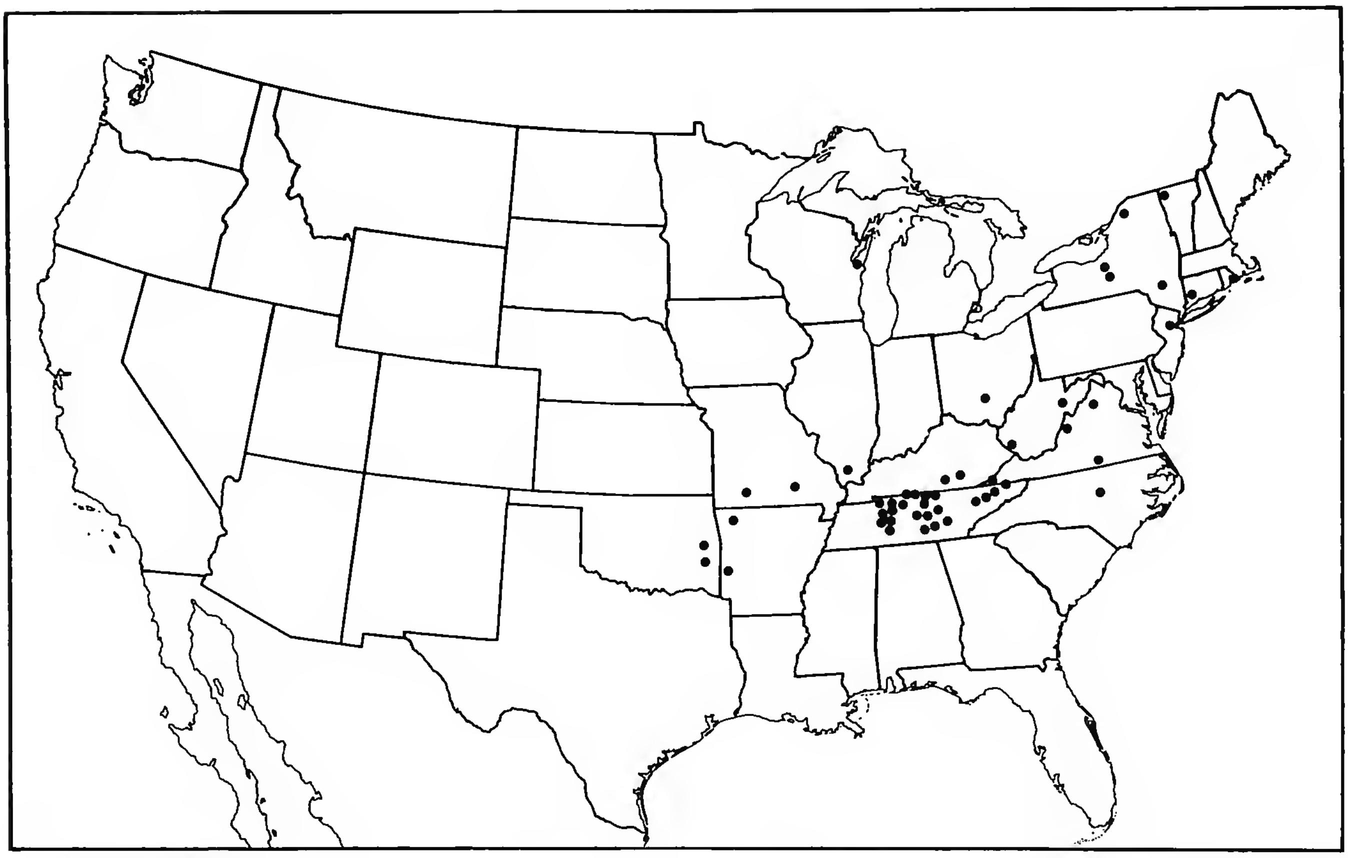


Fig. 79. *H. pulcher* ●.

Larvae.—Unknown.

Type data.—The holotype and allotype are from Trousdale Co., TN, 1 mi. N. Barthelia on Hwy 231–10, 20 June 1977 and were collected by G. W. Wolfe and Jennifer and Jeanne Wolfe. The primary types are deposited in the NMNH with type number 75498.

Range.—Known only from central Tennessee but its presence in central Kentucky is probable (Fig. 77).

Natural history.—This species prefers gravelly stream margins. Many specimens were taken from a section of stream with extensive slabs of bedrock. The beetles were found among algae and leaves in fissures and depressions containing one to several inches of water.

Hydroporus laetus Leech

Hydroporus laetus Leech 1948:90.

This species is characterized by its uniformly dark reddish or brown pronotum and the absence of prosternal setae. The only other species in this subgenus with this combination of characters, *H. sulphurius,* has a distinct subapical ventral projection on the aedeagus and is so far known only from northwestern Arkansas.

Description.—Length 3.15 to 3.30 mm; width 2.0 to 2.15 mm; form elon-

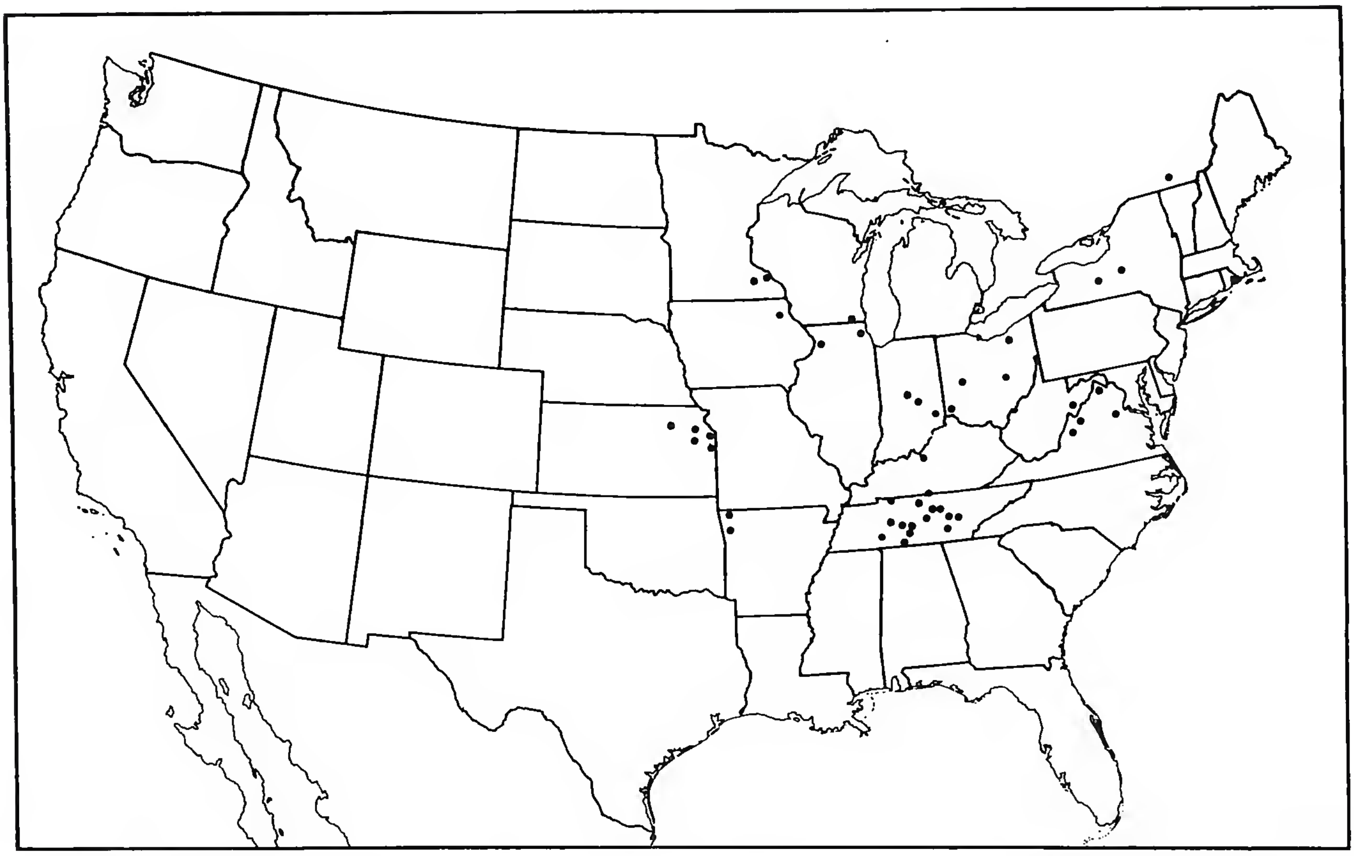


Fig. 80. *H. wickhami* ●.

gate oval, sides subparallel basally, widest at middle; pronotum and elytra continuous in outline. Lateral margins of pronotum evenly and gradually rounded towards the anterior angles; lateral bead distinct, gradually widening anteriorly, at maximum width about equal to the width of the second antennal segment. Prosternal prominence declivitous, somewhat protuberant. File area rugose, process lanceolate posterior to procoxae and bluntly pointed. Modified prosternal setae absent.

Shining dorsally, a little alutaceous. Head reddish or orange brown; clypeus lighter yellow. Pronotum reddish to reddish-brown. Elytra (Figs. 20, 21) with variable yellowish and brownish to blackish fascia which are usually as follows: sutural stripe distinct and extending about half the length of the elytral base, occasionally extending back. Middle and apical fascia connected to sutural stripe, separated from each other and not connected to the basal fascia. An infuscate area present in the anterior light fascia.

Microreticulation evident; head randomly and finely punctate, punctures separated by 1 to 2 puncture widths; sometimes more coarsely punctate on vertex between eyes. Punctures finer anteriorly, densest in shallow depression at antero-medial corner of eye. Pronotal discal punctation sparse, fine, separated by the width of 2 to 3 punctures; somewhat coarser and denser parallel to the anterior margin. Elytral punctures fine and sparse (Fig. 67); separated by as much as 3 puncture widths. Ventrally metacoxal punctures

(Fig. 51) coarser than above, metasternal punctures coarser than those on the metacoxae; both becoming finer medially. Abdominal sternum 1 and anterior portion of 2 coarsely punctate, posteriorly finer.

Male protarsi scarcely modified; protarsi with anterior claw strongly bent basally, sinuate internally. Aedeagus and parameres as in Fig. 36. Female identical to the male except that the anterior protarsal claw is evenly and gradually tapered and curved.

Larvae.—Unknown.

Type data.—The holotype and allotype are from a stream adjacent to Lake Hope, Vinton Co., Ohio. They are deposited in the California Academy of Science. We have examined paratypes loaned by F. N. Young and from the Canadian National Collection.

Range.—The Great Lakes states to Pennsylvania, south to northern Tennessee (Fig. 75).

Natural history.—Teneral specimens were collected by Dr. F. N. Young on 22 September 1968. This species prefers the margins of streams.

Hydroporus ohionis Fall

Hydroporus ohionis Fall 1917:172.

This species is similar to *H. folkertsi, H. jenniferae and H. sulphurius. H. ohionis* is usually smaller, the head is more reddish and the aedeagus is unique. *H. sulphurius* has a uniformly dark pronotum and is known only from the northwestern portion of Arkansas. Furthermore, *H. sulphurius* and *H. folkertsi* lack prosternal setae.

Description.—Length 3.1 to 3.4 mm; width 1.4 to 1.5 mm; form elongate oval, widest at middle with pronotum and elytra continuous in outline. Lateral margins of pronotum gradually evenly curved toward the anterior angles. Lateral pronotal bead distinct, gradually broadening anteriorly; at widest point about equal to the width of the second antennal segment. Prosternum with stiff antecoxal setae; file area rugose; prosternal process lanceolate posterior to procoxae, bluntly pointed.

Shining but evidently alutaceous dorsally. Head orange, a little darker between the eyes. Pronotum orange to reddish discally, with broad dark bands along the anterior and posterior edges; the posterior band not extending as far laterally. These bands are sometimes sufficiently broad that the paler central band is narrow but the dark bands are rarely connected. Elytra with brown and yellowish fascia (Figs. 6, 7). Sutural stripe extending along basal edge for about half the width. Basal dark fascia narrow; middle fascia with uneven anterior and posterior margins; usually connected to the sutural stripe and rarely connected to the apical fascia; the apical fascia smaller. Ventrally dark orange, variably infuscate on the abdominal sterna, especially laterally.

Microreticulation evident dorsally and ventrally. Head with fine sparse punctation, punctures separated by 1 to 2 puncture widths; finer on clypeus, densest in shallow depression at antero-medial corners of eyes. Pronotum sparse, finer discally, punctures separated by up to 4 puncture widths; denser and coarser along anterior and posterior edges. Elytra rather finely and sparsely punctate, punctures separated by 2 to 3 puncture widths (Fig. 69). Ventral punctation distinctly coarser; a little coarser on the metasternum than metacoxae (Fig. 58); both finer medially. Abdominal sternum 1 and anterior portion of 2 coarser, posterior portion of 2 and 3 to 5 finer.

Male with anterior tarsi scarcely modified, anterior claw bent basally but only feebly sinuate. Aedeagus with a thin subapical ventral projection (Fig. 32).

Female very similar to the male. Anterior protarsal claw gradually tapering and curved.

Larvae.—Unknown.

Type data.—Fall's description of this species is based on three males from Cincinnati, Ohio, but he did not designate a type specimen. We have designated as the lectotype of *Hydroporus ohionis* Fall the male specimen from Fall's type series which we have dissected. The specimen bears the following label information: Cincin. Ohio; a small label with the male sex symbol and a label bearing the words H. C. Fall Collection. We have placed a yellow lectotype label on this specimen with the following information: Lectotype, *Hydroporus ohionis*. This specimen has been returned to the Museum of Comparative Zoology, Harvard.

Range.—The Great Lakes states to Pennsylvania and south through Kentucky and Virginia (Fig. 76).

Natural history.—This species seems to prefer the margins of small streams with sand or fine gravel substrates and overhanging vegetation. It is frequently collected in the submerged roots of grass clumps at the stream margin and is occasionally taken from small backwaters.

Hydroporus oppositus Say

Hydroporus oppositus Say 1823:289.

Diagnosis.—This species is most easily separated from the closely related *H. wickhami* by the apex of the aedeagus which is more prolonged (Figs. 26, 27) in lateral view; however, it also averages larger and is somewhat less infuscated and more coarsely punctate ventrally. In the southeastern portions of its range *H. oppositus* is distinctly fasciate with blackish and yellow fascia. In the northeast the darker elytral fascia are reddish and expanded, almost obliterating the yellow fascia. In the south the anterolateral angles of the pronotum are sinuate and the anterior protarsal claw of the male is markedly sinuate (Fig. 39).

Description.—Length 3.4 to 4.1 mm; width 1.7 to 2.1 mm. Form elongate oval, widest at middle with pronotum and elytra continuous in outline. Lateral edges of pronotum gradually curved inward but sometimes slightly sinuate at the antero-lateral corners. Lateral pronotal bead distinct, about as wide as the second antennal segment; gradually broadening anteriorly. Distinct stiff prosternal setae present. Prosternal prominence angularly declivitous, file composed of regularly placed transverse ridges. Prosternal process lanceolate posterior to the procoxae, bluntly pointed.

Dorsally shining. Head flavotestaceous, infuscate in back of the eyes across vertex. Pronotum with even broad dark band along anterior edge; infuscate along the posterior edge but this infuscation not as dark or as broad; discal area rufotestaceous. Elytra with yellow and brownish black fascia (Figs. 17–19). Sutural stripe distinct and extending laterally along the basal edge up to two thirds of the elytral width; then extending posteriorly. This posterior extension is often isolated, forming a discreet spot and is seldom connected to the middle fascia. Middle dark fascia large, undulating, occasionally deeply indented, connected to the sutural stripe; variably connected with the posterior dark fascia. Posterior dark fascia smaller, usually not deeply indented. Ventral coloration variable, usually darkly infuscate, medial areas of metacoxae, metasternum and abdominal sterna often rufotestaceous.

Microreticulation evident dorsally and ventrally. Punctation of head fine, usually denser on vertex, punctures separated by one half to one puncture width, becoming finer anteriorly; densest in shallow depressions at anterolateral corners of eyes. Pronotal punctation coarse; separation variable but up to 2 puncture widths; often finer and sparser medially; a line of coarser punctures parallel to anterior edge. Elytral punctation a little coarser (Fig. 63), separated by 1 to 1 and one half puncture widths. Ventral punctation coarser than above; metacoxae (Fig. 55) and metasternum finer medially. Punctures of abdominal sternum 1 and anterior portion of 2 coarser, posteriorly finer.

Anterior protarsi of male broadened, protarsal claw sinuate, usually lobed (Fig. 39). Aedeagus as in Fig. 26. Female similar to male; more alutaceous; anterior protarsal claw evenly tapered and curved.

Larvae.—Described in Barman (1972).

Type data.—Say's types are generally considered to be lost. Since no material suitable for designation as a neotype was available from the LeConte collection (a usual source for specimens representative of Say's species) a male specimen from Pendleton County, West Virginia is designated as a neotype of *Hydroporus oppositus* Say. This specimen is typical of northeastern specimens of *oppositus* and fits Fall's interpretation of *H. oppositus* Say. The specimen bears the following labels; 1, Pendleton Co., W. Va., V-3-74, Matta; 2, *Hydroporus oppositus* Say, Det. J. F. Matta; 3, Neotype *Hydroporus oppositus* Say. des. 1980 JFM. This specimen has been deposited in the Museum of Comparative Zoology, Cambridge, MA.

Range.—*Hydroporus oppositus* extends from eastern Canada and New England south to North Carolina and Tennessee (Fig. 78).

Variation.—This species exhibits interesting variation in a north-south direction throughout its range and Fall's (1923) analysis, which is based on northeastern specimens, can be misleading if applied to southern material. In the south this species closely approaches *H. wickhami* in coloration; the ventral infuscation is reduced and the dorsum is distinctly fasciate. Specimens with this coloration possess a distinctly sinuate and lobed anterior protarsal claw and the anterior pronotal margin is sinuate. Specimens from more northern areas have the dark fascia expanded and in New England specimens the dark fascia are usually broadly connected and the light yellow fascia reduced to isolated spots. As the coloration becomes progressively more infuscate (nonfasciate) the pronotal sinuation disappears (it is rare in Virginia specimens and absent in material from Pennsylvania and New York) and the anterior protarsal claw becomes less sinuate (the sinuation is scarcely detectable in northern material). In addition *H. oppositus* becomes gradually smaller in the northern part of its range.

Natural history.—This species is usually taken at the margins of streams with gravel margins. It is commonest in smaller and intermittent streams.

Hydroporus ouachitus Matta and Wolfe

Hydroporus ouachitus Matta and Wolfe 1979:289.

Diagnosis.—This species is best identified by the shape of the male genitalia. It is similar to *H. pulcher* but may be separated from that species by the coarser ventral punctation, smaller size and reduction of the anterior pronotal dark spot and distinctly different aedeagus (Fig. 37). The aedeagus is similar to that of *H. laetus* but that species has a uniformly reddish pronotum. The punctation (Fig. 64) is finer than in *H. cocheconis* (Fig. 66) and the presently recorded ranges are allopatric.

Description.—Length 2.80 to 3.20 mm; width 1.35 to 1.45 mm. Form elongate oval, widest at middle; pronotum and elytra continuous in outline with the sides of the elytra very slightly concave basally. Lateral pronotal bead distinct, slightly widened anteriorly. Modified prosternal setae absent although a few short stiff hairs may be present on the prosternum at the base of the coxae. Prosternal process distinctly angulate, prosternal file present but poorly developed. Posterior half of the prosternal process broadly lanceolate with the medial portion slightly rounded and lateral edges margined; the tip bluntly pointed.

Head reddish brown, antennae with last segment infuscate. Pronotum reddish brown with a diffuse dark spot at the anterior margin which reaches from the central line to approximately half the distance to the margin on each side. Posterior margin of pronotum with a thin dark band which narrows laterally. Elytra (Fig. 12) dark brown with subbasal, postmedial and apical pale areas which are separated from the sutures and the lateral margins by thin dark bands. Ventral surface yellow-brown, the legs, prosternum and head reddish brown.

Dorsal surface finely and densely microreticulate; punctation of head fine; punctures separated by 3–4 times the width of a puncture. Pronotum with discal punctures similar to those of the head; with a band of coarser punctures near the anterior margin and with a few coarse punctures scattered along the posterior margin. Elytra rather evenly punctured (Fig. 66), the punctures separated by 1 to 1½ a puncture width. Ventral punctation coarser; the metacoxae (Fig. 50) and metasternum with the punctures separated by less than ½ a puncture width. The abdominal punctures fine, slightly coarser basally.

Male with pro- and mesotarsi short and thickened; the anterior protarsal claw not modified; aedeagus as in Fig. 37. Female similar to the male but averages 0.1 mm longer. There is some minor variation in color pattern but all extant specimens are quite similar.

Larvae.—Unknown.

Type data.—The holotype, allotype and 11 paratypes are from a small stream 2 mi. s of Mena, Arkansas, 19 July 1978, collected by J. F. Matta. The primary types are in the collection of J. F. Matta but have NMNH type number 75966.

Range.—Texas, Arkansas and Oklahoma (Fig. 78).

Natural history.—The type series was collected from the margins of a pool in the bedrock of a small temporary stream. Most specimens were washed out of the roots and sand near grass and bushes which extended partly into the pool.

Hydroporus pulcher LeConte

Hydroporus pulcher LeConte 1855:298.

This is one of the most widely distributed species in the subgenus. It may be easily recognized by the extremely fine ventral punctation (Fig. 61) and by the form of the aedeagus (Fig. 38).

Description.—Length 3.1 to 3.6 mm; width 1.6 to 1.8 mm. Form elongate oval, widest at middle; length to width ratio usually greater than or equal to 2, however occasional specimens are slightly broader; pronotum and elytra continuous in outline. Lateral margins of pronotum evenly rounded toward anterior angles, lateral bead distinct, widening slightly anteriorly; at maximum width about equal to the width of second antennal segment. Modified prosternal setae absent. Prosternal prominence declivitous, not distinctly protuberant, prosternal file quite rugose, prosternal process broadly lanceolate posterior to procoxae, bluntly pointed.

Shining dorsally. Head uniformly pale yellow; antennae yellow with terminal segment vaguely and variably infuscate. Pronotum with even black band along entire anterior edge; posterior margin with narrow medial black band extending across ⅔ of the edge. Disc and lateral margins yellow. Elytra (Figs. 22–24) with distinct undulating yellow and black fascia. Sutural stripe distinct and extending along basal edge ½ to ⅔ of the width to form a basal fascia. Basal fascia extending posteriorly in some specimens occasionally coalescing with middle fascia, sometimes this posterior extension isolated as an anterolateral spot. Middle dark fascia large, usually coalescing with sutural stripe, at maximum extent coalesced with basal and apical fascia; sometimes isolated from all three. Apical fascia smaller than middle, showing same variation as middle fascia. Venter yellow, metacoxae usually lightest, sutural and lateral areas and abdominal sterna sometimes lightly infuscate; mesosternal area darkest.

Microreticulation evident on head and pronotum, reduced on elytra and ventrally. Punctation of head fine, randomly punctate; usually coarser and denser on vertex between the eyes; finer and sparser anteriorly, densest in shallow depressions at anteriomedial corners of eyes. Pronotal punctation fine; punctures separated by 1 to 2 puncture widths; a line of coarser punctures parallel to anterior margin. Elytral punctation (Fig. 61) finer than pronotum except at extreme base; punctures separated by about 2 puncture widths. Punctation of metacoxae (Fig. 48) and abdominal sterna fine, dense; separated by less than 1 puncture width on metacoxae. Metasterna with punctures a little coarser and sparser laterally.

Protarsi of male slightly modified; anterior protarsal claw slightly sinuate on inner margin; strongly bent basally. Apical portion of aedeagus broadly dorsoventrally flattened, with minute subapical ventral projection (Fig. 38).

Female identical to male except that the anterior protarsal claw is evenly curved and tapered.

Larvae.—Unknown.

Type data.—The type specimen is in the MCZ and bears type number 6004. It is from Alabama and was collected by Mr. Hentz.

Variation.—This species is rather uniform throughout its range except that some northern specimens have the darker elytral fascia broadly coalesced and appear almost completely dark.

Range.—Southern Canada south to Virginia; west to Wisconsin and Arkansas. The Minnehaha, Arizona, specimen mentioned by Fall probably represents a mislabeled specimen from Minnehaha, West Virginia (Fig. 79).

Natural history.—Teneral specimens were taken in June and August. This species is found in a wide variety of stream habitats but is most frequently collected from gravel margins of smaller streams.

Hydroporus sulphurius Matta and Wolfe

Hydroporus sulphurius Matta and Wolfe 1979:287.

The unicolorous (infuscate) pronotum and lack of prosternal setae separate this species from all others in the subgenus except *H. laetus*. The punctures of *H. sulphurius* are slightly smaller and sparser than *laetus* and the elytral markings are darker. In addition the ranges of the two species are allopatric. The aedeagus of *H. sulphurius* is distinct (Fig. 30) and may be used to separate it from all species in the genus.

Description.—Length 2.9 to 3.5 mm; width 1.4 to 1.7 mm. Form elongate oval; widest at middle; pronotum and elytra continuous in outline with the lateral margins of the pronotum evenly rounded towards the anterior angles. Margin of pronotum with a distinct lateral bead which appears flattened on top and which is about ½ as wide as the last antennal segment. Modified prosternal setae absent; prosternal process with an angulate protuberance and a poorly defined anterior file. Prosternal process lanceolate posterior to the procoxae and with a bluntly rounded tip.

Head pale brown; antennae concolorous with head, vaguely infuscate on last segment. Pronotum uniformly reddish brown; lateral margins lighter. Each elytron (Fig. 5) reddish brown with anterior, postmedial and posterior light brown pale patches which extend across the width of the elytron and terminate against the sutural stripe. The postmedial spot is interrupted by a narrow dark band cutting across its middle and the apical spot extends anteriorly as a vague narrow streak but does not reach the postmedial spot. Ventral surface light brown with the metacoxal plates, metasternum and prosternal process slightly darker.

Finely and distinctly alutaceous dorsally. Head sparsely and finely punctured. Pronotum with disc finely punctured; with a narrow band of coarse punctures near the anterior margin and a broader band of coarse punctures on the posterior margin. Elytral punctures (Fig. 71) fine and sparsely distributed; separated by at least the width of 1 puncture, usually by the width of several punctures. Ventral surface finely punctured except for the metacoxal plates (Fig. 56) and metasternum where the punctures are 4–5 times larger than normal.

Protarsal claw and protarsi of male unmodified. Aedeagus as in Fig. 30; with a thin subapical ventral projection. Female similar to the male in external characters.

Larvae.—Unknown.

Type data.—The holotype, allotype and all paratypes are from Sulphur Springs, Arkansas, VII-20-1955, collected by P. J. Spangler. The holotype and allotype are in the NMNH and have type number 75967.

Variation.—In the small series available there is little variation. A few specimens have a small vague paler area on the disc, there may be a dark spot at the anterior edge of the anterior elytral spot and the postmedial pale spot may be reduced or split by a dark streak. The dark areas on the ventral surface vary from the typical reduced dark area to large infuscate patches on the abdominal sterna.

Range.—Known only from Sulphur Springs, Arkansas (Fig. 78).

Natural history.—This species has been collected from only one site on the Ozark plateau in an area of numerous springs and small sand bottom streams. No specific habitat data is available for this species however it is probably found at the margins of the smaller streams.

Hydroporus wickhami Zaitzev

Hydroporus wickhami Zaitzev 1907:114.

This species can be separated from most other species in the subgenus by the presence of dense prosternal setae and a blackish venter. It is difficult to separate from *H. oppositus* and the discussion of that species should be referred to for distinguishing characters.

Description.—Length 3.3 to 3.7 mm; width 1.5 to 1.9 mm. Form elongate oval, widest at middle; with pronotum and elytra in continuous outline. Lateral margins of pronotum gradually and evenly curved toward anterior angles. Lateral margins of pronotum with a distinct bead which gradually broadens anteriorly; at its greatest width approximately as wide as the second antennal segment. Distinct stiff prosternal setae present. Prosternal process with angular prominence, file composed of regularly placed transverse ridges; process lanceolate posterior to the procoxae; apex bluntly rounded.

Dorsally shining, occasionally somewhat alutaceous. Head yellowish orange; vaguely infuscate across vertex behind eyes. Pronotum with even broad dark band on anterior margin; posterior margin with a narrower dark band. Elytra markings (Fig. 16) yellow and brown to black. Sutural stripe extending length of suture and ⅔ of way along elytral base, then backward toward medial dark fascia. Medial fascia large, deeply indented and connected to sutural stripe; sometimes barely connected to apical dark fascia. Apical dark fascia smaller, usually connected to sutural stripe. Venter dark; black to reddish black; area between metacoxal lines and abdominal sterna often more reddish. Legs, prosternum and ventral side of head rufotestaceous.

Microreticulation evident dorsally and ventrally. Punctation of head fine, punctures separated by 1 to 2 puncture widths; denser on vertex between eyes, finer anteriorly and coarsest and densest in shallow depressions at anteromedial corners of eyes. Pronotal punctation fine and dense; punctures separated by 1 to 2 puncture widths; a line of coarse punctures parallel to anterior margin. Elytral punctation fine (Fig. 62); punctures separated by 2 to 3 puncture widths; a discal longitudinal line of coarse punctures evident. Metacoxae (Fig. 54) and metasternum more coarsely punctate. Punctures on abdominal sternum 1 and posterior region of 2 coarser; those on the rest of 2 and 3–5 finer.

Anterior protarsi of male broadened; anterior protarsal claws feebly sinuate. Aedeagus distinct (Fig. 27). Female identical to male except that the protarsi are narrower and the anterior protarsal claws are gradually and evenly curved.

Larvae.—Described in Barman (1972).

Type data.—There are two specimens in the type series, a male and a female. The female bears a type label with the type number 6007; however a type designation has never been published and we are designating the male (which we have dissected) as the lectotype and the female as the paralectotype. The type locality is given as Fort Laramie, Nebraska; however, this is now Wyoming (Fall, 1923).

Range.—Southeastern Canada south to north Georgia, west to Kansas and Wisconsin (Fig. 80). The type is recorded from Wyoming; however, we have not seen other specimens from this far west.

Natural history.—This species is found in many stream habitats but is most common at the margins of medium to small streams.

Discussion

The subgenus *Heterosternuta,* as here redefined, is composed of a monophyletic group of species. These species are characteristically found along the margins of piedmont or mountain streams and all but two species are found east of the 100th meridian. The subgenus presents some interesting problems and areas for future work. Barman (1972) has described the larvae and biology of *H. oppositus* and *H. wickhami*; however, the larval and pupal stages of all other species are undescribed and the life history of most species are unknown. The role of the subgenus in the stream community also needs study. They frequently occur in large numbers—particularly in temporary streams—and may have a significant impact on the small invertebrates which presumably make up the major portion of their diet. They are rarely reported in stream surveys however since most stream sampling proceedures neglect the stream margins.

A particularly interesting problem is presented by the prosternal setae which are present in several species. These bristles do not appear in any other North American *Hydroporus* and vary in size and number between the species of *Heterosternuta.* Their function is unknown and it would be interesting to know their biological function.

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Footnote

[1] Parts of this work were also completed during graduate study at the University of Tennessee and during a postdoctoral fellowship at the Smithsonian Institution.

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A NEW GENUS AND SPECIES OF WATER SCAVENGER BEETLE FROM AFRICA (COLEOPTERA: HYDROPHILIDAE: SPHAERIDIINAE)

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The distinctive hydrophilid beetle described herein was found in the National Museum of Natural History collections during routine identifications of miscellaneous beetles for curatorial purposes. The single specimen has been residing in the collections since it was collected by Dr. W. M. Mann 40 years ago. Although we would prefer more specimens for the description, the specimen is a male, which should be easily recognized by the descriptions and illustrations provided here.

Nothing is known about the habits and habitat of this new beetle except that it belongs to the subfamily composed of taxa which are terrestrial rather than aquatic in their habits. Members of this subfamily occur in wet or moist rotting vegetation such as palm logs, fruits, coconut hulls, banana stalks, cactus, etc.; others live in dung. The taxa living in rotting vegetation usually have dense pads of long hairlike pubescence on the ventral surfaces of their tarsi. In contrast, those which live in dung usually lack this pubescence. Therefore, the dense pubescence on the tarsi of this new taxon suggests that it occurs in rotting vegetation.

Sphaeridiini

Kruia, new genus

Body form (Fig. 1) broadly rounded, moderately convex; strongly, coarsely, and irregularly punctate dorsally. Head with anterior margin of clypeus broadly subtruncate and distinctly upturned, expanded shelflike in front of eyes and extending as a canthus to midlength of eye. Labrum short and mostly obscured beneath clypeus. Eyes viewed from above ovoid. Antenna 8 segmented; 2 basal, 2 intermediate, 1 cupule, and 3 club segments; only club segments pubescent. Maxillary palpus 4 segmented; shorter than antennae; basal segment very short; second (pseudobasal) segment inflated, about two-thirds as long as maxillary stipes and shorter than either penultimate or ultimate segment; penultimate segment slightly longer than ultimate segment. Prosternum moderately long in front of procoxal cavities; longitudinally carinate medially; terminating posteromedially in an acute apex between procoxae. Mesosternal process (Fig. 2) a large pentagonal process but appearing triangular with anterior and lateral angles acute; middle tectiform. Metasternum (Fig. 2) apically with an inclined lanceolate process extending between middle coxae; metasternum bearing two large posteromedial mammilliform processes, one on each side of midline in front of metacoxae; each metacoxal process surmounted with a short tuft of setae. Pronotum strongly broadly swollen on discal area and explanate, especially anterolaterally. Elytron with strongly raised sutural margin; humeral areas tumid; base with vestiges of three costiform intervals between humerus and sutural margins; punctures very coarse, confused basally but in rows apically; lateral margins broadly explanate. Epipleura wide and strongly oblique basally and becoming almost horizontal opposite margin of first abdominal sternum. Scutellum a rather large equilateral triangle. All tarsi covered on ventral surfaces with dense golden setae. Middle and hind tibiae arcuate. Inner apical angle of middle tibia bearing a large dense tuft of golden setae. Ventral surface of middle and hind tibiae with long slender rows of golden setae and other golden setae scattered irregularly between rows. Tarsal claws small, equal, strongly curved. Tarsal formula 5-5-5; basal segments longest. First abdominal sternum with low longitudinal carina on midline; carina extending about five-sixths the length of sternum.

Type-species.—Kruia chrysopelma, new species.

Etymology.—Kruia from Kru, a tribe of Liberian natives and a major language in that country. Gender: feminine.

This new genus has the basal segment of the hind tarsus longer than the second segment; antenna longer than the maxillary palpus; last glabrous antennal segment cuplike and snugly embracing triarticulate pubescent club; second segment of maxillary palpus distinctly thicker than third or fourth segments. Therefore, the genus belongs to the subfamily Sphaeridiinae. Furthermore, the head is not narrowed in front of the eyes and the anterior margin is broadly expanded and hides the bases of the antennae. Consequently this new genus is assigned to the tribe Sphaeridiini.

In d'Orchymont's (1937) key to sphaeridiine genera, *Kruia* runs to couplet 12 on the basis of the prosternum being long in front of the procoxal cavities and to *Dactylosternum* in couplet 13 because the mesosternum bears a large pentagonal process with narrow base, therefore, appearing triangular or sagittate, and the eyes are deeply emarginate by intrusion of a strong canthus. However, the facies as well as the morphology of *Kruia* is quite different from the genus *Dactylosternum.* For example, *Kruia* is brown; moderately convex, with extremely coarse punctures; punctures confused basally, in rows apically; elytral margins and anterolateral half of pronotum strongly explanate; eyes deeply emarginate; antenna 8 segmented; edge of broad, truncate clypeus narrowly but distinctly upturned; base of mesosternal process narrowly separated from metasternum; tibiae of middle legs each bearing a tuft of golden setae on inner apical angle; and metasternum

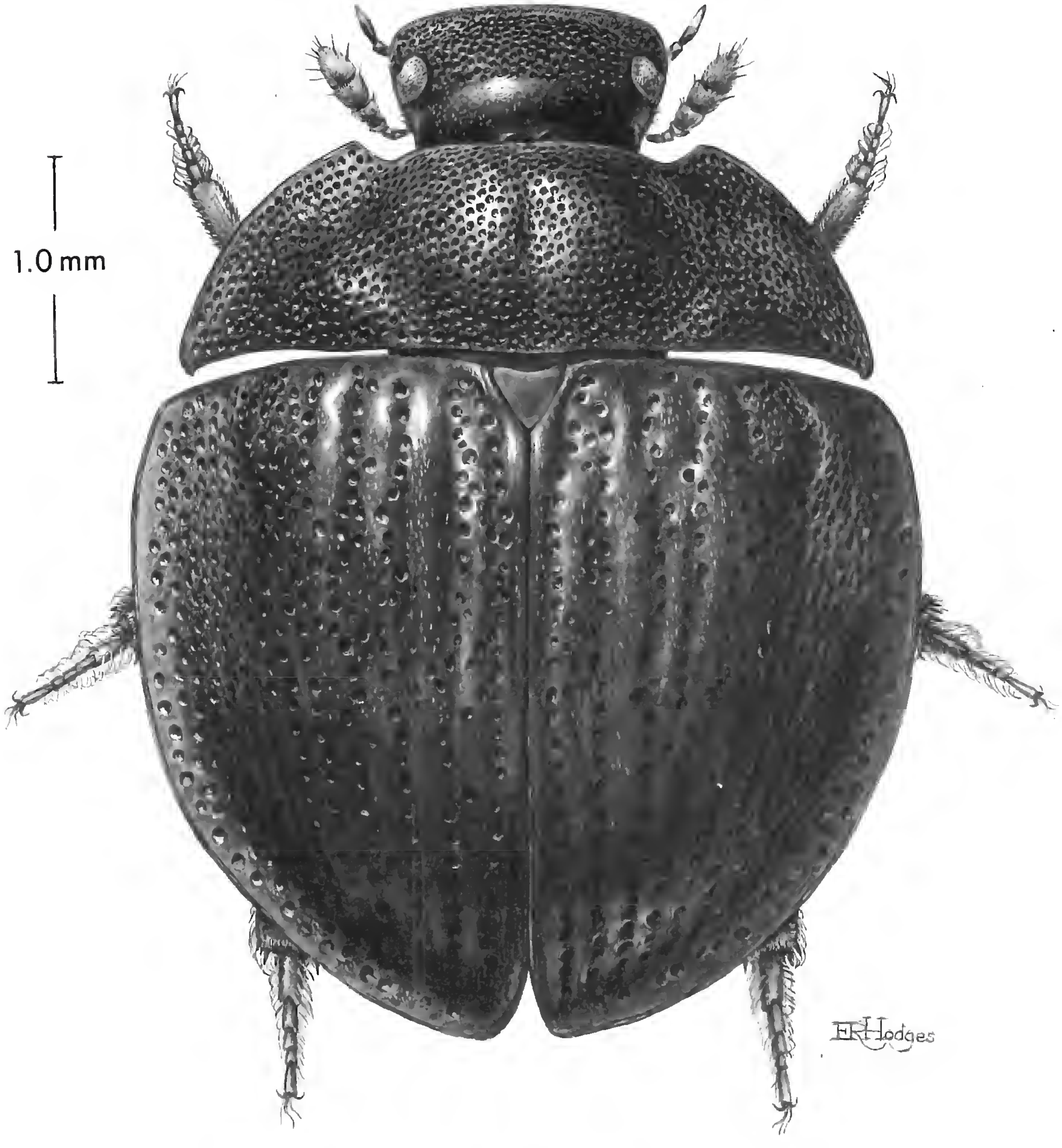


Fig. 1. *Kruia chrysopelma,* n. gen., n. sp., holotype, habitus view.

bearing two large posteromedial mammilliform processes in front of metacoxae. In contrast, *Dactylosternum* is black or black and red; usually strongly convex; elytra distinctly striate or with rows of punctures; punctures small; or moderate in width; elytral and pronotal margins not explanate, eyes may be moderately emarginate; antenna 9 segmented; edge of clypeus not exceptionally broad and not upturned anteriorly; base of mesosternal process broadly separated from metasternum; tibia of middle legs lacking tuft of golden setae; metasternum without large posteromedial processes.

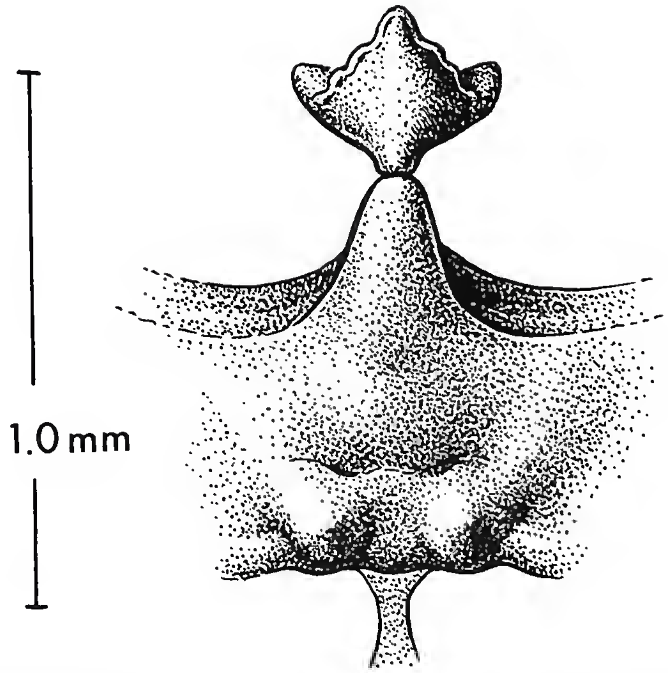


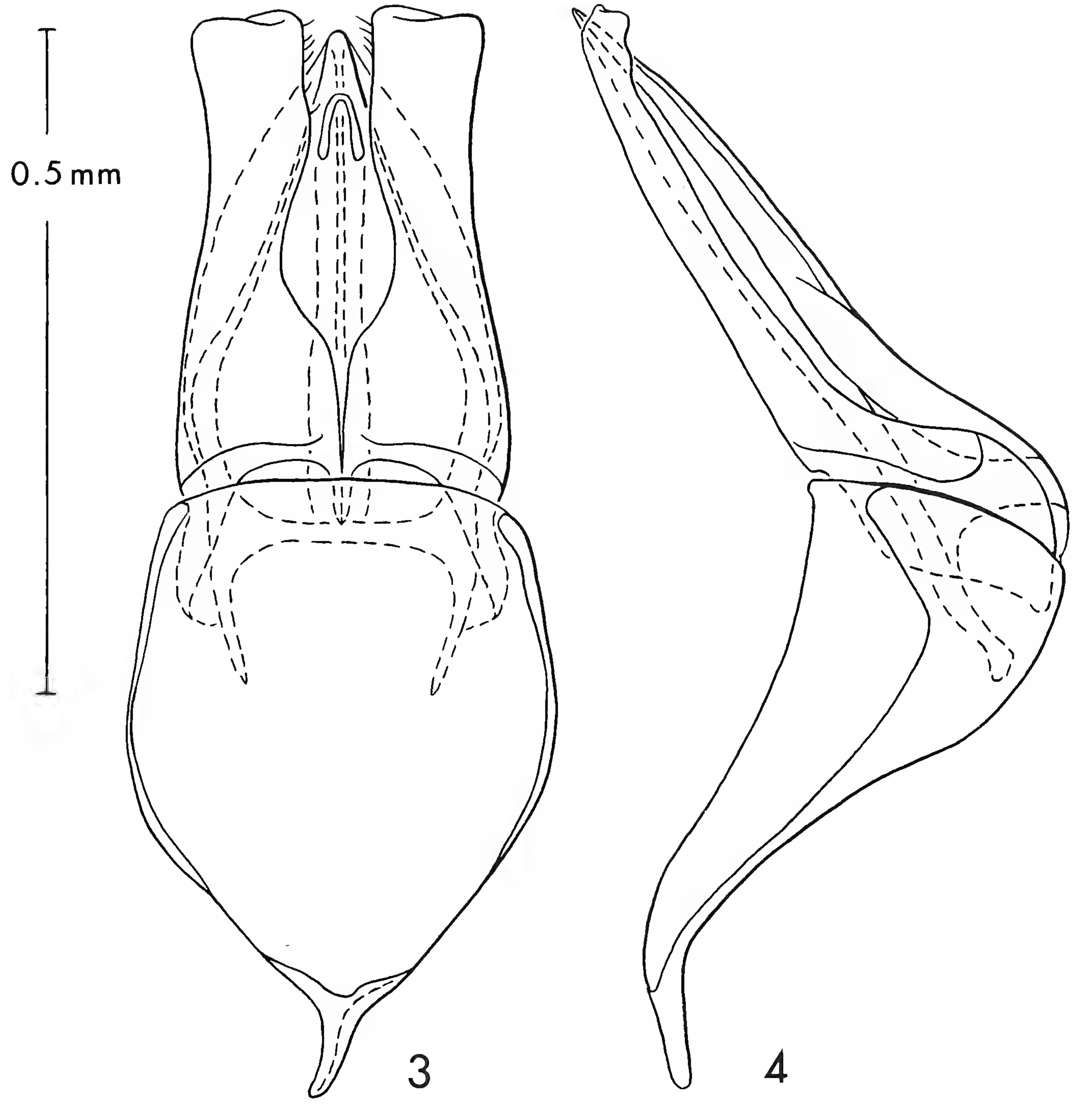
Fig. 2. *Kruia chrysopelma,* n. gen., n. sp., holotype, mesosternum and metasternum.

This new genus may be interpolated into d'Orchymont's key by referring to the following modified couplets.

12. Prosternum long in front of procoxal cavities; elytra striate or punctures in rows at least on apex 13
    Prosternum short in front of procoxal cavities; elytra without striae or rows of punctures .... *Dactylostethus* d'Orchymont
13. Eyes without canthus; mesosternum not sagittate 14
    Eyes sometimes with canthus; mesosternum sagittate 13a
13a. Antenna 8 segmented; elytral margins strongly explanate; clypeal margin upturned; base of mesosternal process narrowly articulates with metasternum .... *Kruia,* n. gen.
    Antenna 9 segmented; elytral margins not explanate; clypeal margin not upturned; base of mesosternal process broadly articulated with metasternum .... *Dactylosternum* Wollaston

Kruia chrysopelma, new species
(Figs. 1–4)

Body form (Fig. 1) broadly rounded; apicolateral halves of margins of pronotum and entire elytral margins broadly explanate. Length 6.8 mm; greatest width 5.5 mm slightly behind midlength. Color of dorsum dark reddish brown except head and pronotum almost piceous and explanate margins of elytra lighter reddish brown. Venter dark reddish brown with labrum, labium, and maxillae lighter reddish brown; antennae and maxillary and labial palpi testaceous.



Figs. 3–4. *Kruia chrysopelma,* n. gen., n. sp., holotype, male genitalia. Fig. 3, Ventral view. Fig. 4, Lateral view.

Head very coarsely, densely punctate; punctures as wide or slightly wider than basal width of ultimate segment of maxillary palpus and separated by about one-third width of a puncture. Clypeus greatly expanded shelflike in front of eyes, expanded laterally as a canthus extending to midlength of eye; anterior margin subtrunctate, slightly arcuate laterally; covering all except anterior margin of labrum. Labrum truncate, setose apically, and finely densely punctate. Ventral surface of head with genae microalutaceous; mentum and stipes coarsely, densely punctate and bearing dense, long, golden setae. Antenna and maxillary palpus as described for genus. Labial palpus

3 segmented; basal segment small, about one-fourth length of second segment; second segment broader than basal segment and bearing a dense tuft of golden setae encircling apex; third segment about half as long as second segment and bearing a tuft of golden setae on apex.

Pronotum slightly narrower at base than base of elytra; about three times wider than long at middle of disc; strongly arcuate laterally; sides narrowly margined; discal area strongly swollen and shallowly broadly longitudinally grooved on midline; punctures larger than those on head and those on disc slightly more widely separated; with a few fine sparse punctures on intervals between coarse punctures. Anterolateral and posterolateral angles obtuse; hypopleura broad, almost vertical, and microreticulate.

Scutellum a moderately large isosceles triangle with base wider than length of sides; bearing two moderately coarse punctures.

Elytron broad, moderately convex, strongly explanate laterally; shining; with broad sutural stria; bearing 10 or 11 rows of very coarse punctures, confused on base and only slightly more distinct apically; humerus swollen; with indications of 3 subcostate intervals on base between humerus and suture. Epipleuron wide; with dense transverse striolae; almost vertical opposite mesosternum and metasternum then becoming almost horizontal to apex.

Prosternum, mesosternum, and metasternum as described for genus. Front, middle, and hind legs with femora microalutaceous; with coarse, sparse punctures; each puncture bearing a short golden seta. Middle and hind tibiae arcuate, narrow at base and diverging strongly to apex; ventral surface with several rows of golden setae along margins and other golden setae scattered between rows. Tarsi with long, dense, golden setae ventrally; basal metatarsal segment longest, about twice as long as second segment; second segment slightly less than third and fourth segments combined; fourth segment shortest; fifth segment as long as third and fourth combined; tarsal claws small, equal in length, and rather strongly curved.

Abdominal sterna with very short dense golden setae; except sparse on middle of second through fifth sterna. First sternum with low, distinct carina on basal five-sixths. Last sternum rounded.

Genitalia as illustrated (Figs. 3 and 4).

Female.—Unknown.

Etymology.—*chrysopelma,* from chrysos, G.—gold, plus pelma from pelma, G.—sole of the foot; in reference to the long, dense, golden setae on the ventral surface of the tarsi.

Type-data.—Holotype male.—LIBERIA, Bendija, Smithsonian Firestone Exp. 1940, W. M. Mann; USNM Type No. 75668, deposited in the National Museum of Natural History, Smithsonian Institution.

Acknowledgments

We are indebted to Mrs. Elaine R. Hodges, Smithsonian Institution staff artist, for preparing the carbon dust and line drawings included herein.

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PAN-PACIFIC ENTOMOLOGIST
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SCIENTIFIC NOTE

NOTES ON NEARCTIC *HELICHUS* (COLEOPTERA: DRYOPIDAE)

The genus *Helichus* Erichson was established for the nearctic species *lithophilus* (Dryops) Germar in 1847. Since that time almost sixty names and descriptions have appeared for species from nearly all continents, which have been assigned to that genus. In the Nearctic Region alone approximately twenty names have been proposed.

Revisionary studies of the nearctic forms are still incomplete; nevertheless, some facts may be securely presented at this time.

A small complex of species exists within the "lithophilus group" of Hinton (1935, Pan-Pac. Entomol., 11:71), consisting of *striatus* LeConte, *foveatus* LeConte, and *columbianus* W. J. Brown. For almost half a century all three names have been considered as applying to a single species population occurring transcontinentally in North America (cf. Brown, H. P., 1972, USEPA Water Poll. Control Res. Ser. 18050ELD04/72:1–82).

It is now possible to state that *H. columbianus* Brown is a distinct species. Its range extends from central California at least into southern Oregon, all across southern British Columbia, and into western Montana.

Helichus striatus LeConte occurs from southeastern British Columbia (apparently in the same streams as *H. columbianus*) completely across southern Canada, including western Newfoundland (reported here for the first time), as well as adjacent parts of the United States. This species is unknown from the west coast of the U.S. In the East I have seen specimens only from as far south as Connecticut, southern New York, Indiana, Illinois, and Iowa. Except for a record in extreme southern Indiana given by Finni and Skinner (1975, J. Kans. Entomol. Soc., 48:388–395), all eastern localities appear to be in recently glaciated country.

It is not yet possible to certainly settle the status of populations ranging from northern Mexico to Utah and Nevada. LeConte described *H. foveatus* from New Mexico, which may be, at most, a subspecies of *striatus*. In any event, *foveatus* is not the same as *columbianus*.

Differences between *columbianus* and *striatus* will be presented in detail in a future publication. Here it may simply be noted that *columbianus* is a larger more robust form that has a noticeable inflation of the elytra at the apical two-fifths (absent in *striatus/foveatus*). Males of the two species are readily distinguishable by examining the lateral aspect of the genitalia. Thus, in *columbianus* the lateral lobes are gradually acuminate to the tip; in *striatus/foveatus* the lateral lobes are continuously smoothly rounded, being blunt at the extreme tip. Holotypes of these species have been studied.

In Musgrave's synopsis of the genus (1935, Proc. Ent. Soc. Wash., 37:137–145) a geographical record for *H. confluentus* Hinton has been a puzzle, and has been repeated in the literature. It requires correction.

Musgrave reported *H. confluentus* as occurring in Georgia at Rabun Bald, as well as in the southwestern United States, where it undoubtedly lives. Examination of collections of the Academy of Natural Sciences of Philadelphia disclosed a series of nine specimens studied by Musgrave, which evidently led to the error. (Another specimen from this series is present in the Musgrave Collection at the Illinois Natural History Survey.) All bear the same Georgia locality data, and were in extremely dirty condition. After cleaning it was discovered that three species were included in the series, all of which are common in the southwestern U.S., and all otherwise unknown from the southeastern states. It seems clear enough that the set of specimens simply received an incorrect label during preparation, and that Musgrave was misled. The Georgia record for *confluentus* should be removed from future catalogs.

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HULEECHIUS, A NEW GENUS OF RIFFLE BEETLES FROM MEXICO AND ARIZONA (COLEOPTERA, DRYOPOIDEA, ELMIDAE)

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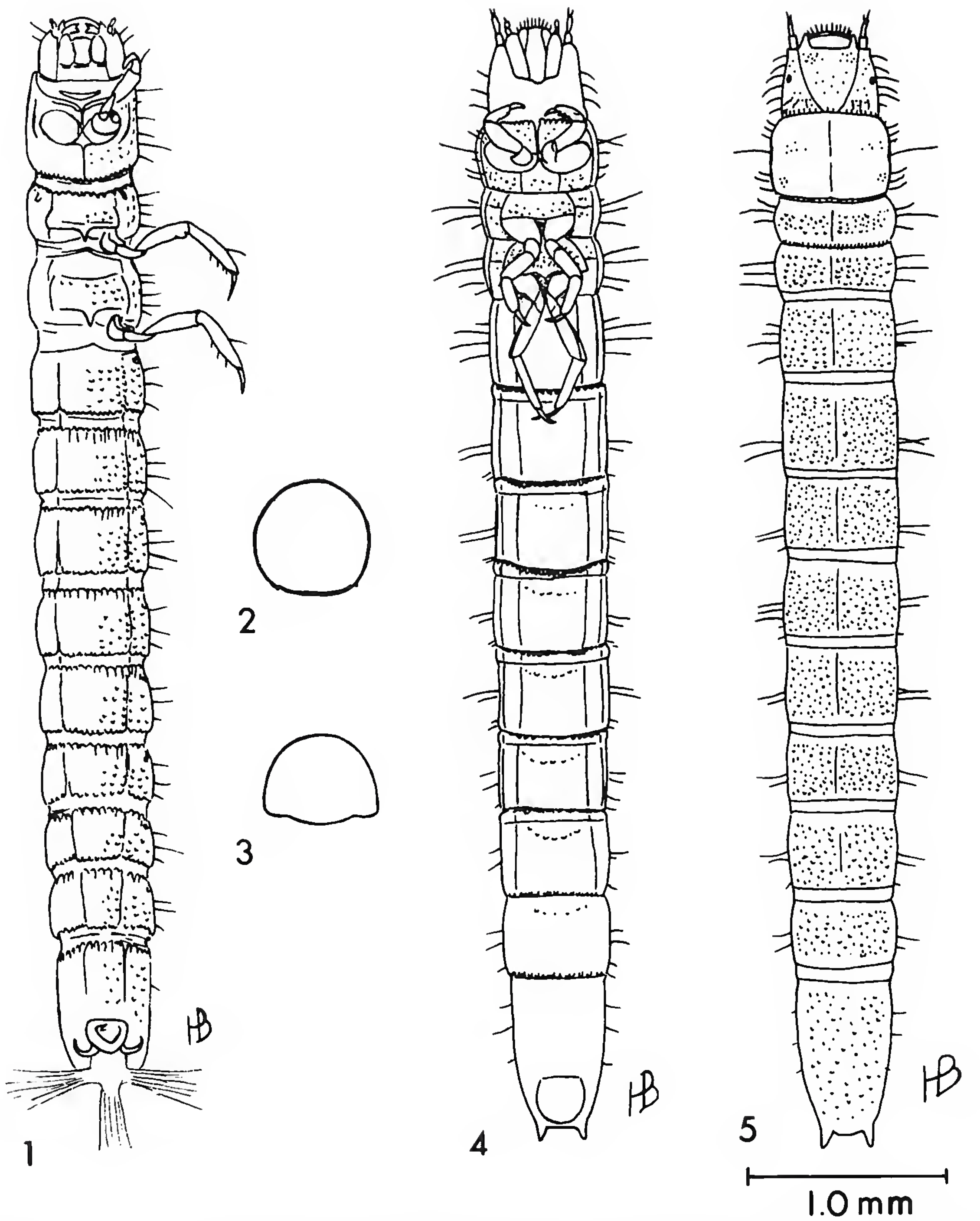
The southern portion of the Mexican state of Baja California is quite arid, as is most of the peninsula. Something of an oasis amid the typical thorn and cactus scrub of the area is the small village of Caduaño, which is located some 30 km from San José del Cabo and 15 km below the Tropic of Cancer. Caduaño boasts several modest springs, only one of which produces more than a mere trickle of water. At least, such was the case during my visits to the site in the summers of 1973 and 1974. The largest spring (or cluster of springs) gave rise to a stream about 30–50 cm wide, 2–5 cm deep, and less than 30 m in length, ending in a small impoundment. The substrate was sand and fine gravel, with an occasional larger pebble. In 1973 the stream was completely overgrown, chiefly by bamboo or "river grass," which, in turn, was overhung by palms and other trees. Access to the stream was at an inconspicuous watering place just above the impounded pool, shared by people and cattle. To collect in the stream I had to stoop—almost to crawl—in the tunnel of vegetation.

The water was crystal clear and cool, and swarmed with amphipods. The only dryopoid beetles I found were blackish elmids ranging from 2.25 to 2.75 mm in length and their larvae, which were yellowish brown, subcylindrical, and about 6 mm in maximum length—very much like tiny elaterid wireworms. The larvae caught my attention. I thought them to be those of *Cylloepus,* and was delighted to find them relatively abundant, for in my 10 years of tropical collecting I had gotten *Cylloepus* larvae only once (in Bolivia) despite the numbers of assorted adults from scores of localities (Brown, 1977).

Later, when I had time and facilities to examine my preserved material, I was not disappointed. But the larvae were not those of *Cylloepus,* though they bear a close superficial resemblance, as do the adults. The combination of larval and adult features indicated that this population represented a genus not previously described.

In June of 1974 I returned to Caduaño with the hope of obtaining pupae of the new genus and of gaining more information concerning the ecology and life history of this population. To my dismay, the habitat had been



Figs. 1–5. Fig. 1. *Cylloepus parkeri* Sanderson, ventral aspect of larva. On the prothorax, the pleurites meet midventrally both behind and in front of the coxae. There are no perceptible meso- or metathoracic pleurites. On the abdomen, sterno pleural sutures extend even onto the last segment. Tergopleural sutures are lateral and cannot be seen from this view, but they also extend onto the last segment. Anal gill filaments extended. Fig. 2. *Cylloepus parkeri,* diagrammatic cross-section of larva. Fig. 3. *Huleechius marroni,* n. sp., diagrammatic cross-section of larva. Fig. 4. *Huleechius marroni,* n. sp., ventral aspect of larva. On the prothorax, note median posterior sternite. Each thoracic segment has distinct pleurites and tergo-pleural sutures. On the abdomen, pleural sutures occur only on segments 1–7. Fig. 5. *Huleechius marroni,* n. sp., dorsal aspect of larva.

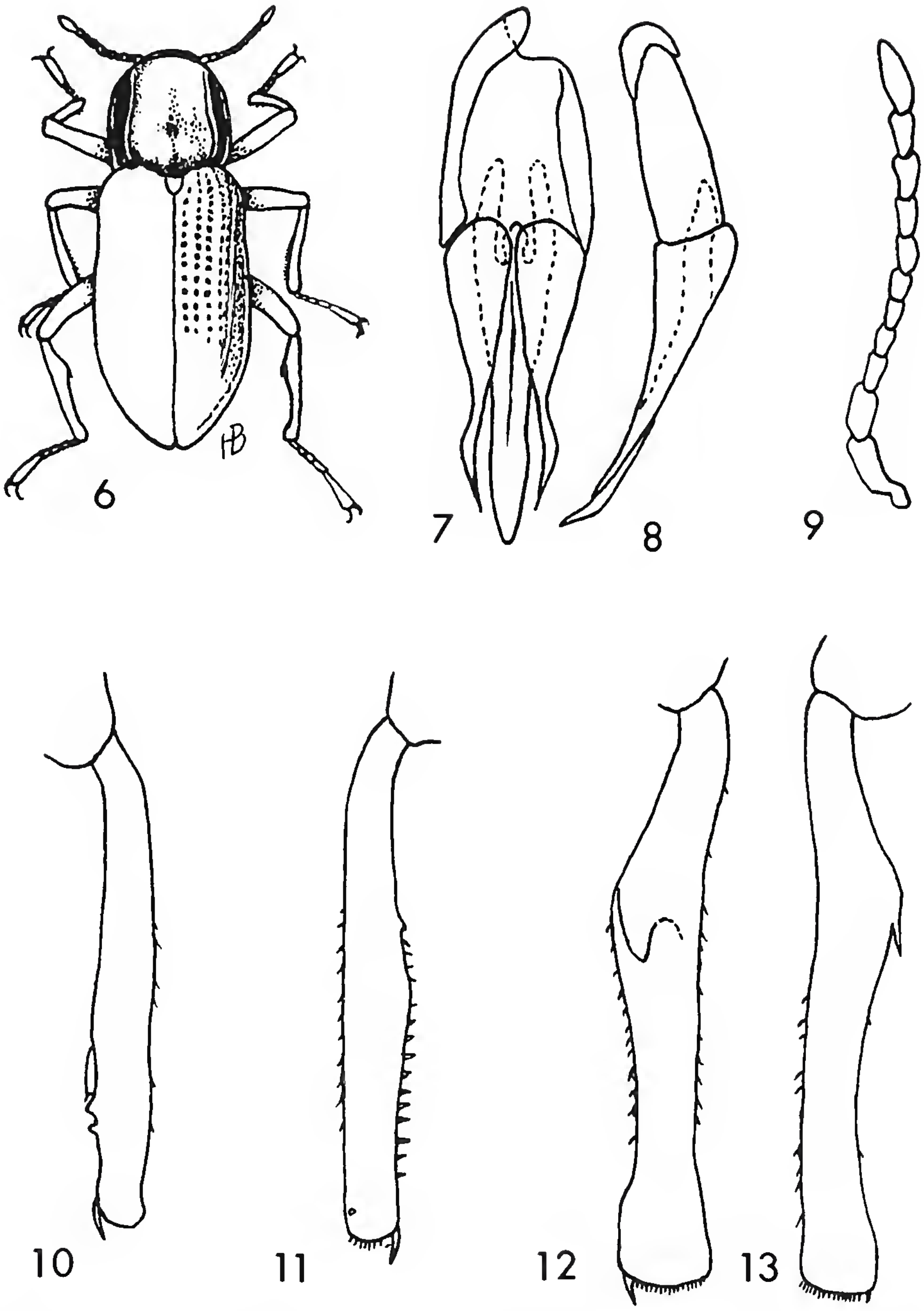
greatly altered. Gone was all the overhanging vegetation. The entire stream course was open and sunlit—and had been thoroughly cleaned out. An hour or two spent examining every little stone in the brook revealed not a single dryopoid, though a number of other groups of aquatic invertebrates were now thriving. Since I have not found specimens of this genus in any other streams of Baja California (though some harbor a reasonable assortment of elmids), it is possible that the genus has been extirpated from the peninsula. For this reason, it seems wise not to designate this local species as type for the genus, but to select one that presumably occupies a less tenuous position. Hinton described such a species in 1934, elaborating upon it in 1940, when he also described what must have been the larvae of his *Cylloepus spinipes*. He had no basis for associating adult with larva, and, quite appropriately, referred to the larva as representing ''*Elsianus* (?) sp. ?'' In my own collection I find adults of the new genus among unidentified specimens of *Cylloepus*, and larvae among those classified as *Elsianus* or ''near *Elsianus*.''

As in the case of *Neocylloepus* (Brown, 1970), I should stress the point that it is the almost certain association of larval type with adult which forces me to conclude that the adults cannot belong to the genus *Cylloepus*. The larva of *Cylloepus* (Fig. 1), first described by Hinton (1940), is unique among elmids in several respects: (1) it lacks tergopleural thoracic sutures; (2) prothoracic pleurites meet in the midventral line posterior to the procoxal cavities as well as anterior to them; (3) mesothoracic and metathoracic pleurites are absent; (4) the first abdominal segment has only sternopleural sutures, but all the remaining abdominal segments have both tergopleural and sternopleural sutures which even extend onto the basal half of the ninth segment, never converging. The larva of the new genus exhibits none of these rather basic features, being quite conventional and resembling very much the larvae of such major genera as *Elsianus* and *Stenelmis*. Prodded by such convincing evidence from the larvae, I have simply had to seek valid characters for separating the adults from those of bona fide *Cylloepus*.

Huleechius, new genus

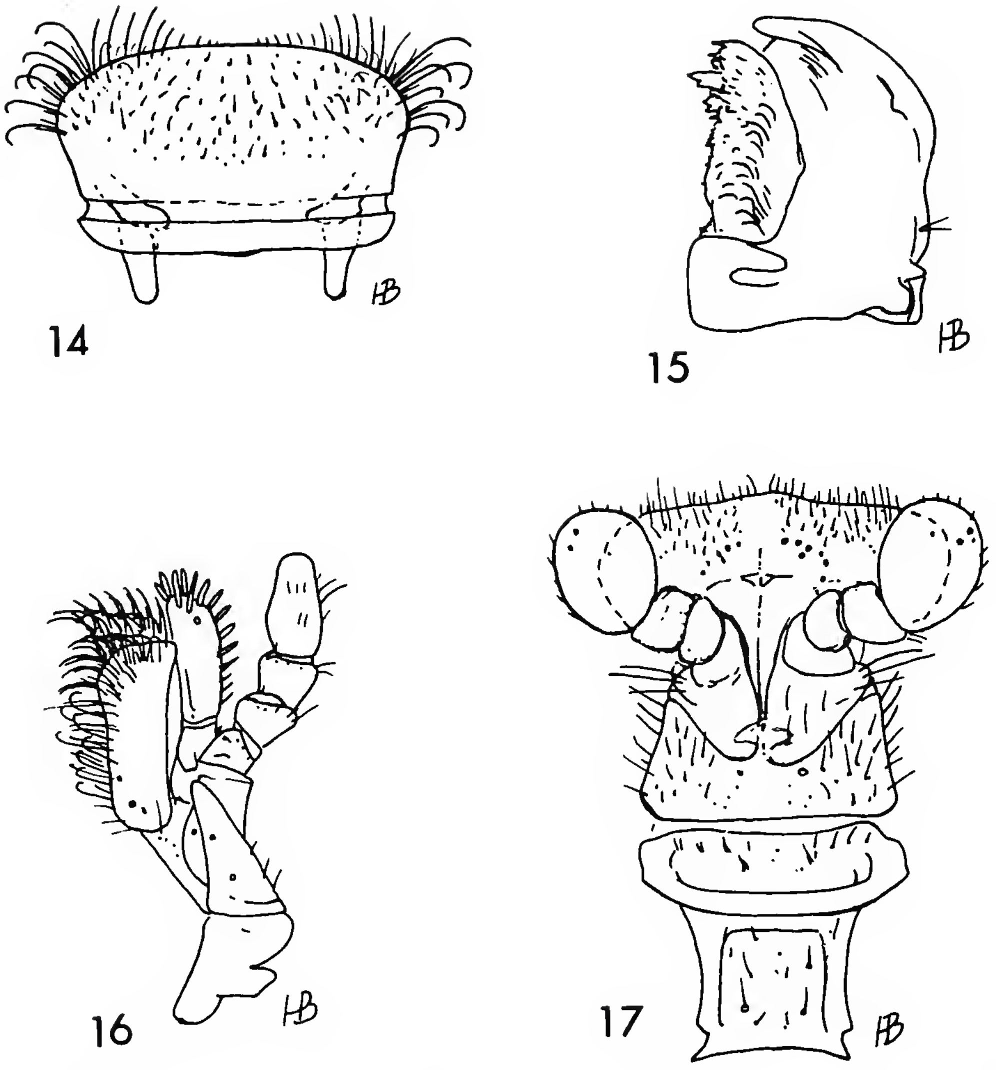
(Figs. 3–34)

Description.—Body elongate, subparallel. Dorsal surface clothed with short, recumbent hairs. Tomentum on genae, epipleura, sides of thoracic and abdominal sternites (none on hypomera), and legs (except tarsi). *Head* retractile almost to antennal base. Antenna 11-segmented, filiform (Fig. 9). Mandible (Fig. 15) with 3 chisel-like apical teeth; prostheca large, membranous, with spinose apex. Maxilla (Fig. 16) with rather small, 4-segmented palp; stipes with well-developed palpifer; galea and lacinia separate and apex of each spinose. Labium (Fig. 17) with palp 3-segmented; prementum



Figs. 6–13. Fig. 6. *Huleechius marroni,* n. sp., adult male, dorsal aspect. Figs. 7–13. *Huleechius spinipes* (Hinton). 7, Male genitalia, dorsal aspect; 8, same, lateral aspect; 9, antenna; 10, front leg, tibia; 11, middle tibia; 12, hind tibia, inner aspect; 13, same, lateral aspect (all from Hinton, 1940).

with palpiger; mentum and submentum transverse. Gula rectangular, conspicuously narrower than mentum or submentum. *Pronotum* on each side with a sublateral longitudinal carina extending from base to apex; with a median longitudinal impression on disk. *Elytra* striate and punctate; without accessory striae; with 2 sublateral carinae. *Hind wing* (Fig. 19) without radial cross-vein or closed anal cell; cubito-anal cross-vein complete, joining cubitus to remnant of first anal; branches of second anal apparently fused; third anal without a second branch. *Prosternum* (Fig. 18) very long in front of procoxae; prosternal process rather long, with posterior margin rounded.



Figs. 14–17. *Huleechius marroni,* n. sp., adult male. Fig. 14. Labrum. Fig. 15. Mandible. Fig. 16. Maxilla. Fig. 17. Labium and gula.

Mesosternum with a rather deep median groove for the reception of the prosternal process, followed by an impressed line to posterior margin. Metasternum with a median longitudinal impressed line. Abdomen slightly longer than broad, with segments 1 and 5 longest; segment 5 on each side with apicolateral margin curled upward and inward to clasp invaginated epipleural margin of elytron. Legs with visible portions of coxae rounded and trochantin concealed by hypomera; tibiae of male with pronounced secondary sexual characters (Figs. 10–13, 20–22); claws without teeth. *Alimentary canal* with 8 caeca on anterior margin of midgut; hind gut with 6 Malpighian tubules. *Male genitalia* (Figs. 7, 8, 23–25) with basal piece well developed; both penis and parameres long and acute at apex. *Female genitalia* (Fig. 26) with both coxites and styli relatively elongate.

Type-species.—Cylloepus spinipes Hinton (1934).

Etymology.—Huleechius is named in honor of Hugh Leech; gender masculine.

Comparative notes.—Huleechius is close to such genera as *Stenelmis, Ordobrevia, Cylloepus, Hexacylloepus,* and *Elsianus.* In the keys of Hinton

(1940), Leech and Chandler (1956), Leech and Sanderson (1959), Arnett (1963), and Brown (1976), adults of the new genus key out to *Cylloepus,* from which they differ in having the gula distinctly narrower than the submentum or mentum, in lacking vein $3A_2$ in the hind wing, in the structure of the male genitalia, and in the nature of the secondary sexual characters of the tibiae of males. *Huleechius* differs from *Stenelmis* and *Ordobrevia* in having hairy tomentum on the anterior tibiae, from *Ordobrevia* and *Elsianus* in lacking an accessory elytral stria between the sutural and second striae, from *Elsianus* in having a median longitudinal impression on the pronotum, and from *Hexacylloepus* in lacking a belt of tomentum across the pronotal hypomeron, in having 8 rather than 6 caeca at the anterior end of the midgut, and in having 6 rather than 4 Malpighian tubules. As mentioned earlier, the larvae of *Huleechius* resemble those of *Cylloepus* only in such superficial features as their very slender, parallel-sided form. They differ from larvae of *Cylloepus* in possessing tergopleural thoracic sutures, a median posterior prosternum, mesothoracic and metathoracic pleurites, and pleural sutures that end on the 7th segment of the abdomen rather than extending all the way to the middle of the 9th segment. The larvae of *Huleechius* are fundamentally very similar to those of *Stenelmis* and *Elsianus* in all the features listed above, as will be discussed in the section dealing with larvae.

Key to the Species of *Huleechius*

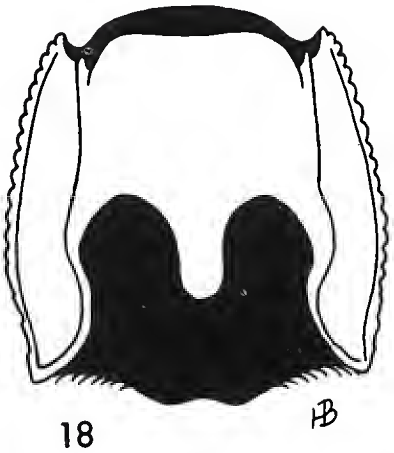
1. Pronotum with disk distinctly granulate; elytra with intervals virtually flat; size larger (at least 2.8 mm) .... *H. spinipes* (Hinton)
   Pronotal disk not noticeably granulate; elytral intervals moderately convex; size smaller (less than 2.8 mm) 2
2. Uniformly very dark brown to black, or elytra with sutural intervals and sublateral carinae somewhat lighter in color, giving the impression of faint vittae .... *H. marroni* Brown, n. sp.
   Pronotum darker than elytra, color ranging from light to moderately dark brown; sutural intervals may be darker than rest of elytral disk .... *H. marroni carolus* Brown, n. subsp.

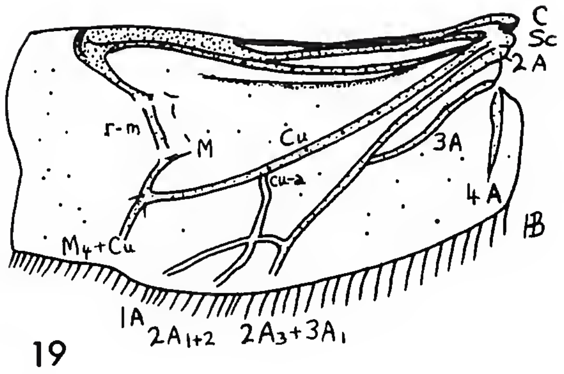
Huleechius spinipes (Hinton), **NEW COMBINATION**
(Figs. 7–13)

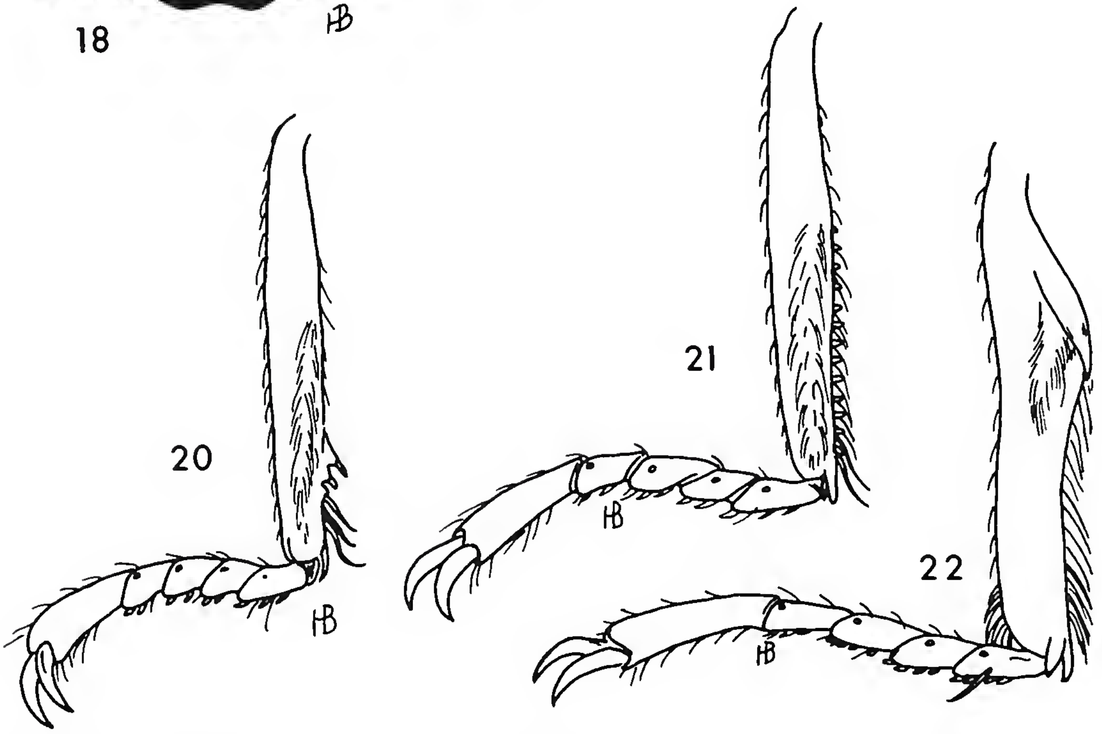
Cylloepus spinipes Hinton 1934. Rev. Ent., Rio de J., 4(2):192.

The following description of this, the type-species of the new genus, is taken from Hinton's (1940) redescription of the species, together with the figures he provided.

Male.—Length, 3.0–3.4 mm; breadth, 1.1–1.3 mm. Clothed with fine, short (about 0.038 mm long), recumbent, brownish-testaceous hairs which arise mostly at intervals equal to slightly less than their lengths; antennae similarly but more sparsely clothed; apical half of labrum clothed with equally fine but much longer (as long as 0.087 mm at sides) and paler hairs which are more erect and much denser. Cuticle shining and for the most part densely alutaceous; piceous to dark rufopiceous; antennae, mouth-parts, and legs paler rufopiceous. Tomentum cinerous with moderate golden reflections. *Head* with a scarcely noticable, broad, feebly oblique impression which extends shortly on each side near anterior half of eyes. Clypeal suture strongly impressed and feebly arcuate; anterior margin of clypeus very broadly and feebly arcuately emarginate, with the angle on each side obtusely rounded and sides moderately arcuate. Labrum broadly and feebly rounded in front, with the angle on each side broadly rounded. Surface with the alutaceous microsculpture appearing somewhat granulate; with granules which are usually round, slightly coarser than facets of eyes, and usually separated by less than to once their diameters; granules on clypeus similar; labium without granules, apical half punctate with very fine punctures which are usually separated by once to twice their diameters. *Pronotum* at broadest point, which is at basal half, broader than long (1.05:0.97 mm) and base broader than apex (0.96:0.72 mm). Apical margin as seen from above moderately feebly arcuate at middle and deeply sinuate on each side behind eye before apical angle; apical angles acute and strongly produced forwards and very slightly inwards; sides feebly arcuate, more strongly so at basal half, nearly straight at apical fourth and scarcely noticeably sinuate just before basal angles; lateral margins feebly crenate; basal angles feebly acute, nearly rectangular and scarcely produced; base trisinuate, broadly and moderately strongly sinuate on each side and shortly and very shallowly sinuate in front of scutellum. *Pronotum* with the sublateral carinae prominent, very slightly converging towards apex, moderately sinuate at basal two-fifths, and extending to apical margin, while the broadest portion of the carinae is from basal fifth to apical fourth. Pronotum also as follows: a very broad and feebly raised portion extends from base to base of disk; on each side of this raised area with a feeble, moderately broad, feebly curved and oblique impression extending to broad, moderately shallow, indefinite impression near sinuation of sublateral carina which when viewed from a nearly lateral position seems to very shallowly extend across sublateral carinae at about middle; median longitudinal impression in some specimens extending from base to basal third as a very shallowly impressed line and in others beginning only at basal third, but in all extending from basal third to about apical third as a navicular, moderately deep impression which is broadest at middle where it is not quite as broad as scutellum. Surface with the alutaceous microsculpture similar but not as evident as that of head; set with round to feebly obovate granules which are nearly twice as coarse as facets of eyes,

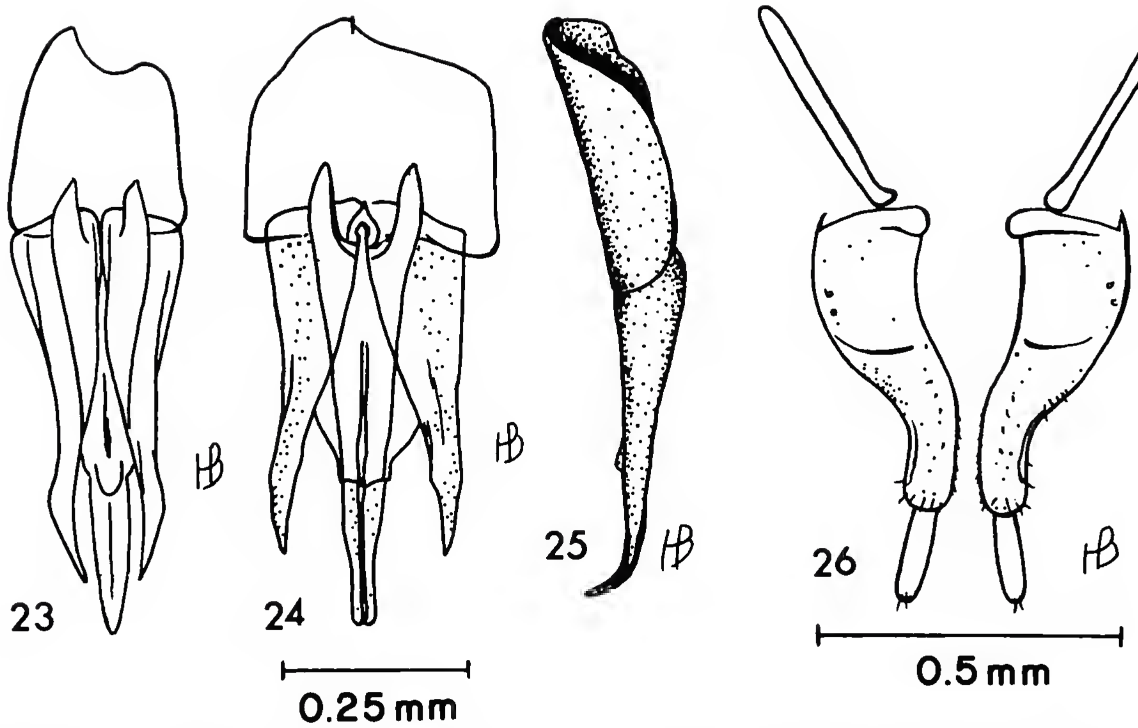






Figs. 18–22. *Huleechius marroni,* n. sp., adult male. Fig. 18. Prothorax, ventral aspect. Fig. 19. Hind wing, with venation after Forbes. Fig. 20. Front tibia and tarsus. Fig. 21. Middle tibia and tarsus. Fig. 22. Hind tibia and tarsus.

low (only feebly convex), and are usually separated by slightly less than their own diameters; granules on sublateral carinae coarser and denser; granules anteriorly on disk slightly finer and sparser. *Elytra* more than twice as long as pronotum (2.30:0.97 mm) and feebly broadening to broadest point, which is at apical third, and is here broader than base of pronotum (1.32:0.96 mm). Apices broadly and moderately feebly produced and conjointly broadly rounded. Lateral margins feebly but regularly crenate. Surface striate with the discal striae moderately coarse at base, becoming finer towards apex, and beyond apical fourth obsolete except for sutural; discal strial punctures round to subquadrate and at basal third a third to two-thirds as broad as intervals, separated longitudinally by once to twice their diameters; these punctures are narrower basally and towards apex rapidly become fine and sparse so that at apical eighth they are about a fourth as coarse as those at basal third. Discal intervals nearly flat and subequal in breadth, at base



Figs. 23–26. *Huleechius marroni,* n. sp., adult. Fig. 23. Male genitalia, ventral aspect. Fig. 24. Same, but more flattened beneath cover glass. Fig. 25. Same, but lateral aspect. Fig. 26. Female genitalia.

all except sutural are slightly convex, and of the convex intervals the third is only slightly more so than the others; surface of intervals at base alutaceous somewhat as pronotum, elsewhere much more sparsely and differently alutaceous; on basal fourth set with granules which are similar in size to those of pronotum and similarly distributed; these granules rapidly become sparser so that beyond basal half the disk is free of granules; granules of carinate intervals equal in size and density to those of elytral base. *Scutellum* flat, subovate, broader than sutural interval (0.14:0.10 mm), longer than broad (0.15: 0.14 mm), very feebly and broadly rounded basally, nearly truncate, and at apex narrowly rounded; surface nearly free of granules. *Prosternum* with the process rounded at apex; prosternum and process evenly and moderately depressed, with the anterior two-thirds (not including prosternal process) strongly and abruptly lobed; surface granulate as that of elytral base; hypopleura slightly more sparsely granulate. Mesosternum nearly entirely depressed for the reception of the prosternal process; sides near middle coxae very strongly and broadly raised and at apex with a dozen or less slender, long (about 0.075 mm), erect, brownish-testaceous hairs; surface similar to prosternum but more sparsely granulate. Metasternum with nearly the entire discal region occupied by a deep, transverse, oval depression; posterior margin on edge of each side of middle with a moderately deep and large subtriangular impression; with a broad (0.375 mm broad in specimen 3.0 mm long) and shallow median longitudinal impression which ends rather abruptly at apical fifth and basal seventh; discal surface granulate similarly to pronotum; sides similarly sculptured but with the granules sparser and extreme sides with the granules very flat. Middle basal portion of first abdominal sternite strongly depressed and sculptured similarly to metasternal disk; ventral sternites elsewhere more sparsely granulate than disk of metasternum and especially sparsely so at middle. Front tibiae with three toothlike structures as figured (Fig. 10). Middle tibiae with a ventral row of teeth (Fig. 11). Hind tibiae with a large, flat, knife-like tooth on inner ventral side at basal two-fifths (Figs. 12, 13). Surface of femora and tibiae granulate similarly to ventral abdominal segments. *Genitalia* as figured (Figs. 7, 8).

Female.—Externally similar to male except as follows: (1) sides of mesosternum only moderately convex and without the group of long hairs; (2) disk of metasternum not as broadly nor as strongly depressed; and (3) front and hind tibiae without the toothlike structures and middle tibiae without the row of teeth.

Type.—Male in the U.S. National Museum. MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. 6000–7000 ft, May–July 1933 (H. E. Hinton and R. L. Usinger).

Specimens examined.—68, with same data as type but a few of these also collected at Temascaltepec, alt. about 5000 ft; 25, as above but collected in June and July, 1934 (H. E. Hinton).

Variations.—The only notable variation is that in some specimens the median longitudinal line on the pronotum extends from base to basal third as a very shallowly impressed line, while in others it is absent on basal third and only present from basal third to apical third.

Although the description above is adapted from Hinton (1940), I might add that I have collected a few additional specimens from other localities in Mexico, as follows: also in the state of Mexico, 2 adults from near Ixtapan de la Sal 19/XI/64, and 1 from Cieneguillas 13/VIII/70; 1 from Coahuila near Bella Union 16/VIII/70; 1 from Jalisco s. of Mazamitla 23/XI/64; 1 from Nuevo Leon in the Rio Ramos n. of Linares 8/X/64. The latter two are only 2.8 mm in length, and may actually represent another closely-related species.

Huleechius marroni, new species
(Figs. 3–6, 14–34)

Holotype.—Male. Like *H. spinipes* (Hinton) except as follows: length 2.5 mm, width 0.95 mm; pronotum 0.8 mm in length and width, broadest at basal third; elytra 1.85 mm in length, 0.95 mm in width, broadest at or just posterior to middle; antenna 0.7 mm in length, slightly greater than width of head across eyes. Antenna testaceous rather than rufopiceous. Labrum

(Fig. 14) not granulate, with long, pale hairs mostly curved rather than straight. Mandible as figured (Fig. 15). Maxilla (Fig. 16) with galea and lacinia spinose laterally as well as apically; palp small, with apical segment not enlarged. Labium (Fig. 17) with apical segment of palp less flattened and pubescent than in male of *H. spinipes*. Gula square, about half as broad as submentum. Pronotum with granulation inconspicuous. Elytral intervals moderately convex. Hind wings reduced (Fig. 19), proportionately much smaller than in *H. spinipes*. Prosternum (Fig. 18) medially less depressed and less coarsely granulate than in *H. spinipes*. Mesosternum with pale hairs on lateral prominences less conspicuous than in *H. spinipes*. On the tibia of the front leg (Fig. 20), of the inner subapical spines, the first or proximal one differs from that of *H. spinipes* in being less apically directed, but the features of all 3 tibiae (Figs. 20–22) are remarkably similar to the corresponding ones of *H. spinipes* (Figs. 10–13). The male genitalia (Figs. 23–25) are also strikingly similar to those of *H. spinipes*.

Variations.—Other males range from 2.15 to 2.65 mm in length and 0.85 to 1.0 mm in width. In some, the sutural intervals and sublateral carinae are slightly paler in color than the rest of the elytra, giving an appearance of faint vittae.

Females.—Slightly larger than males (length 2.4–2.75 mm, width 0.9–1.1 mm) and externally similar to males except as in *H. spinipes*. Female genitalia are shown in Fig. 26.

Types.—Holotype male: MEXICO: Baja California Sur: spring at Caduaño, Trapiche de Marrón, 28/VII/73, H. P. Brown, deposited in the National Museum of Natural History, Smithsonian Institution. Allotype: same data as holotype, deposited with holotype. Paratypes: 32 with same data as holotype, some deposited in the collection of the California Academy of Sciences, but most in the Stovall Museum of Science and History, Norman Oklahoma.

Etymology.—The species is named in honor of Sr. Anselmo Ciro Marrón Alvarez, on whose property the specimens were collected and who graciously conducted me to the site and gave me permission to collect.

Habitat.—All specimens were taken from a small, clear, spring-fed brook less than 1 m in width and no more than a few cm in depth, completely shaded by overhanging vegetation. The substrate was sand and rather fine gravel. The surrounding region is quite arid. Caduaño is south of the Tropic of Cancer, just a few miles north of San José del Cabo. No other dryopoid beetles were seen in the stream.

Comparative notes.—Members of this species are smaller and less noticeably granulate than those of *H. spinipes*. From specimens of *H. marroni carolus* they differ most conspicuously in their much darker and essentially uniform coloration.

Huleechius marroni carolus, new subspecies

Holotype.—Male. Length 2.35 mm, width 0.9 mm. Like *H. marroni* except as follows: pronotum smooth, darker than elytra. Labrum with pale hairs reduced to stubble.

Variations.—Other male 2.5 mm in length, 0.95 mm in width.

Females.—Slightly larger than males (length 2.6–2.7 mm, width 0.97–1.0 mm) and externally similar to males except as in *H. spinipes.*

Types.—Holotype male: ARIZONA: Gila Co. border with Graham Co., in San Carlos River ca. 30 km e San Carlos, 3/VIII/73, H. P. Brown, deposited in Stovall Museum of Science and History, Norman Oklahoma. Allotype: same data as holotype, deposited with holotype. Paratypes: 1 male with same data as holotype, deposited in the National Museum of Natural History, Smithsonian Institution, and 1 female with same data except collected 20/VI/74, deposited in the entomological collection of the University of Arizona, Tucson.

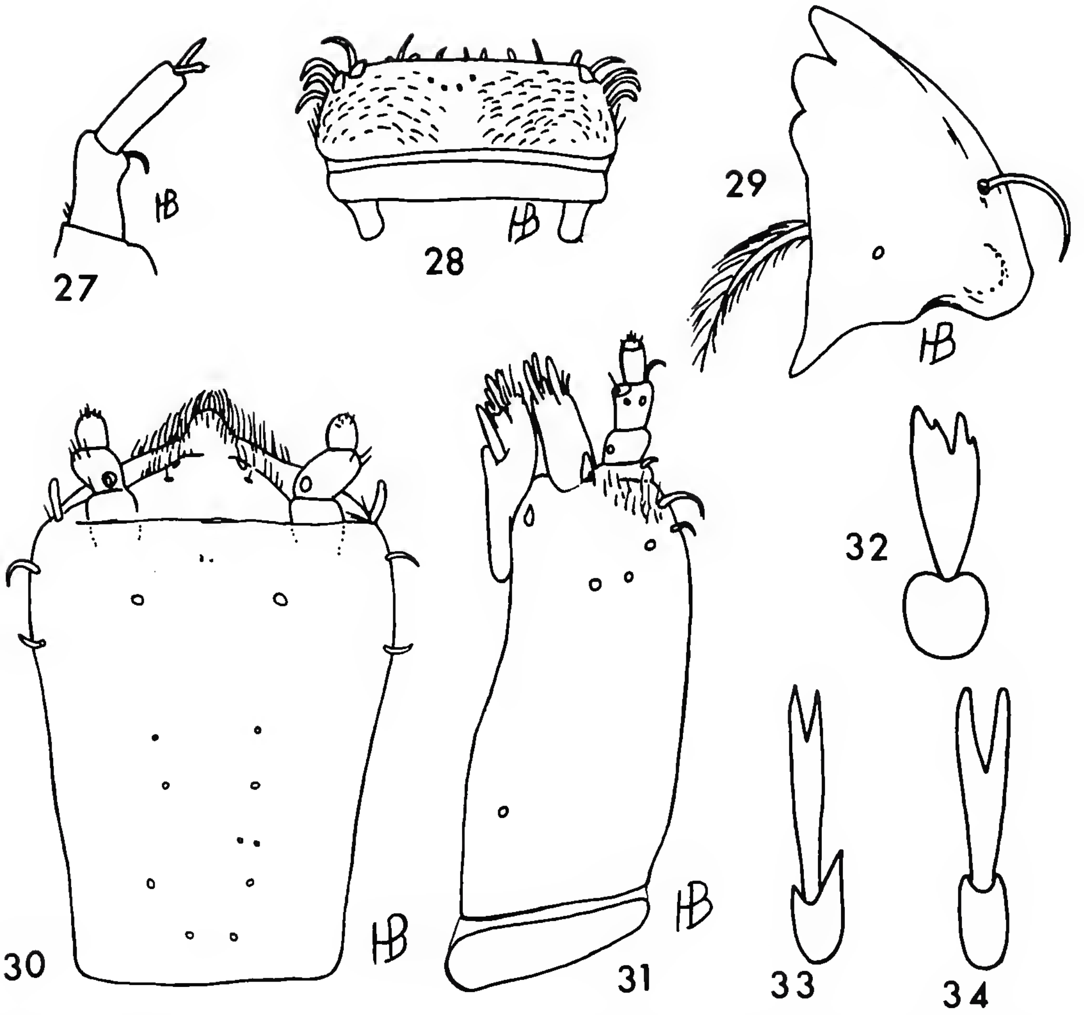
Etymology.—The subspecific epithet is derived from the collection site, the San Carlos River, on the San Carlos Indian Reservation.

Habitat.—All specimens were taken from stream rapids below a ford, less than 100 m downstream from several large warm springs. The substrate consists of sand, gravel, and rocks of considerable size. Other dryopoid beetles found in the same portion of the stream included representatives of the following genera: the dryopid *Helichus,* the psephenid *Psephenus,* and the elmids *Elsianus, Hexacylloepus,* and *Neoelmis.*

Comparative notes.—Although members of this subspecies are about the same size as those of *Huleechius marroni,* they exhibit a distinctively different appearance, with elytra conspicuously lighter in color than the pronotum. The cuticle is translucent and reminiscent of caramel, but the specimens are not teneral. From *H. spinipes,* which is opaque, they also differ in being smaller, with little trace of the conspicuous labial moustache, and without the granules studding the pronotum.

Larvae

The larvae of *Huleechius* have been determined not by rearing, which would be desirable, but by elimination and by association with adults under circumstances that preclude any other interpretation: 74 larvae of appropriate dimensions in a small permanent, isolated stream from which I also collected 34 adults of *Huleechius marroni* but no other larval or adult elmids. Other larvae with the same facies have also been taken from localities in which *H. spinipes* (Hinton) is relatively common, although they were mistakenly identified as probably larvae of *Elsianus* (Hinton, 1940).



Figs. 27–34. *Huleechius marroni,* n. sp., mature larva. Fig. 27. Antenna. Fig. 28. Labrum. Fig. 29. Mandible. Fig. 30. Labium. Fig. 31. Maxilla. Fig. 32. Setiferous tubercle from posterior margin of pronotum. Fig. 33. Setiferous tubercle from posterior margin of 4th abdominal sternite. Fig. 34. Setiferous tubercle from posterior margin of 4th abdominal tergite.

Generic Characters of Larvae of *Huleechius*
(Figs. 3–5, 27–34)

Body parallel, subcylindrical, elateriform (Figs. 3–5).

Head very large, exposed; anterior margin with a conspicuous tooth on each side between clypeus and base of antenna. With one ocellus on each side. Antenna (Fig. 27) 3-segmented and partially retractile; last segment setiform and small, bearing a minute terminal seta, and side by side with apical seta of second segment. Clypeus short and broad. Labrum (Fig. 28) broader than long. Mandible (Fig. 29) with 3 subacute or obtuse apical teeth; prostheca long, slender, and densely spinose. Maxilla (Fig. 31) with palp 4-segmented; stipes without palpifer; galea and lacinia separate, each with apex spinose. Labium (Fig. 30) with mentum rather elongate and broadening apically; labial palp 2-segmented; prementum with a well-developed palpiger. Gula well-developed.

Prothorax with anterior sternite reduced to a small intercoxal sclerite which is easily overlooked; pleura obscurely divided into 2 parts, the prepleurites (anterior pleurites) meeting in midventral line; posterior sternite pentagonal, with anterior apex projecting acutely between procoxae; coxal cavities closed behind.

Meso- and metathorax each with pleura divided into 2 parts.

Abdomen without carinae; segments 1–7 with pleura bounded by tergo- and sternopleural sutures; segments 1–8 bordered posteriorly by tubercles bearing flat, branched setae; segment 8 forming a complete sclerotized ring; apex of segment 9 emarginate; operculum with 2 strongly sclerotized claws attached to its dorsal membrane. Anal tufts of gill filaments well-developed. Spiracles present on mesothorax and abdominal segments 1–8.

Description of Mature Larva of *Huleechius marroni*
(Figs. 3–5, 27–34)

Length 6.0 mm; breadth 0.75 mm. Elongate, subparallel, cylindrical to hemicylindrical. Cuticle testaceous and feebly shining.

Head slightly broader than long (0.63:0.55 mm); posterior margin broadly and feebly emarginate; epicranial suture 0.08 mm long; frontal suture extending on each side in a subsinuate line to anterior margin above medial base of antenna; anterior margin on each side between base of clypeus and antenna with a prominent tooth subequal in length to first antennal segment. Cuticle sparsely pubescent with short, decumbent hairs arising chiefly from flattened granules; a few long, recurved hairs arise from the lateral portions of the head and longer, erect hairs (0.2 mm) are conspicuous on the ventral portion; vertex devoid of granules and setae; basal portion at level of epicranial suture rather densely covered with very small scales; anterior to level of epicranial suture the small scales are interspersed by large setiferous tubercles; toward base of antenna and marginal tooth only the larger tubercles are present. Antenna (Fig. 27) with first segment constricted laterally so that second segment articulates at a 45-degree angle; second segment subequal in length to first. Labrum (Fig. 28) with anterior margin subtruncate and bordered by recurved setae resembling curled eyelashes; angles broadly rounded; anterior angle on each side with 1 or 2 very short, toothlike setae or spines; upper surface on each side with numerous small hairs directed medially or, toward midline, posteromedially. Mandible (Fig. 29) with a single, large, recurved seta arising below middle of outer margin. Both maxilla and labium virtually devoid of hairs except near apex. Maxilla (Fig. 31) with a short, toothlike spine at lateral base of galea and another at base of lacinia. Labium (Fig. 30) with apex mammiform.

Pronotum with anterior angles rounded, not produced. Cuticle devoid of tubercles except near lateral margins and in a small band 2–4 tubercles in width that extends dorsally from near anterior margin of procoxal cavity; bordered posteriorly by a row of flattened scales bearing furcate, flattened setae (Fig. 32). Meso- and metanotum rather generally covered with tubercles except in several bilaterally symmetrical patches and in a narrow band near posterior margin; bordered posteriorly by a row of flattened tubercles or scales bearing furcate, flattened setae.

Abdomen with tergites 1–8 even more uniformly tuberculate except for small dorsolateral and lateral bare patches symmetrically located on each segment and bordered posteriorly by flattened tubercles bearing flattened setae that are usually symmetrically branched (Fig. 34); these marginal tubercles are darker than the rest of the cuticle, forming a brownish band at the posterior margin of each segment; the projecting flat setae form a sort of collar around the intersegmental membrane and anterior portion of the succeeding segment. Segment 9 circular in cross-section; cuticle rather uniformly tuberculate except near apex; posterior margin deeply and broadly emarginate with apices acute and produced.

Ventrally, prosternite of prothorax reduced to a small, fusiform sclerite between procoxae; poststernite with apex acute and heavily sclerotized; lateral margin of coxal cavity close to lateral margin of segment; division between pre- and post-pleurite difficult to observe. Meso- and metasternum with posterior margins medially acute; cuticle uniformly tuberculate; prepleurites smaller than post-pleurites. Abdomen with tergopleural and sternopleural sutures convergent on each side of segment 7; sternites and pleurites uniformly tuberculate. On segment 9, operculum lacks tubercles, and is about one-third the length of the segment. All but last segment bordered posteriorly by a row of flattened tubercles bearing flat, furcate setae which are more asymmetrical toward the lateral margins (Fig. 33).

Specimens examined.—74 from MEXICO: Baja California Sur, Caduaño, 28/VII/73, H. P. Brown, deposited in Stovall Museum of Science and History. Some of these specimens are of earlier instars.

Comparative notes.—The larva of *Huleechius marroni* is very similar to that described by Hinton (1940:284) as "*Elsianus* (?) sp. ?" Since Hinton's 3 specimens upon which he based his description were collected at Temascaltepec, in the state of Mexico, where he also took adults of *Huleechius spinipes* (Hinton), it is reasonable to assume that his description pertains to the larva of *H. spinipes*. The larva of *H. marroni* differs from that of *H. spinipes* in being smaller (6.0 mm as compared with 8.5 mm), lighter in color, with the pronotal transverse belt of tubercles broader (2–4 tubercles in width rather than about 2 tubercles), and in having the mesonotum, metanotum, and abdominal tergites rather uniformly covered with tubercles. There are also other minor differences in setal and tubercular details.

Two larvae I collected 17/VIII/70 at Rancho de Carrales, about 20 km e

Cuatro Cienegas, Coahuila, presumably represent another species. One is ca. 5, the other, ca. 6 mm in length. Both are pale, with large bare patches (free of tubercles) on the mesonotum, metanotum, and posterior medial portion of abdominal tergite 1. At least the smaller, if not both larvae, would probably be immature.

I also have two larvae from South America which apparently represent species of *Huleechius*. Each is about 7 mm in length. They differ from the larva of *H. marroni* in having a greater portion of the mesonotum and metanotum devoid of tubercles and in having on each side above the spiracles on abdominal segments 1–7 a diagonal patch devoid of tubercles. One is from the Rio Piray near Santa Cruz, Bolivia, 8/XI/71 (H. P. Brown). The other is from the Rio Chanchan, Bucay, Prov. Guayas, Ecuador, 13/XI/71 (H. P. Brown). The latter specimen is much darker than the larvae of *H. marroni*. As yet, I have not detected adults of *Huleechius* from South America.

Although the larva of *Huleechius* was first described by Hinton (1940) as "*Elsianus* (?)," it is actually closer in appearance to larvae of *Stenelmis*. Fortunately, the distributional ranges of the two genera do not quite overlap. If it should turn out that they do overlap, it will probably be difficult to separate the larvae. All the true *Elsianus* larvae studied by Hinton (about 14 species by 1940) exhibit on each side of abdominal segments 2–7 an accessory longitudinal suture above what appears to be the normal tergopleural suture. *Huleechius* larvae lack such sutures; they are apparently unique to *Elsianus,* though in some species they occur only on segments 2–6. *Huleechius* larvae differ from those of *Stenelmis* in having the prothorax on each side with the pleuron divided into pre- and post-pleurites, though this division is difficult to see, and in possessing a vestige of the prosternite in the form of a fusiform intercoxal sclerite.

Acknowledgments

I wish to express my appreciation to the University of Oklahoma Faculty Research Committee for Polaroid film used in recording dissections and other microscopic features, and to Ms. Karen Herbst for photographing my drawings.

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NOTICE

This is the last issue to be edited by T. D. Eichlin and A. R. Hardy. The new editor of The Pan-Pacific Entomologist will be Dr. Gordon Marsh. Manuscripts and other items of an editorial nature should be sent to the new editor:

Dr. Gordon Marsh
Museum of Systematic Biology
University of California
Irvine, CA 92717

It has been a rewarding experience serving as your editors, but all must realize that no editor can function without a great deal of help. Over the years we have had the aid of several editorial assistants, who have lightened the load. We have had an excellent working relationship with the always professional and responsive staff at Allen Press.

In our approximately four and one-half year tenure, we have processed nearly 500 manuscripts, all requiring critical review. To all of those dedicated scientists, who were willing to lend their expertise to review papers, we owe a very special debt of gratitude, because they, in large part, insure a high quality of our publication.

Finally, we want to thank the Pacific Coast Entomological Society for giving us the opportunity to serve the Society and our profession.

T. D. Eichlin, A. R. Hardy, Co-editors

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A DURABLE, LIGHTWEIGHT NET AND A MANUAL ASPIRATOR FOR COLLECTING AQUATIC ORGANISMS

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The net and aspirator described herein were designed for use in collecting aquatic Coleoptera. However, the net has been used for collecting a wide variety of aquatic invertebrate and vertebrate organisms, and the aspirator works just as well on terrestrial insects.

When I first started collecting aquatic insects about 30 years ago I tried using one of the lightweight aquatic dip nets sold for student use by some biological supply companies. Although these nets are satisfactory for dipping up surface inhabiting taxa, the circular net frame invariably bent when the net bag became laden with aquatic vegetation or when it was pushed through dense growths of aquatic plants. The heavy accumulation of vegetation in the net occurs frequently when one collects in grassy margins of aquatic habitats where some of the most interesting aquatic forms are found. After I had straightened the net frame several times, the frame would invariably break. Therefore, a sturdy net was necessary for this type of collecting.

I next tried using a sturdy dip net with a triangular frame, the base of which was imbedded in a lead-filled ferrule attached to a heavy wooden handle. However, the net was very heavy when the additional weight of wet vegetation was added to it or when the net was used in streams with rapid current. The net proved to be very fatiguing after only a few hours' use; in time, the wooden net handles rotted and broke and had to be replaced.

Consequently, I constructed an inexpensive, sturdy, lightweight net (Figs. 1–3) that has proved to be very satisfactory. The net may be constructed with a single piece handle or with one that can be dismantled (Figs. 2, 3) so it will fit into a suitcase for travel. The items used in constructing the net are as follows.

1—Aluminum tubing, 8′ long, 1″ in outside diameter
1—Net bag, purchased from biological supply company
1—Copper or brass wire, about 90″
1—Metal rod, ⅜″ diameter and 42″ long—for net frame
1—Crutch tip, 1″ inside diameter
4—Screws, roundhead, brass, no. 7, ⅝″ long

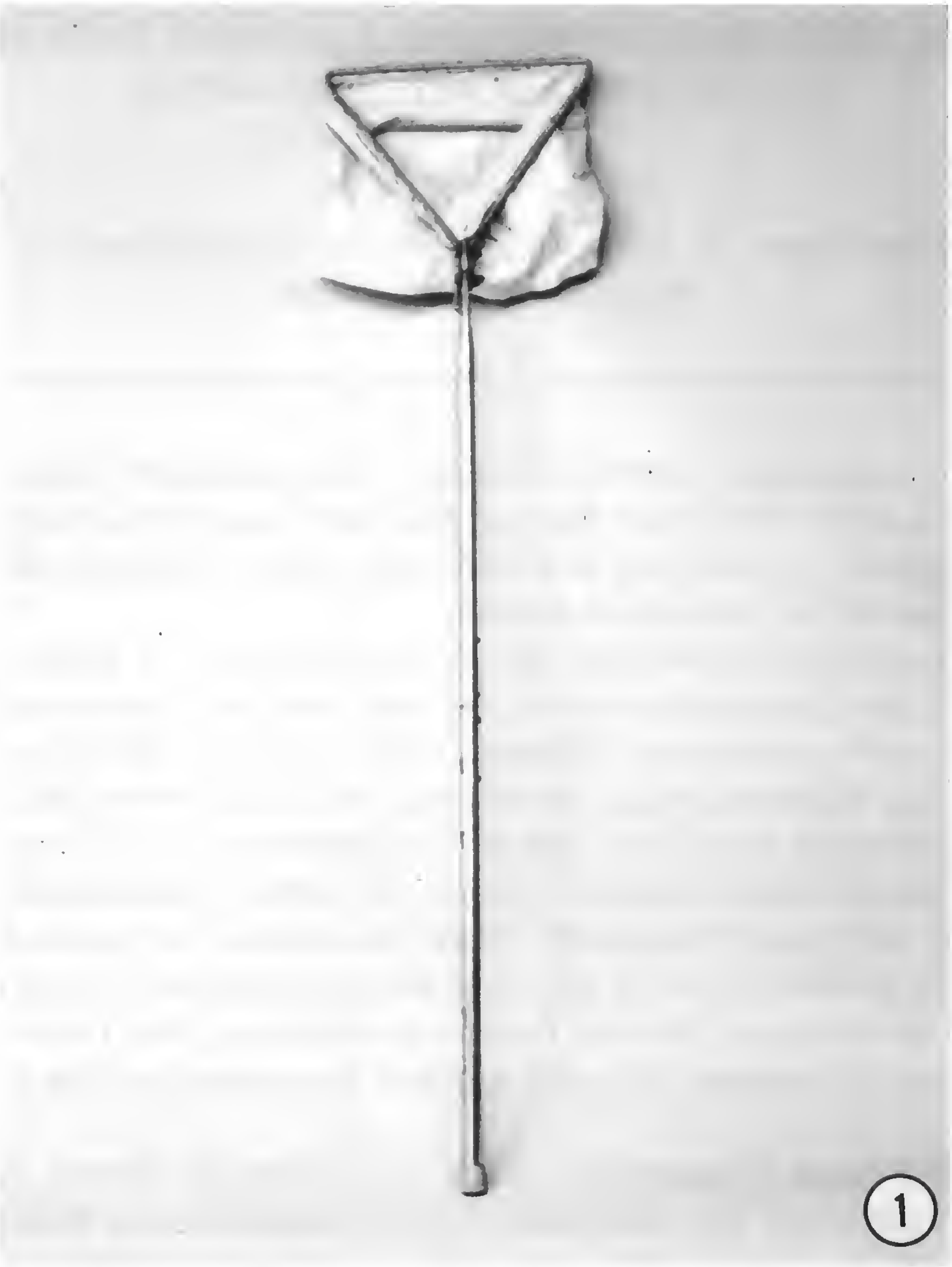
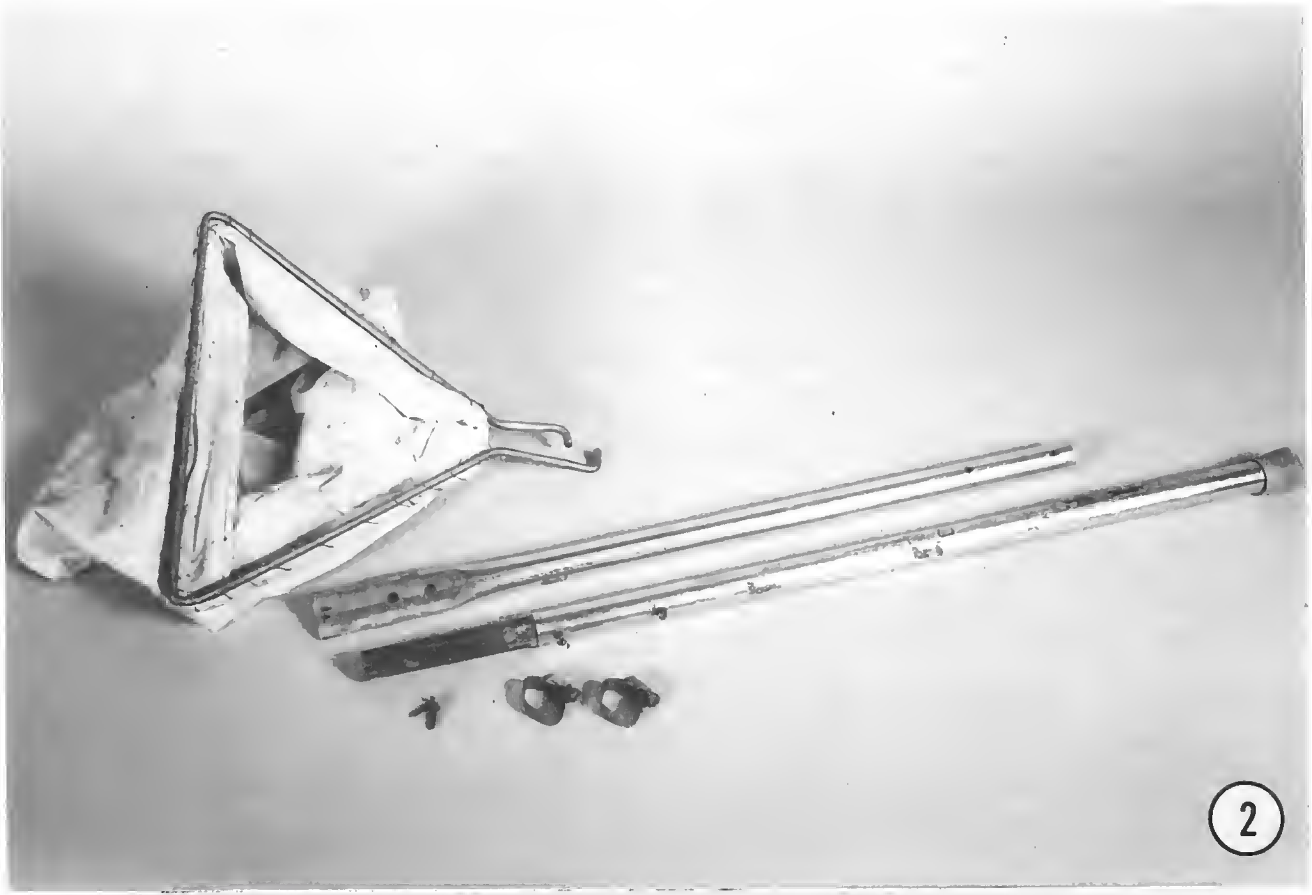
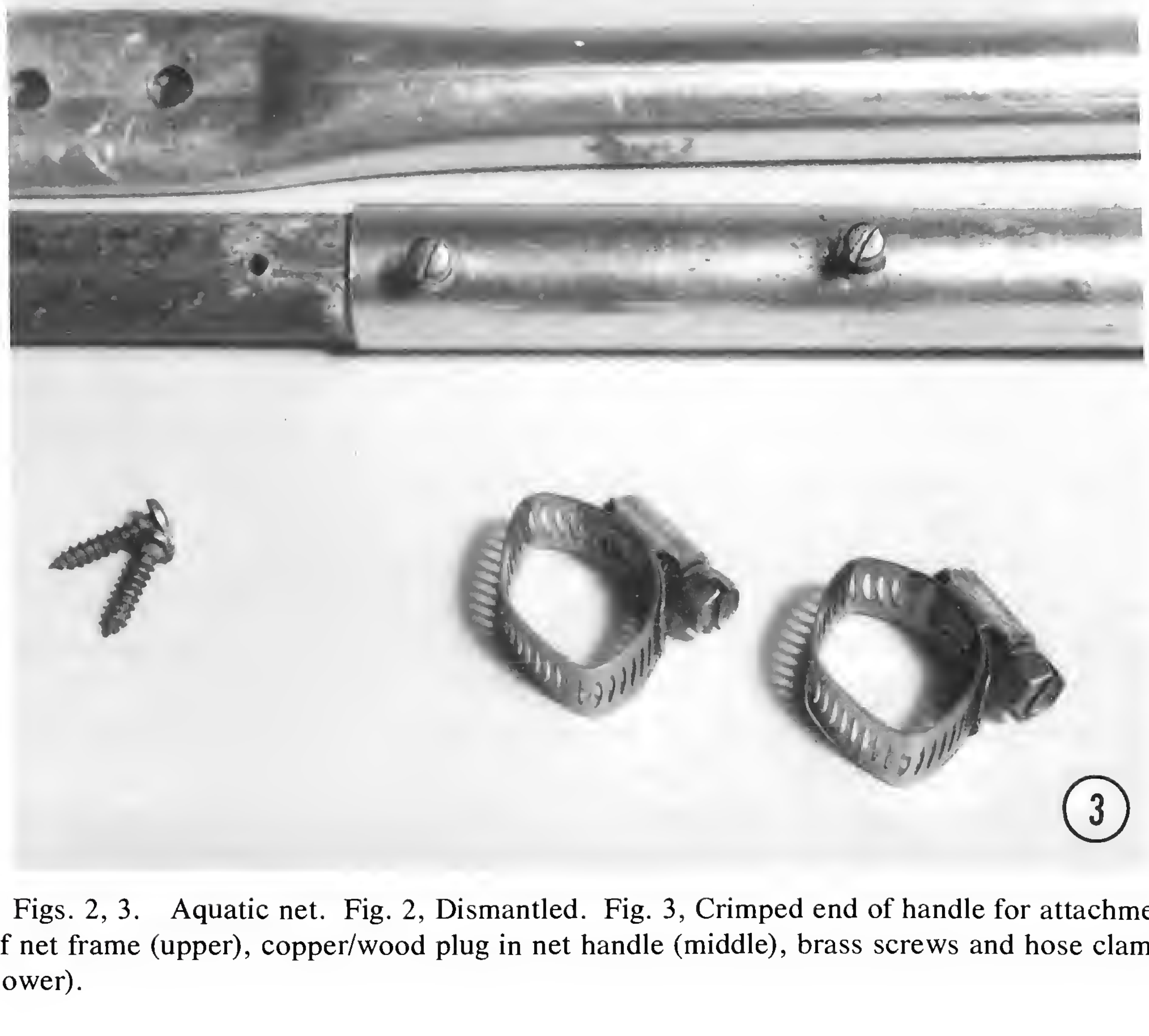


Fig. 1. Aquatic net, complete.

1—Wooden dowel, ¾″ diameter and 8″ long
1—Copper or brass tubing, ⅞″ outside diameter, 8″ long
2—Hose clamps

The aluminum tubing for the handle is usually available in two standard lengths of 6 or 8 feet and with a smooth or knurled surface. I purchase the 8-foot length and make two 4-foot handles from it; the overall length of the net is then about 5 feet. If a longer net handle is necessary, the 6- or 8-foot length can be used as purchased or shortened as desired. I prefer the tubing with the knurled surface because it provides a firmer grip and holds paint better than the smooth surface. The iron rod used for the net frame does not need to be rust resistant if the net bag is dried before storing, but a rustless metal rod at a slightly higher cost may be desired. So that com-





Figs. 2, 3. Aquatic net. Fig. 2, Dismantled. Fig. 3, Crimped end of handle for attachment of net frame (upper), copper/wood plug in net handle (middle), brass screws and hose clamps (lower).

mercially available net bags could be used, the dimensions of the net frame are the same as those of the bag. The rod can be bent in a sturdy vise in a home workshop to form the triangular net frame; the leading edge of the frame is 13¼″ wide, the sides are 11″ long and the basal pieces that are clamped to the handle are 3½″ long on one side and 2½″ long on the opposite side (Fig. 2). The shape of the new frame may be circular, rectangular, or triangular depending on personal preference. I have tried all three forms and have found that the triangular frame is most satisfactory because it offers a straight edge and the acute angles can be worked more easily through thick vegetation and into small spaces that would be inaccessible with other types. The crutch tip on the end of the net handle is used only to prevent the handle from scratching the palms of one's hands or the paint of car interiors, etc., and to keep mud out of the end of the handle.

In order to adapt the net handle so that it can be carried in luggage I find the following method works well. (1) The aluminum handle is cut in half, i.e., cut into two 2-foot lengths. (2) An 8″ piece of copper tubing that fits snugly inside the aluminum handle is cut. (3) An 8″ wooden dowel that fits snugly inside the copper tubing is cut. (4) Then the copper tubing filled with the wooden plug is inserted 4″ into the end of one section of the aluminum handle; two holes are tapped through the aluminum and the copper tubing; and brass, round-headed screws are inserted into the holes. (5) The other half of the aluminum handle is then slipped over the still exposed 4″ piece of copper tubing and two screws installed as mentioned above. Placing wax, soap, or oil on the screws before inserting them will ease their removal. The inner copper tubing prevents the wooden dowel from swelling and the handle will slip apart easily. Thus the dismantled parts of the handle can be reduced to pieces not more than 24″ long and these can be packed in luggage.

The hollow aluminum tubing has two minor disadvantages. It can be dented or bent if subjected to an unusually severe blow; and in some waters a chemical reaction occurs that causes a temporary dark stain on the hands. This stain can be washed away easily with soap, but staining can be prevented altogether by painting the handle with a metal paint.

The new frame is fastened to the handle in a manner similar to an ordinary aerial insect net (Figs. 1–3). However, the end of the handle is partially flattened to receive the ends of the net frame and two hose clamps replace the metal sleeve of ordinary nets. With hose clamps as illustrated (Fig. 3) and sufficiently large slots in the heads of the brass screws, a coin may be used to dismantle the net; otherwise a screwdriver is needed.

The net bag may be purchased or constructed, if satisfactory sewing equipment is available. The bag may be made of any satisfactorily strong netting of desired mesh. The upper edge of the bag should include a stout ¼″ diameter cord in the hem to prevent the bag from tearing away after it is wired to the net frame. The entire net bag should be inside a stout,

Fig. 4. Aspirator and ground cloth.

Photographs by Victor Krantz, Smithsonian Institution staff photographer.

lightweight canvas sleeve to prevent snagging the netting on limbs, thorns, etc. The sleeve slightly impedes drainage of the water from the net but this slight disadvantage is far outweighed by the prolonged "life" of the bag. The net bag is wired to the frame so that the leading edge of the net is the iron rod and not the net bag itself. This too decreases damage to the net bag and prolongs its "life." I have used copper wire to fasten the bag to the frame because of the ease of bending it around the frame and because it does not rust and thereby weaken the bag as some other wire might do.

I have used the type of aquatic net described above for 20 years and it has been used by students in my aquatic entomology class at the University of Maryland for 14 years. Only once, after 4 months of daily use, did a handle break. The break occurred at a stress point at the end of the copper/wood plug closest to the net frame. The 4″ piece of aluminum tubing that broke loose was removed and the remaining piece of the handle was slipped over the copper/wood plug, new holes were punched with a nail, the screws secured, and the net, although 4 inches shorter, was as good as new.

Most individuals who have used oral aspirators for collecting insects probably have had the unpleasant experience of aspirating fine dust, tiny specimens, or acrid defensive insect gases into their mouths; and many have experienced a dry throat reaction from these aspirators. Luckily, few have gotten myiasis of the sinuses as reported by Hurd (1954). Because I was preparing to collect in the Neotropics and did not want to experience the same problems Hurd had, I purchased a mechanical aspirator. However, this aspirator was very large and awkward; it promptly rusted from water sucked into it with the aquatic beetles and it soon ceased to function. I then constructed an aspirator (Fig. 4) with a rubber pressure/suction bulb which is available from scientific supply dealers. The bulb is small, has no metallic parts to rust, and is durable. With this bulb, one must squeeze the air from it and suction occurs when the bulb is released. The amount of pressure put on the bulb combined with the speed by which the bulb is released regulates the force exerted on the insects being aspirated. The aspirator may be used with a plastic or glass vial which is dry or contains alcohol.

This device seems slightly awkward when first used because one expects the squeezing action to aspirate and this is not true with this device. However, the user becomes a believer after using this aspirator for only a short time. When small beetles are abundant in a net or on a ground cloth, several are often aspirated with one release of the bulb and all specimens are collected much more rapidly and with less damage than when collected with forceps or fingers. Where schistosomiasis organisms may be present this aspirator is useful in reducing exposure to them and provides greater peace of mind. I have used the type of aspirator described above for 17 years and would not want to be in the field without one. Eventually the multiple squeezing of the bulb causes it to weaken and break, but replacement bulbs are inexpensive.

The aspirator works well when aquatic plants and specimens are dumped onto a nylon ground cloth. The ground cloth, 2½ feet square, drains rapidly; the insects, free of mud, crawl out of the drying plants and are easy to see and collect with the aspirator. Triangular pockets may be sewn in the corners of the ground cloth, and when sticks are placed in diagonal corners the cloth will serve as a beating cloth.

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A NEW GENUS AND A NEW SPECIES OF LACCOPHILINE WATER BEETLE FROM ECUADOR (COLEOPTERA: DYTISCIDAE)

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The predaceous diving beetles (Coleoptera: Dytiscidae) of the subfamily Laccophilinae are a large and widespread group with 9 genera presently recognized. Most of the species belong to the cosmopolitan genus *Laccophilus* Leach (1817). Species of *Neptosternus* Sharp (1882) are known from the Old World tropics. The other genera have a more limited distribution and are represented by few species: *Laccodytes* Régimbart (1895) is neotropical, *Philaccolus* Guignot (1937), *Philodytes* J. Balfour-Browne (1939b), and *Africophilus* Guignot (1947) are African, *Laccoporus* J. Balfour-Browne (1939a) is known only from Tibet, and *Australphilus* Watts (1978) is found in Australia and Tasmania. The new genus described in this paper is represented by a single new species from the eastern foothills of the Andes Mountains in Ecuador.

Napodytes, new genus

Form oval, somewhat flattened, more convex dorsally than ventrally; outer margin of head, pronotum and elytra forming a continuous smooth outline; surfaces smooth and polished (Fig. 1).

Head broad, evenly rounded dorsally; eyes rounded except for straight posterior side, not protuberant. Clypeus broadly, shallowly emarginate. Labrum broad, evenly rounded on each side of a deep, rounded, median emargination. Antennae with segments 1 and 2 not much thicker than segments 3 and 4, cylindrical; segments 5–10 enlarged and flattened in male, smaller, cylindrical in female. Segment 11 elongate, pointed, with anterior side nearly straight, posterior side curved. Maxillary and labial palpi similar in form, with apical segments shaped like those of antennae.

Pronotum broad, 2.5 times as wide as long, widest at base, narrowing to width of head anteriorly; anterior margin straight, with a rounded emargination behind eyes; posterior margin obtusely angulate at middle, narrowly arcuate to sides; lateral margins finely beaded. Prosternum sharply carinate from base to apex of prosternal process; process narrowed between front coxae, abruptly widening to a rhomboid apex, with pointed tip fitting into a V-shaped notch in metasternum (Fig. 2A). Scutellum hidden.

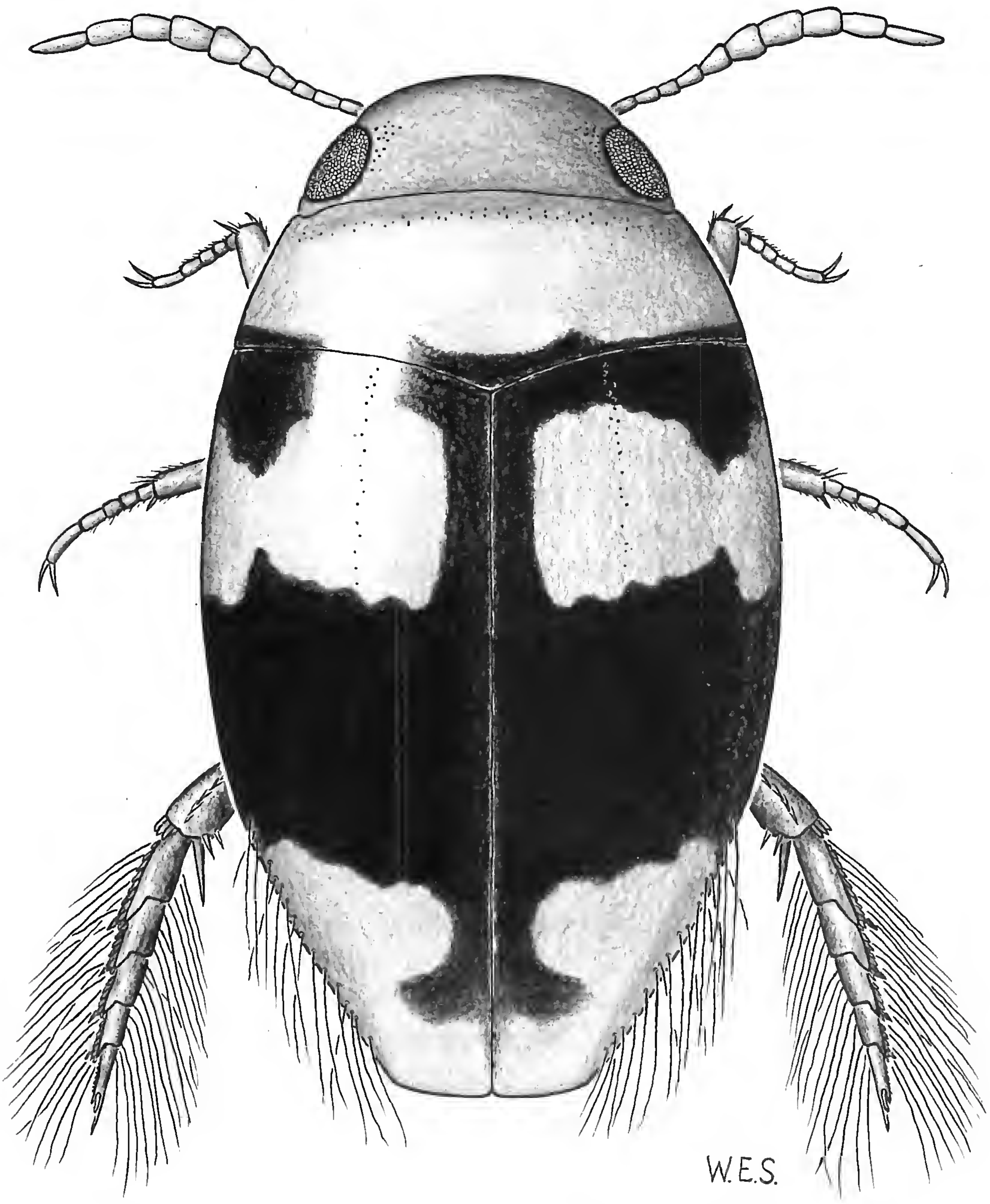

Fig. 1. *Napodytes boki,* male, dorsal habitus. Total length 1.8 mm.

Elytra widest at basal ⅓, more than twice as long as wide, narrowly and obliquely truncate at apex; lateral margins finely beaded, with an irregular row of long, fine setae along apical ⅓ of elytra; epipleura gradually tapering from base, extending nearly to outer corner of truncation. Episterna of metathorax not reaching mesocoxae (separated by mesepimera). Metasternum with a small, polished, median elevation at posterior apex. Metacoxal lines widely separated, gradually diverging posteriorly to metacoxal pro-

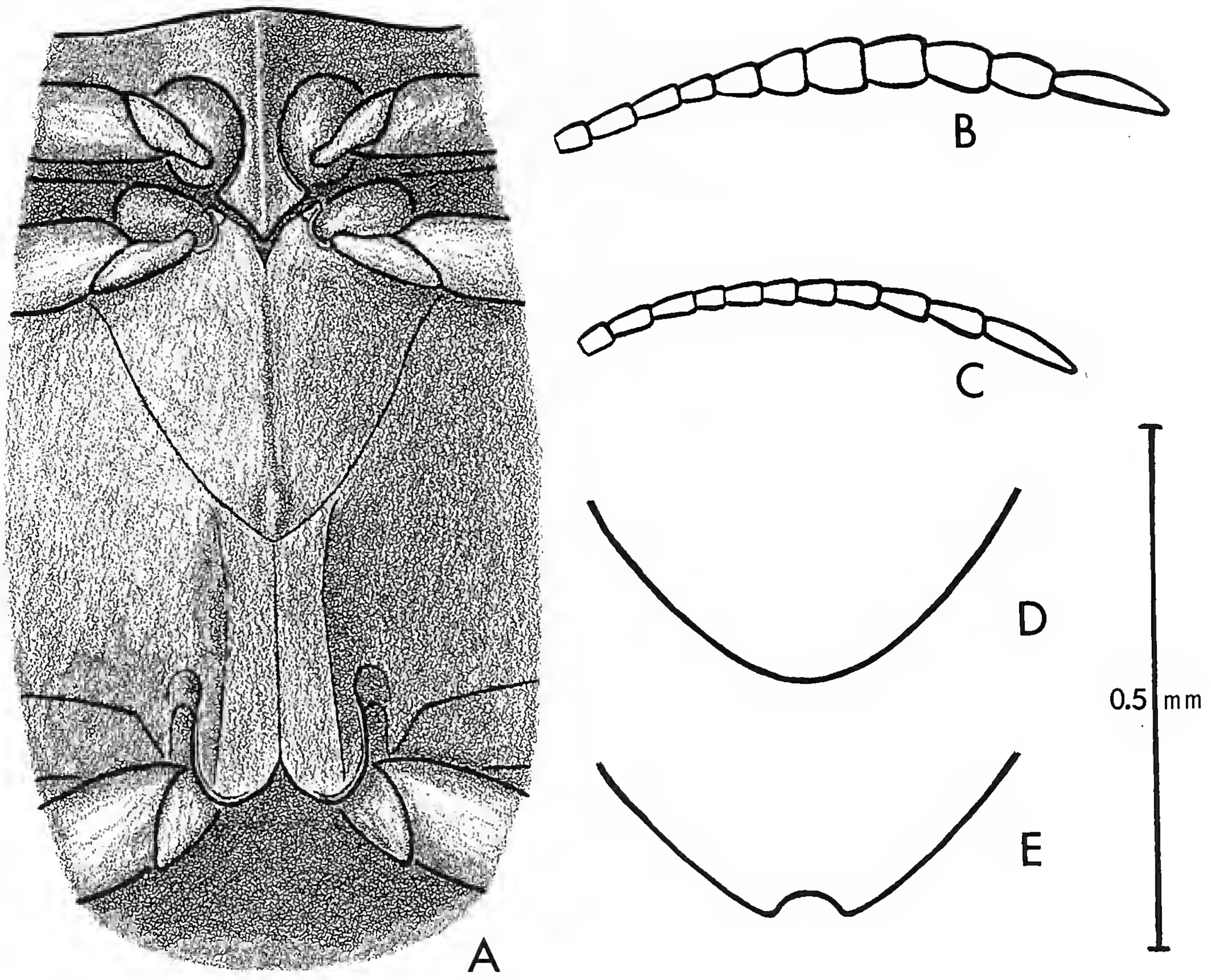

Fig. 2. *Napodytes boki.* A, Area of sternum showing prosternal process, metasternum, and metacoxal lobes. B, Antenna, male. C, Antenna, female. D, Apex of abdomen, male. E, Apex of abdomen, female.

cesses. Metacoxal processes rounded, separated by a narrow V-shaped cleft (Fig. 2A). Metasternal side wings strongly arcuate, evenly, narrowly tapered to a point. Abdominal sterna each with a transverse row of setigerous punctures; apex of last visible sternum entire and evenly rounded in male, emarginate in female.

Front and middle femora somewhat flattened, not setose. Front femora with a comb of stiff, posteriorly curved setae along apical ⅓ of front ventral margin (well-developed in male, less so in female). Front and middle tarsi long, slender; segments 1–3 short, roughly equal in size, as long as wide; 4th segment longer; 5th segment very long, as long as the 2 preceding segments combined; segments 1–3 ventrally with narrow pads of adhesive hairs in male, a few short, stout setae in female; segments not dilated or thicker in male; claws equal, slender. Hind femora oblong, flattened. Hind tibiae short, robust, with a single, large, sharply pointed apical spur (Figs. 3A, B). Hind tarsal segments 1–4 with prominent ventrolateral lobes roughly ⅓ as

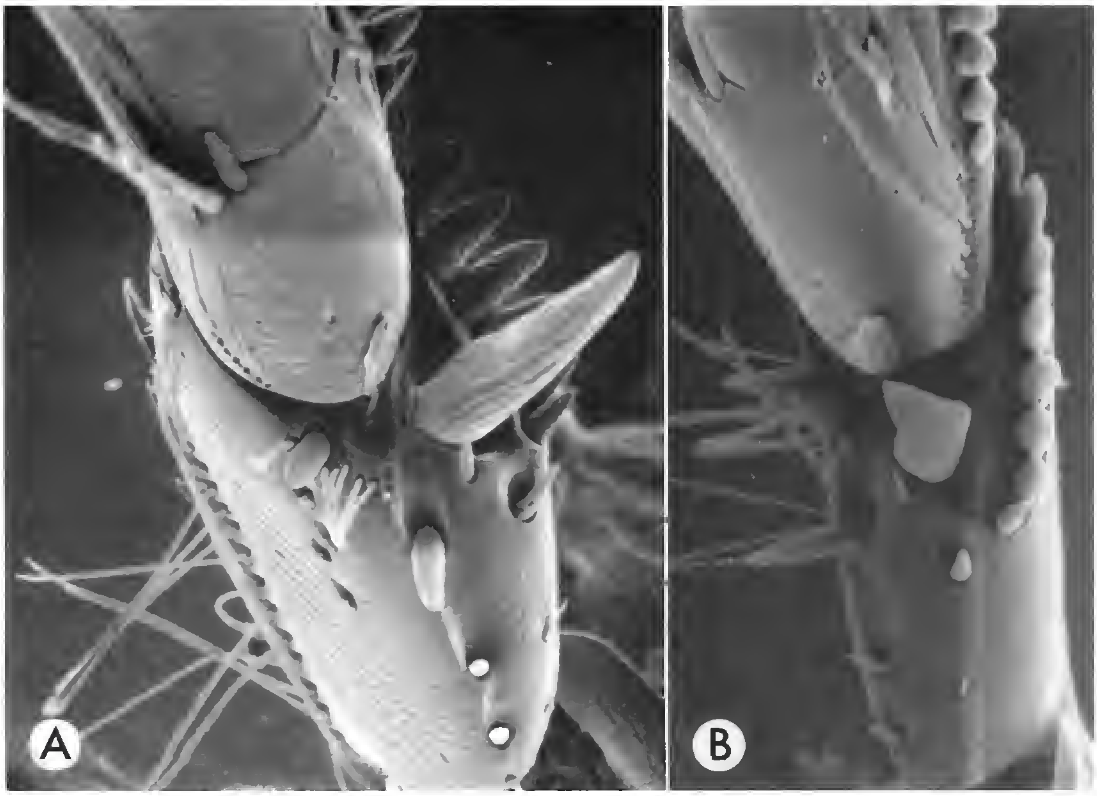

Fig. 3. *Napodytes boki* (allotype, ♀), right hind tibia, apex. A, Oblique view of apical spur. B, Direct view of apical spur. ×400.

long as the segments; outer edge of each segment and lobe armed with a long ventral spur and an outer row of 7–10 stout spines; natatory hairs long and fine. Apical segment small, narrow, prolonged apically to a sharp spine; lateral lobe and spines reduced; a single, inconspicuous, flattened claw present between apical spine and lobe, lying along inner side of spine, about ½ as long as spine.

Male genitalia with median lobe asymmetrical, bladelike; parameres asymmetrical, thin, leaflike, nearly straight on ventral side, widely rounded dorsally; left paramere with a single apical seta; right paramere with 2 apical setae. Female genitalia knifelike, with fused second valvulae (ovipositor) serrated ventrally, resting between long, curved, laterally flattened first valvulae.

Type species.—*Napodytes boki,* new species.

Etymology.—The name of the genus is derived from *Napo,* the name of the major river in eastern Ecuador and the province where the type-species was collected, and *dytes* (Greek), "diver," a component of many of the generic names in the family. The gender is masculine.

Napodytes boki, new species

Length 1.8 mm; greatest width 1.0 mm; greatest thickness 0.6 mm. Head light brownish yellow; dorsal surface shining, polished, with a small, faintly punctate area above each eye. Eyes narrowly ringed with black. Pronotum mostly yellow, brownish yellow anteriorly, with dark brown to black coloration along posterior margin; surface polished, with a narrow band of very fine, inconspicuous punctures behind anterior margin. Elytra black with undulate yellow patches, as illustrated (Fig. 1); surfaces shining, very finely, faintly reticulate, with a row of small punctures down basal ⅓ of disc. Appendages, epipleura, and ventral surfaces of head, prothorax, and abdomen yellowish; metathorax and metacoxal plates darker, brownish.

Antennae of male (Fig. 2B) with segments 5–10 flattened, more rounded and expanded anteriorly than posteriorly, convex dorsally, slightly concave ventrally; segment 7 widest, nearly as wide as long; segments 8–11 successively narrower and longer; segment 11 nearly 4 times as long as wide. Antennae of female (Fig. 2C) not modified, with most segments roughly twice as long as wide, only slightly flattened; segments 3–10 successively widening gradually (10th segment widest); segment 11 like that of male, but smaller.

Ventral surfaces of body shining, very finely reticulate. Abdominal sterna not as smoothly polished as metasternal and metacoxal plates. Last visible abdominal sternum (Figs. 2D, E) in female with emargination small, semicircular, with apical corners narrowly rounded.

In male profemoral comb of 4 enlarged, rigid setae proximally, several very small, fine setae distally; first (proximal) seta largest; comb reduced in female, with only 3 small setae visible.

Male genitalia (Figs. 4A–D) with median lobe slender, arched dorsally, with apex flattened and knifelike, twisted from axis of base like a blade of a propeller; left side of blade with edge thin and sharp, with a very thin flange expanded outward at base (midlength of median lobe); right side thick and rounded in cross section, narrowly sinuate along length of median lobe in dorsal view, angled to form a broadly, obliquely truncate apex; tip narrowly rounded. Left paramere twisted, narrower than right paramere, with a single, long, stiff, apical seta. Right paramere broad, cupped around base of median lobe, with 2 long apical setae.

Female genitalia (Figs. 4E, F) with ovipositor long and slender, heavily sclerotized, with a row of fine, closely spaced teeth along each side of a median ventral groove from base to apical $^1/_5$, where rows merge into a single row of 4 very large, flattened, triangular teeth. Outer (1st) valvulae long and gradually curved upward to a sharp apex, with a second subapical point on dorsal edge; valvulae connected at a small dorsal swelling just beyond midlength.

Types.—Holotype ♂, and allotype: ECUADOR: Napo, 17 km. SW Tena, 28 May 1977 (W. E. Steiner). The types are deposited in the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C.; USNM type no. 76602.

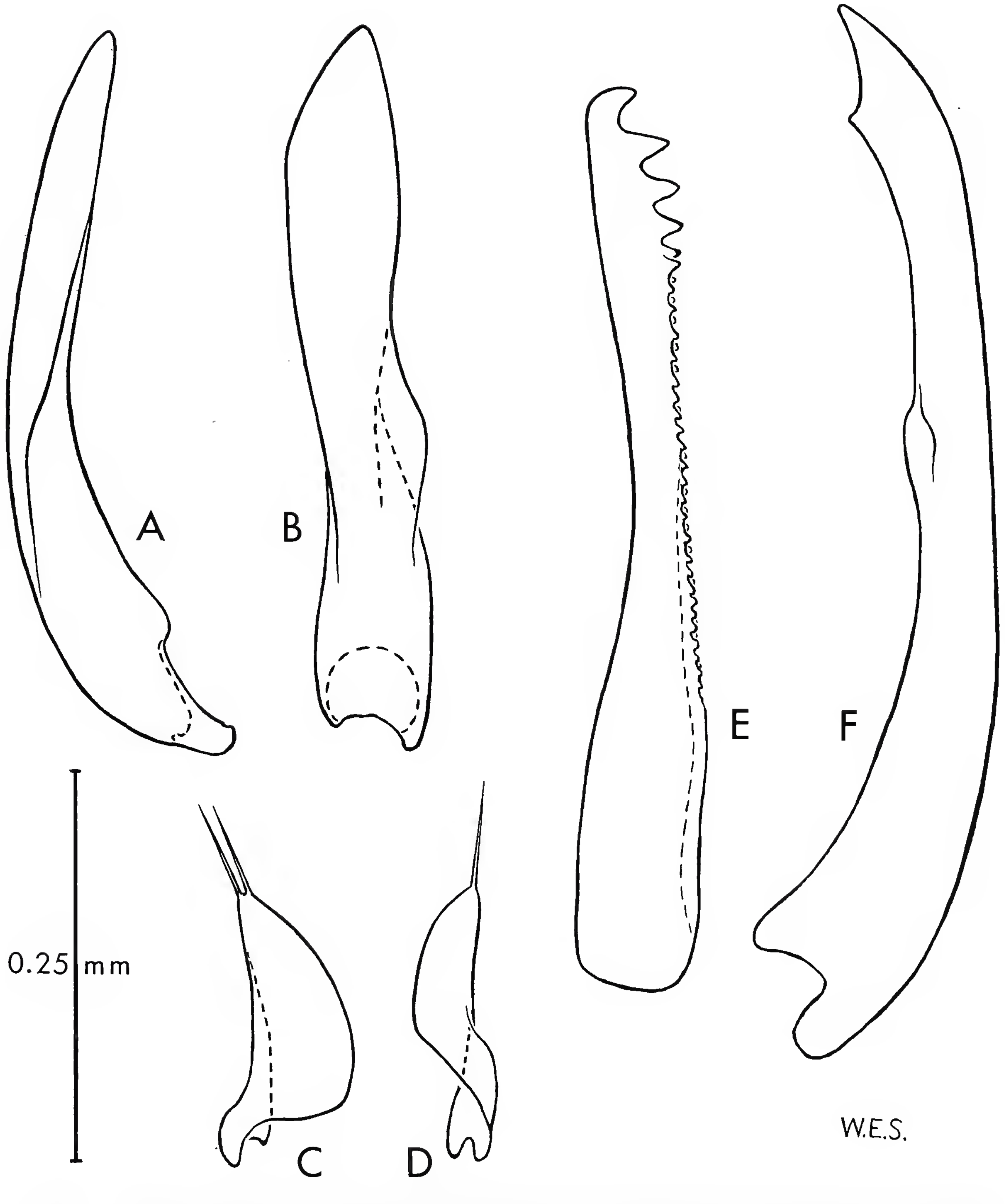

Fig. 4. *Napodytes boki,* male and female genitalia. A, Median lobe, lateral view. B, Median lobe, dorsal view. C, Right paramere, lateral view. D, Left paramere, lateral view. E, Ovipositor, lateral view. F, First valvula, lateral view.

Etymology.—It gives me great pleasure to name this species in honor of Gordon Bok, folklore artist from Maine, who has given us many inspiring songs and stories of the water and the life so dependent on it.

Known distribution.—The species is known only from the 2 specimens from the type-locality.

Biotope at the type-locality.—The specimens of *Napodytes boki* were collected at a blacklight shortly after dark during a light rain. The light was operated in an open roadside clearing near a swift, rocky creek. Steep hills of montane rain forest surrounded the site. Elevation approximately 660 m; temperature about 23°C.

The specific microhabitat of *Napodytes boki* cannot be determined; in addition to the stream, other nearby aquatic habitats included shaded seepages, small creeks, roadside puddles, and water in epiphytic plants. Members of other laccophiline genera are known to be associated with a variety of temporary lentic habitats and margins of small streams.

Behavior.—When collected from the sheet beneath the blacklight, the beetles were observed jumping actively in various unexpected directions. This evasive behavior is seen in other laccophilines when out of water and disturbed, and seems to be characteristic of the group. It has been described as a method of escape in *Africophilus* species (Omer-Cooper, 1965).

Discussion

The genus *Napodytes* is placed in the subfamily Laccophilinae because of the separation between the metepisterna and mesocoxae, hidden scutellum, single hind tarsal claws, smoothly oval body outline, and serrate ovipositor. The small size, form of the prosternal process, and emarginate abdominal apex in the female are characters shared by the members of the genus *Laccodytes*. These apotypic features are not seen in the other known laccophiline genera, suggesting that *Napodytes* and *Laccodytes* are closely related sister groups.

The single apical spur of the hind tibia in *Napodytes boki* is, however, a unique and unusual character among the Dytiscidae. Members of other known laccophiline genera have two large spurs arising from the excavated apex of the tibia: a longer dorsal (posterior) spur and a shorter but equally strong ventral (anterior) spur, with bases contiguous. In *Napodytes boki* the single spur arises medially, and no trace of a second spur is evident, as illustrated by the scanning electron micrographs (Figs. 3A, B). The setae and small, peglike spurs surrounding the smooth apical excavation are not homologous with the second large spur; these small ones are also present and arranged similarly in other laccophilines with two normal spurs. The single spur in *Napodytes* is probably the result of an evolutionary loss of one of the spurs, or a fusion of the two.

The modified antenna in the male of *Napodytes boki* is also an unusual feature not previously known in the Laccophilinae. Régimbart's (1895) two species of *Laccodytes* (including the type-species, *phalacroides*) were described from females only, but both sexes of *Laccodytes americanus* Peschet (1919) are known and have antennae simple, not sexually dimorphic.

The following key will serve to identify the genera recognized at present. Key characters were taken from the descriptions and other keys in regional studies (Balfour-Browne, 1939; Omer-Cooper, 1965). I have not seen examples of all of the genera.

Key to the Known Genera of Laccophilinae of the World

1. Hind tibiae with a single large apical spur; antennal segments enlarged and flattened in male .... *Napodytes*
   Hind tibiae with 2 large subequal apical spurs; antennae not noticeably different between sexes, filiform 2
2. Prosternal process trifurcate, with 3 long sharply pointed spines directed posteriorly; hind angles of pronotum spiniform *Neptosternus*
   Prosternal process variably lanceolate, with a single pointed apex; hind angles of pronotum squared or narrowly rounded, not spiniform 3
3. Hind tibial spurs bifurcate at apex .... *Laccophilus*
   Hind tibial spurs with a simple sharp apex 4
4. Size small, under 2.5 mm long; prosternal process widely broadened and angulate at sides behind front coxae, forming a diamond-shaped apex .... *Laccodytes*
   Size larger, over 2.5 mm long; prosternal process more narrowly lanceolate, not angulate behind front coxae 5
5. Base of pronotum angulate at middle, sinuate to sides 6
   Base of pronotum straight or broadly rounded across middle 7
6. Surfaces of legs densely punctate; prosternal process distinctly carinate .... *Laccoporus*
   Surfaces of legs smooth; prosternal process not strongly carinate .... *Philodytes*
7. Elytral reticulation irregular; metacoxal lines parallel anteriorly .... *Africophilus*
   Elytral reticulation transverse; metacoxal lines divergent anteriorly 8
8. Hind coxal processes bilobed; reticulation of metacoxal plate rounded .... *Australphilus*
   Hind coxal processes simple, rounded; reticulation of metacoxal plate transverse .... *Philaccolus*

The curious single spur of the hind tibia and obvious sexual dimorphism in the antennae of *Napodytes boki* are unique apotypic features among the Laccophilinae, and are the key characters separating *Napodytes* from the other genera in the group. The adaptive advantages of these modifications are uncertain; the presence of these characters and the relatively flattened body form suggests that the species may have an unusual aquatic niche and microhabitat. These questions and the relationships among the genera may be worked out when the Neotropical fauna can be more thoroughly studied, and the larval stages and biologies are discovered.

Acknowledgments

Thanks are due to Philip D. Perkins, Paul J. Spangler, and G. William Wolfe for their helpful comments concerning this study, and assistance in searching the literature. I am especially indebted to Paul J. Spangler for his generous help while collecting in Ecuador. I also thank Donald R. Givens, Lawrence J. Pinto, and David L. Vincent for their company and assistance in the field.

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SOME OMICRINI FROM THE ORIENTAL AND PACIFIC REGIONS (COLEOPTERA: HYDROPHILIDAE: SPHAERIDIINAE)

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Smetana's (1975) recognition and erection of the tribe Omicrini have been catalytic to my study of sphaeridiine phylogeny. I have elaborated on his tribal description and emended his list of included genera (Malcolm, 1980). The following new species were discovered in the course of identifying material for the Bernice P. Bishop Museum and British Museum (Natural History). The description of the aedeagus of *Omicrus brevipes* Sharp comes about as the result of my wish to compare the Marquesan specimens with *O. brevipes,* the only *Omicrus* previously known from the Pacific Region. Fifteen other species are known from the neotropics (Smetana, 1975). That new species of *Omicrus* should be found on Pacific islands is not surprising; their occurrence in rotting wood and other decaying plant material would seem to make them excellent candidates for dispersal by rafting. The same might be said for many other taxa of Sphaeridiinae, particularly some other Omicrini, which appear to have radiated widely throughout Indonesia and other Pacific island groups. It is in the Pacific and Oriental Regions that one must look for insight into the evolutionary history of Omicrini.

Omicrus brevipes Sharp, 1879

Smetana (1975) based his redescription of *Omicrus brevipes* Sharp on two of the three specimens in the original series. He did not figure the male genitalia, as one specimen appeared to be a female and he preferred not to dissect the lectotype. I was able to examine the third specimen of *O. brevipes* through the courtesy of the British Museum (Natural History). Imagine my surprise to find it a male, with the aedeagus already dissected out and preserved in glycerin. The specimen is labeled: "♂"/"Hawaiian Is. Rev. T. Blackburn. 1888–30"/"Omicrus brevipes." Although partly dissected, its length is about 1.45 mm, its width is 0.98 mm. In external characters the specimen agrees with Smetana's redescription. I do not doubt that it is conspecific with the two specimens examined by Smetana. The aedeagus (Fig. 1A) is 0.67 mm long, the basal piece proportionally much longer than in any other known *Omicrus,* and the parameres strongly curved ventrally at their tips.

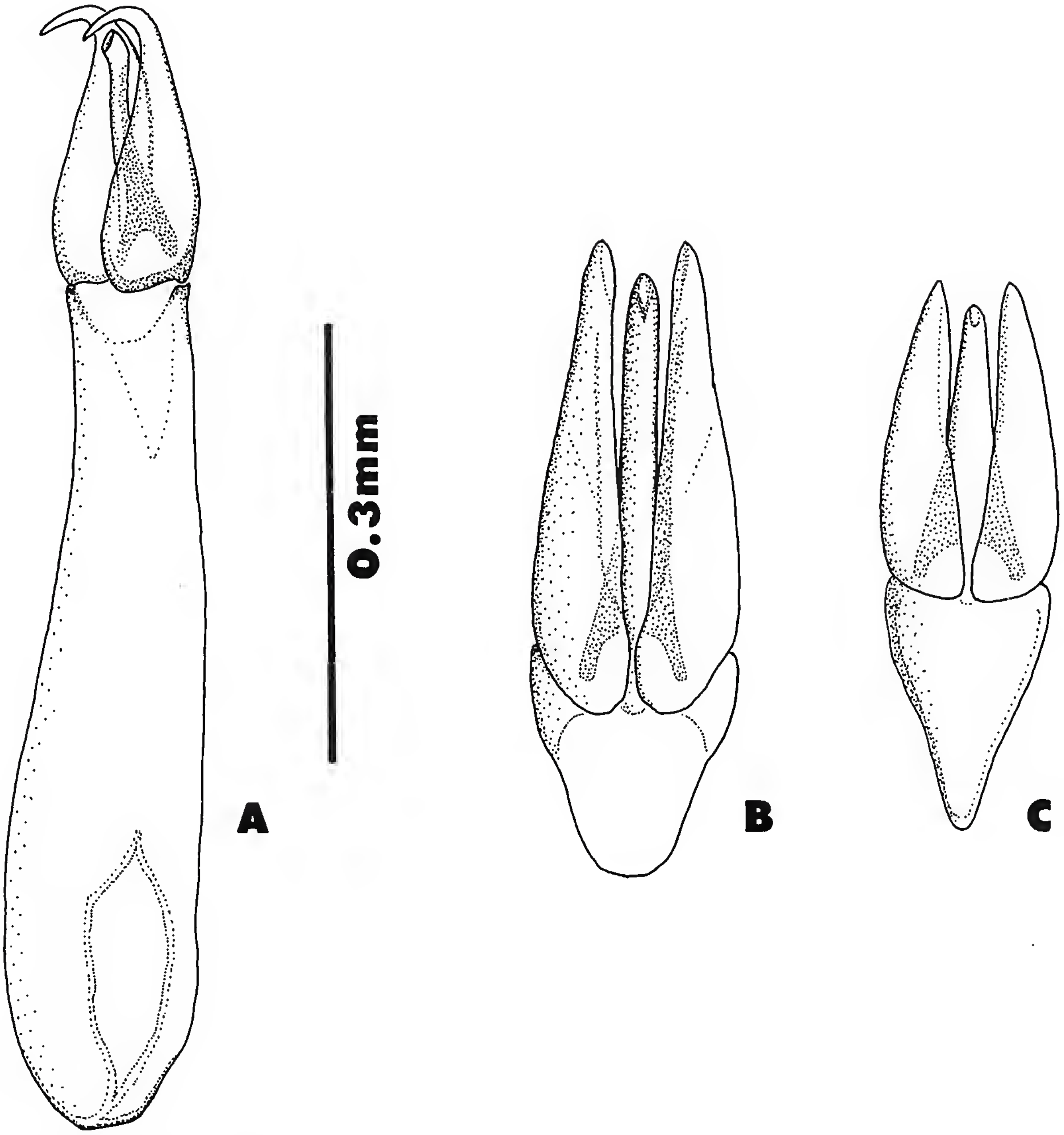

Fig. 1. Male genitalia of *Omicrus*: A, *O. brevipes* Sharp; B. *O. smetanai* new species; C, *O. milleri* new species.

Omicrus smetanai, new species

Holotype.—Male; Marquesas Islands, Temetiv Ridge, Hivaoa, 3900 ft, 14-1-1932, Le Bronnec Coll., Pacific Entom. Survey (Bernice P. Bishop Museum).

Length 1.97 mm; width 1.41 mm; head rufobrunneus, slightly lighter anteriorly, sparsely finely punctate, without trace of microsculpture; antennae, maxillary palps, and labrum testaceous; pronotum rufobrunneus, with few widely separated fine punctures, microsculpture barely visible as fine waves laterally; scutellum with a few very fine punctures; elytra rufobrunneus except lighter at extreme apex, punctation slightly coarser and more dense than on pronotum, especially laterally, microsculpture virtually obsolete as on pronotum; thoracic sterna dark rufobrunneus, mesosternal elevation rather narrow basally, elevated middle portion of metasternum sparsely punctate, each moderate-sized puncture bearing a long golden seta, metasternum microreticulate laterally; legs rufotestaceous, tarsi fringed with long golden setae below, first hind tarsal segment about equal to second; abdomen rufobrunneus, microreticulate; aedeagus as in Fig. 1B.

Paratypes.—4 specimens (one ♂, the others not dissected), same data as holotype (Bernice P. Bishop Museum); 1 specimen (sex not determined), same data as holotype, (retained by the author).

This is the largest *Omicrus* species yet described, averaging 2.10 mm long (range 1.97–2.25 mm) and 1.46 mm wide (range 1.39–1.52 mm). Of the neotropical species it most nearly resembles *O. laevis* (Sharp), from which it can be distinguished by its larger size and aedeagus with shorter basal piece. The wings are reduced to functionless slips. Paratype labels include habitat as "in rotting leaves." The species is named for Dr. Aleš Smetana in recognition of his contributions to the knowledge of Hydrophilidae, especially Omicrini.

Omicrus milleri, new species

Holotype.—Male; Marquesas Islands, Temetiv Ridge, Hivaoa, 3900 ft, 14-1-1932, Le Bronnec Coll., Pacific Entom. Survey, in rotting leaves (Bernice P. Bishop Museum).

Length 1.56 mm; width 1.07 mm; head rufopiceous, punctures of moderate size separated by spaces 2 or 3 times their diameter, microsculpture of irregular waves visible on clypeus, obsolete on vertex; antennae, maxillary palps, and labrum testaceous; pronotum rufobrunneus, appearing almost impunctate, punctures very sparse and fine, microsculpture barely visible as rudimentary irregular waves; scutellum with a few punctures slightly coarser than those on pronotum; elytra rufobrunneus, diffusely lighter posterolaterally, punctures uniformly moderately coarse, tending to be arranged in distinct rows laterally, punctation of intervals equally coarse but less regular in pattern, microsculpture lacking; thoracic sterna rufobrunneus, mesosternal elevation rather narrow, distinctly lanceolate raised along midline, elevated middle portion of metasternum sparsely finely punctate except at base, each puncture bearing a long golden seta, metasternum microreticulate laterally; legs fuscotestaceous, tarsi fringed with long golden setae below, first hind tarsal segment about equal to second; abdomen rufotestaceous, microreticulate; aedeagus as in Fig. 1C.

Paratypes.—8 specimens (sex not determined), same data as holotype (Bernice P. Bishop Museum); 2 specimens (sex not determined), same data as holotype (retained by the author).

Average length is 1.67 mm (range 1.56–1.85 mm), average width 1.09 mm (range 0.98–1.23 mm). This species superficially resembles *O. brevipes,* particularly in the coarseness of elytral punctation, but differs in the lack of strong pronotal microsculpture and in the form of the male genitalia. The wings are reduced to functionless slips. The species is named for Dr. David C. Miller, who introduced me to the study of Hydrophilidae and who pointed out the series of the Bishop Museum collection on which this and the previous species are based.

Peratogonus grandis, new species

Holotype.—Sex not determined; Sikkim: Gopaldhara, Rungbong Vall., H. Stevens (British Museum (Natural History)).

Length 2.21 mm; width 1.64 mm; head piceous, finely microreticulate, finely densely punctate; labrum rufotestaceous; antennae and maxillary palps testaceous; pronotum rufopiceous, microreticulate as head, punctures slightly coarser, more widely separated than on head; elytra rufopiceous, 10-striate, striae deeply impressed except on disc, intervals shining, very sparsely, minutely punctate; ventral surface rufobrunneus, microreticulate; mesosternal elevation very broadly pentagonal, anterior margin raised, distance between mesocoxae equal to width of coxa; metasternum excavated laterally for reception of mesotibiae, medially finely, densely punctate, punctures becoming less dense and much coarser laterally; 1st abdominal sternum longitudinally carinate; legs rufobrunneus; profemora microreticulate, angulate at apex of trochanter, grooved anteriorly for reception of tibiae, slightly concavely bowed posteriorly; protibiae grooved externally for reception of tarsi; meso- and metafemora having microsculpture consisting of short lines parallel to the length of the femur; tarsi short, not very hairy, first segment about equal to second.

I have before me one specimen of *P. reversus* Sharp, lent me by the Institut royal des Sciences naturelles de Belgique, determined by Armand d'Orchymont. In comparison, *P. grandis* is much larger (the specimen of *P. reversus* measures 1.72 mm long and 1.31 mm wide) and has more and finer punctures laterally on the metasternum (the punctures of *P. reversus* are exceptionally large and deep).

Peratogonus and the closely related genus *Noteropagus* were placed in Megasternini by d'Orchymont (1919), primarily on characters of sternal morphology. I find *Noteropagus* and *Peratogonus* (hereafter abbreviated N & P) to belong to Omicrini for the following reasons:

1. N & P possess the depressed explanate clypeus of Omicrini, although this condition is partly masked by the development in most species of a false clypeal margin. The explanate clypeus is a key synapomorphy defining Omicrini.

2. N & P share with Omicrini the possession of a bifurcate vein Cu 2 in the flight wing. They, and all Omicrini, lack the pre-apical spur on the M-Cu loop found in Cercyonini and Megasternini.
3. N & P have distinct elytral epipleura in the basal half, a plesiomorphic condition. Megasternini are apomorphic for the loss of epipleura.
4. N & P have elytral punctation of a derived omicrine type, that is, all series follow the curve of the elytral convexity. Thus lateral striae end progressively further anterior of the elytral tip. In Megasternini the lateral series are parallel to the elytral margin.
5. N & P have the profemoral base angulate in common with Omicrini, but not Megasternini.
6. N & P lack the secondarily derived suture between frons and clypeus common to all Megasternini except *Megasternum.*
7. N & P lack the femoral lines of all Megasternini except *Megasternum* and *Emmidolium* (which appear to have lost them secondarily).
8. The pentagonal mesosternum and elevated prosternum by which N & P were placed in Megasternini are found also in some Omicrini, and approximated in some Cercyonini and Sphaeridiini.

d'Orchymont (1919) separated *Noteropagus* from *Peratogonus,* stating that the former were smaller, with body form more oblong, more depressed, and less globose, without a series of larger punctures against the posterior margin of the pronotum, with the elytra finely seriatopunctate (rather than distinctly striate), and with epipleura more visible up to the sutural angle. While the described species of *Noteropagus* are all smaller than those of *Peratogonus,* and while the other characters hold in most cases, it is not apparent that these features warrant generic status for *Noteropagus.* I propose that *Noteropagus* be retained pending further study of the hydrophilid fauna of the Pacific and Oriental Regions, where I have no doubt more species await description.

Ischyromicrus, new genus

Etymology.—"Stubborn *Omicrus*": combining reference to the difficulty in determining the relationships of the genus (Ischyros = stubborn *Gr*) and the type-genus of Omicrini. Gender: Masculine.

Type-species.—*I. julieae* new species

Form oval, moderately convex; antennae 9 segmented (6 + 3), first segment elongate, segments 3–5 minute, club moderately compact, pubescent; clypeus strongly depressed and explanate immediately anterior to antennal bases; maxillary palpi shorter than antennae, 2nd (pseudobasal) segment slightly swollen, 3rd and 4th segments about equal, shorter than 2nd; eyes located on lateral angular prominences of head, not emarginate anteriorly; labrum visible, emarginate medially, fringed with setae; labium and maxillae

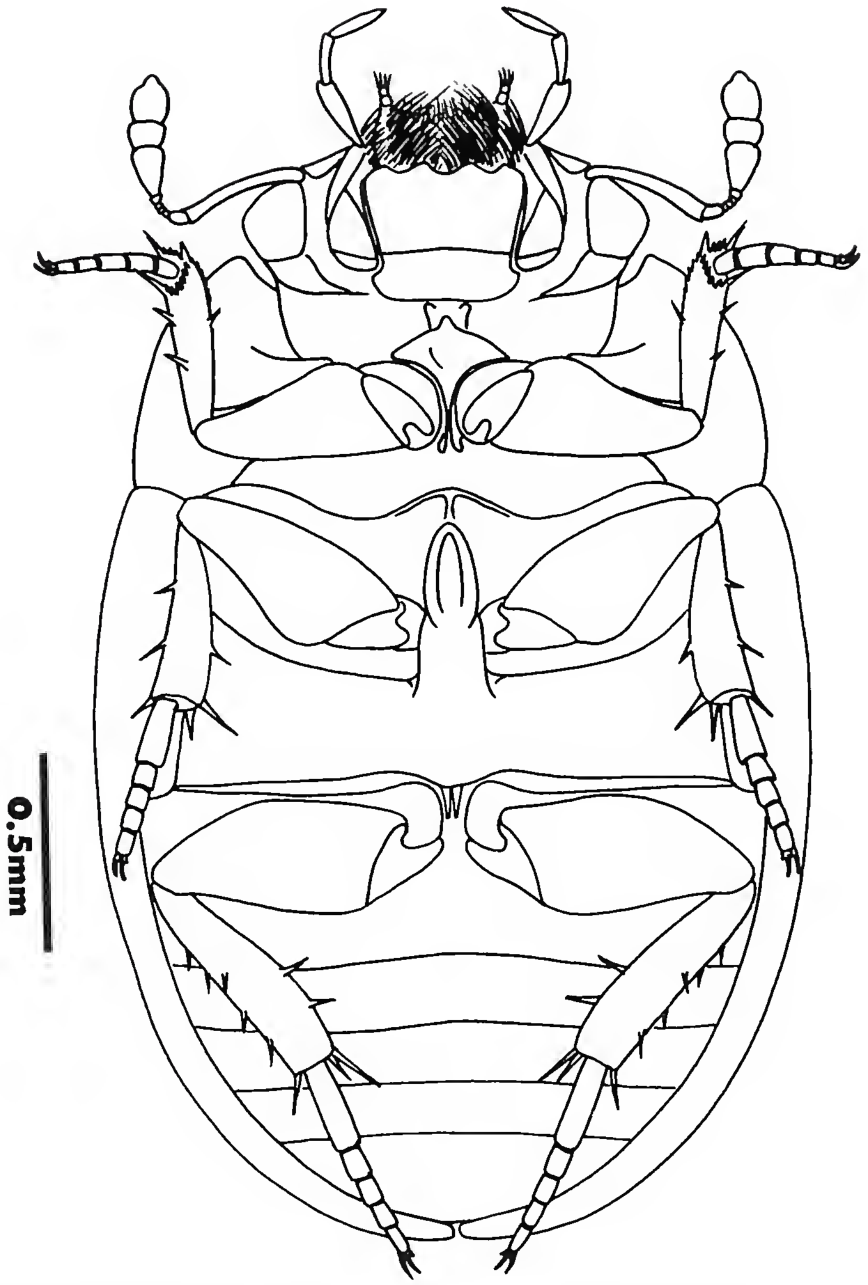

Fig. 2. *Ischyromicrus julieae* new species, Holotype, Ventral View.

separated from posterior head region by a transverse groove, submentum obliquely sloping, entire labium slightly concave below for reception of median prosternal projection; labial palps of moderate length; maxillae, labium, and labial palps fringed with setae; pronotum convex to margin, not explanate, deeply emarginate anteriorly for reception of head; prosternum very short, almost vertical anterior to coxae, raised strongly towards medial rounded prominence, median projection with a short spine anteriorly, narrowly carinate raised between coxae, carina split posteriorly; mesosternum elevated medially in the form of a flat plate, grooved longitudinally, convexly narrowed to a point anteriorly, broadly contacting metasternal projection posteriorly; metasternum linearly raised medially, projecting between mesocoxae, mesocoxae appearing moderately widely separated, actually close together under metasternal projection, metepisterna not nar-

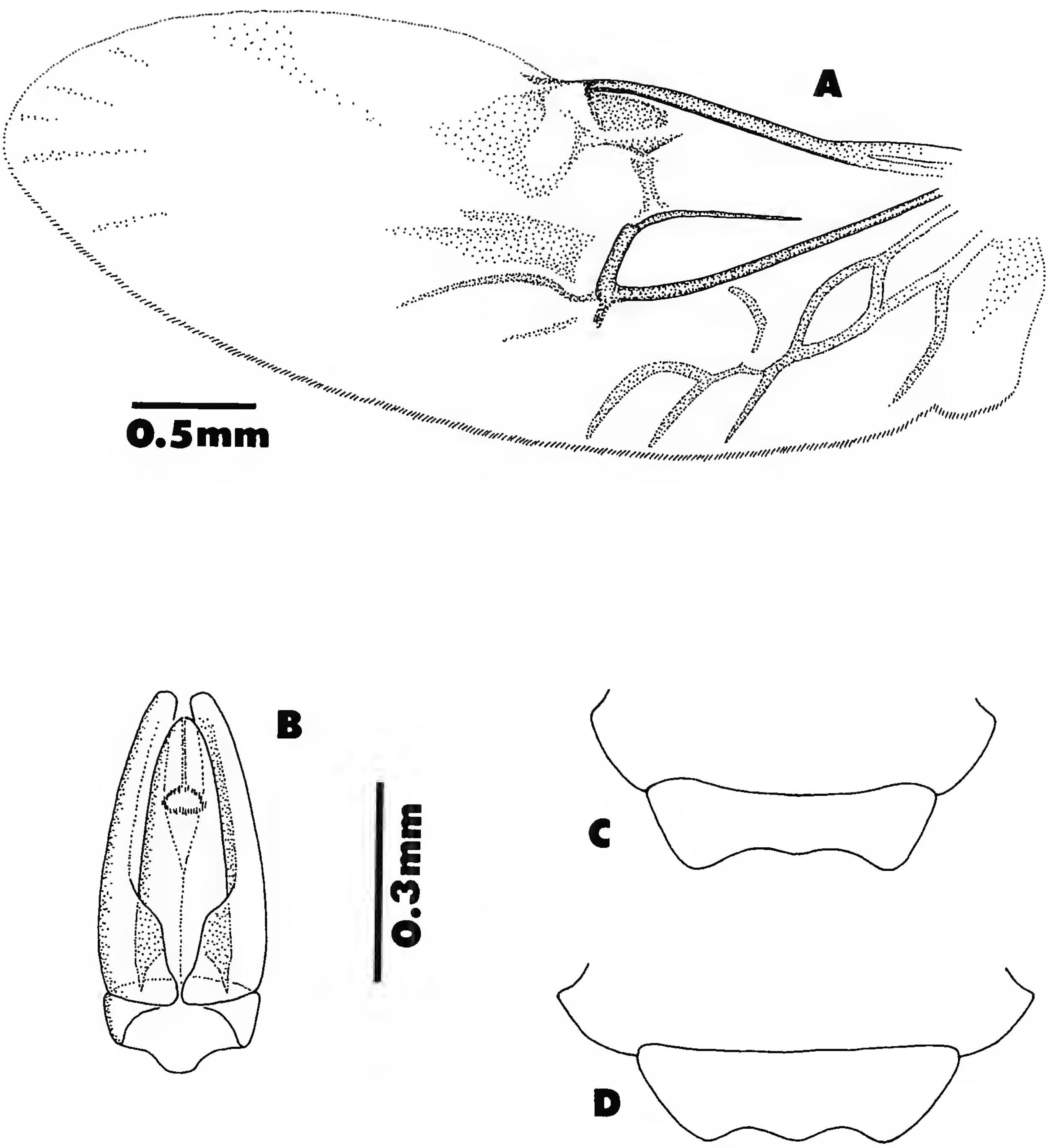

Fig. 3. A–C, *Ischyromicrus julieae* new species: A, wing venation; B, male genitalia; C, labrum. D, *I. cognitus* new species: labrum.

rowed; elytra with sutural stria in apical half, otherwise not striate but with 10 rows of punctures, epipleura broad from base to apex, broadest in basal third; wing venation as in Fig. 3A, two closed cells in cubito-anal region, jugal lobe weakly defined but present; tarsi long, hind tarsi as long as tibiae, 1st hind tarsal segment about equal to 2, 3, and 4 together; 1st abdominal sternum not longitudinally carinate.

Ischyromicrus presents a suite of characters, some quite generalized, others autapomorphic, which at first obscured the affinities of the genus. Nevertheless I am convinced that the genus is omicrine, resembling most closely the genera *Heteryon* Sharp and *Oreomicrus* Malcolm. *Ischyromicrus* is placed in Omicrini based on its possession of an explanate clypeus, its eyes on lateral angular prominences of the head, and its metasternum prolonged between the mesocoxae. Like *Heteryon* and *Oreomicrus* the 1st abdominal sternum is not longitudinally carinate, the prosternal projection is split behind the coxae, the profemora are not angulate at their base, the submentum is not perpendicular, and, like *Heteryon,* the elytral punctation pattern is simple. Although the antennae are 9 segmented, segments 3–5 are minute, perhaps a precursor to the loss of one segment as in *Heteryon* and *Oreomicrus.* The antennal clubs are similarly shaped in all three genera. The long 1st hind tarsal segment is an apomorphic condition found in no other omicrine genus, where the rule is short tarsi with the first segment about equal to the second. The flight wing has two closed cells in the cubito-anal region, a plesiomorphic condition. In Sphaeridiinae, exclusive of Rygmodini, I have found two closed cells only in *Omicrus* sp. and in *Andotypus ashworthi* Spangler (1979) of the Sphaeridiini. *Ischyromicrus* possesses autapomorphically derived pro- and mesosterna. The mesosternal projection is reminiscent of that found in Cercyonini, yet differs by being longitudinally grooved and closely joined to the metasternum between rather than behind the mesocoxae.

Ischyromicrus julieae, new species
(Fig. 2)

Holotype.—Male; North Borneo (SE), Forest Camp, 9.8 km SW of Tenom, 19.XII.1962, Y. Hirashima Collector, Bishop (Bernice P. Bishop Museum).

Length 2.95 mm; width 1.80 mm; head brunneus, moderately, finely punctate, each slit-like puncture with a minute hair-like projection; labrum, maxillary palps, and antennae testaceous, except antennal club fuscous, labrum with single emargination (Fig. 3C); pronotum light brunneus, punctures as on head; scutellum impunctate; elytra light brunneus, puncture rows very fine, intervals with still finer punctures irregularly placed; ventral surface light brunneus, microreticulate, mesosternal elevation about twice as long as wide, metasternal projection slightly narrowed anteriorly; legs brunneus; aedeagus as in Fig. 3B.

Paratype.—1 female; length 3.03 mm, width 1.97 mm, same data as holotype, Bernice P. Bishop Museum.

The species is named for Ms. Julie Ramsey, who has been a constant source of encouragement to me over the last two years.

Ischyromicrus cognitus, new species

Holotype.—Female; Haut Mekong, Muong Sing (North Vietnam), 18.IV.1918, R. V. de Salvaza, Brit. Mus. 1921–89 (British Museum (Natural History)).

Length 3.44 mm; width 2.05 mm; head rufopiceous, moderately, finely punctate, punctures round, not slit-like; labrum, maxillary palpi, and antennae rufobrunneus, except antennal club fuscous, labral emargination deeper on each side of midline (Fig. 3D); pronotum rufopiceous, punctures as on head; scutellum impunctate; elytra rufopiceous, fading to rufobrunneus posteriorly, puncture rows fine on disc, becoming larger laterally and posteriorly, intervals with much finer punctures irregularly placed, elytra slightly explanate posterolaterally; ventral surface rufopiceous, microreticulate, mesosternal projection about three times as long as wide, narrowed slightly posteriorly, metasternal projection fairly narrow, only barely overlapping coxae; legs rufopiceous.

This species is easily separated from *I. julieae* by its narrower mesosternal projection, coarser elytral punctation, and doubly emarginate labrum.

Acknowledgments

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ON THE IDENTITY OF *AMPHIZOA KASHMIRENSIS* VAZIRANI (COLEOPTERA: AMPHIZOIDAE)

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Since its discovery and original description (LeConte, 1853), the genus *Amphizoa* has been the focus of considerable interest and study (Edwards, 1951) in spite of its low diversity (only six species described). Members of this genus, considered by most workers since Horn (1881) as representing a distinct, monobasic, phyletically relict family, demonstrate a combination of structural characters which appears to be intermediate between those of the Caraboidea and the Dytiscoidea of Adephaga. *Amphizoa* is thus a crucial group for understanding adephagan phylogeny in general and relationships among terrestrial and aquatic representatitves of the suborder in particular.

Amphizoids are also of interest for their presumed geographical distribution—four species restricted to western North America and two species described from the Himalayan region. This particular disjunction pattern, seen in at least a few other groups (e.g. in Opisthiini, another relict adephagan (Carabidae) group), has been interpreted as a remnant of a formerly more continuous distribution pattern. Undoubtedly some groups are presently distributed in this pattern, but we are uncertain that it actually represents the distribution of Amphizoidae. Our doubts, and this report, center on the identity of the Palaearctic components of this pattern.

Palaearctic Amphizoidae

Past efforts by North American workers (e.g. Edwards, 1951; Kavanaugh, 1980) to study or even locate identified material representing these presumed Palaearctic amphizoid taxa have failed. The location of type specimens or any other representatives of *Amphizoa davidi* Lucas (1882:157) is unknown at present. Régimbart (1899:192) indicated that at least one specimen was to be found in Museum d'Historie Naturelle de Paris (MHNP); but recent searches in that collection have uncovered nothing referable to this taxon.

Similarly, identified specimens of *Amphizoa kashmirensis* Vazirani (1964:145) have not been available for study, and structures illustrated in the original description of this taxon are unlike those of Nearctic *Amphizoa* members. This led Kavanaugh (1980) to question the familial relationships of these Palaearctic 'amphizoids' and, hence, occurrence of the genus *Amphizoa* in the Palaearctic region. However, in the absence of material representing these taxa, the problem has remained unsolved.

"*Amphizoa kashmirensis*"

Fortunately, and through the kind assistance of Dr. K. Rai, Director of the Zoological Survey of India (ZSI), Calcutta, Kavanaugh recently obtained two female paratypes of *A. kashmirensis* on loan from that institution. An initial examination of these specimens revealed that they share characteristics (in structure and form of pro- and metasterna, coxal cavities, pro- and metacoxae, and hind legs [fringed with natatorial setae]) typical of dytiscids rather than of amphizoids. Kavanaugh then asked Hugh B. Leech to review the specimens and venture an opinion on their familial affinities. Leech agreed that the specimens are dytiscids and suggested further that they belong to the genus *Gaurodytes,* subgenus *Hydronebrius* (sensu Zaitsev, 1953), which included a single species, *G. cordaticollis* (Reitter, 1896), known from the U.S.S.R. (Uzbekistan and Tadzhikistan).

Independently and somewhat earlier, Roughly had obtained unidentified material from the Canadian National Collection (CNC), Ottawa, which he subsequently identified as representative of the genus *Hydronebrius* Jakovlev (1897) (Dytiscidae), perhaps of *H. cordaticollis* (Reitter). It occurred to him at that time that these beetles could easily be mistaken for amphizoids and, further, that Palaearctic records for the latter family could actually be based on specimens of this dytiscid taxon.

We became aware of our parellel studies in early 1980 and immediately began collaborative work. We first obtained material identified as *Hydronebrius cordaticollis* (Reitter) from the British Museum (Natural History) (BMNH), London, compared same with the *A. kashmirensis* paratypes, and found all to be similar in almost every detail. A key character in recognition of *Hydronebrius* members is the absence of the short row of setae found on the ventral posteroapical angle of the hind femur in Agabini (Brinck, 1948); *A. kashmirensis* paratypes also lack this setal row.

At that point, the identify of *A. kashmirensis* appeared to be established (pending review of *H. cordaticollis* type material). However, two important papers have subsequently come to our attention which confound the issue at present. Vazirani (1970) described a second species of *Hydronebrius, H. guignoti* (from Kashmir), and illustrated pronotal silhouettes and aedeagi for members of both this species and *H. cordaticollis*. A third species, *Hydronebrius mattheyi* (from Pakistan) was described by Brancucci (1980) whose illustrations of pronota and aedeagi for all three *Hydronebrius* species agree well with those of Vazirani (1970). Our comparisons of material at hand with these illustrations of pronota and original descriptions suggest the following: (1) *Amphizoa kashmirensis* Vazirani (1964) and *Hydronebrius guignoti* Vazirani (1970) appear to be synonymous, in which event the former name has priority and the valid name for the taxon would be *Hydronebrius kashmirensis* (Vazirani). (2) Specimens from CNC appear to be members of *H. guignoti* rather than *H. cordaticollis*. (3) Specimens from BMNH identified as *H. cordaticollis* appear to be members of *H. mattheyi*. (4) We have not yet seen specimens of *H. cordaticollis*.

We admit that our comparisons have been severely limited because we have not yet studied males of *A. kashmirensis* nor type specimens of any of the three *Hydronebrius* taxa. Present ambiguities are no doubt due, at least in part, to a willingness among past workers to describe new taxa based on too few specimens and/or without reference to type specimens of previously describe taxa. We therefore refrain from making any formal identifications or designations of synonymy at this time, pending a more complete review of genus *Hydronebrius,* especially type material. We have no doubt, however, that *A. kashmirensis* is a dytiscid rather than amphizoid and, further, that it belongs in genus *Hydronebrius* Jakovlev.

Our findings certainly weaken the case for occurrence of Amphizoidae in the Himalayan region; but in the absence of type material for *Amphizoa davidi* and, hence, certainty as to its identity, the question can not yet be resolved.

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TRACHYPACHIDAE AND HYDRADEPHAGA (COLEOPTERA): A MONOPHYLETIC UNIT?[1]

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Members of *Trachypachus* represent an extremely interesting phylogenetic relic taxon, probably derived from near the branching point of Caraboidea and Dytiscoidea (Bell, 1966; Evans, 1977). Most investigations of the phylogenetic position of *Trachypachus* have been done by morphologists and/or carabidologists. The purposes of this paper are to: 1. bring this taxn to the attention of hydradephagan workers and to call for their views, 2. summarize the contributions of these workers, 3. point out some of the problem areas in hydradephagan phylogeny, 4. test the presumption that Trachypachidae belongs with Hydradephaga, and 5. re-evaluate the monophyly of Hydradephaga itself.

My working hypothesis is that the suborder Adephaga comprises two monophyletic lineages: Caraboidea and Dytiscoidea, the latter including Trachypachidae and Hydradephaga. Trachypachids have traditionally been placed within Carabidae, at the tribal level, on the basis of possession of tibial antennal cleaner, carabiform adult and larval habitus and terrestrial life style. Trachypachidae contains two genera: *Trachypachus* and *Systolosomus,* together including six extant species. Trachypachidae were first recognized to be of importance to discussions of hydradephagan evolution by Crowson (1955) who elevated the tribe to family status. Specimens of *Systolosomus* are not common in collections and none were examined during this study. Sharp (1882) and Hammond (1979) described structural details of *Systolosomus* and concurred with other authors that these two genera are closely related. Hydradephaga presently includes Amphizoidae, Hygrobiidae, Haliplidae, Noteridae, Dytiscidae and Gyrinidae.

Cladistic methods were used. For an explanation of this technique see Hennig (1966) and Kavanaugh (1972, 1978) and the references cited therein. Polarity of characters was determined by comparison to character states found in presumed sister groups. Dytiscoidea and Caraboidea are almost certainly sister groups with Dytiscoidea being derived from an ancestor which probably would be placed within the division Isochaeta of Carabidae (Bell, 1966). For Dytiscoidea, characters are polarized from plesiotypic states exhibited by members of Caraboidea.

This analysis would be strengthened if character states for the primitive sister group of Adephaga could be determined. Unfortunately this taxon is probably something other than an extant member of Coleoptera and perhaps is best represented by members of the extinct suborder Protocoleoptera (*sensu* Crowson, 1975), known only from fossils of Lower Permian age. Crowson (1975) listed the character states known for this group. The extant group nearest to the ancestor of Adephaga are probably Megaloptera (Crowson, 1975).

Discussion of Characters

The best treatment of imaginal structure of Hydradephaga remains Sharp's (1882, pp. 190–257) analysis of "Dytiscidae." Sharp's concept of Dytiscidae includes the currently accepted families Amphizoidae, Hygrobiidae, Noteridae and Dytiscidae *s. str.* Throughout his discussion Sharp compared dytiscids to carabids and haliplids in sufficient detail to provide good structural knowledge of most of Dytiscoidea. This account should be supplemented by Hatch's (1926) work on gyrinid structure. Sharp (1882, pp. 967–972) also analyzed similarities and differences in character states between Carabidae and Dytiscidae *sensu* Sharp, some of which were missed by later authors.

The following discussion is restricted to those characters in which the majority of Dytiscoidea exhibit the apotypic states. Distribution of character states among various groups of Adephaga is shown in Table 1.

Character 1. Antennal pubescence. Antennae of all adult hydradephagans are glabrous or almost glabrous. The apex of each antennomere of adult *Trachypachus* does have setae, but antennomeres I–X lack the close set pubescence common in adult Caraboidea (Bell, 1966; Hammond, 1979; Sharp, 1882). However, antennomere XI does have a small area of pubescence. A similar condition was found in adult members of some Pseudomorphini and Scaritini (Sharp, 1882) and in Gehrinigiini (Bell, 1966) of Carabidae. This is a weak synapomorphy because it is a loss state (Hecht and Edwards, 1976).

Character 2. Prosternal process. Characteristic of adults of Dytiscoidea is an elongate, well-developed prosternal process (Sharp, 1882), although it is somewhat less well-developed in gyrinids (Hatch, 1926). Members of Protocoleoptera and most Caraboidea do not have the prosternal process as well-developed as in Dytiscoidea (Crowson, 1975; Sharp, 1882). Possible reasons for increased importance of the prosternal process may be inferred from an ecological and structural perspective. Concomitant with an increase in body streamlining is a decrease in size of the prosternum (Nachtigall, 1974). This has resulted in a decrease in ventral contact of procoxae with the prosternum but is compensated for by an increase in dorsal contact to produce articulation around a wheel-like rim (Evans, 1977). The prosternal process forms a strong union between the prothorax and the remainder of the sternum. The benefits of such a union are a major increase in structural integrity and protection of this major and potentially vulnerable body joint by thick cuticle (Hlavac, 1972). The latter would be very important to hydradephagan beetles which respire at the water surface and thereby expose their venters to attack by predators. A well-developed prosternal process is also found in adults of the carabid genera *Omophron* (Omophronini) and *Cyclosomus* (Masoreini) (Sharp, 1882).

Character 3. Open procoxal cavities with post-coxal bridge. All adult Dytiscoidea, in which this character has been investigated possess open procoxal cavities and a post-coxal bridge formed by extension of the prosternum and proepimeron (Bell, 1965, 1966, 1967; Baehr 1979). This condition is distinct from closed procoxal cavities in which a coxal bar is present (Bell, 1966, 1967). It is also found in adult members of *Carabus* (Carabini), *Hiletus* (Hiletini) and *Leistus* (Nebriini) of Carabidae (Hlavac, 1975).

Characters 2 and 3 could form a functional complex in that a change in the prosternal process could be correlated with a change in the type of procoxal cavity. If this can be demonstrated then Characters 2 and 3 should be treated as a single character.

Character 4. Prosternal-metasternal contact. Contact of the prosternal process with the metasternum is common to most Hydradephaga and there is no such contact in adult Protocoleoptera and most Caraboidea (Crowson, 1975; Sharp, 1882). Prosternal-metasternal contact is possible because the mesosternum is shortened and occupies an almost vertical rather than a horizontal plane. The cavity thus formed conceals the prothoracic legs of larger dytiscids during swimming—a hydrodynamic co-adaptation (Nachtigall, 1974). Smaller dytiscids use all three pairs of legs for locomotion (Nachtigall, 1974), and in some groups (*i.e.* some Bidessini and Vatellini of Hydroporinae) prosternal-metasternal contact appears to be secondarily lost. Adult *Trachypachus* also have shortened mesosterna, but they are not as vertical as in most Hydradephaga. Actual contact of the prosternal process with the metasternum can be attained only by maximum deflection of head and prothorax. The question is whether this is due to resumption of a more typically caraboid (*i.e.* terrestrial) life style or whether it represents a truly primitive step in the evolution of the character. Within Carabidae, only adult *Cyclosomus* (Masoreini) have prosternal-metasternal contact.

Adult member of Gyrinidae have the prosternum contacting the mesosternum (Sharp, 1882; Hatch, 1926). In gyrinids, the mesosternum is horizontal rather than vertical. Therefore, streamlining has taken a different form in response to life on the water surface habitats rather than the subsurface habitats of other Hydradephaga. Flexibility of the prosternal joint would be important to life on the water surface. As well, a near vertical mesosternum in gyrinids would represent an extreme, antistreamlined condition (Nachtigall, 1974). Possession of the plesiotypic state by adult haliplids remains unexplained.

Character 5. Metacoxal cavities of interrupted type. All adult dytiscoids have metacoxae which are extended laterally to reach the elytral epipleura, *i.e.* metacoxal cavities of the interrupted type (Bell, 1965, 1966, 1967). Members of Gehringiini and Rhysodini of Carabidae also possess this character state, although they are believed to have achieved it independently (Bell, 1967). Most adult Caraboidea and Protocoleoptera have uninterrupted coxal cavities (Bell, 1967; Crowson, 1975).

Character 6. Metacoxal fusion. In trachypachids and hydradephaga the metacoxae are fused medially, the fusion being marked by a single internal intercoxal septum continuous with the metafurca and the median sternal ridge (Evans, 1977). This metacoxal immobilization of Dytiscoidea is undoubtedly related to their aquatic existence. The metasternum and metacoxae function as a single sclerite and great expansion of the metacoxae is coincident with expansion of coxal swimming muscles (Evans, 1977). Adaptation to aquatic existence has allowed a change in function of metacoxae from femoral counter-rotation in the wedge-pushing movement of Caraboidea to the propulsion movement of Dytiscoidea (Evans, 1977). It is interesting to note that Evans (1977) believes that metacoxal immobilization has been achieved in a different manner among members of Haliplidae than by other members of Dytiscoidea.

Character 7. Setal patch of flight wings. Microtrichia of the metathoracic wings of some Dytiscoidea are organized into a distinct setal patch just posterior to vein Cu_2 near the wing margin (Ward, 1979). This setal patch acts as a mechanism for binding the flight wings against a roughened area on the underside of the elytra and together they function in wing-folding (Hammond, 1979). Among adult Adephaga the setal patch is found in trachypachids, amphizoids, most dytiscids and most noterids (Hammond, 1979; Ward, 1979). It has presumably been secondarily lost in certain genera among Bidessini, Hydrovatini and Hyphydrini (Hydroporinae: Dytiscidae), whose adults are quite small, and within some members of Notomicrini and Noterini of Noteridae (Hammond, 1979).

Character 8. Giardina body. Within the ovaries of some female dytiscoid beetles, development of oogonia is similar to that of most insects having polytrophic ovarioles up until the preoocyte stage of oogenesis. At this stage an extrachromosomal Giardina body appears. The accepted role for the Giardina body is that the extrachromosomal DNA which it contains is the nucleolus organizing region of the genome responsible for synthesis of ribosomal RNA (Urbani, 1969).

In insects, Giardina bodies are known only in females of *Acheta* (Gryllidae: Orthoptera), *Tipula* (Tipulidae: Diptera) and Dytiscoidea (Urbani

1969). The Giardina bodies appear to be of a different type in Dytiscoidea than in other insects. Too little study has been devoted to the distribution of this character within Dytiscoidea and closely related groups for its real value as a synapomorphy to be ascertained. It is known from representatives of Gyrinidae, Hygrobiidae, Colymbetinae and Laccophilinae (Dytiscidae). Among investigated Dytiscinae (Dytiscidae) it is absent in members of *Eretes* (Eretini) and *Cybister* (Cybistrini) but present in members of *Hydaticus* (Hydaticini), *Acilius* (Thermonectini) and *Dytiscus* (Dytiscini). It was not found in the single member of Hydroporinae studied (Urbani, 1969), and there is no information about Trachypachidae, Amphizoidae, Haliplidae and Noteridae.

Character 9. Size and armature of internal sac. The great majority of male caraboids have, within the median lobe of the aedeagus, a well-developed internal sac equipped with setae and spines known as armature (Jeannel, 1955). Male dytiscoids have the internal sac greatly reduced or absent and I have not seen any published reports of armature within the internal sac. The character states of members of Protocoleoptera is unknown, but I have interpreted the dytiscoid state as apomorphic. The problems of interpreting this character have to do with reduction and character polarity. Character states exhibited by dytiscoids could be: derived once and indicate monophyly; achieved independently through reduction from the caraboid state and give a false impression of monophyly; or, they could be the primitive form of the character with the caraboid type being derived, in which case, it would be invalid to use for monophyly.

Character 10. Dilator muscle of vagina. Adult female Dytiscoidea possess a muscle which originates on the upper surface of the vulvar sclerite and inserts dorsolaterally on the vagina, termed dilator of the vagina by Burmeister (1976). This muscle was absent from all caraboids examined by Burmeister and appears to have been secondarily lost from some members of Bidessini and Hydroporini (Hydroporinae: Dytiscidae).

Analysis of Distribution of Characters

Trachypachids possess nine of 10 synapomorphies with Hydradephaga, and the tenth has not been investigated within this group. Amphizoids, hygrobiids, noterids, gyrinids and the dytiscid subfamilies Laccophilinae, Colymbetinae and Dytiscinae each have a majority of apomorphic states.

One difficulty affecting deduction of relationships among Adephaga is the age of the groups. Division into Caraboidea and Dytiscoidea (Geadephaga and Hydradephaga) was probably complete by the end of the Triassic period and most extant families were present before the end of the Jurassic (Crowson, 1975). The great age of these two superfamilies greatly increases the chances of evolutionary change, specialization and modification which could

Table 1. Characters, character states and their distribution among family-level taxa of Adephaga. Only those used in phylogenetic analysis of the monophyly of Dytiscoidea are included. Character polarity is based on ex-group comparison to Protocoleoptera and Caraboidea.

			Dytiscoidea								
				Hydradephaga							
	Character states										
Character no. and description	Plesiomorphic (−)	Apomorphic (+)	Carabidae	Trachypachidae	Amphizoidae	Dytiscidae	Hygrobiidae	Noteridae	Gyrinidae	Haliplidae	Exceptions within a family-level taxon with a majority of one character state
1. Antennal pubescence.	present	absent	±	+	+	+	+	+	+	+	(+) Scaratini, Pseudomorphini, Gehringiini—Carabidae
2. Prosternal process.	not well-developed	well-developed	±	+	+	+	+	+	+	+	(+) Omophronini, Masoreini—Carabidae
3. Procoxal cavities open & post-coxal bridge.	combination absent	combination present	±	+	+	+	+	+	+	+	(+) Carabini, Hiletini, Nebriini—Carabidae
4. Prosternal-metasternal contact.	no contact	contact	±	+	+	±	+	+	−	−	(+) Masoreini—Carabidae (−) Bidessini, Vatellini—Dytiscidae
5. Metacoxal cavities.	not interrupted	interrupted	±	+	+	+	+	+	+	+	(+) Gehringiini, Rhysodini—Carabidae
6. Metacoxal fusion.	not fused	fused	−	+	+	+	+	+	+	+	
7. Setal patch.	absent	present	−	+	+	±	−	±	−	−	(−) Bidessini, Hydrovatini, Hyphydrini—Dytiscidae (−) Notomicrini, Noterini—Noteridae

Table 1. Continued.

			Dytiscoidea								
				Hydradephaga							
	Character states										
Character no. and description	Plesiomorphic (−)	Apomorphic (+)	Carabidae	Trachypachidae	Amphizoidae	Dytiscidae	Hygrobiidae	Noteridae	Gyrinidae	Haliplidae	Exceptions within a family-level taxon with a majority of one character state
8. Giardina body.	absent	present	−/?	?	?	±	+	?	+	?	(−) Hyphydrini, Eretini, Cybistrini—Dytiscidae
9. Internal sac.	large with armature	small without armature	±	+	+	+	+	+	+	+	(+) Rhysodini—Carabidae
10. Vaginal dilator muscle.	absent	present	−	+	+	±	+	+	+	+	(−) Bidesini, Hydroporini—Dytiscidae
Total				+9 −0	+9 −0	+10 −4	+9 −1	+8 −1	+8 −2	+6 −2	(+) 12 (−) 12

obscure phyletic relationship. Therefore, it is not surprising that carabids have gained some apotypic states similar to those of Dytiscoidea. The important aspect is that no group of carabids has gained more than two apotypic states of the characters included in Table 1.

Dytiscoidea and Caraboidea have undergone different rates of adaptive radiation as indicated by their diversity. Trachypachidae, Amphizoidae and Hygrobiidae are groups with less than 10 described, extant species. Gyrinidae (*ca.* 700 spp.), Noteridae (*ca.* 150 spp.), Haliplidae (*ca.* 200 spp.) and Dytiscidae (*ca.* 4,000 spp.) (Britton, 1970) are much more diverse but are still quite a bit less than Carabidae with about 40,000 species (Thiele, 1977). Species diversity is derived by periodic radiation of species known as taxon pulses (Erwin, 1979). Caraboidea have undergone taxon pulses as recently as the Quaternary (Erwin, 1979). In Dytiscoidea, while we lack overall resolution of similar scale, there is no evidence to suggest the action of recent taxon pulses except among a few, widely separated tribes and genera. Presumably extensive, older radiations have taken place such that, with subsequent extinctions, Dytiscoidea is presently comprised of evolutionarily disjunct sets of taxa. This can also obscure phyletic relationship.

At this point we need to examine the classification of Adephaga. Generally, land-dwelling Adaphaga were placed in Caraboidea and aquatic Adephaga were assigned to Dytiscoidea. Therefore, until recently, higher taxa were based on features concerned with way of life. Groups were assigned to families on the basis of similarity of phenotype and assignment of family rank was based on 'appropriate' amounts of dissimilarity (see Ball, 1979 for a general history of classification of caraboids). This same pattern runs throughout the classification of Dytiscoidea. This system may have led to formation of polyphyletic groups. The first major attempt to demonstrate the naturalness of Hydradephaga (as Dytiscidae and excluding Gyrinidae and Haliplidae) is that of Sharp (1882) and his conclusions were that:

> ". . . although several pecularities may be pointed out as being especially characteristic of the Dytiscidae, yet all of them when taken *seriatim* disappear within the bounds of the family or are found in one or more members of the Carabidae." (Sharp, 1882, p. 967).

Probably the single greatest difficulty in any attempt to establish monophyly is to separate characters which have evolved in parallel as a result of adaptation to aquatic habitats (Bell, 1966)—phenetic similarity—from those which show evolutionary relationship. There are at least two methods by which this distinction can be made. First, is the demonstration of a few, well-founded and well-understood synapomorphies not related to aquatic existence. This would seem to be the preferred method (Hecht and Edwards, 1976). However, this is not yet possible because we lack knowledge of the functional importance of characters in relation to aquatic habitats. A second tactic is to tabulate a number of characters which, in total, are highly suggestive of monophyly. The supposition of this approach is that the chances of 10 different characters attaining the exact same state in different groups are very low.

It must be understood that the 10 characters in Table 1 are not of equal value. For instance, fusion of the metacoxae (character 6) is probably the best character. Other characters are of lesser value for different reasons, for example, the distribution of the Giardina bodies (character 8) among Coleoptera is too poorly known. Also, characters 1 to 5 are related to an aquatic mode of life (see Discussion of Characters). One way to establish their use as synapomorphies is to examine the character states found in other groups of aquatic beetles outside the Hydradephaga. This analogy will establish whether or not the character states of Dytiscoidea are common aquatic adaptations of beetles, or, whether they may be used as phylogenetic indicators.

The group of beetles best suited for comparison with dytiscoids are aquatic members of the superfamily Hydrophiloidea because of their occurrence in similar habitats to, and their general behavioral similarity to Hydradephaga. Members of the superfamily Dryopoidea and the suborder Myxophaga can also be used, but only to a limited extent because the adaptive zone of these groups is quite different (mainly bottom dwellers with plastron respiration). For Character 1, the majority of adults of all three groups have at least some antennomeres with close set pubescence (Britton, 1970; Reichardt, 1973). As well, a few carabids such as *Carabus clathratus* L. have attained an aquatic lifestyle (Thiele, 1977) yet the antennomeres are pubescent. Therefore, a complete lack of antennal pubescence is not necessarily correlated with aquatic life. Different strategies are employed by these three analogous groups (Hydrophiloidea, Dryopoidea, and Myxophaga) with respect to each of characters 2 to 5. While each of these character states shown by dytiscoids is an aquatic adaptation, they are not the only character states which could be derived in conjunction with aquatic life. Each group has responded to the same situation in a different manner. Therefore, I think they can be used as a basis for inferring monophyly, providing that they are found to be achieved in the identical manner.

Analysis of Table 1 reveals that trachypachids are more similar to Hydradephaga, in the apomorphic states of the characters used, than they are to Carabidae, where they have been placed traditionally. Trachypachids possess nine of a possible 10 derived states and the tenth has not been investigated within the group. They show a striking affinity to a group of families including Amphizoidae, Dytiscidae, Noteridae and Hygrobiidae (Fig. 1). Therefore, the original question is only partly answered—Trachypachidae and at least part of Hydradephaga form a natural evolutionary

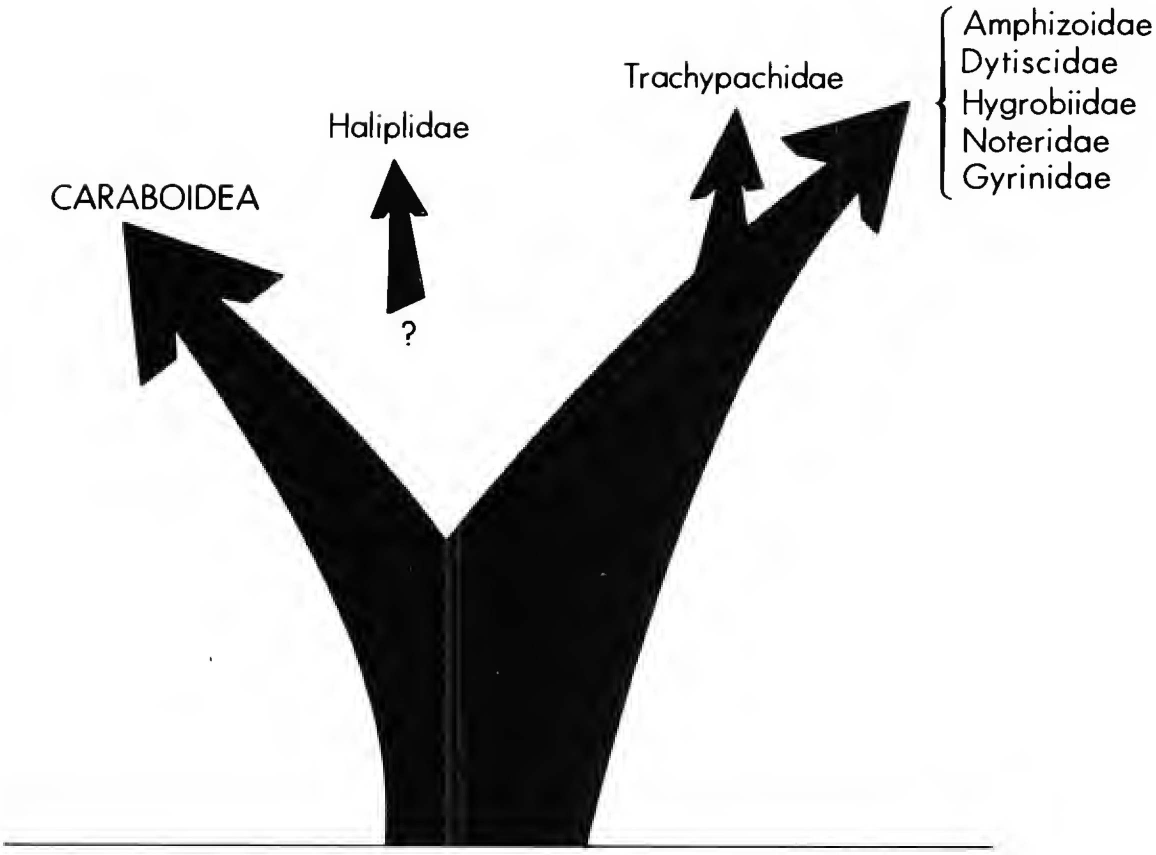

Fig. 1. Schematic representation of the proposed relationships of Adephaga.

unit. This qualified statement, however, leads to another question—are the Hydradephaga monophyletic?

The characters presented here are insufficient to arrive at a definitive conclusion but they are suggestive of areas where intensive investigation will be helpful. For instance, eight of 12 supposedly independent character losses within family-level taxa of Dytiscoidea occur in a single subfamily (Hydroporinae) of Dytiscidae. Some of these exceptions are probably explained by the small physical size of these beetles (less than 6 mm, Sharp, 1882), but members of Notomicrini and particularly members of *Notomicrus* (1.0 to 1.6 mm, Young, 1978) are among the smallest of Dytiscoidea and yet they are not nearly (one of 12) as autapomorphic. Thus Hydroporinae may not belong with the remainder of dytiscids. If the present classification is to be retained, they must be demonstrated to be closer to other subfamilies of Dytiscidae than to any other group of Dytiscoidea. It is important to note that Burmeister (1976) could find no synapomorphies between female Hydroporinae and the remainder of Dytiscidae, in his study of ovipositor musculature. In addition, Burmeister (1976) could not define a systematic position for *Notomicrus* even though he was convinced that it was not a member of Noteridae.

Haliplidae have only six of 10 synapomorphies with other Dytiscoidea (Table 1) and all but two (Character 1, 2, 3 and 6) are possibly associated with adaptation to aquatic life. Further, Evans (1977) demonstrated that the metacoxal plates (Character 6) were derived in a manner quite unlike that of other members of Dytiscoidea (see also Sharp, 1882, p. 972). Adults of *Omophron* (Omophronini: Carabidae) have a resemblance in the type of peg and socket mesocoxal articulation (Evans, 1977). However, Burmeister (1976) indicated three synapomorphies between female haliplids, gyrinids and *Noterus* and another six between haliplids and *Noterus*. The position of Gyrinidae must be similarly re-analyzed. The relationships of Dytiscoidea inferred from the characters used in this analysis are shown in Fig. 1.

It should be clear from these few examples that we need more characters, as well as a greater understanding of their functional significance before we can test our existing schemes of classification within Dytiscoidea. This search should be carried out at all levels within the hierarchies of Adephaga. After all, the positioning and rearrangement of higher taxa is only an extension of a systematist's desire to classify species. From an optimistic viewpoint, the beetles have the characters and now all we have to do is go and find them.

One critical question concerning trachypachids remains to be answered. If they are indeed related to Hydradephaga then why do the extant members live in xeric terrestrial habitats (Evans, 1977)? My evolutionary hypothesis is similar to that of Evans (1977), and would have primitive trachypachids in aquatic situations analogous to those in which *Carabus clathratus* occurs (see Thiele, 1977). Subsequent taxon pulses of trachypachids could have given rise to some terrestrial members. As Hydradephaga arose and diversified they replaced the aquatic or semi-aquatic trachypachids, and the terrestrial Trachypachidae are all that remain.

Acknowledgments

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Footnote

[1] Part 1 of A Phylogenetic Classification of Dytiscoidea (Coleoptera).

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PAGELMIS AMAZONICA, A NEW GENUS AND SPECIES OF WATER BEETLE FROM ECUADOR (COLEOPTERA: ELMIDAE)

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The new genus of riffle beetle described here was found among the very rich and interesting collections of aquatic insects made during the Ecuador-Peace Corps-Smithsonian Institution Aquatic Insect Survey of Ecuador that was conducted from 1975 through 1979. Specimens of this new genus were very abundant in catches in blacklight traps. The large number of specimens (6,000+) and the unusual and extensive plastron drew attention to this beetle and resulted in its description here. All specimens I have seen of this species—except for parts of the legs, head and its appendages, and a narrow area on the pronotum and on the elytra—are covered with a plastron. Other elmids, with few exceptions, have a plastron restricted to the ventral surfaces. Scanning electron micrographs provided visual evidence of the structure of the plastron of this new taxon and suggested a possible manner by which the plastron may be formed; following the descriptions of the new taxa, the plastron and other features of the cuticular ultrasculpture are discussed.

Pagelmis, new genus

Body elongate, subparallel, and moderately convex (Fig. 1). Integument with an opaque plastron which apparently covers body except head, eyes, antennae, mouthparts, middle of mesosternum, metasternum between middle coxae, a narrow medial area on basal two-thirds (Fig. 2) of pronotum, scutellum, and a band four times wider at base than at apex and paralleling elytral suture (Fig. 1).

Head when seen from below partly retracted into pronotum; dorsal surface partially hidden by anterior prolongation of pronotum. Mouthparts visible. Maxillary palpus 4 segmented. Labial palpus 3 segmented. Antenna 11 segmented, arising beside inner edge of eye and separated from clypeus by a deep transverse groove. Labrum rather broad and transversely rectangular.

Pronotum (Fig. 2) widest at basal one-third then narrowing anteriorly, becoming evenly arcuate over head, rimmed apicomedially, also narrowingly slightly posterolaterally; posterolateral angles moderately acute; posterior margin bisinuate; carinae absent. Elytra with first row of punctures distinct, laterally other rows become increasingly effaced; carinae absent; humeri slightly swollen. Prosternum long in front of forecoxae; prosternal process slender, moderately elongate (Fig. 5), parallel sided and bordered by a distinct rim, apex bluntly rounded. Mesosternum deeply depressed on midline in front of and between anterior half of mesocoxae for reception of prosternal process. Metasternum between mesocoxae without opaque plastron, remainder with opaque plastron; disc with narrow, longitudinal, shallow, posterior depression on midline. Legs with visible portion of front coxae rounded and trochantin concealed by hypomera. Protibiae, mesotibiae, and metatibiae without cleaning fringes. Hind trochanters of male each with a strong tubercle apicoventrally (Fig. 7). Claws small, slender, without teeth.

Abdominal sterna 1–5 normally convex and not lobed laterally.

Type-species of the genus.—Pagelmis amazonica, new species.

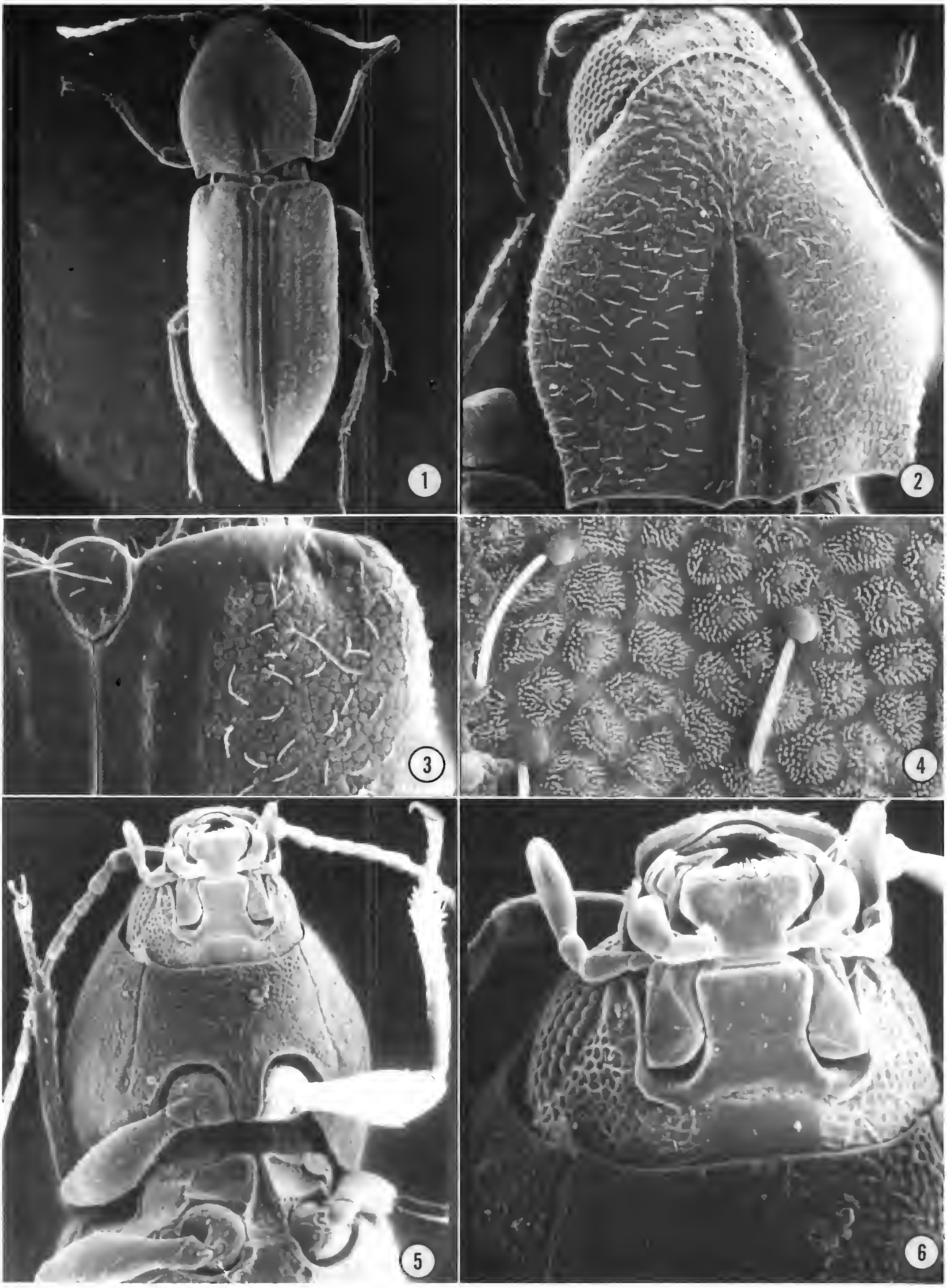
Etymology.—Pagelmis from pago, G.—frost, in reference to the opaque, frostlike appearance of the plastron covering much of the pronotum, elytra, and venter; plus elmis from the nominate genus of the family, *Elmis*. Gender: feminine.

Comparative notes.—This new genus, because the dorsal surface of the integument is mostly opaque as described above, resembles a miniature *Stenhelmoides* but may be distinguished by the following combination of characters: prosternal process parallel sided and narrow, about a third as wide as long (Fig. 5); hind trochanter of males each with an apicoventral tubercle (Fig. 7); all tibiae without cleaning fringes (Figs. 7, 8).

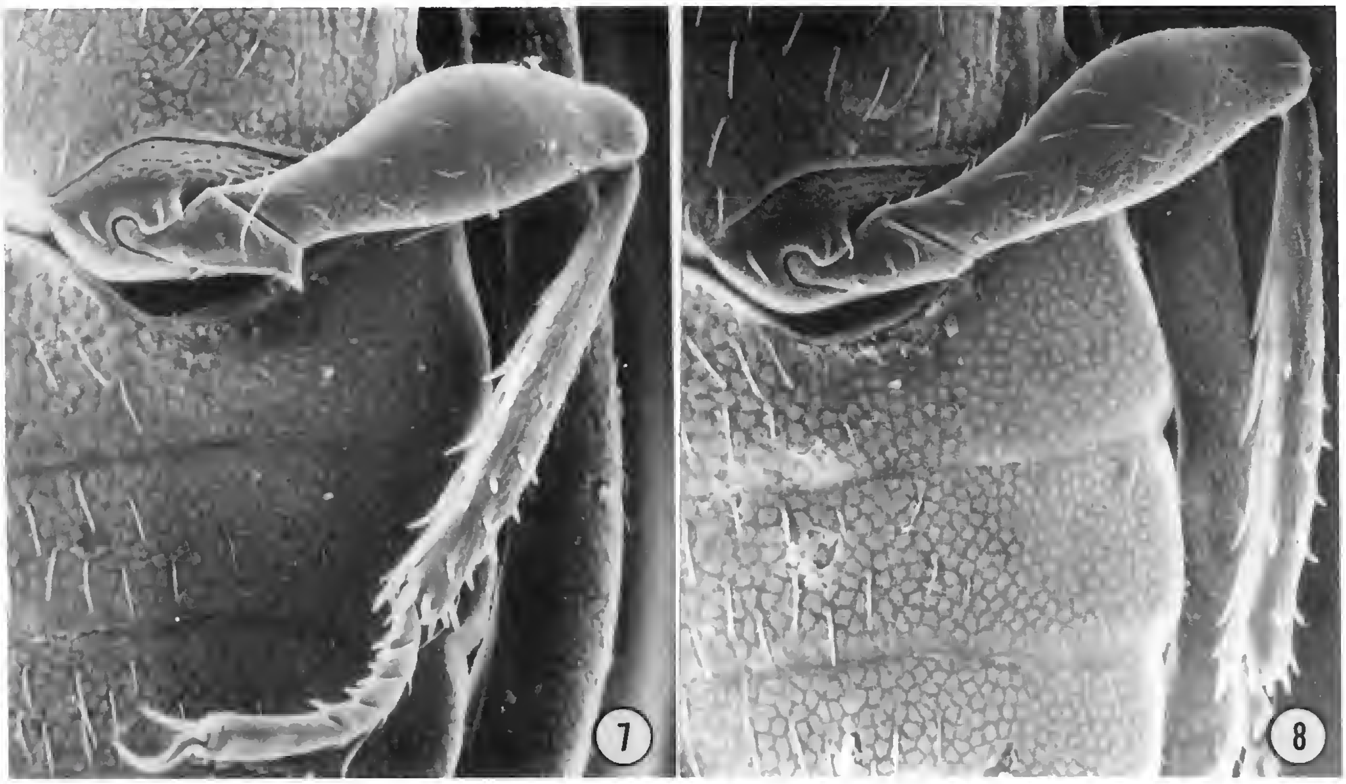
Pagelmis amazonica, new species
(Figs. 1–17)

Holotype male.—Form and size.—Body form elongate, subparallel, and moderately convex (Fig. 1); length 2.2 mm; width 0.8 mm.

Coloration.—Plastron covers integument except those areas listed under generic description. Also, dorsum with contrasting, shiny, narrow, sinuous, microalutaceous, longitudinal area on midline of posterior half of pronotum and a similarly shiny contrasting area on each elytron. Shiny area of elytron a narrow band across base and a wider band along suture; shiny band narrows at apical fourth of elytron. Head and pronotum reddish brown but color obscured by opaque plastron. Pronotum with short, sparse, golden setae. Elytra reddish brown except each elytron with 1 basal and 1 subapical dark brown macula; maculae joined by a dark, poorly defined, subsutural stripe; coloration obscured by plastron. Elytra with short, sparse, golden setae on indistinct intervals.



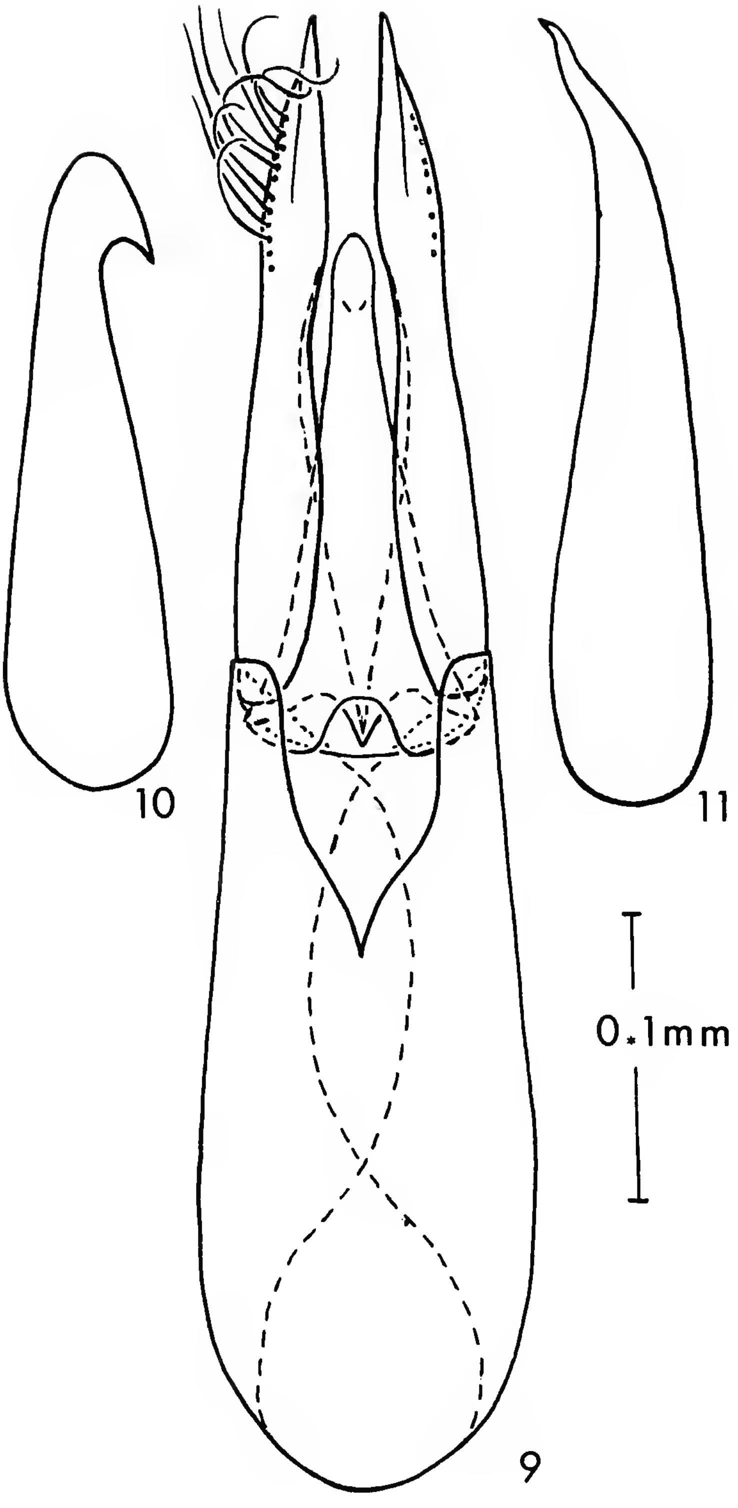
Figs. 1–6. *Pagelmis amazonica,* n. gen., n. sp.: Fig. 1, habitus view, 44×. Fig. 2, pronotum, 140×. Fig. 3, base of elytron, 220×. Fig. 4, plastron on base of elytron, 1100×. Fig. 5, prosternum, 100×. Fig. 6, head, ventral surface, 230×. Photographs reduced ⅓.



Figs. 7–8. *Pagelmis amazonica,* n. gen., n. sp.: Fig. 7, hind leg, male, 160×. Fig. 8, hind leg, female, 160×. Photographs reduced $^1/_6$.

Head.—Partly retracted into pronotum (Figs. 5, 6). Mouthparts visible. Maxillary palpus 4 segmented (Fig. 6). Labial palpus 3 segmented. Antenna 11 segmented, arising beside inner edge of eye and separated from clypeus by a deep transverse groove. Labrum rather broad, transversely rectangular, and coarsely punctate.

Thorax.—Pronotum widest at basal third, converging anteriorly and extending apicomedially over base of head; narrowing slightly posterolaterally; sides strongly, evenly arcuate; base shallowly bisinuate; posterolateral angles moderately acute; integument impunctate but small sparse granules basally and numerous coarser granules on anterior third; apicomedial margin arcuate and distinctly rimmed on medial third; carinae absent. Prosternum with coarse granules; long in front of forecoxae; prosternal process slender, moderately elongate (Fig. 5), about 3 times as long as wide, parallel sided and bordered by a distinct rim, apex bluntly rounded. Mesosternum deeply depressed on midline in front of and between anterior halves of mesocoxae for reception of prosternal process. Metasternum with opaque plastron except area between mesocoxae without plastron; disc with narrow, longitudinal, shallow depression posteriorly on midline. Elytron with first (sutural) row of punctures coarse, punctures separated by 1 to 2 times their width; other rows of elytral punctures indicated but indistinct, becoming increasingly effaced laterally. Legs with visible portion of front coxae rounded and trochantin concealed by hypomera. Protibiae, mesotibiae, and metatibiae



Figs. 9–11. *Pagelmis amazonia,* n. gen., n. sp.: Fig. 9, male genitalia, ventral view. Fig. 10, median lobe, lateral view. Fig. 11, paramere, lateral view.

without cleaning fringes (Figs. 7, 8). Hind trochanter with a strong tubercle apicoventrally (Fig. 7). Claws small, slender, without teeth (Fig. 7).

Abdomen.—Abdominal sterna 1–5 normally convex and not lobed laterally.

Male genitalia.—As illustrated (Figs. 9–11).

Female.—Similar to male except the tubercles on the hind trochanters are much smaller than those on the male (Fig. 8).

Variations.—The type-material was obtained from blacklight traps which typically contain many teneral specimens; many of these specimens are lightly pigmented and the elytral maculae are indistinct. In the more darkly pigmented specimens, the prosternum, mesosternum, and metasternum instead of being uniformly reddish brown, have the discal areas darker reddish brown. These color differences are more obvious on specimens in liquid preservatives.

Type-data.—Holotype male and allotype: ECUADOR: Pastaza Province, Tzapino (1°11′S, 77°14′W) (Tigueno, 32 km northeast), 400 m elev., 22 May 1976, Jeffrey Cohen, Ecuador, Peace Corps, Smithsonian Institution Aquatic Insect Survey. USNM Type No. 75669, deposited in the National Museum of Natural History, Smithsonian Institution. Paratypes: Same data as holotype, 6,000 specimens; same data as holotype except 24 May 1976, 19 specimens and 25 May 1976, 10 specimens. Napo Province: Limoncocha, 3 June 1977, W. E. Steiner, 24 specimens; Limoncocha, 8 June 1977, W. E. Steiner, 8 specimens; Limoncocha, 5 June 1977, P. J. Spangler and D. R. Givens, 11 specimens; Limoncocha, 15 June 1977, P. J. Spangler and D. R. Givens, 26 specimens; Limoncocha, 16 June 1977, P. J. Spangler and D. R. Givens, 49 specimens; Puerto Montufar, 26 April 1976, J. Cohen, 6 specimens.

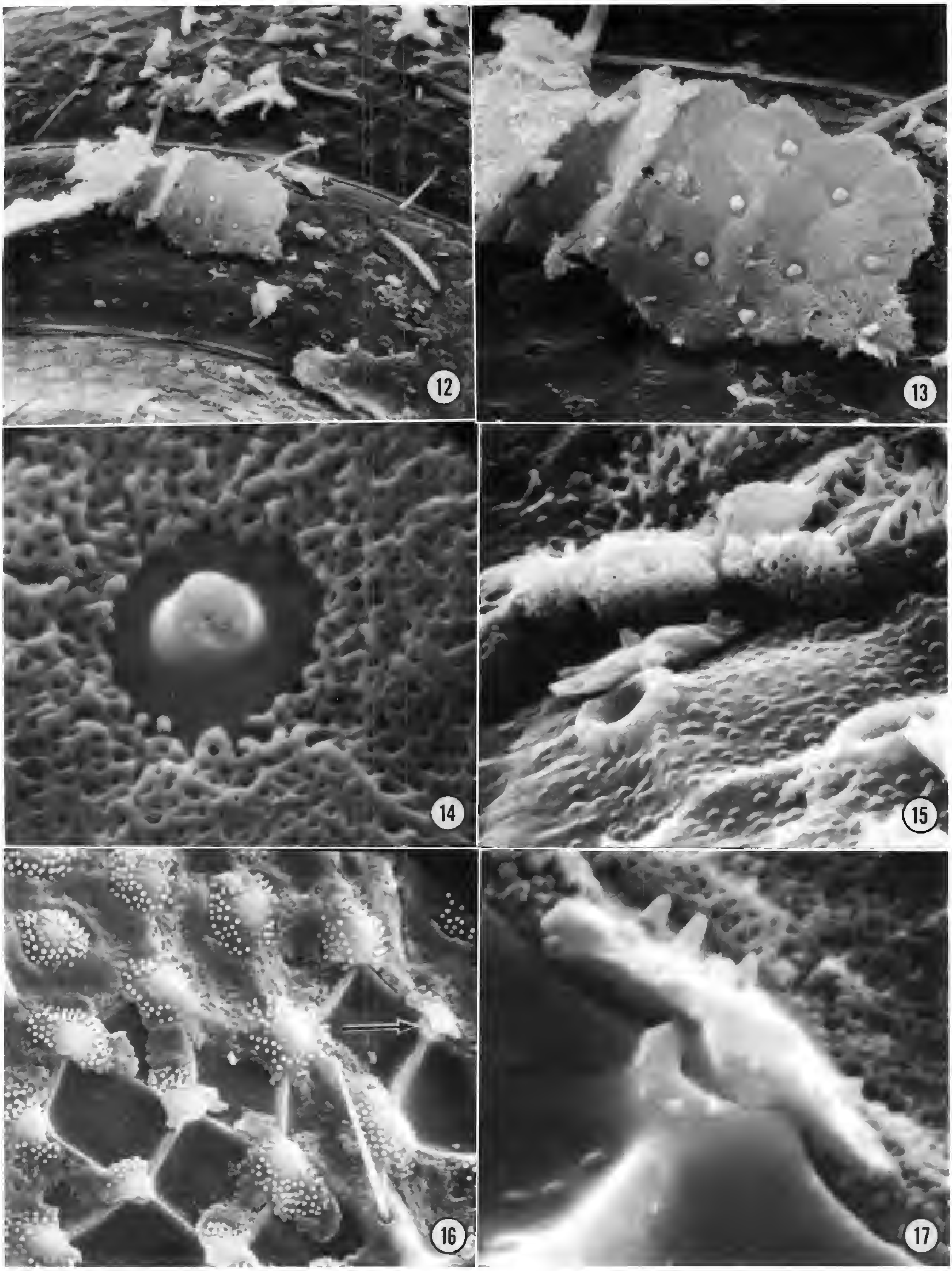
Paratypes will be deposited in the American Museum of Natural History, New York; British Museum (Natural History), London; California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; Instituto Lillo, Tucuman; Institut Royal de Histoire Naturelle de Belgique, Bruxelles; Museum of Comparative Zoology, Cambridge; Museum Nacional de Historia Natural de Chile, Santiago; Museum National de Histoire Naturelle, Paris; Museo Argentina de Ciencias Naturales, Buenos Aires; Zoologische Sammlung Bayerischen Staates, München; and the Stovall Museum of Science and History, University of Oklahoma, Norman.

Etymology.—amazonica, in reference to the occurrence of this taxon in the Amazon River Basin.

Habitat.—Unknown; all material was collected in blacklight traps.

Plastron

Elmid beetles that live in aquatic habitats with a high calcium content often are found to be heavily coated with calcium carbonate; however, those coatings occur irregularly on many areas of the body. The glazed, frosted, or opague areas covering most of the integument of *Pagelmis,* when examined under a stereoscopic microscope, resembled the calcareous coatings. However, these opaque areas were consistently present in a symmetrical pattern and suggested a non-calcareous cuticular sculpture which probably was produced when the pupa changed into the adult form. Never-



Figs. 12–17. *Pagelmis amazonica,* n. gen., n. sp.: Fig. 12, plastron (scraped loose) of abdominal sterna, 600×. Fig. 13, plastron showing plugs from pores in cuticle, 1500×. Fig. 14, plug and plastron texture, 12,500×. Fig. 15, pore, cuticular microtubercles, and porous plastron, 6000×. Fig. 16, cuticular surface of prosternum with broken plastron, 1625×. Fig. 17, pore and cuticle, enlarged, seen (arrow) in Figure 16, 11,500×. Photographs reduced ⅓.

theless, I placed some beetles in acetic acid and in a sonic cleaner in an effort to remove the opaque areas, but neither treatment altered the surface sculpture. Subsequently, I scratched the opaque area on the abdomen of a specimen with a pin and then examined the beetle with the scanning electron microscope.

Instead of a plastron made up of a dense layer of often overlapping scale-like setae that I expected to find, and as illustrated for some species in the elmid genera *Austrolimnius, Cylloepus, Elmis, Elsianus, Hexacylloepus, Limnius, Pilielmis, Portelmis, Stegoelmis,* and *Tyletelmis* by Hinton (1976), it appeared that the plastron of *Pagelmis* is similar to the plastron of members of the aquatic weevil genus *Neochetina* as illustrated and discussed by Hinton (1976). However, the plastron of *Neochetina* is divided into porous scale-like plates supported on microtubercles and the plastron of *Pagelmis* is a porous sheetlike layer supported by microtubercles.

By good fortune, pieces of the plastron that I disrupted with the pin were turned upside down but remained on the specimen examined under the SEM. From this specimen it is evident that in *Pagelmis* the true cuticle (Figs. 3, 12, 13) is relatively smooth and apparently well sclerotized. However, pore-like openings (Figs. 12, 13, 15–17) in the cuticle and cast-like impressions on the lower side of the plastron (Figs. 12–14) suggest that the plastron (Figs. 13–17) probably resulted from secretions exuded from the pores; the micrographs also show that the plastron is porous (Figs. 15, 17). The micrographs show that the plastron rests on microtubercles on the true cuticle and this presumably leaves a thin air space under the plastron and this air space extends into the porous areas in the plastron. In addition, the microcarinae (Fig. 17) radiating from the pores also would support the plastron above the air space.

Because the plastron is distributed more extensively over the ingement, specimens of *Pagelmis* presumably have a larger supply of air available for respiration than do elmids with a reduced plastron. This seems to be an unusual condition because most elmids of the same small size as *Pagelmis* have only a ventral plastron. These small elmids with the smaller, ventral plastron are known to occur in streams and brooks with high to moderate oxygen content; but, unfortunately, the habitat of *Pagelmis* is unknown because all available specimens came from lighttrap collections. It is possible that specimens of *Pagelmis* occur in slow-moving streams or similar habitats which may be low in dissolved oxygen. This suggestion is further supported by the topography and low elevation of the areas from which the type-material was collected. The meandering streams in those areas generally have a low gradient, are more sluggish, and, consequently, contain less oxygen. Under these conditions it seems reasonable that a more extensive plastron would be advantageous and may have evolved in *Pagelmis*. Specimens described in the genus *Stenhelmoides* have a similar glazed, frosty, or opaque appearance on the venter and extensively on the elytra as well. Unfortunately the habitat of members of this genus also are unknown, but they have been collected in the same localities as the type-material of *Pagelmis*. The plastron on *Stenhelmoides* as seen under the SEM after it has been scraped loose is similar to that illustrated here for *Pagelmis*; the plastron on *Stenhelmoides* will be discussed in greater detail in a revision of *Stenhelmoides* that is in progress.

Acknowledgments

The new taxon described above is one of many new taxa collected during an aquatic insect survey of Ecuador. The survey was financed, in part, by the Ecuadorian Ministry of Agriculture, the United States Peace Corps, the Smithsonian Institution, and the National Geographic Society and I extend my deep appreciation to them for their assistance.

I thank Andrea Langley-Armstrong, Jeffrey Cohen and Joseph Anderson, former Peace Corps volunteers, and Warren Steiner and Donald Givens, Museum Technicians, for their efforts in collecting specimens of this new taxon and many other insects from Ecuador.

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HUGHLEECHIA GIULIANII, A NEW GENUS AND NEW SPECIES OF INTERTIDAL BEETLE FROM AUSTRALIA (COLEOPTERA: HYDRAENIDAE)

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As part of ongoing studies of the Hydraenidae of Australasia, I have received specimens from the Commonwealth Scientific and Industrial Research Organization (Canberra) and the Western Australian Museum (Perth) which represent an interesting new genus and new species of flightless, intertidal hydraenid, which is herein described as *Hughleechia giulianii.* All specimens were collected by Derham D. Giuliani along the south and west coasts of Australia. Mr. Giuliani comments thusly (in litt.) concerning the habitats of these beetles: "They occurred in rock crevices covered by high tides, dry rock crevices in the high tide splash zone, and usually most numerously in rock pools a few feet above the water line (created by splash and spray but seldom or never reached by waves). In this latter case they were found walking around the edge of the pools on the rock just below the surface, never more than an inch down, often including apparently mating pairs." Some were collected near Albany, "in rock pools on cliffs up to at least 50 feet above the high tide level. Whether these pools were created by seeps or rain or storm-driven spray I do not know."

Two other genera of flightless Hydraenidae are specially adapted for coastal or intertidal existence, *Meropathus* Enderlein and *Neochthebius* d'Orchymont, both of which are members of the subfamily Ochthebiinae Perkins (1980). *Neochthebius* includes two species, one inhabits the pacific coast of North America, the other lives in Japan (Satô, 1963; Perkins, 1980). These two species are truly intertidal, living in rock crevices below high tide line. Eight species are currently included in *Meropathus*: one on the subantarctic islands of Prince Edward, Kerguelen and Heard (Enderlein, 1901; d'Orchymont, 1938; Jeannel, 1940; Janssens, 1967), three on islands of the New Zealand subregion (Ordish, 1971), three inland species in eastern Australia (Janssens, 1967), and one species on the Falkland Islands and Isla de los Estados at the southern end of South America (Perkins, 1980). *Meropathus* species are terrestrial or semi-aquatic, the insular species being found in bird nests and among stones and grass tussocks in coastal areas (Ordish, 1971).

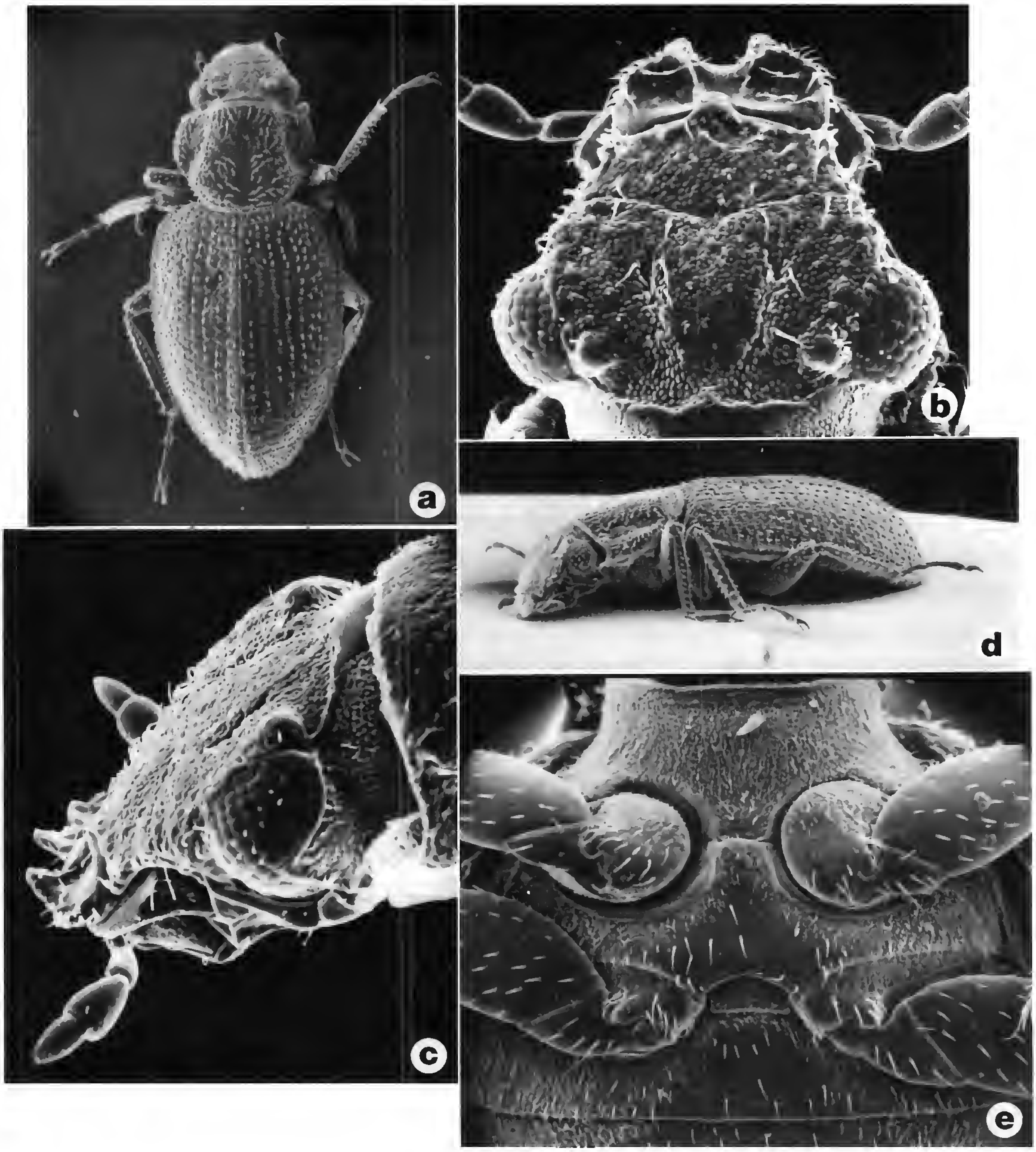

Fig. 1. *Hughleechia giulianii* n. g., n. sp.: (a) dorsal view, 45×; (b) head, male, dorsal view, 185×; (c) head, male, oblique view, 175×; (d) lateral view, 45×; (e) meso- and metasternum, 140×.

Phylogenetic relationships of **Hughleechia**

In addition to similarities in habitat, the phylogenetic relationship of this new genus to *Meropathus* and *Neochthebius* is clearly indicated by the fused elytra, reduced metasternum, body form, antennal configuration and by the short, stiff recumbent elytral setae. It is immediately differentiated from *Meropathus* and *Neochthebius* by the widely spaced meso- and me-

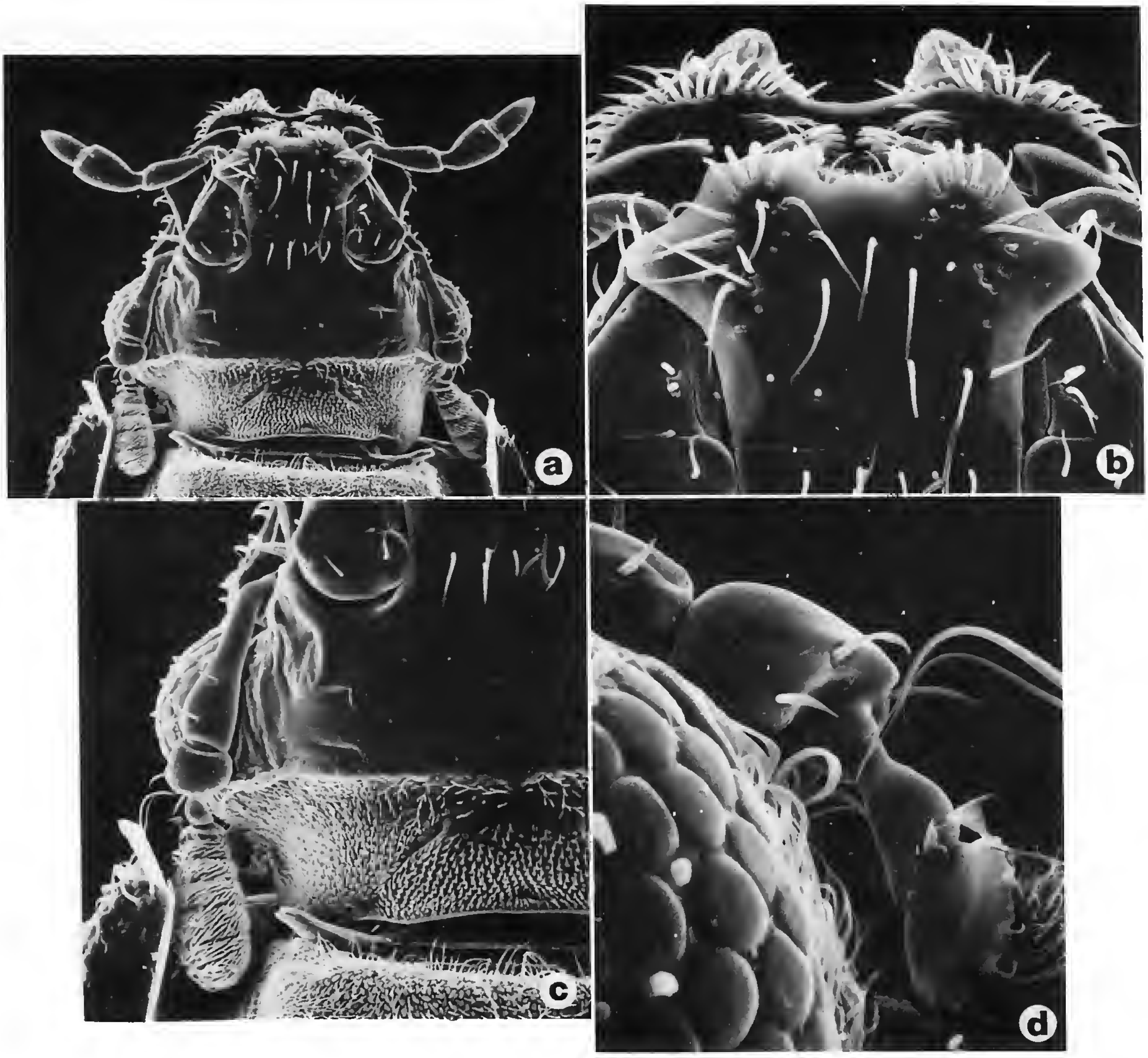

Fig. 2. *Hughleechia giulianii* n. g., n. sp.: (a) head, ventral aspect, 150×; (b) mentum, 400×; (c) antenna, 250×; (d) basal antennal segments, 950×.

tacoxae (Fig. 1e) and the unusual aedeagus. In *Meropathus* and *Neochthebius* the meso- and metacoxae are nearly contiguous, separated by only a lamina.

In *Meropathus* the aedeagus lacks parameres, whereas *Neochthebius* has fully developed parameres which originate at the base of the main-piece. The aedeagus of *Hughleechia* is a morphocline intermediate, having the parameres originating at mid-length of the main-piece (Fig. 4c). Elsewhere (Perkins, 1980) I have discussed possible mechanisms of paramere loss in the family Hydraenidae, a process which occurs in all major lineages. It appears that *Hughleechia* represents an intermediate stage in paramere loss for the *Neochthebius-Hughleechia-Meropathus* lineage, and suggests that loss in this lineage is accomplished by fusion of parameres to the main-piece, although it is possible that the location of the parameres is a result

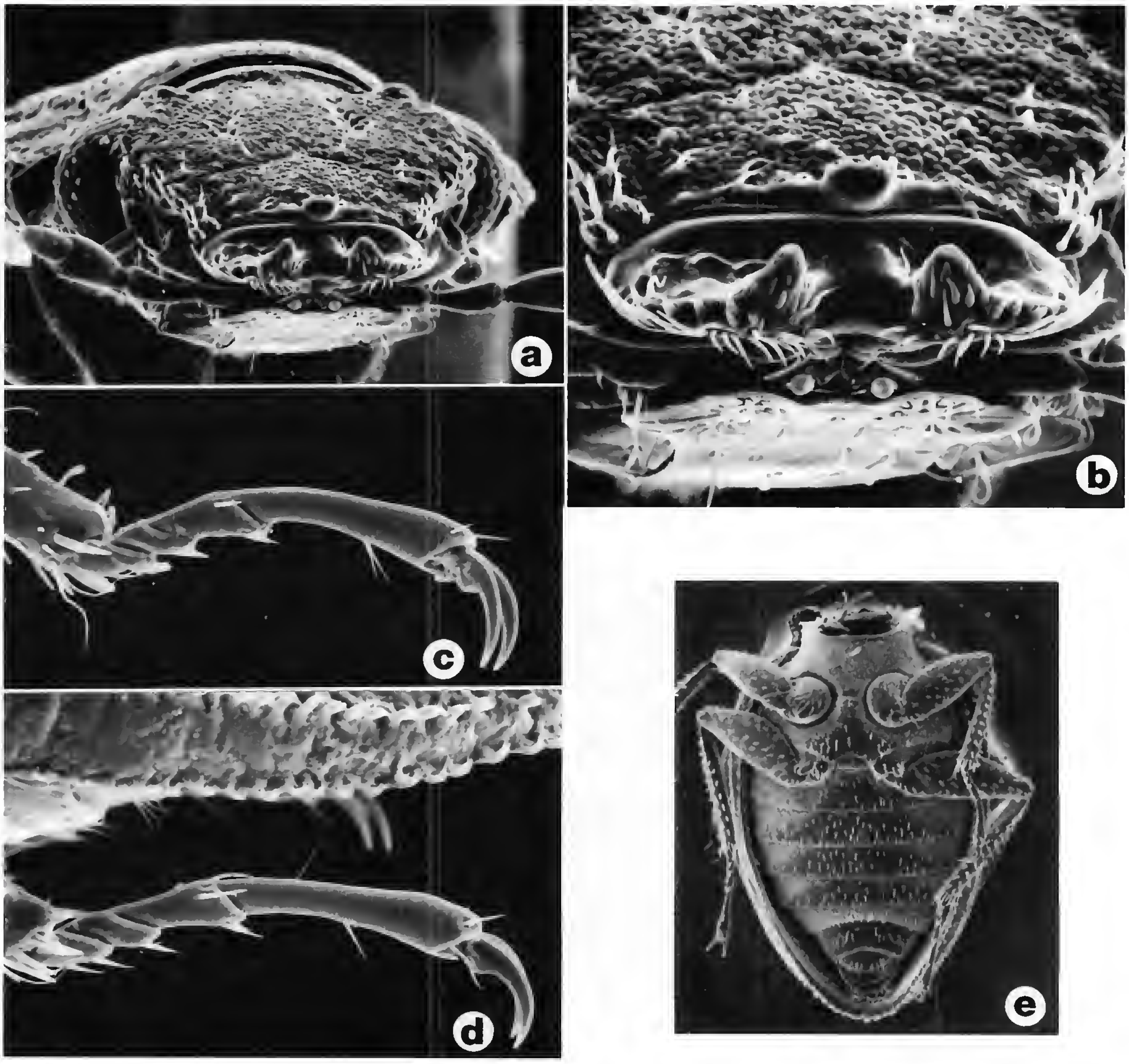

Fig. 3. *Hughleechia giulianii* n. g., n. sp.: (a) head, male, anterior view, 165×; (b) clypeus and labrum, male, 340×; (c) mesotarsus, 240×; (d) metatarsus, 240×; (e) meso-, metasternum and abdomen, 50×.

of elongation of the main-piece (for a discussion of terminology and other possible processes in paramere reduction and loss, see Perkins, 1980).

In addition to the widely spaced meso- and metacoxae, *Hughleechia* differs externally from *Meropathus* and *Neochthebius* by lacking hydrofuge pubescence on major portions of the metasternum and abdominal segments (Figs. 1e, 3e), and having more elongate tarsi (Figs. 3c, d). The eyes of *Meropathus* and *Neochthebius* are relatively small and separated from the ocelli. The eyes of *Hughleechia* are larger and the ocelli are adjacent to the eyes (Fig. 1b).

Hughleechia differs further from certain *Meropathus* species by lacking a median sulcus of the metasternum, having elytra devoid of ridges, and

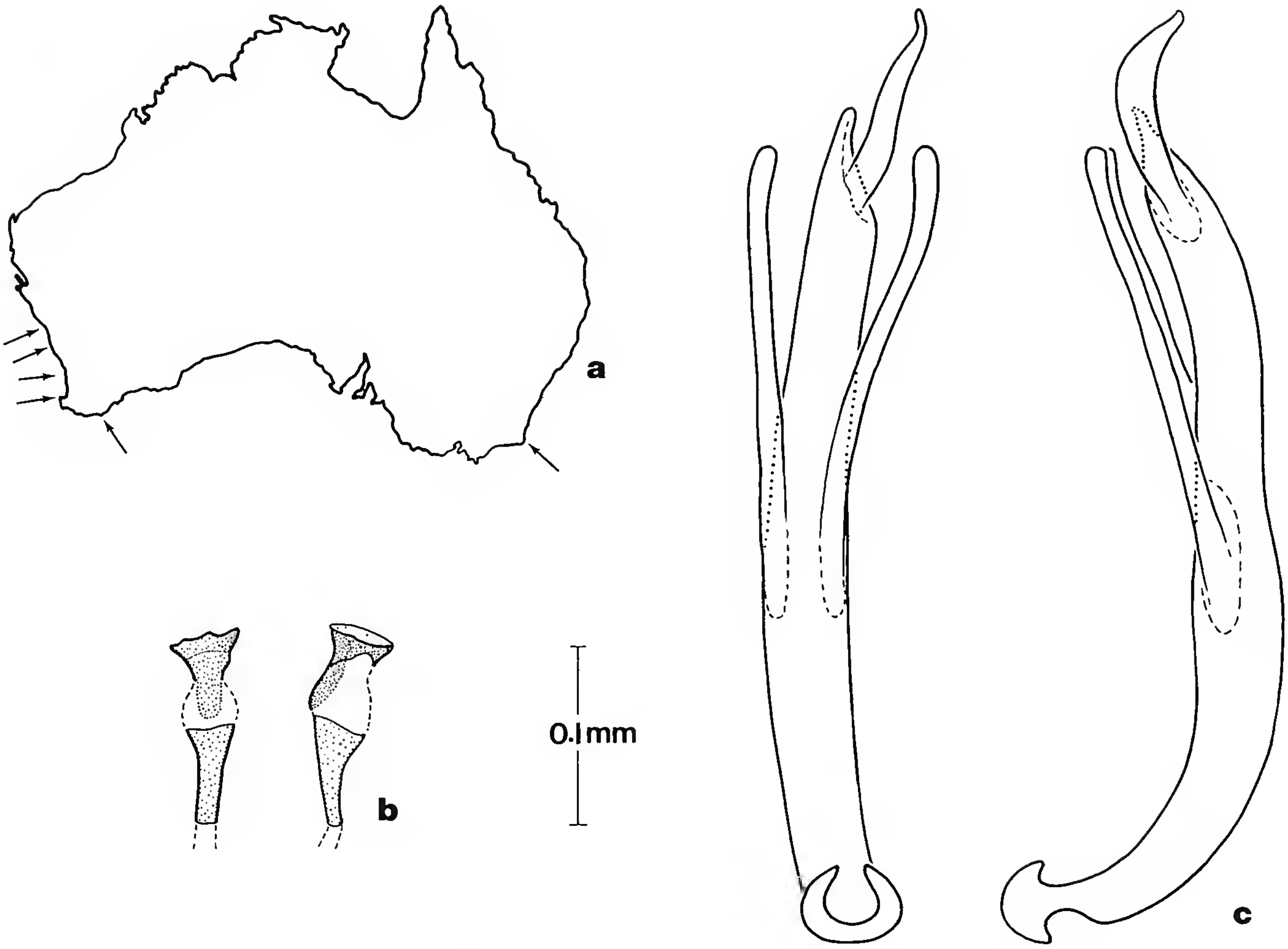

Fig. 4. *Hughleechia giulianii* n. g., n. sp.: (a) known geographical distribution; (b) spermatheca; (c) aedeagus, dorsal and lateral views.

possessing a well developed antennal fossula of the hypomeron. Males of *Hughleechia giulianii* have the labral lobes produced as small, acute, upturned processes and also have an apicomedian upturned process of the clypeus which is slightly larger than the labral processes (Figs. 1b, c, 3b). Males of some *Meropathus* species have the labral lobes rather remarkably produced, but neither *Meropathus* nor *Neochthebius* males have a clypeal process.

Hughleechia, new genus

Type-species.—*Hughleechia giulianii,* new species.

Gender.—Feminine.

Body form elongate oval, depressed. Head with distinct ocelli next to protuberant eyes; dorsum of head flat, frons and clypeus in same plane. Maxillary palpus short, 4-segmented, segment 1 very small, segment 2 subequal in length to segment 3, segment 3 broader than other segments, segment 4 slightly shorter than segment 3. Antenna (Figs. 2c, d) 9-segmented; 2 basal, 1 small intermediate, 1 small cupule, and 5 pubescent segments which form a compact club. Pronotum with anterior margin weakly rounded in middle, posterior margin much more strongly rounded; anterior and posterior margins with narrow hyaline border, sides lacking hyaline border; disc with shallow median longitudinal depression which is slightly constricted at midlength; lateral fossulae well developed; pronotal surface with moderately dense and moderately long hairs, except hairs absent in median depression and in lateral fossulae. Elytra ovoid, fused together at suture which is weakly elevated; each elytron with 8 rows of punctures, each puncture with a short, stiff, recumbent seta; rows 6–8 much less distinct than discal rows, sometimes random. Flight wings absent. Hypomeron with well developed fossula. Prosternum slightly and evenly elevated in midline, not carinate; procoxae contiguous. Mesosternum (Fig. 1e) broad between mesocoxae, lacking carinae, with hydrofuge pubescence. Metasternum (Fig. 1e) reduced, length in midline approximately equal to that of mesosternum; intercoxal process broad, equal in size to intercoxal process of mesosternum; metacoxae widely separated; hydrofuge pubescence restricted to lateral areas and narrow band along edge of mesocoxal cavities. Abdomen (Fig. 3e) 7-segmented; intercoxal sclerite broader than long; segments 1–4 with hydrofuge pubescence restricted to sides; segment 5 totally hydrofuge pubescent; segments 6 and 7 with a few sparse hairs. Legs rather long. Tarsi long, slender for most of length, but distinctly broadened apically; tarsal formula 5-5-5; segments 1–3 very small, combined length subequal to length of segment 4; segment 5 slightly longer than other segments combined.

Etymology.—It is with pleasure that I dedicate this new genus to Hugh B. Leech, a small gesture in recognition of his aid to the advancement of Coleopterology in general, and specifically in appreciation for his many and lasting contributions to the knowledge of aquatic beetles.

Hughleechia giulianii, new species

Type-data.—Holotype male and allotype. Western Australia, Fisherman's Island, 28-IV-1969, D. D. Giuliani. Deposited in the Western Australian Museum, Perth.

Paratypes (80 specimens; all collected by D. D. Giuliani).—Western Australia: Little Anchorage, 24-IV-1969. Small island just offshore of Little Anchorage, 25-IV-1969. Fisherman's Island, 28-IV-1969. Beaches and points of Rottnest Island, 3-V-1969. Bald Head, Albany, 10-V-1969. 50 miles S Dongara, 4-IV-1969 (all above in WAM). Peron Point nr. Rockingham, 28-IX-1969. Cape Naturalist (33.32s 115.01e), 30-X-1969 (this and previous in CSIRO). New South Wales: Green Cape, 8-VIII-1968 (WAM).

Description.—Holotype male 1.80 mm long, 0.84 mm wide. Color black dorsally, infrequently with faint metallic blue reflections; venter and legs dark brown.

Head.—Length 0.36 mm, width 0.46 mm. Frons strongly granulose, sparsely pubescent at sides; interocular foveae oblique impressed lines, area between foveae flat; interocular tuberculi well developed, adjacent to posteromedian margin of eyes, sparsely setose. Frontoclypeal suture very shallowly bisinuate. Clypeus length ½ width, less strongly granulose and hence more reflective than frons, sparsely punctate; apicomedian margin upturned to form a blunt tooth. Labroclypeal suture weakly arcuate. Labrum length ½ width; apicomedian emargination well developed, hemispherical, at each side of which is a distinctive tooth; surface of labrum smooth and shiny. Maxillary palpus with penultimate segment moderately wide; ultimate segment tapering to apex, ¾ length of penultimate. Mentum produced at sides (Figs. 2a, b), shiny, very sparsely punctate. Submentum shiny. Genae swollen in midregion, shiny, finely sparsely punctulate. Postgena pubescent, punctulate.

Thorax.—Pronotum length at midline 0.46 mm; maximum width (slightly before midlength) 0.60 mm; sparsely pubescent on reliefs; depressions granulose, reliefs punctate and less strongly granulose, hence more reflective than depressions; anterior margin weakly arcuate, with narrow hyaline border; sides rather strongly convergent from midlength; posterior margin with narrow hyaline border which is overlaid with a row of setae; median depression without setae, slightly constricted in midlength, anterior ½ more strongly granulose than posterior ½; a shallow depression on each side at base which connects to base of median depression, these oblique depressions with pubescence like that on reliefs; lateral fossulae well developed. Prosternum evenly rounded in midregion, antennal fossulae well developed; coxae contiguous. Mesosternum pubescent, with broad intercoxal process whose width at apex is about equal to length of last segment of maxillary palpus; carinae totally lacking, not even with remnants anteriorly. Metasternum hydrofuge pubescent except for shiny triangular area in midregion which has only a few setae; intercoxal process broad, about equal in length and width to mesosternal intercoxal process, but with apex on a plane slightly higher than that of latter; posteromedian area between metacoxae broadly emarginate to receive intercoxal sclerite.

Elytra.—Length 1.08 mm; maximum width (near midlength) 0.84 mm. Wings absent, elytra interlocked. Each elytron with 5 distinct discal rows of punctures, and 3 semi-serial rows laterally, each puncture with a short, stiff recumbent seta, some punctures confluent in basal $^1/_5$; suture very slightly raised. Explanate margin moderately developed. Elytron distinctly declivous in apical ¼.

Abdomen.—Intercoxal sclerite broader than long. Sterna 1–4 hydrofuge pubescent laterally; shiny, non-hydrofuge pubescent median area of sternum 1 forming equilateral triangle, similar areas of sterna 2–4 forming broad triangles (Figs. 1e, 3e). Hydrofuge pubescence completely covering sternum 5, absent from sterna 6 and 7, the latter two with sparse hairs.

Legs.—All legs moderately long and slender. Tarsi broadened apically, claws large. Segment 5 (last) of all tarsi longer than respective basal segments combined. Segment 4 of meso- and metatarsi equal to combined lengths of segments 1–3. Protarsi with segment 4 slightly shorter than combined lengths of segments 1–3.

Genitalia.—Aedeagus with parameres originating near midlength of mainpiece (Fig. 4c). Spermatheca as illustrated (Fig. 4b).

Variation.—Females average slightly larger than males, some individuals attaining 2.00 mm in length. Females lack clypeal and labral processes seen in males.

Distribution.—Currently known from the south and west coasts of Australia (Fig. 4a).

Etymology.—I am pleased to dedicate this new species to Derham D. Giuliani, who collected all known specimens.

Acknowledgments

I am grateful to Terry Houston of the Western Australian Museum (WAM) and to John F. Lawrence of the Commonwealth Scientific and Industrial Research Organization (CSIRO) for making specimens in their care available for study. Thanks are also extended to Susann Braden and Mary Jacque Mann of the Smithsonian Institution for taking the micrographs included herein. Finally, sincere appreciation is expressed to Derham D. Giuliani, whose careful fieldwork made this study possible.

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A CLARIFICATION OF THE AUTHORSHIP OF SOME NAMES IN *LACCOBIUS* ERICHSON (COLEOPTERA: HYDROPHILIDAE)

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In 1971, B. S. Cheary completed his studies and received the Ph.D. degree for a revision of the genus *Laccobius* Erichson of the New World. At approximately this same time (1970), R. B. Willson was completing a master's thesis on the Hydrophilidae of Michigan, which included a draft of two new species of *Laccobius*. At about this same time (1971), S. E. Malcolm was completing a paper on the Water Beetles of Maine. Both Cheary's and Malcolm's papers included Willson's species (Cheary 2 sp., Malcolm 1 sp.), and Malcolm's paper included a species of Cheary's.

Both Cheary and Malcolm assumed that Willson's paper would appear first, Cheary's second, and then Malcolm's. Cheary's paper was submitted to the University of California Press, where delays, including the death of Editor D. D. Jensen and subsequent editor changes, have contributed to a situation where the paper was never published in this series. Willson's paper has likewise never appeared. Malcolm's paper appeared in late 1971 (Sept.–Nov.). In 1979 Malcolm published a paper which attempted to clarify the status of the authorship of *L. reflexipenis* (originally Cheary) and *L. spangleri* (originally Willson). His assessment, after discussion with Cheary and others, was that both species should be credited to Malcolm. Accordingly, the 1979 paper contained type designations and amplified descriptions. At about this time, Cheary approached Hardy for assistance with the publication of his (Cheary's) thesis. It was Hardy's assumption that the form of Cheary's thesis at the time the degree was awarded constituted valid scientific publication. Under Section III, Article 8 of the International Code of Zoological Nomenclature, a publication to be regarded as valid must:

> "(1) be reproduced in ink on paper by some method that assures numerous identical copies;
> (2) be issued for the purpose of scientific, public, permanent record;
> (3) be obtainable by purchase or free distribution; and
> (4) not be reproduced or distributed by a forbidden method [Art. 9]."

At the completion of the degree work, Cheary had 50 copies of his thesis reproduced by offset press and bound in a formal soft-cover binding, by a local print-shop. They appeared, and are dated, June 1971. These copies were sent free to cooperators and others. Some were sent upon request. At present only 3–4 copies remain.

Cheary's thesis, then, meets all criteria for publication, as outlined above. This opinion has been concurred in by C. Sabrosky, who has had informal discussions with other members of the International Commission of Zoological Nomenclature on Cheary's paper. This then means that the author of *reflexipenis* is indeed Cheary, and Malcolm's *reflexipenis* should be considered a homonymous synonym. Likewise, Malcolm's (originally Willson's) *spangleri* should be credited to Cheary. Cheary had examined Willson's type series in their entirety, and the types, deposited in the Michigan State University Collection, should stand as the types of Cheary's species.

The synonymies should stand as follows:

Laccobius arenarius Cheary 1971

(*Laccobius arenarius* Willson 1970:45, ms. name.)
"*Laccobius arenarius* Willson," Cheary 1971:93.

Laccobius spangleri Cheary 1971

(*Laccobius spangleri* Willson 1970:40, ms. name.)
"*Laccobius spangleri* Willson" Cheary 1971:93; Malcolm 1971:40.
Laccobius spangleri Malcolm 1979:62. **NEW SYNONYM.**

Laccobius reflexipenis Cheary 1971

Laccobius reflexipenis Cheary 1971:101.
"*Laccobius reflexipenis* Cheary" Malcolm 1971:40.
Laccobius reflexipenis Malcolm 1979:59. **NEW SYNONYM.**

In the paper by Cheary, then, these names were described, and should be considered valid as of 1971:

Laccobius carri pallidus n. ssp. Cheary 1971:90
L. arenarius Cheary 1971:93.
L. spangleri Cheary 1971:93

L. piceus australis n. ssp. Cheary 1971:98.
L. tridentipenis Cheary 1971:99.
L. bruesi Cheary 1971:100.
L. reflexipenis Cheary 1971:101.
L. oregonensis Cheary 1971:102.
L. leechi Cheary 1971:104.
L. hardyi Cheary 1971:105.
L. teneralis Cheary 1971:107.
L. borealis Cheary 1971:110.
L. magnus Cheary 1971:114.
L. occidentalis Cheary 1971:116.
L. chandleri Cheary 1971:119.

Acknowledgments

The authors would like to thank Drs. C. Sabrosky and R. Hodges, both associated with the United States National Museum of Natural History, for their opinions and discussions of this problem, especially during the Denver Meetings (1979) of the Entomological Society of America.

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TWO NEW PERUVIAN SPECIES OF THE RIFFLE BEETLE GENUS *XENELMIS* (COLEOPTERA: ELMIDAE)

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The riffle beetle genus *Xenelmis* Hinton is comprised of minute elmids, the adults of which are less than 2 mm in length and have robust body form. Nine species have been previously described; these are known from Central America (1 species), Brazil (7), Paraguay (1), northern Argentina (2) and Ecuador (1). Five of the Brazilian species are apparently restricted to that country, the other two species range into Paraguay and northern Argentina. With the exception of the Central American species, *X. bufo* (Sharp), adults of this genus are very rarely collected; the combined total of known specimens for the other eight species being less than 50 specimens (Hinton, 1946; Delève, 1968; Brown, 1970).

Described below are two new species of *Xenelmis* collected by W. E. Steiner in Peru. Both species are presently known only from holotype males. These specimens were collected from an open, sunlit section of a fairly rapid stream, about 2 m wide and 15–20 cm deep, on submerged, moss-covered rocks. The surrounding vegetation was dense, secondary-growth, montane rain forest. This stream, a tributary of the Rio Marcapata, is about one km north of the town of Quince Mil, at an elevation of about 900 m. A number of other elmid species representing several genera were also taken at this site; individuals of these species were much more abundant than those of *Xenelmis*.

Xenelmis leechi, new species
(Figs. 1, 3)

Type-data.—Holotype male. Peru, Department of Cuzco, Quince Mil, 26-I-1979, W. E. Steiner, Jr. Deposited in the National Museum of Natural History, Smithsonian Institution; type no. 76696.

Description.—Holotype male 1.52 mm long, 0.92 mm wide. Body broadly obovate and strongly convex (Fig. 1). Cuticle feebly shining, dorsum and venter nearly black; pronotum with bronze cast; legs dark brown; antennae and palpi brown.

Head on each side with a row of low granules extending forward from near mid-dorsal line on vertex and terminating between upper margins of eyes; frons microreticulate and granulate, granules smaller than facets of eyes, separated by 2–4 times granule diameter. Labrum with sculpture similar to frons.

Pronotum 0.56 mm long, 0.72 mm wide at base; disc rather evenly convex, sparsely, randomly granulate, granules smaller than facets of eyes, separated by about 4 times diameter of a granule; each granule with a small seta; lateral margins strongly granulate, granules contiguous or nearly so, subserial, twice size of those on remainder of pronotum; base trisinuate. Dull lustre of pronotum especially well developed in basal half; a fine pin will make a scratch line in this surface.

Elytra 1.04 mm long, 0.92 mm wide (slightly before midlength); nonstriate; serial punctures small, especially those of sutural row which are smaller than facets of eyes, separated by about 5 times diameter of a puncture; serial punctures becoming increasingly larger and more deeply impressed from suture toward lateral margin, punctures of row 4 slightly larger than facets of eyes; rows of punctures separated by about 5 times diameter of a puncture; intervals 5 and 7 each with a row of closely spaced granules which are distinctly larger than other granules on elytra; remaining intervals with small, random granules about equal in size to those on pronotal disc, but slightly denser; lateral margins granulate, forming a bead which is 3 times width of sublateral rows of granules; epipleura with sparse, random granules. Anterior margin of elytra very finely crenulate.

Prosternum 0.32 mm long; prosternal process 0.16 mm long, 0.30 mm wide; a low, indistinct ridge extending anteriorly from mesial margin of procoxa for half distance to anterior margin of prosternum, area between ridge and anterior margin rugulose, remainder of disc and process finely, irregularly punctate, with very short, sparse setae directed anteriorly, each seta arising from base of very small, nearly imperceptible granule; margins of prosternal process raised slightly. Mesosternum finely microreticulate, raised slightly behind prosternal process. Metasternum with a finely impressed median longitudinal line in posterior $^2/_3$; anterior $^1/_6$ with a distinctive transverse depression, middle ⅓ of which has a transverse groove; disc with shallow setiferous punctures equal in size to facets of eyes, separated by 1–4 times their diameter; sides of metasternum with dull lustre and small granules as on pronotum, dull lustre ending midway between middle of coxal cavities and median longitudinal line. Abdomen extremely finely microreticulate and with a dull lustre in all areas except intercoxal process of first sternum; sparsely granulate, granules similar to those of pronotal disc; granules of last sternum denser than those on other sterna; intercoxal process with anterior margin shallowly trisinuate.

Legs without apparent modification. Cleaning fringes on the following surfaces: protibiae—anteromedial, occupying distal ½; mesotibiae—antero- and posteromedial, occupying distal ⅓ and ½ respectively; metatibiae—posteromedial, occupying distal ⅔.

Genitalia.—Aedeagus as illustrated (Fig. 3).

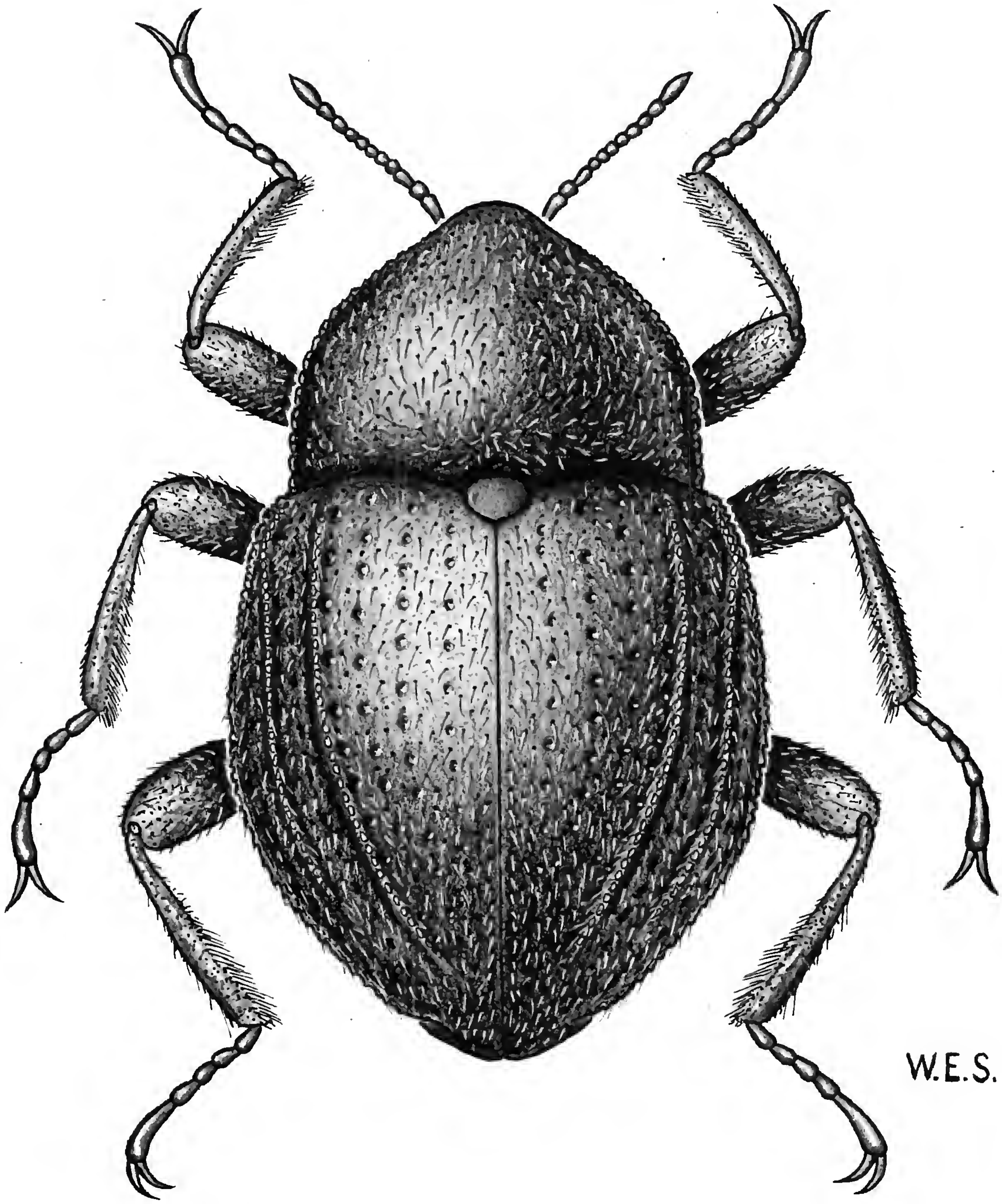


Fig. 1. *Xenelmis leechi* holotype, habitus (body length 1.52 mm).

Distribution.—Currently known only from the type-locality near Quince Mil, Department of Cuzco, Peru.

Etymology.—We are pleased to dedicate this new species to Hugh B. Leech, who has so greatly influenced the study of Coleoptera.

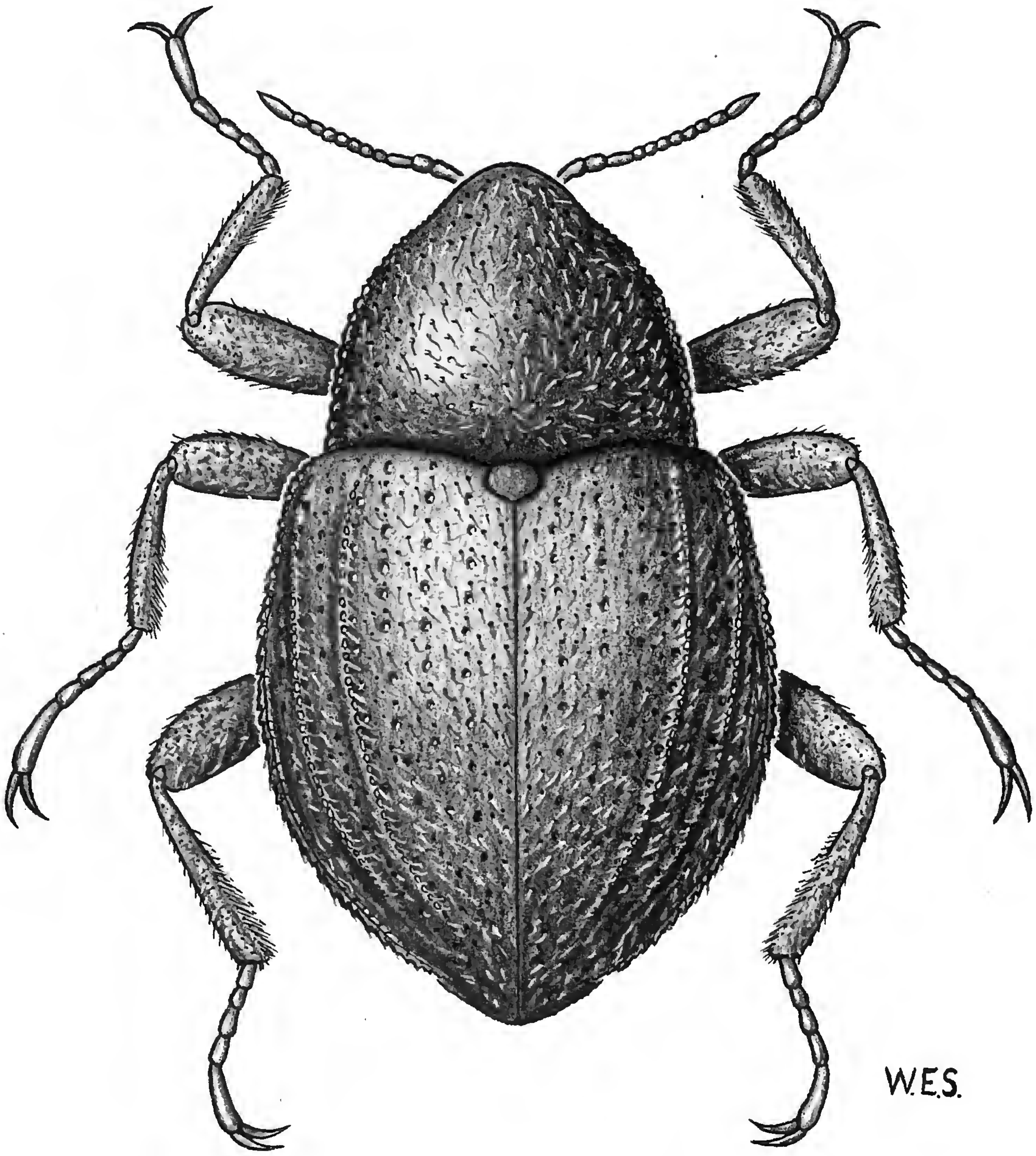


Fig. 2. *Xenelmis marcapata* holotype, habitus (body length 1.36 mm).

Xenelmis marcapata, new species
(Figs. 2, 4)

Type-data.—Holotype male. Peru, Department of Cuzco, Quince Mil, 26-I-1979, W. E. Steiner, Jr. Deposited in the National Museum of Natural History, Smithsonian Institution; type no. 76697.

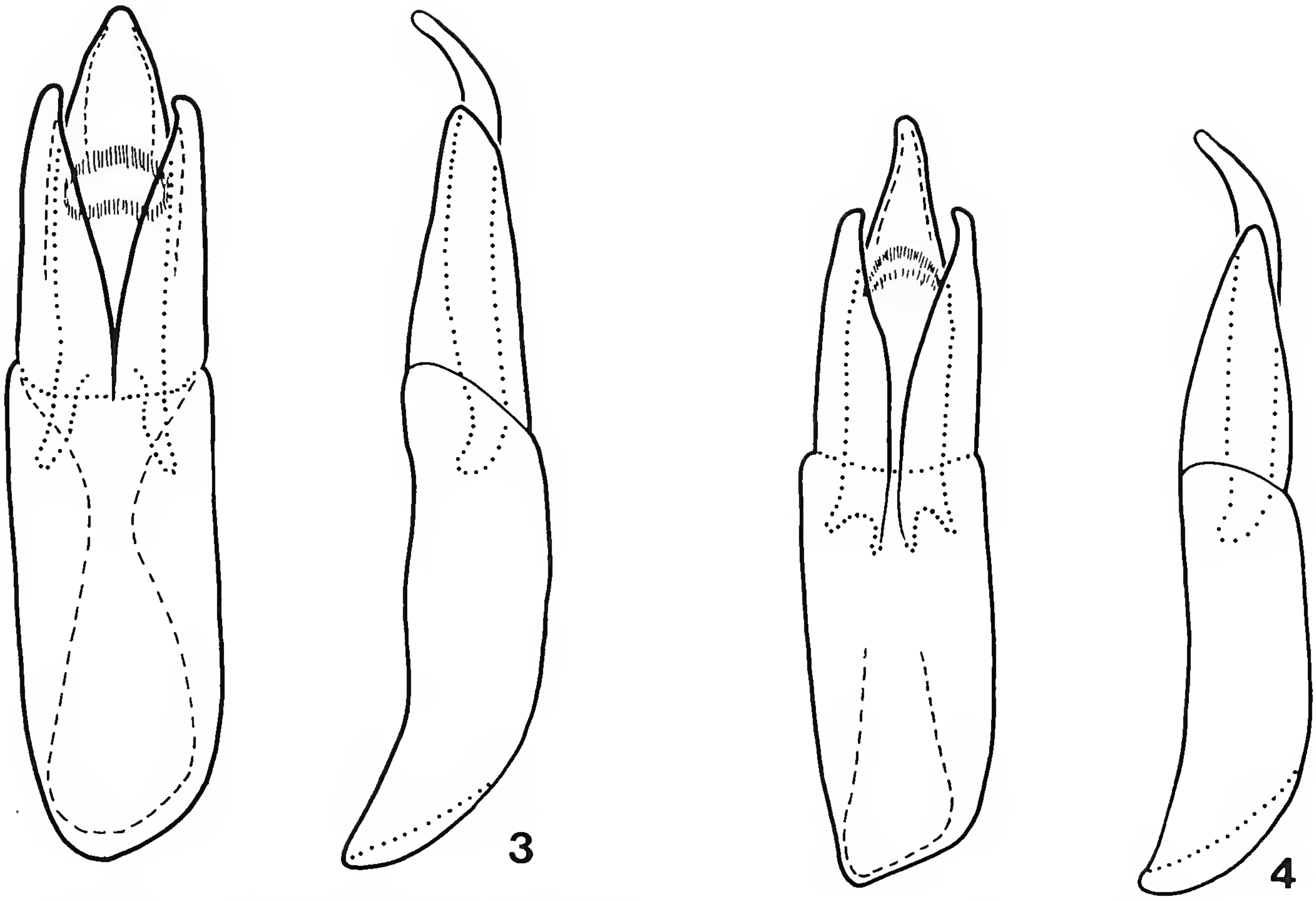
Description: Holotype male 1.36 mm long, 0.84 mm wide. Body broadly obovate and strongly convex (Fig. 2). Cuticle feebly shining, pronotum with slight bronze cast, dorsum and venter brown to rufopiceous; legs brown; antennae and palpi testaceous.

Head on each side with a row of low granules extending forward from near mid-dorsal line on vertex and terminating between upper margins of eyes; frons microreticulate and granulate, granules about equal in size to facets of eyes, separated by 1–2 times their diameter. Labrum with sculpture similar to frons.

Pronotum 0.50 mm long, 0.62 mm wide at base; disc rather evenly convex, with random, rather evenly spaced granules which are smaller than facets of eyes and separated by about 3 times the diameter of a granule; a distinctive, golden adpressed seta emerging from mesial margin of each granule; seta length equal to distance separating granules; in general, setae form a pattern as each is directed toward most elevated region of pronotum, which is median basal ⅓. Lateral margins granulate but not strongly so, each granule about equal in size to eye facet, usually contiguous. Dull lustre of pronotum weakly developed.

Elytra 0.98 mm long, 0.84 mm wide (slightly before midlength); nonstriate; serial punctures small, especially those of sutural row which are smaller than eye facets, separated by about 5 times diameter of a puncture; serial punctures becoming increasingly larger and more deeply impressed from suture toward lateral margin; punctures of row 4 about size of eye facets; rows of punctures separated by about 5 times diameter of a puncture; intervals 5 and 7 each with a row of closely spaced granules which are about twice as large as other granules on elytron; remaining intervals extremely finely microreticulate (much less so than head) and with small, random granules about equal in size to those on pronotal disc, but slightly sparser; lateral margins granulate, forming a bead which is only very slightly wider than width of sublateral rows of granules; epipleura with a distinct row of elongate granules along ventral edge adjacent to metasternum, granules similar in size to those of sublateral rows, separated by their lengths, remainder of epipleura with random, sparse granules. Anterior margin of elytra very finely crenulate.

Prosternum 0.28 mm long; prosternal process 0.12 mm long, 0.30 mm wide, margins slightly raised; a low, indistinct ridge extending anteriorly from mesial margin of procoxa for half distance to anterior margin of prosternum; area between ridge and anterior margin, and remainder of disc, smooth, with small, sparse setae arising from tiny granules. Mesosternum finely microreticulate, raised slightly behind prosternal process. Metasternum with a finely impressed, median longitudinal line in posterior ⅔; a distinct transverse depression occupying anterior $^1/_5$, middle $^1/_3$ of which has a transverse groove; disc with shallow setiferous punctures equal in size to facets of eyes, separated by 1–3 times their diameters; dull lustre on sides of metasternum, disc without dull lustre. Abdomen extremely finely micro-



Figs. 3, 4. Aedeagi of *Xenelmis*. Holotypes, dorsal and lateral aspects. Fig. 3, *X. leechi,* new species. Fig. 4, *X. marcapata* new species.

reticulate and with a dull lustre in all areas except intercoxal process of first sternum; granules small, size equal to meshes of microreticulation, sparse on middle $^{3}/_{5}$ of sterna 1–4, lacking, or nearly so, on lateral $^{1}/_{5}$; granules of sternum 5 twice as dense as those on other segments.

Legs without apparent modification. Cleaning fringes on the following surfaces: protibiae—anteromedial, occupying distal ½; mesotibiae—antero- (less distinct) and posteromedial, occupying distal ⅓ and ½ respectively; metatibiae—posteromedial, occupying distal ⅔.

Genitalia.—Aedeagus as illustrated (Fig. 4).

Distribution.—Currently known only from the type-locality near Quince Mil, Department of Cuzco, Peru.

Etymology.—*marcapata,* a noun in apposition, refers to the Rio Marcapata. The stream at the type-locality is a tributary of this river.

Hinton (1946) published a key to the species of *Xenelmis* known at that time. This key was modified by Brown (1970) for inclusion of his new species, *X. laura* from Brazil, but *X. rufipes* Delève 1968 from Ecuador was not included in that key. The two new species from Peru described herein, plus *X. rufipes* Delève, may be distinguished by replacing couplet 4 of Brown's (1970) key with the following couplets:

1. Elytra with a conspicuous row of coarse granules on basal three-fifths of third interval 2
   Elytra without a row of coarse granules on third interval 3
2. Male with last metatarsomere broadly dilated and densely pubescent beneath; aedeagus as illustrated (Fig. 1 in Hinton, 1940); Mato Grosso, Brazil .... *X. tarsalis* Hinton
   Male with last metatarsomere not dilated nor densely pubescent beneath; aedeagus as illustrated (Fig. 19 in Delève, 1968); Ecuador .... *X. rufipes* Delève
3. Head on each side with a row of granules extending forward from near mid-dorsal line on vertex and terminating near base of antenna; aedeagus as illustrated (Figs. 193, 194 in Hinton, 1940); Central America .... *X. bufo* (Sharp)
   Head with rows of granules short, not reaching bases of antennae, terminating between upper margins of eyes; Peru 4
4. Larger (1.56 mm), broader, more markedly sculptured species (Fig. 1); integument rugulose between anterior margin of prosternum and mesial margin of procoxae; metasternum with dull lustre except on median longitudinal ½ of disc; abdominal sterna 1–4 with well-developed granules laterally; aedeagus as illustrated (Fig. 3) .... *Xenelmis leechi* new species
   Smaller (1.36 mm), narrower, less markedly sculptured species (Fig. 2); integument smooth between anterior margin of prosternum and mesial margin of procoxae; metasternal disc lacking dull lustre as seen laterally; abdominal sterna 1–4 agranulate laterally; aedeagus as illustrated (Fig. 4) .... *Xenelmis marcapata* new species

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PAN-PACIFIC ENTOMOLOGIST
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ECTOPRIA LEECHI, A NEW FALSE WATER PENNY FROM THE UNITED STATES (COLEOPTERA: EUBRIIDAE)

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The family name Eubriidae, representing the false water penny beetles, is probably unfamiliar to most coleopterists. The genera included here have been placed with the Dascillidae (Leng, 1920; Arnett, 1968) or, especially, the Psephenidae (Leech and Chandler, 1956; Leech and Sanderson, 1959; Brown, 1972; Doyen and Ulrich, 1978). Bertrand (1972) points out that a number of earlier investigators established *Ectopria* LeConte and related genera (*Acneus* Horn and, presumably, *Alabameubria* Brown and *Dicranopselaphus* Guérin-Méneville in North America) as a distinct family. *Ectopria* is included in the Eubriidae by Bertrand (1972) and Brigham (1981).

Ectopria has long been considered monospecific in the United States, with *Ectopria thoracica* (Ziegler, 1844), *Ectopria tarsalis* LeConte 1853, and *Ectopria tibialis* LeConte 1853 being considered synonymous with *Ectopria nervosa* (Melsheimer, 1844). The genus currently is under revision by this author. Preliminary observations indicate that both *Ectopria nervosa* and *Ectopria thoracica* are valid species and that one new species, described below, occurs in the United States.

Ectopria leechi, new species

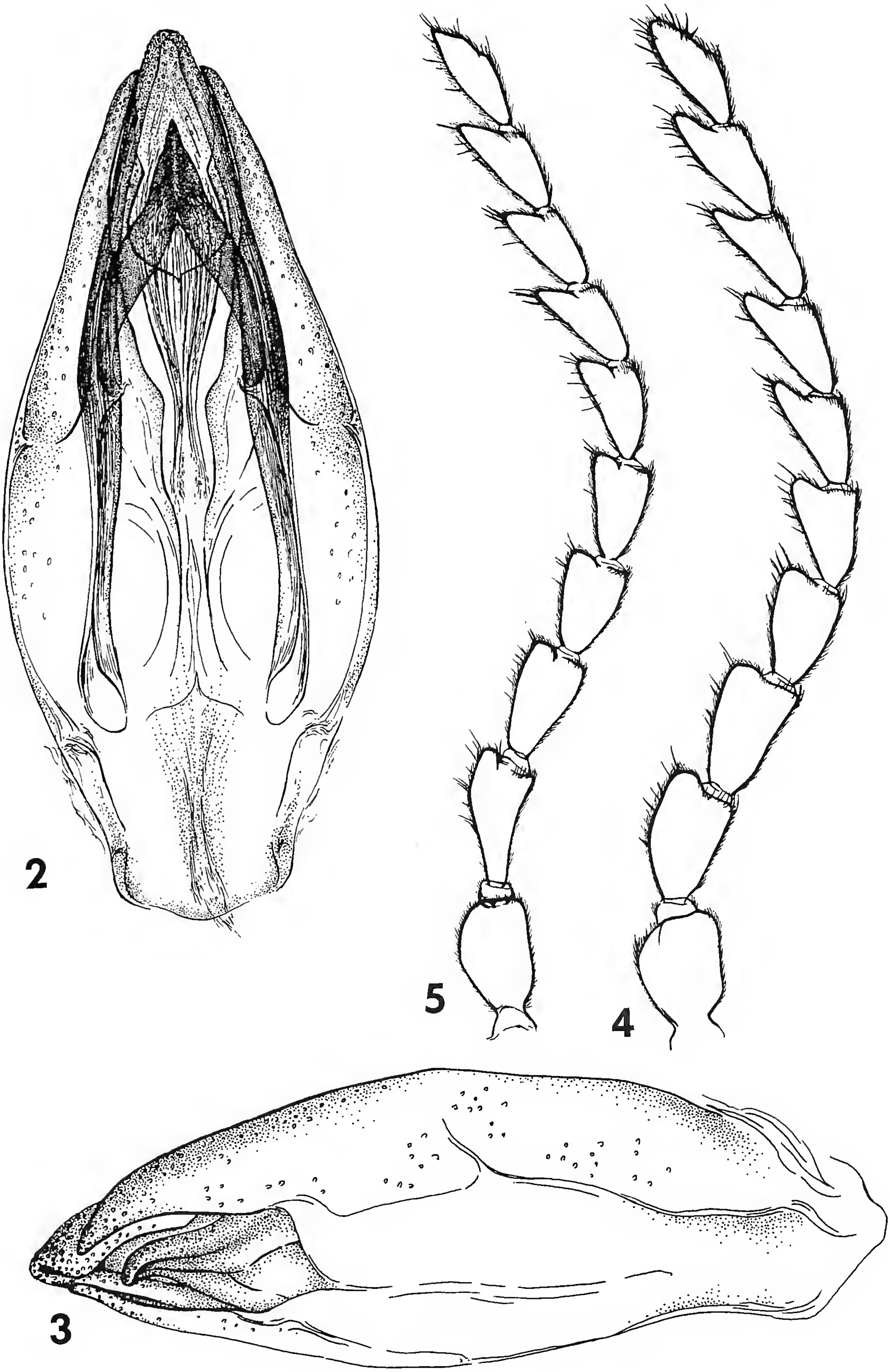
Holotype male.—Pear-shaped, widest approximately ⅔ distance from humeral region of elytra to apex (Fig. 1). Greatest width 2.01 mm; greatest length 3.30 mm. *Head:* Maximum width through eyes 0.72 mm, minimum width between eyes 0.33 mm; surface of vertex and frons granular, purplish-black, darker around eye; ventral projection between bases of antennae excavated between and especially below antennae, with a distinct margin, purplish-black anteriorly, margin darker, light brown laterally and ventrally; mouthparts testaceous. *Antenna:* Serrate (Fig. 4); basal segment trapezoidal, glabrous; segment 2 cylindrical, glabrous; segments 3 through 10 triangular, dull, with numerous short setae and a few long hairs ventrally; segment 11 elongate-oval, dull, with numerous short setae and longer hairs; lengths of segments (from basal segment) 0.24 mm, 0.05 mm, 0.21 mm, 0.24 mm, 0.24 mm, 0.24 mm, 0.24 mm, 0.24 mm, 0.23 mm, 0.21 mm, 0.30 mm; color light brown, darker dorsally, the basal segment darker brown. *Pronotum:* Width at apex 0.90 mm, width at base 1.59 mm, length along midline 0.81 mm; surface granular, densely covered with appressed silvery hairs

Fig. 1. *Ectopria leechi,* holotype male, habitus.

except along anterior margin; distinctly margined laterally, finely margined anteriorly, posterior margin crenulate; disc strongly inflated above plane of anterior and posterior margins, somewhat inflated posterolaterally; a pair of shallow foveae near basal margin, each fovea located just laterad of lateral margin of scutellum; color light brown with margins, disc, and a spot laterad from each fovea darker brown, clouded with darker brown from disc to lateral margin. *Scutellum:* Obtusely triangular; width at base 0.36 mm, width along midline 0.24 mm; surface shining, densely covered with appressed silvery hairs; basal margin straight, crenulate; lateral margins curved, converging to form obtuse angle; color light brown, darker along lateral margins, basal margin dark brown. *Elytron:* Surface, in part, coarsely granulate, the coarse granules confined to slightly impressed vermiculations, remainder of elytral surface finely granulate, densely covered with appressed silvery hairs; anterior margin crenulate from suture to humeral region; distinctly margined in humeral region, laterally, and apically; faintly margined suturally; lateral margin reflected, more strongly so anteriorly; color very light brown, becoming darker basally where it matches light brown of pronotum, margins very dark brown, vermiculations dark brown, elytron with four longitudinal dark brown lines extending toward, but not reaching, apex, sutural line arising from scutellum, discal lines arising from near base of elytron, humeral line arising from base of elytron, lines anastomosing posteriorly as in Figure 1. *Venter:* Densely covered with appressed silvery hairs; prosternum with surface finely granulate, margin beaded except along prosternal process, prosternal process parallel-sided, extending posteriorly to base of fore trochanter, slightly concave ventrally, truncate apically, coloration light brown, darker posteriorly, margin and prosternal process dark brown; mesosternal process trapezoidal, deeply concave, truncate apically, with a few coarse granulations, extending posteriorly to base of middle trochanter, coloration light brown with lateral margin darker, mesepisternum dark brown; metasternum transversely excavated at base, below plane of apex of mesosternal process, color light brown, except metepisternum dark brown, elongate glabrous area posteriorly along midline; abdomen light brown, darker laterally, apical sternite with a pair of foveae laterally along basal margin. *Legs:* Testaceous, densely covered with appressed silvery hairs, hairs thinning along dorsal surfaces of femora; fore coxa ovate, middle coxa conical, hind coxa transverse, remaining leg-segment measurements as follows (in mm)

	leg		
segment	fore	middle	hind
trochanter	0.18	0.21	0.18
femur	0.69	0.75	0.81
tibia	0.72	0.78	0.81
tarsus (base)	0.15	0.20	0.23
tarsus (2nd)	0.11	0.12	0.12
tarsus (3rd)	0.09	0.09	0.09
tarsus (4th)	0.08	0.08	0.08
tarsus (apex)	0.24	0.24	0.24

Genitalia: Trilobed (Figs. 2, 3); maximum length of sclerotized parts 723 μ, maximum width 289 μ; aedeagus complex, with two parts, dorsal piece V-



Figs. 2–5. *Ectopria leechi:* Fig. 2, holotype male, genitalia, dorsal aspect. Fig. 3, holotype male, genitalia (from below). Fig. 4, holotype male, antenna. Fig. 5, allotype female, antenna.

shaped, length 553 μ, width at base 182 μ, apparently articulating anteriorly with parameres, apex bluntly rounded, with coarse punctures, concave ventrally and receiving apex of ventral piece, extending 31 μ beyond apices of parameres, ventral piece V-shaped, length 201 μ, width at base 132 μ, apparently articulating anteriorly with midpoint of dorsal piece, apex sharply rounded, curving ventrally and received by concave ventral surface of apex of dorsal piece, terminating 54 μ proximal to apices of parameres; parameres with membranous dorsal and ventral margins forming sheath around aedeagus, apices closely applied to lateral margins of dorsal piece of aedeagus.

Allotype female.—Similar to holotype except antenna less serrate, especially basally (Fig. 5). Greatest length 4.4 mm, greatest width 2.5 mm.

Variation.—Gross variation within the type series of *Ectopria leechi* is limited to the longitudinal anastomosing lines on the elytra, being less distinct in older specimens; the coloration of the antennae and legs, varying from testaceous to light brown; and the body measurements. Twenty-nine males ranged in length from 2.8 mm to 3.6 mm (mean length 3.15 mm ± 0.21 mm) and in width from 1.7 mm to 2.0 mm (mean width 1.87 mm ± 0.12 mm). Twenty-one females ranged in length from 3.6 mm to 4.9 mm (mean length 4.08 mm ± 0.34 mm) and in width from 2.5 mm to 2.9 mm (mean width 2.57 mm ± 0.13 mm). Body proportions were roughly similar between males and females, though the females were distinctly larger. The width of 20 males averaged 0.602 ± 0.022 times the length. The width of 10 females averaged 0.615 ± 0.033 times the length.

Diagnosis.—Pear-shaped medium-sized *Ectopria* which keys to *Ectopria nervosa* in Brown (1972) and keys to *Ectopria* and most closely fits *Ectopria nervosa* in Brigham (1981). It is distinct from other *Ectopria* in coloration (Fig. 1) and in the distinctive type of male genitalia (Figs. 2, 3). Legs and antennae testaceous or light brown, pronotum light brown with margins, disc, and a spot laterad from each basal fovea darker brown, clouded with darker brown from disc to lateral margin; elytron light brown with distinct dark brown vermiculations and four longitudinal dark brown anastomosing lines extending toward apex; male genitalia broad, 0.4 times as wide as long, parameres nearly straight apically, smooth, without subapical callosities. The following modifications of Brigham's (1981) key are necessary to include the new species.

1. Elytron light brown with distinct dark brown vermiculations and four dark brown anastomosing lines extending toward apex (Fig. 1); legs and antennae testaceous or light brown; aedeagus broad, 0.4 times as wide as long, without subapical callosities (Figs. 2, 3) .... *Ectopria leechi* Brigham, new species

   Elytron uniformly brownish-black or black or dull dusky reddish-brown with faint dark vermiculations, without longitudinal dark anastomosing lines; legs and antennae brown or black, although tarsi may be lighter; aedeagus elongate, 0.26 times as wide as long or 0.32 times as wide as long with distinct subapical callosities on parameres 2

2. Pronotum bicolored, yellow or gold laterally, dusky or black medially; elytron uniformly brownish-black or black; aedeagus very elongate, 0.26 times as wide as long . . . . *Ectopria thoracica* (Ziegler)

   Pronotum uniformly black or brown; elytron dull dusky reddish-brown with faint dark vermiculations; aedeagus elongate, 0.32 times as wide as long, parameres with distinct subapical callosities . . . . *Ectopria nervosa* (Melsheimer)

Distribution.—Holotype ♂ ILLINOIS, Ogle Co., White Pines St. Pk., Trib. of Pine Cr. in youth campground, 27 June 1972 #35, W. U. Brigham & M. W. Sanderson; Allotype ♀ ILLINOIS, Boone Co., North Kinnikinnick Cr. at Boone Co. Conserv. area, 26 June 1972 # 22, W. U. Brigham & M. W. Sanderson; Paratypes 1 ♂ ARKANSAS, Washington Co., 2 July 1939, M. W. Sanderson; CONNECTICUT, 1 ♂ [Litchfield Co.], Cornwall, 7 June 1925, sweeping field, L. B. Woodruff Coll. Acc. 26824; ILLINOIS, 1 ♂, 2 ♀♀ same data as holotype; 1 ♀ same data as allotype; 1 ♀ Winnebago Co., Trib. of North Branch Otter Cr. 2 km NE of Durand, 26 June 1972 #23, W. U. Brigham & M. W. Sanderson; INDIANA, 1 ♂, 1 ♀ [Floyd Co.], Edwardsville; 3 ♂♂ Chas. Palm Coll. Acc. 5409; KENTUCKY, 3 ♂♂, 4 ♀♀ [Jefferson Co.], Louisville, 3 June, H. Soltau Coll.; 1 ♀ [Jefferson Co.], Louisville, 22 June, H. Soltau Coll.; 1 ♂, 1933, H. F. Wickham Coll.; MICHIGAN, 1 ♂ Midland Co., 1 July 1936, R. R. Dreisbach; PENNSYLVANIA, 1 ♂, 1 ♀ [Lehigh Co.], Bethlehem, 20 June 1933, H. F. Wickham; NO LOCALITY, 15 ♂♂, 9 ♀♀ #3995.

Distribution of other specimens of Ectopria leechi, *but not designated as paratypes.*—CONNECTICUT, 1 ♀ [Litchfield Co.], Goshen, 5 July 1925, Chamberlain; KENTUCKY, 3 ♀♀ [Franklin Co.], Frankfort, 9 June, H. Soltau Coll.; NEW YORK, 1 ♀ [Erie Co.], Lancaster, 4 June 1911, M. C. Van Duzee, C. A. Frost Coll.; OKLAHOMA, 1 ♀ [Ottawa Co.], Wyandotte, 19 June 1939, Kaiser-Nailon; VIRGINIA 4 ♀♀ Liebeck Coll. A single female bore no label other than a small blue-grey disc. LeConte used identical discs to designate specimens collected from the north shore of Lake Superior during his visit to the lake with Agassiz during the early 1840's. If this specimen is from LeConte material, it represents the northernmost record for *Ectopria leechi.* Figure 6 shows the distribution of *Ectopria leechi* based upon the type series and other known specimens listed above. No Virginia records have been plotted because the specimens labelled "VA" lacked more specific locality information.

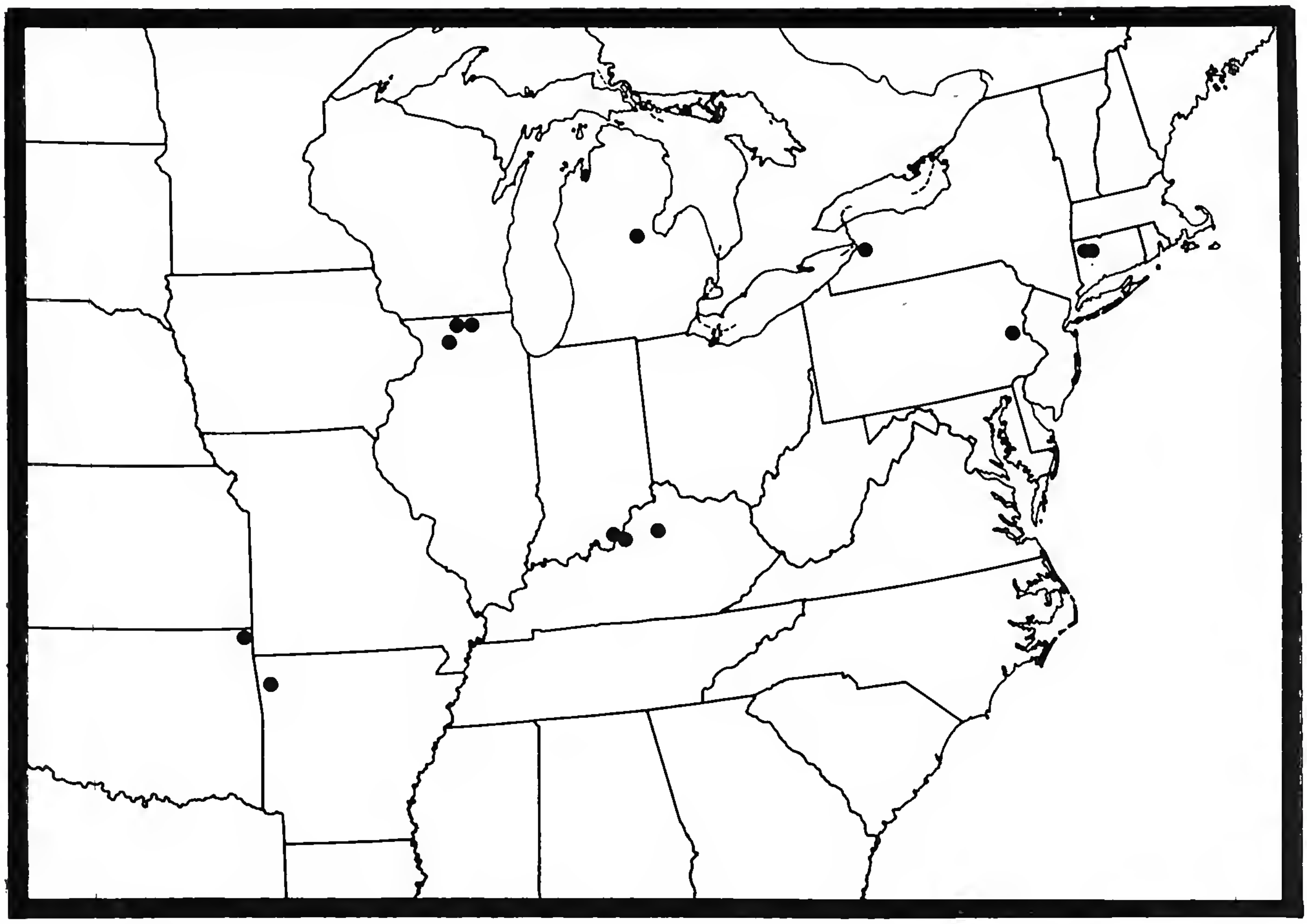


Fig. 6. Distribution of *Ectopria leechi* (also known from Virginia, but without specific locality).

The holotype and allotype are in the collection of the Illinois Natural History Survey. Paratypes are in the collections of or have been distributed to the American Museum of Natural History, California Academy of Science, Field Museum of Natural History, Museum of Comparative Zoology, National Museum of Natural History, and Stovall Museum of Science and History.

Etymology.—The epithet *leechi* honors Hugh B. Leech for his many contributions to the study of aquatic Coleoptera.

Habitat.—All Illinois specimens of *Ectopria leechi* came from small, swift-flowing streams. Stream width ranged from 1 m to 2 m and depth ranged up to 10 cm. Water temperatures were cool for the localities and time of year ranging from 15°C to 17°C. Substrate composition ranged from mud-sand to cobble riffles. Surrounding countryside was predominantly gently rolling agricultural land with a narrow belt of young trees along the streams. The type-locality, however, was open woodland. One stream bank here was a sheer rock bluff approximately 10 m high.

Adults from the type-locality were taken by sweeping insects from the moist undersurfaces of a log and rocks closely overhanging the stream. Adults from other localities presumably were taken from streamside grasses growing down into the water.

Ectopria larvae believed to be *Ectopria leechi* were taken from the undersurfaces of cobble-sized rocks in riffles. They appeared to be gregarious in that a few rocks yielded most of the specimens. These larvae were taken in association with the dryopoid genera *Dubiraphia, Helichus, Optioservus,* and *Stenelmis*.

The illustrations were prepared by Ms. Aleta A. Holt of the Illinois Natural History Survey.

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ON THE IDENTITY OF *SALDULA LATICOLLIS* (REUTER) (HETEROPTERA: SALDIDAE)

PER LINDSKOG

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Polhemus (1977) concluded that the American forms of shore bugs currently referred to as *Saldula palustris* (Douglas) are specifically differentiated from the true *S. palustris,* a species originally described from England and widely distributed in the Palaearctic region. According to that author, the valid name of one of the American forms is *Saldula fernaldi* Drake. This is a predominantly coastal species which is commonly distributed in salt marsh habitats along the Pacific coast from Alaska to Baja California and on the Atlantic coast from New England northwards (Polhemus and Chapman, 1979). Independent studies by the present author fully confirm the conclusions reached by Polhemus as to the specific separation of *S. palustris* and the allied New World forms. However, my studies also show that *S. fernaldi* is a synonym of *Saldula laticollis* (Reuter, 1875). As *S. laticollis* has priority by age, this name must replace *S. fernaldi* as the valid name of this form. This conclusion was reached after a revision of the type material of *S. laticollis* and studies of the North American forms involved.

S. laticollis is listed by Polhemus (op. cit.) as a synonym of *Saldula pallipes* (F.), therein following the view of Reuter (1890) and reiterated by subsequent authors (Oshanin, 1908; Drake and Hoberlandt, 1951). Further, "Siberia" is quoted as the *terra typica* of *S. laticollis.* However, as already explained by Reuter (1912), the assignment of Siberia as the *terra typica* in the original description of *S. laticollis,* as well as the more specific indication "Ad Irkutsk habitans" given under the redescription of this form in Reuter (1879) was based upon a misinterpretation. The type material of *S. laticollis* had in fact been collected at Sitka on the Baranof Island, Alaska, by the well-known Finnish entomologist and explorer, Reinhold Ferdinand Sahlberg, during his stay there in 1840–1841 (cf. Saalas, 1958), i.e. at a time when the Alaskan Peninsula still was a Russian colony.

A revised synonymy and nomenclature of *S. laticollis* and included nominal forms is given below, together with supplementary taxonomic data on this and allied species of the Holarctic *S. pallipes-palustris* complex. The figures and descriptions of male genital structures are based upon dry mounts prepared from fully sclerotized specimens, according to Lindskog (1974).

NRS = Naturhistoriska Riksmuseet, Stockholm (the Swedish Museum of Natural History).

Saldula laticollis (Reuter)

Acanthia (=*Salda*) *laticollis* Reuter, 1875: 544. LECTOTYPE male, ALASKA: Sitka (NRS), here designated. Reuter, 1879: 32 (redescription (as *Salda*)). Reuter, 1890: 251 (*laticollis* reduced to a variety of *Acanthia pallipes* Fabricius, 1794). Reuter, 1912: 71 (discussion of taxonomic status, earlier statements of type locality of *laticollis* corrected). Drake and Hoberlandt, 1951 (catalog; *laticollis* listed as synonym of *Saldula pallipes* (F.)).

Saldula fernaldi Drake, 1949: 191. Drake, 1962: 116 (*fernaldi* synonymized with *Saldula palustris* (Douglas, 1874)). Polhemus, 1977 (unpublished dissertation; *fernaldi* restored to specific status, separated from *palustris*).

Saldula notalis Drake, 1950: 4. Polhemus, 1977 (unpublished dissertation; *notalis* synonymized with *fernaldi*).

Saldula notabilis Drake, 1950: 5 (alternate spelling for *notalis* Drake, 1950 in the same work). Drake and Hoberlandt, 1951 (catalog; adoption of *notabilis* as the correct name).

Saldula palustris of authors (nec Douglas).

Type material.—The original description of *S. laticollis* was based upon material deposited in Coll. NRS ("Mus. Holm."). The number of specimens was not stated by the author. Two specimens of the same species are present under *laticollis* in Coll. NRS. They have no type label or any other determination labels attached to them. However, they clearly represent the authentic material of this form, as evidenced by the locality and collector data and their diagnostic features.

Lectotype male, labelled: "Sitka," "Stål" /= Coll. Stål/, "Lectotypus *Acanthia laticollis* Reuter, P. Lindskog." Female, labelled: "Sitka," "F. Sahlberg /= collector/, "Paralectotypus *Acanthia laticollis* Reuter, P. Lindskog." Both specimens are pinned and in a fairly good state of preservation. The primary diagnostic features (dorsal pilosity, hemelytral coloration) are clearly observable. Total body length, male (lectotype) = 4.86 mm, female = 5.38 mm.

Taxonomic remarks.—The intricate problem of the taxonomic relationships of the Old and New World forms of the *S. pallipes-palustris* complex has been a subject of much discussion and confusion (Cobben, 1960a; Schuh, 1967; Stock, 1972; Polhemus, 1977). This confusion stems from the fact that European populations of *S. pallipes* and *palustris* have served as the basis of comparison when discussing the identity and status of the American forms. Accordingly, the standard concept of these two species is

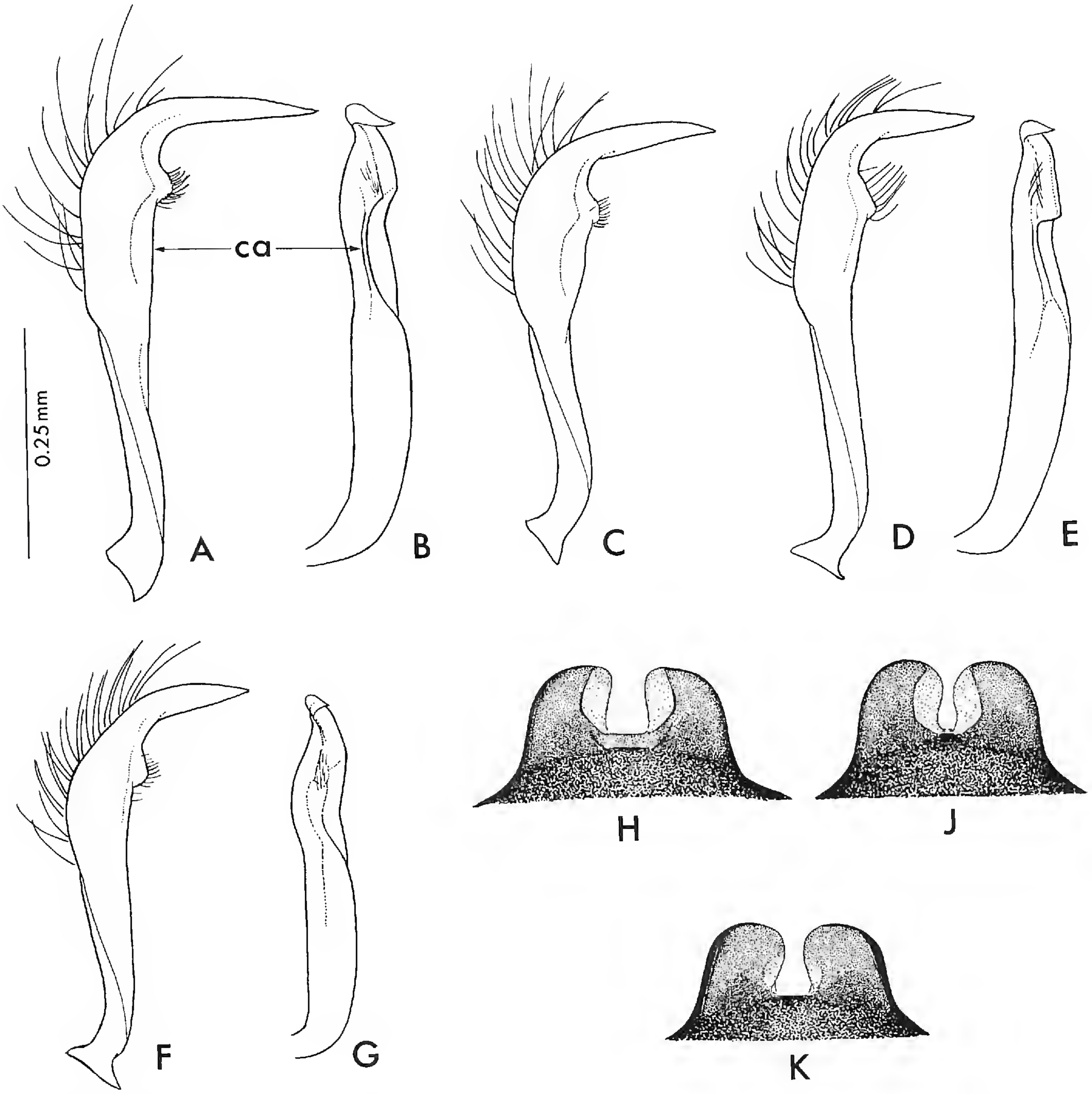

Fig. 1. Right paramere in front and inner view (A–G) and parandria, hind views (H–K)—A + B, *Saldula laticollis* (orig. Oregon: Toledo)—C, idem (orig. California: Tomales Bay)—D + E, *S. pallipes* (orig. Siberia: Abakan)—F + G, *S. palustris* (orig. Kamchatka)—H, *S. laticollis* (orig. as in A)—J, *S. pallipes* (orig. as in D)—K, *S. palustris* (orig. as in F). ca = carina.

based upon the differential diagnostic characters of the orderly or eunomic patterns of sequential variation of the dark and light coloration of the hemelytra and in the length of the hairs of the processus sensualis of the male parameres, as first elaborated in more detail by Wagner (1951) and Cobben (1960b) and then primarily with regard to (West) European populations. Both species have very wide trans-Palaearctic ranges, however, and patterns of geographic variation must be accounted for. In fact, a geographic variation in hemelytral color eunomies between several Central European populations of *S. pallipes* and *palustris* has recently been described (Karnecká, 1978). Moreover, populations from North America, notably the northwestern regions (Alaska, etc.), should primarily be compared with populations from East Eurasia, viz. NE Siberia and Kamchatka, where the presence of both species recently has been confirmed. I have had the opportunity to study material of *S. pallipes* and *palustris* from their entire Palaearctic range, including a very large material from the U.S.S.R. and adjacent Asiatic regions in the collections of the Zoological Institute of the Academy of Sciences of the U.S.S.R., Leningrad. When considering the total spectrum of variability of *S. pallipes* and *palustris,* a complete intergradation and overlap in hemelytral color patterns, shape and proportions of the body and body parts and features of the dorsal pilosity between these species can be established. Thus none of these external features can be employed as a universally valid character for identifying and separating these geographically broadly overlapping species. However, when each regional situation in the phenetic interrelationships of these two species is studied and treated separately, a more or less reliable separation by means of various combinations of these characters is generally possible. A similar situation is likely to exist among the American species of this complex.

The basic diagnostic characters differentiating *S. pallipes* and *palustris* concern the structure and shape of the male parameres (Fig. 1D–G). *S. pallipes* is primarily distinguished by the very long hairs of the processus sensualis (Fig. 1D) and by the shape of the inner side of the paramere body (corpus parameri) which is produced as a sharp edge at the level of the processus sensualis (Fig. 1E) instead of being smooth as in *palustris* (Fig. 1G). Further, the parameres of *S. pallipes* are markedly longer and less curved and the ventral carina (cf. Fig. 1A–B) proximal to the processus sensualis is more strongly developed and prominent compared with *palustris* (Fig. 1E, G). The distinctive features of *S. pallipes* and *palustris* in the structure and the overall shape and size of the parameres illustrated in Fig. 1 on the basis of specimens from Western Siberia and Kamchatka, respectively, are seen to agree quite closely with the situation previously described for populations from Finland (Lindskog, 1974, Fig. 1), and have further been verified in material from many other regions (e.g. North Africa, Middle and Central Asia). In addition to the type material, specimens of *S. laticollis* were studied from Alaska: Valdez Bay, Oregon: Yaquina River estuary, and California: Tomales Bay and San Diego, which form part of the material of Bahr and Schulte (1976), and which were determined by J. T. Polhemus (in 1973) as *S. palustris* and *S. notalis.* As stated by Polhemus (1977), *S. laticollis* (=*S. fernaldi*) is distinguished by the constant presence of long, curved, semi-recumbent or suberect setae on the head. The dorsal pilosity is rather variable, sometimes markedly coarse and shaggy with several longer, erect or suberect setae on pronotum (=*S. notalis*). In *S. palustris* and *S. pallipes* (Old World populations) the pubescence of the head and dorsum is uniformly short and recumbent. The parameres of *S. laticollis* are rather variable in shape and size, as partly shown by Fig. 1 and also noticed and illustrated by Polhemus (1977). All specimens studied by me clearly differ from *S. palustris* as well as *S. pallipes* by the ventrally more strongly carinate paramere body (Fig. 1A–C) and the generally longer and more strongly acuminate processus hamatus. *S. laticollis* further differs from *S. pallipes* by the shorter hairs of the processus sensualis and through the lack of any similarly marked edge-like structure on the inner side of the paramere body. The male parandrial lobes of *S. laticollis* are separated by a moderately wide notch and their inner membranous margins are only slightly converging distad (Fig. 1H). In *S. pallipes* and *palustris* the parandria are distally more broadly and evenly rounded and their inner margins more or less strongly converging distad (Fig. 1J–K). Generally the parandria of *S. pallipes* are more narrowly separated and often less extensively sclerotized compared with *S. palustris,* as shown by the figures. These latter differences are essentially of a statistical nature only and cannot be used for a critical species identification.

I have not been able to study authentic material of *S. pallipes* from the New World. A few specimens in the aforementioned material from San Diego determined as *S. pallipes* were found to be light color forms of *S. laticollis*. Some specimens in NRS labelled ''Colorado'' (Morrison lgt.) have been determined as ''*S. pallipes* var.'' by C. J. Drake. With respect to the hemelytral color pattern they agree with *S. pallipes* as well as with *S. palustris,* notably with some forms of the latter species occurring in the arid zones of southern Russia and Middle Asia (relatively small size, pronotum with a relatively dense and moderately long, fine, appressed, silvery or golden pubescence). The parameres are also closely similar to *S. palustris,* but the parandria are of a quite different shape, size, and configuration compared with this and the other species above. This form probably represents an undescribed species. The male genital structures of *S. pallipes* from America figured by Polhemus (1977) well agree with the Old World form, except for the apparently short hairs of the processus sensualis. More studies are clearly needed in order to clarify the phenetic and taxonomic relationships between the Old and New World forms of this taxon.

Acknowledgment

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THE LARVAL DESCRIPTION AND ECOLOGICAL NOTES OF A CADDISFLY, *NECTOPSYCHE TAVARA* (ROSS) FROM THE CENTRAL FLORIDA REFUGIUM (TRICHOPTERA: LEPTOCERIDAE)

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The genus *Nectopsyche* (formerly *Leptocella*) in North America was revised by Haddock (1977) and at that time the larval stage of *N. tavara* was unknown. This paper provides a description of the larvae and notes on their bionomics.

Nectopsyche tavara (Ross) appears to be restricted to the lakes of the central Florida highlands region. Adults have been recorded from Lake, Levy and Orange counties (Ross, 1944) and have also been collected from Lake Placid in Highlands County and Prairie Lake in Seminole County. The hypothesis of a Florida refugium has had considerable support by zoogeographers working with a variety of organisms. Clench and Turner (1956) showed that the antiquity and distinctiveness of the freshwater molluscan fauna offer evidence that the central Florida region was an island during the Pliocene and Pleistocene eras. They also found that a considerable number of species of freshwater molluscs did not range east or south of the Suwannee River in northcentral Florida and that the fauna indicated that the headwaters of the Chattahoochee and Flint Rivers have persisted since mid-Tertiary time. They termed the Florida refugium area "Orange Island," a modification of the "island of Florida," coined by Dall (1903). Howden (1969) also cites several additional examples of well-studied groups such as some meloids, scarabs, the genus *Melanoplus* and certain lycosid spiders that show evidence of having survived the Pleistocene in several parts of peninsular Florida.

Recently, a series of adults and the previously unknown larvae of *N. tavara* were collected from Lake Conway and nearby Lake Fredrica. These lakes may be characterized as unpolluted, good-water quality lakes falling in the mesotrophic range of eutrophication. Utilizing the limnological lake

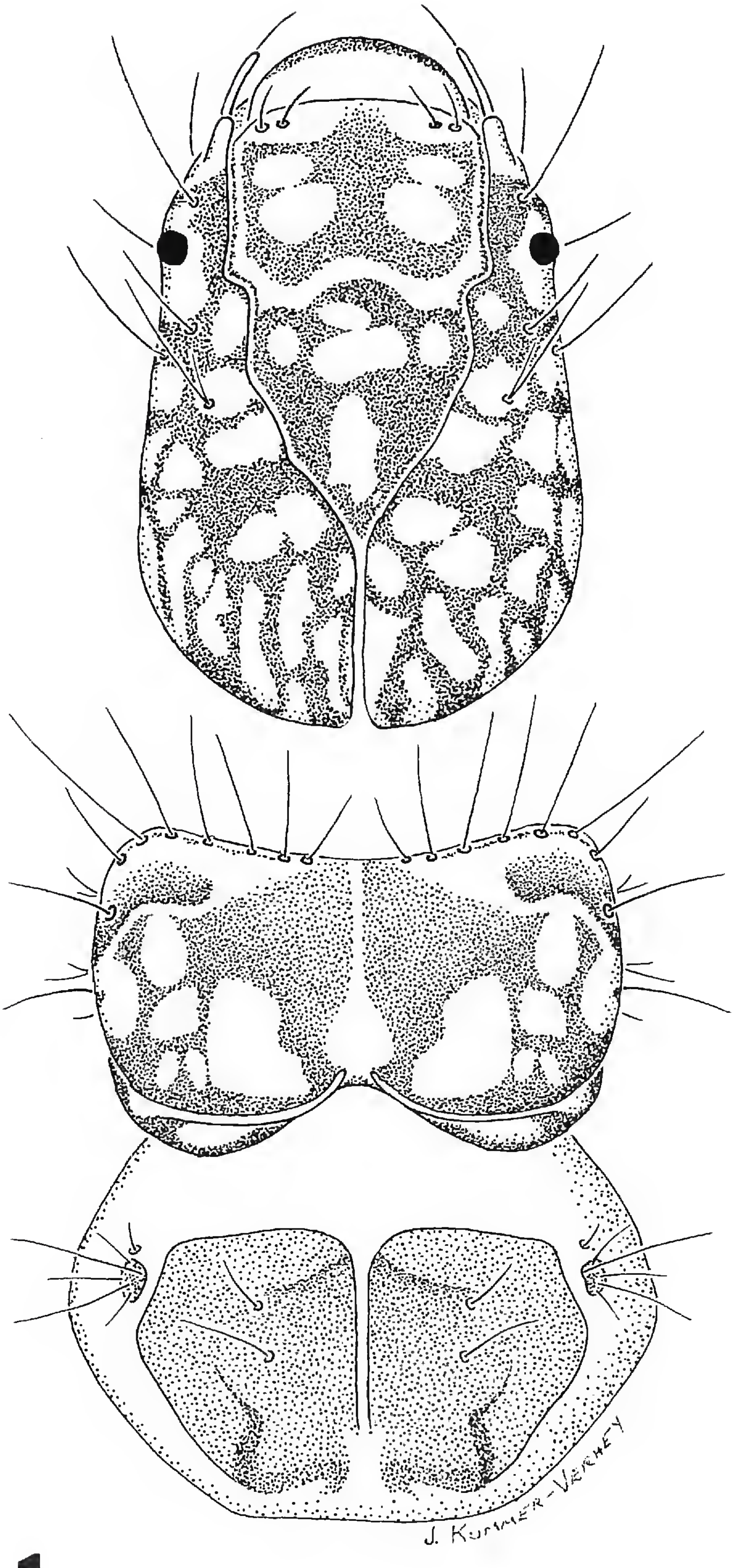

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Fig. 1. *Nectopsyche tavara* head capsule, pro and mesothorax, dorsal view, ×80.

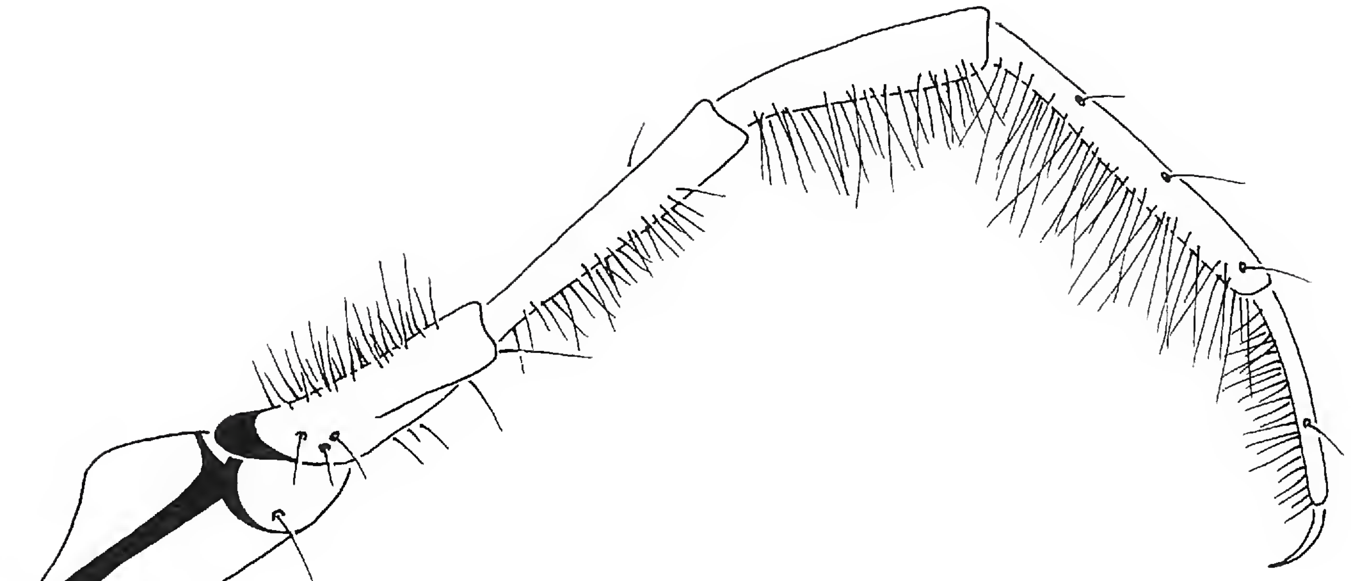

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Fig. 2. *Nectopsyche tavara* swimming brush on metathoracic leg, lateral view, ×50.

classification scheme of Shannon and Brezonik (1972) the two lakes would be considered mesotrophic in three categories. Water analyses revealed that chlorophyll a readings for Lakes Conway and Fredrica were 6.5 and 5.0 mg/l respectively. Total phosphates were 0.025 and 0.026 mg/l with total organic nitrogen 0.60 and 0.50 mg/l.

The larvae are phytophagous, feeding on submerged aquatic macrophytes such as southern naiad (*Najas guadalupensis* (Spreng.) Magnus), fanwort (*Cabomba caroliniana* Grey), Illinois pondweed (*Potamogeton illinoensis* Morong), stonewort (*Nitella megacarpa* L.), and hydrilla (*Hydrilla verticillata* Royle). Adult associations were made from larvae reared in the laboratory on these plants with various size groups observed in daytime feeding. No attempt was made to establish a chronological life-history with detailed instar classification data. Both early and late instar larvae swim utilizing the swimming brush on the metathoracic leg. The larval case is elongate-linear, composed primarily of sand grains and typically with a plant stem attached to the antero-dorsal side (Fig. 3). The length of the case averages about 18 mm. Prior to pupation the larvae affix themselves to suitable sites on food plant leaves and stems by means of an anterior and a posterior secreted holdfast. The larvae modify their pupal chamber by sectioning off part of the posterior case and any inherent plant matter. Pupal duration averages about 20 days except for the overwintering generation.

Adults can be collected from March to October on vegetation, grasses and trees along the shoreline. They appear to be multivoltive as many size classes of larvae can be collected. An emergence period occurs in late March

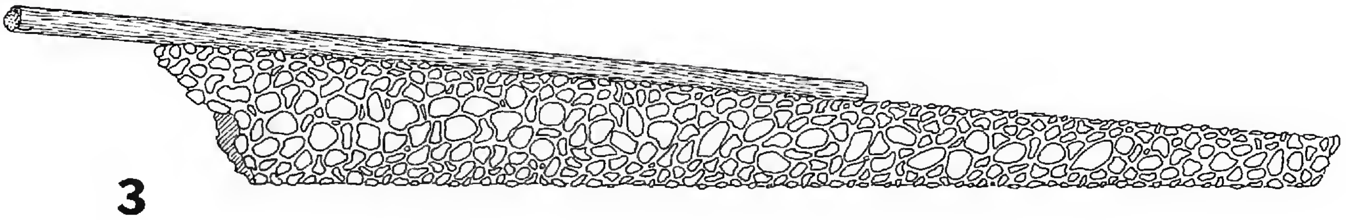

Fig. 3. *Nectopsyche tavara* larval case, lateral view, ×16.

followed by the peak summer emergence in early July. A smaller fall emergence follows in late September.

Description.—Larval characters for *N. tavara* are consistent with the generic diagnosis of *Nectopsyche* larvae provided by Wiggins (1977). A ventral band of tiny spines lateral to the anal opening, characteristic of some mature *Nectopsyche* larvae, is absent in this species.

Diagnosis.—Larvae of *N. tavara* can be distinguished from other Nearctic species of *Nectopsyche* on the basis of the following combination of characters: anterior half of fronto-clypeus with medial, longitudinal, brown stripe dividing four oval, luteous spots that appear as "figures 8's"; an inconspicuous gill found in the posterolateral region of the metanotum; a well-developed swimming brush on the metathoracic leg and the absence of gills on the first abdominal segment.

Mature larvae are very similar to those of *N. spiloma* but can be distinguished by the presence of numerous luteous spots surrounded by brown pigmentation in the posterior half of the gena in addition to the coloration of the fronto-clypeus as mentioned above. *N. spiloma* is allopatric from *N. tavara* and is common in the large rivers of the Mississippi River drainage, in the Edwards plateau of Texas as well as extending into Central America.

Larvae of *N. tavara* also bear a superficial resemblance to a western species, *N. gracilis* (senior synonym of *N. intervena* Banks in Wiggins, 1977) but shows consistent difference in head and pronotal color patterning. In addition, *N. gracilis* larvae have no metanotal gills.

Mature larva.—Maximum body length 13 mm. *Head* (Fig. 1).—Anterior margin of labrum with narrow transverse brown band; mandible with basal two-thirds luteous, distal portion black; anterolateral margins of fronto-clypeus luteous; anterior region of fronto-clypeus with two pairs of luteous spots, in some larvae separation of spots indistinct; posterior half of fronto-clypeus with four luteous markings of unequal size; entire dorsum of head with luteous oval to oblong-shaped spots separated by dark brown irregularly-shaped reticulations; subocular line of weakness present, bisecting gena; posterior portion of gena with many luteous spots similar to those on fronto-clypeus; vertical area of gena luteous with light brown border along medial margin; black spot present anterior to base of antenna; ventral apotome triangular, pale. *Thorax.*—Pronotum with area medial to lines of weakness ranging from light to dark brown posteromedial portion luteous; lateral areas of pronotum with marbled blotching as seen on dorsum of head; sclerotized portion of mesonotum predominantly brown with luteous indistinct stripe in central area; posterolateral corner of metanotum with dark brown sclerotized stripes running posteriorly; inconspicuous gill present in posterolateral area of metonotum. *Legs.*—Legs luteous to light brown in color; tarsus of prothoracic leg with 3 or 4 bristles on ventral margin; prothoracic tibia with two stout spines on ventral margin near apex and two bristles lying slightly mesad; prothoracic femur with many bristles on ventral margin; mesothoracic tibial spines on ventral margin shorter than maximum width of tibia; well-developed swimming brush on metathoracic leg (Fig. 2) consisting of double fringe of setae on femur and tibia and single row of setae on tarsus. *Abdomen.*—Tracheal gill formula on abdominal segments: I-0; II-3; III-1; IV-1; V-1; VI-1; VII-0,1; abdominal segment I with sclerotized bar and circular roughened area on each lateral hump characteristic for genus; ventral band of tiny spines absent from area lateral to anal opening.

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BIOLOGICAL OBSERVATIONS ON THREE *TRYPOXYLON* WASPS IN THE SUBGENUS *TRYPARGILUM*[1] FROM COSTA RICA: *T. NITIDUM SCHULTHESSI, T. SAUSSUREI,* AND *T. LACTITARSE* (HYMENOPTERA: SPHECIDAE)

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The genus *Trypoxylon* subgenus *Trypargilum* occur in temperate and tropical regions of the Western Hemisphere (Bohart and Menke, 1976). These solitary spider wasps are either mud daubers or they nest in preexisting cavities. They are unusual among all wasps in that males normally remain in nests as guards while females forage (Peckham and Peckham, 1895; Rau, 1928; Fattig, 1936; Paetzel, 1973; Coville and Coville, 1980). In addition, many species groups and complexes of *Trypargilum* appear to have distinctive nest architecture, cocoon morphology, and prey preferences (Krombein, 1967; Matthews and Matthews, 1968; Lin, 1969; Coville, 1979). The last three traits may become useful taxonomic characters when information becomes available on more species, especially in the Neotropics. Coville and Coville (1980) recently reported on the biology of *Trypoxylon* (*Trypargilum*) *tenoctitlan* Richards in Costa Rica. The purpose of this paper is to present biological data obtained from nests of three other Costa Rican *Trypargilum* during that study: *T. nitidum schulthessi* Richards, *T. lactitarse* Saussure, and *T. saussurei* Rohwer.

Methods

Trap-nests with borings of 4.8, 6.4, and 9.5 mm drilled to a depth of 152 mm were used to obtain wasp nests. Coville (1979) and Coville and Coville (1980) describe the technique in detail.

The study was conducted in 1975 in Guanacaste Province, Costa Rica. One study site was 25 km SW of Bagaces at the Organization for Tropical Studies Field Station at Palo Verde on the Comelco Property. Two other sites were 4 km NW Cañas at La Pacifica 1) in the riverine forest along the Rio Corobici and 2) on the porch of a cabin.

Trypoxylon (*Trypargilum*) *nitidum schulthessi* Richards

Richards (1934) placed *T. nitidum* Smith in the subgroup of *T. nitidum* (=*nitidum* complex) of the *nitidum* group. This polytypic species is found

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[1] The author prefers to treat *Trypargilum* as a subgenus until its relationship to the diverse species groups of subgenus *Trypoxylon* is carefully studied.

Table 1. Contents of 6 *Trypoxylon nitidum schulthessi* nests from La Pacifica, Costa Rica.

	Rio Corobici		Cabin Porch
	Bore Diameter (mm)		
	6.4	4.8	4.8
Nests examined	1	2	3
Provisioned cells	8	7	22
Cells provisioned but without wasp egg	1	–	1
Cells with contents preserved or died	–	3	7
Wasps Reared:			
T. nitidum schulthessi ♂♂	–	1	6
♀♀	3	3	9
Natural Enemies Reared:			
Chrysididae			
Neochrysis lecointei (Ducke)	4	–	–
Acarina			
Pyemotes sp.	–	–	1

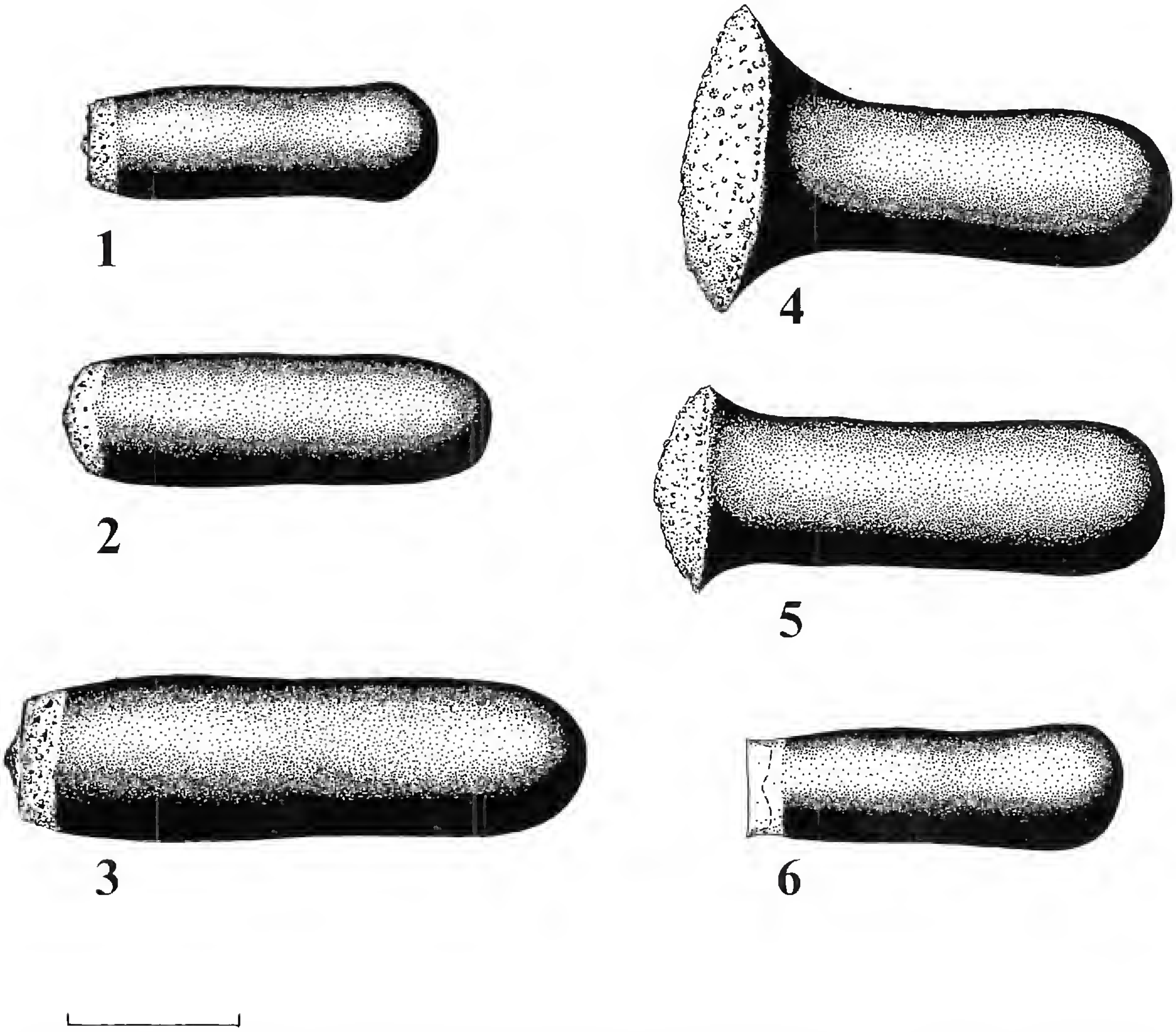
throughout the tropics. *Trypoxylon nitidum schulthessi,* previously known only from the original description of Richards (1936), occurs in Costa Rica.

This species occupied 6 trap-nests at La Pacifica, Costa Rica. Three traps were from one bundle set out in the narrow forest along the Rio Corobici. The other three were from bundles attached to a chair on the cabin porch. One nest from the Rio Corobici was in a 6.4 mm boring; the other 5 were in 4.8 mm borings. Contents of these nests are summarized in Table 1.

Adult behavior.—On February 7, each of two pairs of *T. nitidum schulthessi* entered trap-nests on the cabin porch. The males followed the females that were searching for nests. Thereafter, the males remained in the nests as guards with their heads facing outwards at the nest entrance. Three marked males and two marked females of *T. tenoctitlan,* a larger species, were observed trying to enter the nests of *T. nitidum schulthessi.* The guard (presumably the male) successfully defended his nest except for one extremely aggressive female that had to be repeatedly driven away (see Coville and Coville, 1980).

One of the wasps in each of the nests on the porch regularly spent the night away from the nest and returned at 0647–0732 AM CST, a time which was 7–29 minutes before the males of *T. tenoctitlan* returned to their nests. At that time air temperature was about 25°C.

When the female returned to the nest with prey, she alighted at the entrance. The male guard then left the tunnel, mounted the female's back, and attempted to copulate as the female entered the nest head first.



Figs. 1–6. Cocoons of *Trypargilum* (anterior on the left). Fig. 1. *T. nitidum schulthessi.* Fig. 2. *T. tridentatum.* Fig. 3. *T. orizabense.* Fig. 4. *T. tenoctitlan* from trap-nest with 9.5 mm diameter tube. Fig. 5. Same from 6.4 mm trap-nest. Fig. 6. *T. clavatum.* Scale equals 5 mm.

One of the 2 nests started on February 7 was completed on February 16 and contained 8 provisioned cells; the other nest was completed on February 18 and contained 6 provisioned cells.

Nest architecture.—Nests consisted of a linear series of provisioned cells separated by mud partitions, followed by one or more vestibular cells, and a mud closure plug. A preliminary mud plug was always present at or near the inner end of the trap-nest boring. The 6.4 mm nest contained 8 provisioned cells and one vestibular cell. The 4.8 mm nests contained 2 to 8 provisioned cells and 2 or 3 vestibular cells. Closing plugs consisted of 2 elements resembling 2 thickened, closely spaced cell partitions. Closing plugs were at the entrance in 4 nests but were recessed 12 mm in the 6.4 mm nest and 18 mm in one of the 4.8 mm nests. The last nest contained only 2 provisioned cells. Nest dimensions are shown in Table 2.

Prey.—Cells were provisioned with 7 to 17 spiders ($\bar{x}$ = 10.9, N = 7). Identifications of 52 spider prey are as follows:

ARANEIDAE: 2 ♂♂ *Eustala* sp.; 4 imm., 2 ♀♀, 5 ♂♂ *Metazygia* sp.; 2 ♂♂ *Metepeira* sp.; 34 imm. undetermined Araneidae.
THERIDIIDAE: 3 ♀♀ *Theridion* sp.

Life history.—The egg, about 2 mm long, is attached to the abdomen of one of the last spiders stored. Eclosion of the larva takes place about 1–1.5 days after the egg is laid. One larva completed feeding on 12 spider prey in about 2 days, spent 2 days spinning its cocoon, and then pupated 7 days later. The imaginal molt occurred after 20 days, but the adult waited 4 more days before attempting to chew through the gelatin capsule in which it was confined for observation.

The time interval from nest completion to emergence of the adult from the cocoon is 34 to 49 days. No diapause or quiescent stage was noted. The distribution of the sexes in the nest appears to be random.

The cocoon is dark brown, varnished in appearance, and brittle. It is cylindrical with the posterior end rounded; the anterior end is truncate with a median nipple, which is gray and more coarsely granular than the rest of the cocoon (Fig. 1). Two male cocoons were 8.7 and 9.5 mm long and 2.9 mm wide. Six female cocoons ranged 9.7–11.0 mm long ($\bar{x}$ = 10.2) and 3.0–3.6 mm wide ($\bar{x}$ = 3.3).

Natural enemies.—Four females of *Neochrysis lecointei* (Ducke) were reared from the 6.4 mm nest (Table 1). The chrysidids emerged from March 25 to 31, whereas 3 females of *T. nitidum schulthessi* reared from the same nest emerged on March 15 and 16. This late emergence of the parasite is unusual [and perhaps indicates poor adaptation of *N. lecointei* to *T. nitidum schulthessi*.] The innermost cell in one of the 4.8 mm borings was infested by *Pyemotes* mites.

Trypoxylon (*Trypargilum*) *lactitarse* Saussure

This species occurs from Canada to Argentina. Richards (1934) placed *T. lactitarse* (under the name *cinereum*) in the *punctulatum* group. Its biology (under the names *striatum* and *albopilosum*) is well known in North America (Peckham and Peckham, 1895; Rau, 1928; Krombein, 1967; Medler, 1967).

Trypoxylon lactitarse occupied 2 trap-nests in Costa Rica. A 9.5 mm nest was from a bundle set out on January 12 at the Rio Corobici site at La Pacifica. The nest was collected on January 31 along with the female wasp that was constructing the closing plug. No male wasp was observed at the nest. A 6.4 mm nest set out on January 14 at Palo Verde was collected on February 25 and had a chrysidid emergence hole in the closing plug.

Nest architecture.—Nest structure was similar to that of *T. nitidum schulthessi.* Both *lactitarse* nests had preliminary mud plugs deposited at the inner end of the tunnels. The 9.5 mm nest had 7 provisioned cells and 1

Table 2. Nest dimensions of *Trypoxylon* subgenus *Trypargilum* from trap-nests in Costa Rica.

Species	Nest Diameter (mm)	Sex	Provisioned Cell Length (mm)	Vestibular Cell Length (mm)	Cell Partition Thickness (mm)	Closure Plug Thickness (mm)
			Mean SD (N)	Mean SD (N)	Mean SD (N)	Mean SD (N)
nitidum schulthessi	6.4	♀	12.4 ± 1.4 (5)	31.7 (1)	0.5 ± 0.1 (8)	1.4 (1)
		♂	—			
	4.8	♀	13.7 ± 1.8[1] (8)	26.4 ± 31.5 (9)	0.6 ± 0.2 (22)	2.7 ± 1.3 (4)
		♂	11.1 ± 1.5 (7)			
lactitarse	9.5	♀	18.6 ± 0.1 (2)	11.0 (1)	1.2 ± 0.2 (7)	—
		♂	17.5 (1)			
	6.4	♀	—	39.2 ± 36.8 (2)	1.6 ± 0.3 (2)	—
		♂	19.5 ± 1.6 (2)			
saussurei	4.8	♀	29.5 (1)	21.3 ± 28.2 (2)	0.6 ± 0.1 (2)	1.8 (1)
		♂	—			

[1] Female cells are significantly longer than male cells ($t = 2.95$, $df = 15$, $p < 0.05$).

vestibular cell. The 6.4 mm nest contained 3 provisioned cells and 2 vestibular cells. Nest dimensions are shown in Table 2. All cell partitions in the 6.4 mm nest and most partitions in the 9.5 mm nest had a globule of mud at the center of the outer surface. The globules of mud were probably deposited by the female wasps after they detected a chrysidid oviposition hole in a partition. The nests were heavily parasitized by chrysidids.

Prey.—Two cells from the 9.5 mm nest each had 7 spider prey. Identifications of 13 of these spiders are as follows:

ARANEIDAE: 3 ♀♀, 1 ♂ *Araneus pegnia* (Walckenaer); 6 imm. *Eriophora* sp.
THERIDIIDAE: 1 imm. *Argyrodes* sp.
SALTICIDAE: 1 ♀ *Pseudicius* sp.
THOMISIDAE: 1 ♀ *Misumenops* sp.

Life history and natural enemies.—The first 5 cells in the 9.5 mm nest contained developing larvae on January 31. Female *T. lactitarse* emerged on May 23 and 28 from cocoons taken from the first and second cells. A male from the fourth cell emerged on May 22. Male *Neochrysis lecointei* emerged from the third (date undetermined) and fifth cell on March 19. On January 31 the sixth cell contained a first instar chrysidid larva devouring a wasp egg attached to the abdomen of a spider, and the seventh cell contained a chrysidid egg near the inner end and a wasp egg on a spider abdomen near the outer end. Both cell contents were preserved.

The first two cells in the 6.4 mm nest contained wasp cocoons on February 25. Male *T. lactitarse* emerged on May 13 and 14. A chrysidid had presumably emerged from the third cell before the nest was collected, since the cell contained remnants of a chrysidid cocoon.

The cocoon of *T. lactitarse* has been described by Krombein (1956, 1967), Balduf (1961), and Medler (1967) from nests collected in the United States. Cocoons are similar in Costa Rica. The brittle, dark brown cocoons are cylindrical with the posterior end rounded, and the anterior end usually flared outwardly to the walls of the boring, the amount of flare being dependent on the tunnel diameter. Two cocoons from the 9.5 mm nest had the anterior end bluntly rounded. Krombein (1967) reported similar occurrences in large diameter tubes. The anterior face of the cocoon is convex, gray, and more coarsely granular than the rest of the cocoon. In the 9.5 mm nest one cocoon was 15.8 mm long, 5 mm wide at the middle, and 9.0 mm wide at the anterior end. Another cocoon with the anterior end bluntly rounded was 16.4 mm long and 5.2 mm wide.

Trypoxylon (*Trypargilum*) *saussurei* Rohwer

Trypoxylon saussurei, a member of the *spinosum* group of Richards (1934), has been confused with the similar *T. salti* Richards, but the male genitalia are quite different. *T. saussurei* is found in Central America and southern Mexico.

This species occupied a 4.8 mm trap-nest at the cabin porch site at La Pacifica. The nest was indirectly determined to be that of *T. saussurei,* since no adults were reared. Nevertheless, I was able to identify 1 female that died shortly before emerging from the pupa as either *T. salti* Richards or *T. saussurei.* Since numerous males that I have seen from Guanacaste Province have all been *T. saussurei,* I assume that the female is also of that species.

Adult behavior.—On February 7 two wasps slowly flew and hovered around the cabin door. One of them, presumably the female, was examining dark knots and beetle holes and entered a 4.8 mm trap-nest that I held up to her. The nest was attached to the arm of a chair, and the wasp completed it on February 16.

When the female returned to the nest with spider prey, the male left the boring and mounted the female's back as she entered head first. On February 12 and 13 a marked *T. tenoctitlan* female harassed the wasps and once succeeded in entering the nest and chasing the male out. The marked female was forcibly removed with a pair of forceps. The male reentered shortly, followed by the resident female who returned with a spider.

Nest architecture.—The nest contained a preliminary plug at the inner end of the tube followed by 3 provisioned cells and 2 vestibular cells. The closing plug consisted of a single mass of mud. Nest dimensions are shown in Table 2.

Prey.—The second and third cells contained 12 and 17 spider prey, respectively. Identifications of 28 spiders are as follows:

ARANEIDAE: 1 imm. *Acanthepeira* sp.; 2 imm., 1 ♂ *Araneus pegnia* (Walckenaer); 2 imm. *Larinia directa* (Hentz); 1 imm., 1 ♂ *Metepeira* sp.; 1 imm., 1 ♂ undetermined Araneidae.
PHOLCIDAE: 7 imm. *Physocyclus globosus* (Taczanowski).
OXYOPIDAE: 1 imm. *Oxyopes* sp.
SALTICIDAE: 1 imm. *Bryantella* sp.; 1 imm., 1 ♀ *Corythalia* sp.; 2 ♂♂ *Hentzia* sp.; 2 imm. *Lyssomanes* sp.; 1 ♂ *Rudra* sp.; 1 imm. *Thiodina sylvana* (Hentz).
THOMISIDAE: 1 imm. *Imarus* sp.

Life history.—An egg attached to the side of the abdomen of a pholcid spider was in the third cell. The cocoon is brittle, dark brown and varnished in appearance. It is cylindrical with the posterior end rounded and with a gray collar extending beyond the anterior end.

Discussion

Richards (1934) divided *Trypargilum* into five species groups: *superbum, albitarse, punctulatum, nitidum,* and *spinosum* groups. He also recognized several species complexes within the *nitidum* group: *aureovestitum, excavatum, fugax, nitidum,* and *vagum* complexes. This discussion pertains to the *punctulatum, nitidum,* and *spinosum* groups.

In the *spinosum* group, besides *T. saussurei,* prey and cocoons are known of *T. clavatum clavatum* Say (Krombein, 1967), *T. clavatum johannis* (Richards) (Krombein, 1967), *T. californicum* (=*arizonense,* Matthews and Matthews, 1968), and *T. texense* (Kurczewski, 1963; Lin, 1969; personal obs. of cocoons). Lin (1969) also reported on prey of another species, *T. spinosum* Cameron. As pointed out by Matthews and Matthews (1968) the prey of the *spinosum* group include a wide variety of spider families with as many wandering spiders (those that pursue or ambush prey, e.g., Oxyopidae, Salticidae, and Thomisidae), as snarebuilders (those that entangle their prey in webs, e.g., Araneidae, Pholcidae, and Theridiidae). The general pattern of prey preferences in *Trypargilum* are often still evident when sample sizes are small, as in *T. saussurei* (N = 28). Cocoons of all *spinosum* group species have a gray collar that extends beyond the anterior end (Fig. 6).

Within the *nitidum* group biological data exist only for representatives of the *nitidum* complex, *fugax* complex, and a species of uncertain placement, *T. tridentatum* Packard (Krombein, 1967). In the *nitidum* complex, besides

T. nitidum schulthessi, prey and cocoons are also known of *T. collinum collinum* Smith (Krombein, 1967), *T. collinum rubrocinctum* (Packard) (Krombein, 1967), and *T. orizabense* Richards (Coville, 1979). Their prey include primarily snarebuilding spiders, and their cocoons have a truncate anterior end that bears a small median nipple (Figs. 1 and 3). Cocoons of *T. nitidum schulthessi* and *T. collinum* are virtually indistinguishable (Fig. 1), but those of *T. orizabense* are relatively more elongate (Fig. 3). Prey of *T. tridentatum* are similar to the *nitidum* complex. However, cocoons of *T. tridentatum* have a more rounded anterior end, and often have a weak nipple (Fig. 2).

Cocoons of *T. tenoctitlan* Richards (*nitidum* group, *fugax* complex, Figs. 4 and 5) described by Coville and Coville (1980) are indistinguishable from those of *T. lactitarse* (*punctulatum* group). Cocoons of both species have the anterior end flaring outwardly to the walls of the nesting tube. This suggests that the *punctulatum* group and the *fugax* complex are closely related. In fact, Bohart and Menke (1976) have suggested combining the *punctulatum, nitidum,* and *spinosum* groups on the basis of adult morphology. Cocoon characteristics of the *punctulatum* and *spinosum* groups are no more distinctive than those of species complexes of the *nitidum* group.

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THE LARVA OF *SYMPETRUM MADIDUM* (HAGEN) (ODONATA: LIBELLULIDAE)

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Sympetrum madidum (Hagen) is a dragonfly widely distributed through much of western North America, ranging from the Northwest Territories south through British Columbia to California and east to Manitoba and Missouri (Walker and Corbet, 1975).

In 1904 J. G. Needham published a description of a single *Sympetrum* larva that he attributed by supposition to *S. madidum* (Needham, 1904). The characteristics of this larva subsequently were treated as those of *S. madidum* in other works (Byers, 1927; Needham and Westfall, 1955).

Recently, Walker and Corbet (1975) recognized that the *S. madidum* adult was similar to those of *S. corruptum* and *S. illotum* which were considered by Needham and Fisher (1936) and Needham and Westfall (1955) and others to belong to a separate genus, *Tarnetrum*. Consequently, Walker and Corbet (1975) placed *S. madidum* in a subgenus *Tarnetrum* within *Sympetrum*, agreeing with Gloyd and Wright (1959) and Kormondy (1958, 1960) in not giving *Tarnetrum* full generic rank.

The larvae of the subgenus *Tarnetrum* are different from those of other *Sympetrum* species: they are larger, have reduced lateral spines and lack dorsal hooks on the abdomen. Needham's larva was considerably smaller than the expected size of the larva of *S. madidum*, and moreover, had dorsal hooks and long lateral spines. This, as well as Needham's professed doubts as to the identity of the larva he described, led Walker and Corbet (1975) to disregard the 1904 description and consider the larva of *S. madidum* to be unknown.

On 19 June 1978 at Riske Creek, British Columbia (51°58′, 122°30′) I found a teneral *S. madidum* female with an exuvia about one m away. The association of adult and exuvia was not conclusive, however, and despite the fact that the exuvia fitted all the requirements for a larva of *S. madidum* (the other species in the subgenus are not known to occur anywhere near this region), no definite claim for the discovery of the larva could be made.

Similar larvae were collected from a pond in Langford, ten km west of Victoria, British Columbia (48°28′, 123°30′) on 3 June 1979. On 10 June an adult male and female *S. madidum* emerged from these larvae in the laboratory and another female did so on 11 June. A second collection of larvae from the same pond on 16 June produced ten more adults.

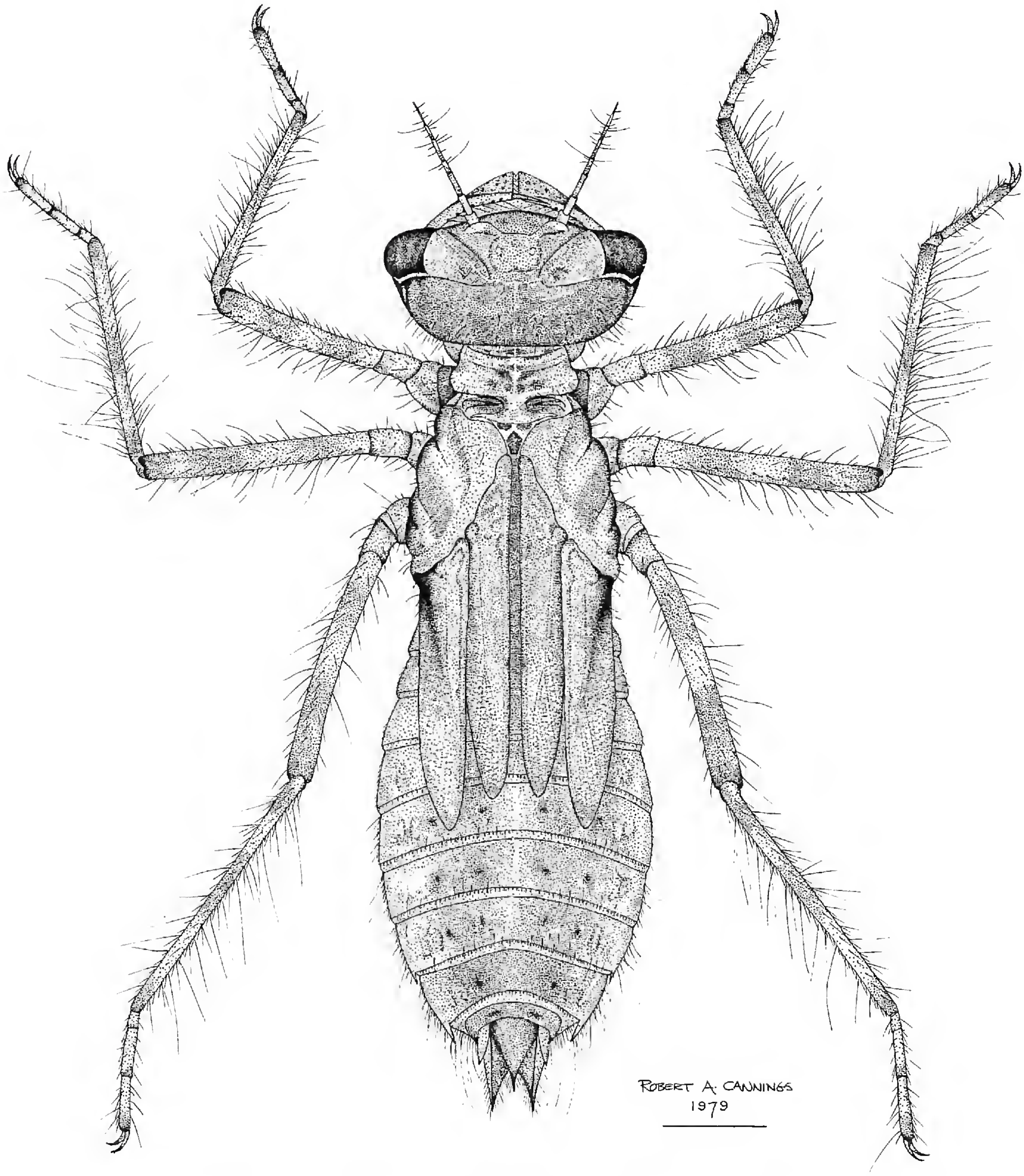


Fig. 1. *Sympetrum madidum,* final-instar larva, dorsal view. Scale line = 2 mm.

Sympetrum madidum (Hagen), final instar of larva
(Fig. 1)

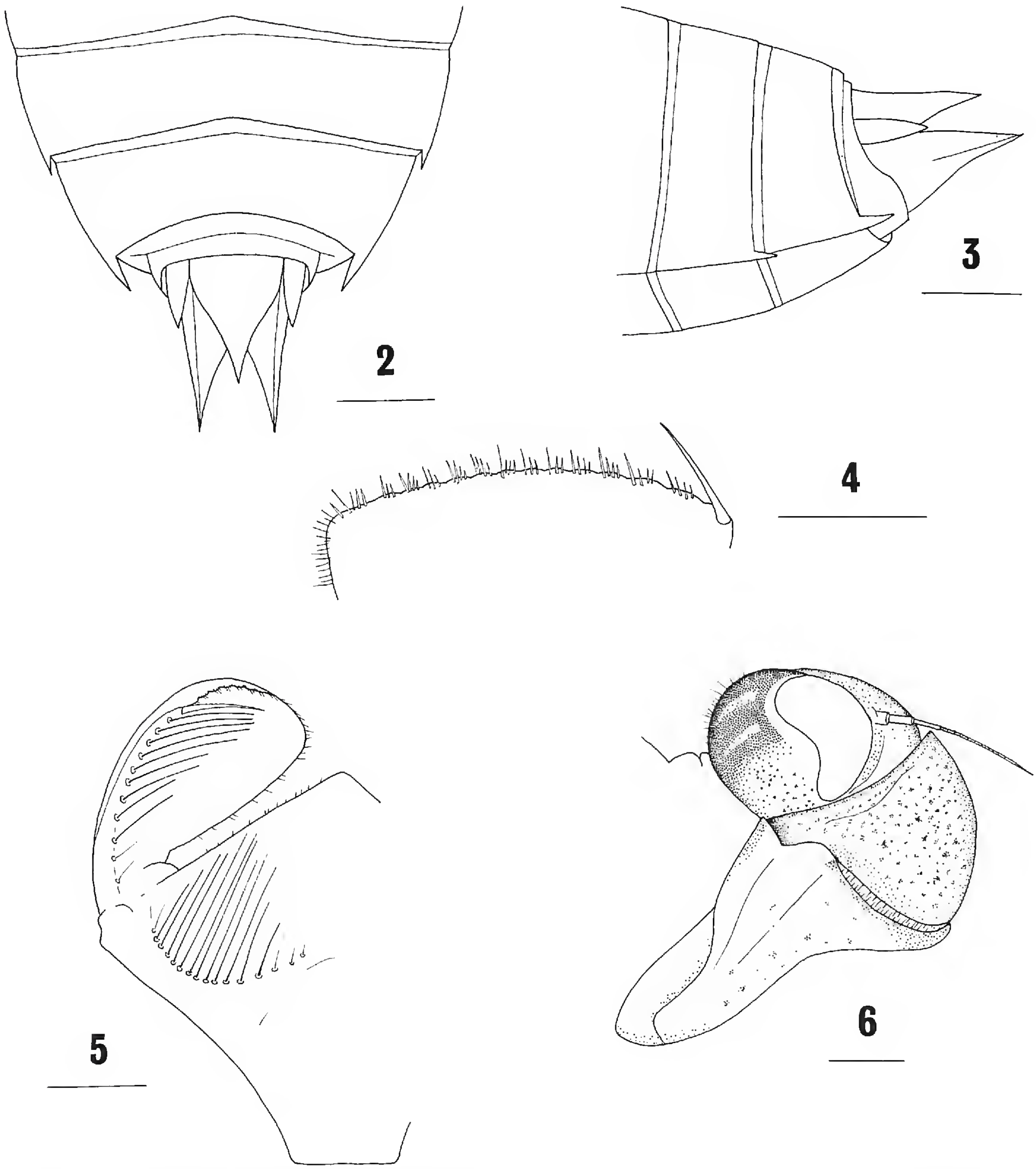
Description.—Male and female similar except in minor aspects of developing genitalia. Coloration described from living specimens. Those preserved in 70–80 percent ethanol lose all green color and light areas become yellow-brown; darker areas become medium to red-brown. Fresh exuviae are ash-brown. Total length 17.8–20.3 mm (19.0 ± 0.26 mm) (range with mean and standard error in parentheses; n = 10).

Head with dorsum brown; eyes brown with black stripes across ommatidia and bordered posteriorly by white bar (Fig. 6). Antennae with socket and segments 1 and 2 white, 3 brown, 4–6 brown with apices white, 7 white with apex black. Prementum and labial palps light brown, with scattered dark spots especially on the palps. Head 5.2–5.5 mm (5.3 ± 0.03 mm) across eyes, 2.7–2.8 mm (2.7 ± 0.02 mm) long at midline. Antennae with segments (from base) having mean lengths of 0.20, 0.33, 0.43, 0.22, 0.35, 0.59 and 0.49 mm. Division between segments 3 and 4 less distinct than between others; one exuvia from Riske Creek with segments 3 and 4 fused, giving 6 segments in total, the third segment measuring 0.53 mm. Labium as in Fig. 5 (terminology as in Corbet, 1953); venter of folded prementum (excluding hinge) 4.2–4.5 mm (4.3 ± 0.02 mm) long, 4.3–4.6 mm (4.4 ± 0.03 mm) at widest point and 1.0–1.2 mm (1.1 ± 0.02 mm) at base. Ratio of length to greatest width 0.95–1.0 (0.98 ± 0.01). Folded prementum extending posteriorly to middle of mesocoxae. Premental setae 13–18 (15.3 ± 0.30) on each side, the inner 2 or 3 usually minute; 8–10 very short setae on each side of non-crenulate distal margin of median lobe of prementum. Labial palps with 10–13 (11.4 ± 0.23) palpal setae; 12–15 shallow, rounded crenulations on distal margin of palp, each crenulation with 2–4 short spiniform setae diminishing in size dorsally (Fig. 4).

Thorax and wing sheaths brown with dark brown markings on dorsal midline of prothorax and laterally on thorax dorsal to coxae. Legs yellow-brown, coxae and trochanters margined with dark brown. Femora with brown bands, one at apex, a wider one at middle of distal half and one at middle of proximal half; distal bands on metafemora fused in some specimens. Tibiae with dark bands at base and apex, tarsal segments with dark apices. Setae on legs pale, those on tibiae up to 2.0 mm long. Hindwing sheath 5.3–6.6 mm (5.7 ± 0.07 mm) long, extending to anterior margin of abdominal segment 6. Metafemur 5.3–5.7 mm (5.5 ± 0.05 mm), metatibia 6.6–7.3 mm (6.9 ± 0.08 mm) and metatarsus 2.5–2.9 mm (2.7 ± 0.04 mm) long.

Abdomen green-brown with brown punctae; setal bases on posterior margin of segments black. Setae on segment 10 pale, up to 1.7 mm long. Abdomen widest at segment 6, 5.0–5.9 mm (5.5 ± 0.09 mm). Epiproct (Figs. 2 & 3) 1.3–1.4 mm (1.3 ± 0.02 mm) long and 1.0–1.1 mm (1.1 ± 0.01 mm) wide at base; paraprocts 1.6–1.9 mm (1.8 ± 0.03 mm) long; cerci 0.6–0.8 mm (0.7 ± 0.02 mm) long. No dorsal hooks present. Lateral spines short, those on segment eight 0.17–0.26 mm (0.23 ± 0.01 mm) long, or 0.13–0.18 (0.17 ± 0.01) the length of the lateral margin of the segment including the spine; spine on segment nine 0.40–0.50 mm (0.43 ± 0.01 mm) long, 0.23–0.28 (0.25 ± 0.01) the length of the lateral margin of the segment.

Color pattern variable from a light green venter with light green-brown or



Figs. 2–6. *Sympetrum madidum,* final-instar larva. Fig. 2, apex of abdomen, dorsal view; Fig. 3, apex of abdomen, lateral view; Fig. 4, distal margin of labial palp, dorsal view; Fig. 5, left half of prementum and left labial palp, dorsal view; Fig. 6, head, lateral view. Scale lines = 1 mm.

yellow-brown dorsally, to dark brown over most of the body. Lighter larvae may be those which have most recently molted.

Material examined. BRITISH COLUMBIA. Spencer School Pond, Langford, 4 larvae, 4 exuviae (3 reared), 3.VI.1979 (R. A. Cannings); 12 larvae, 9 exuviae (reared), 16.VI.1979 (R. A. Cannings); 4 larvae, 23.VI.1979 (R. A. Cannings). Riske Creek, 1 exuvia 19.VI.1978 (R. A. Cannings). All above specimens located in the Spencer Entomological Museum, University of British Columbia. Measurements and counts are based on ten final instar larvae. Measurements made of all exuviae show no significant differences between them and preserved larvae except in the dimensions of the head which in the exuviae are distorted during emergence.

Diagnosis and remarks. Walker and Corbet (1975) added *Sympetrum madidum* to the subgenus *Tarnetrum,* containing *S. corruptum* and *S. illotum,* on the basis of similar wing venation and genitalia characters. Further, they noted that adult *S. madidum* seemed intermediate between the subgenera *Sympetrum* and *Tarnetrum* (e.g. lack of an accessory transverse carina on abdominal tergite 4). Concerning the reflection of these relationships in larval structures, Walker and Corbet state that the larvae of *S. corruptum* and *S. illotum* "stand apart from other North American *Sympetrum* in lacking dorsal hooks on the abdomen, and in the extreme reduction or absence of lateral spines on abdominal segment 8." The newly discovered larva of *S. madidum* also fits this description, justifying the placement of this species in the subgenus *Tarnetrum.* Like the adult, the larva is a link between the *Tarnetrum* and *Sympetrum* subgenera: the lateral abdominal spines are small, but are not as rudimentary as those of *S. corruptum* or *S. illotum.* They are never absent as is often the case in the latter two species.

Spines on segment 8 average 0.17 the length of the segment (including the spine) compared to 0.10 or less in *S. corruptum* and *S. illotum.* Spines on segment 9 average 0.25 the length of the segment whereas they are less than 0.13 the length in the other two species (Walker and Corbet, 1975; Musser, 1962).

S. madidum is as large (total length 17.8–20.3 mm) as *S. corruptum* (17–19 mm) and *S. illotum* (18 mm). Most other *Sympetrum* larvae measure under 18 mm (Walker and Corbet, 1975).

The number of premental setae ranges from 13–18 but is usually 14–16 while in *S. corruptum* there are 14–18 (usually 16–17) and in *S. illotum* about 13 (Walker and Corbet, 1975). The number of palpal setae in *S. madidum* (10–13, usually 11) also falls between the counts in *S. illotum* (9) and *S. corruptum* (13–15). Several other measurements show the same relationship. The head width is 5.2–5.5 mm compared to 5.0 mm in *S. illotum* and 5.8 mm in *S. corruptum*; the metafemur is 5.3–5.7 mm long in *S. madidum* while in *S. illotum* it is 5.0 mm and in *S. corruptum* 6.5 mm. The cerci in *S. madidum* are always less than 0.45 (0.37–0.44) the length of the paraprocts while in *S. corruptum* they are "about one-half" the length and in *S. illotum* "about two-thirds" the length of the paraprocts (Walker and

Corbet, 1975). A more detailed description of *S. illotum* than is available would enable these three similar larvae to be distinguished more reliably.

Key to the Final Instar Larvae of *Sympetrum* (*Tarnetrum*) Species

1. Dorsal hooks present on abdomen .... *Sympetrum* (*Sympetrum*)
   Dorsal hooks absent *Sympetrum* (*Tarnetrum*) 2
2. Cerci 0.67 the length of paraprocts; palpal setae 9 .... *illotum*
   Cerci 0.50 or less the length of paraprocts; palpal setae 10 or more 3
3. Lateral spines on abdominal segment eight 0.13 or more the length of segment including spine; those on segment nine 0.23 or more the lateral length of segment; metafemur less than 6.0 mm long; palpal setae (on each palp) 10–13, usually 11 or 12 .... *madidum*
3. Lateral spines on segment eight, if present, about 0.10 or less the length of the segment including the spine; those on segment nine less than 0.13 the lateral length of the segment; metafemur 6.0 mm or longer; palpal setae 13–15 .... *corruptum*

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A LABORATORY METHOD FOR REARING *BONNETIA COMTA* FALLÉN (DIPTERA: TACHINIDAE)[1]

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Bonnetia comta Fallén (Diptera: Tachinidae) is a parasite of several noctuid larvae, including the black cutworm, *Agrotis ipsilon* (Hufnagel) (Arnaud, 1978). *B. comta* is among the most frequently reared parasites of the black cutworm in Ohio (Levine and Clement, unpub. data). Because *A. ipsilon* is an important pest of corn in the Corn Belt, we wished to conduct laboratory studies to determine the effect of parasitism by *B. comta* on larval longevity and damage potential of black cutworms.

Although Strickland (1923), Allen (1926), and Wen et al. (1965) studied the relationship of *B. comta* with lepidopterous hosts, they did not describe methods for rearing this parasitic fly. In this paper we describe methods for rearing sufficient numbers of *B. comta* to conduct small-scale laboratory studies involving this parasite and the black cutworm. We also provide new information on developmental interactions between *B. comta* and *A. ipsilon*.

Rearing Methods

Flies were obtained in June 1978 from a large number of 4th–6th instar black cutworms collected in a Wayne County, Ohio cornfield. These host larvae were reared individually in 35 ml capped plastic cups on a pinto bean diet (Nielsen et al., 1979) at 27 ± 1°C, 60 ± 10% RH, and 16 hr photoperiod. Flies that emerged from these larvae were transferred to 38 × 39 × 39-cm plexiglass and plastic mesh cages, 10–20 flies per cage. The sex ratio of these flies was not determined; however, the ♀:♂ sex ratio of 148 flies from several cages was 1.1:1. The cages were provided with two 60 ml cups, one containing cotton soaked with water, the other containing cotton soaked with 25% honey solution. Female flies were induced to larviposit by providing each cage with fresh (<24 hr old) black cutworm fecal pellets in open petri dishes lined with filter paper. Feces (provided daily) were obtained from 5th–6th instars fed pinto bean diet. We observed females larviposit on or within 5 mm of a fecal pellet.

We were able to establish a laboratory colony of the fly once larviposition had begun. Parasitization of black cutworms (5th–6th instars) was accomplished by transferring maggots (=planidia) with a dissecting probe (one per

Table 1. Larviposition response of *Bonnetia comta* to feces and vomitus from the black cutworm.

Test materials	Mean no. of planidia[1]		
	Cage 1	Cage 2	Cage 3
Feces	116.3 a[2]	68.0 a	58.0 a
Vomitus	17.3 b	7.8 b	17.0 b
Control	6.0 b	0.5 c	2.0 c

[1] Values based on 4 replicates/treatment/cage.

[2] Numbers in each column followed by the same letter are not significantly different ($P < 0.05$) (DNMRT).

host) to the upper abdominal surface of larvae. With this technique it was not necessary to remove larvae from their 35 ml diet cups. Parasitized larvae were reared under the aforementioned conditions. Host larvae and feces were obtained from a black cutworm colony maintained at the Ohio Agricultural Research and Development Center.

Although the above rearing method proved to be satisfactory we did modify it in January 1980 by reducing the number of flies per larviposition cage to 2 or 4 (1:1 sex ratio). Males can be sexed by their pulvilli which are more elongate than females. Flies were observed to mate freely in cages containing either 10–20 or 2–4 flies.

To determine if larviposition is triggered by a substance produced by black cutworm larvae, a laboratory bioassay was conducted as follows. We placed a male and female fly in each of 3 cages shortly after their emergence from puparia. Then each cage was supplied with water and honey solution as previously described and placed in a rearing room (24 ± 1°C, 80 ± 5% RH, and a 16 hr photoperiod). Test materials on filter paper in petri dishes were introduced into each cage 7 days after fly eclosion since females started to larviposit about that time. The petri dishes (4 replicates/treatment) were arranged in a randomized complete block design. Larviposition was recorded, test materials were replaced, and petri dishes were re-randomized 2–3 times per cage during the length of the test period (48–96 hr). Test materials, which were obtained from 6th instars fed pinto bean diet, included fresh fecal pellets (one pellet/petri dish) and vomitus (one small drop/petri dish). Controls consisted of empty petri dishes.

Table 1 shows that significantly more ($P < 0.05$) planidia were deposited in petri dishes with feces. Vomitus elicited a statistically stronger ($P < 0.05$) larviposition response than did empty petri dishes in 2 cages. These results suggest that a substance (kairomone) in the feces, and perhaps in the vomitus, stimulates *B. comta* to larviposit.

Interestingly, Wen et al. (1965) stated that *B. comta* larviposited on soil surfaces over which *A. ipsilon* moved, as well as on plant surfaces where this host fed. In contrast, Strickland (1923) and Allen (1926) reported that *B. comta* larviposited freely on foliage in the absence of host caterpillars but these observations are not surprising since some tachinids may larviposit in the absence of a larvipositional stimulant, apparently because of the pressure of eggs in the uterus (see Clausen, 1940). In fact, we observed a few females larvipositing in cages lacking the larvipositional stimulant. However, it is clear that knowledge of the stimulus influencing the ovipositional behavior of *B. comta* has been important in maintaining our laboratory colony of this parasite.

We have maintained a laboratory colony of *B. comta* since June 1978. Feral flies were introduced into the colony in July 1979.

Parasite Development

Planidia entered hosts by boring through segmental membranes, activity which usually took <5 min. Duration of the endoparasitic period varied significantly with the host's stage of development at which parasitization occurred. The average duration of this period within hosts parasitized as 3rd, 4th, 5th, and 6th instars was 14.2a ($n = 18$), 10.9b ($n = 18$), 8.8c ($n = 12$), and 9.7c ($n = 9$) days, respectively (means followed by the same letter are not significantly different, $P < 0.05$). Thus, maggot development was generally accelerated with advance in host larval stage parasitized.

Parasite pupation occurred within 6 hr after fully developed maggots emerged from host larvae. The pupal period was significantly ($P < 0.01$) longer for parasites reared from larvae parasitized as 6th instars (11.2 ± 0.2 days, $n = 9$, $\bar{x} \pm$ SE) than for those reared from larvae parasitized as 3rd instars (10.5 ± 0.1 days, $n = 14$). Pupae that developed from planidia placed on 5th and 6th instars weighed 128.3 ± 7.4 mg ($n = 12$) and 125.6 ± 3.4 mg ($n = 9$), respectively. These values are significantly ($P < 0.01$) greater than an average weight of 104.8 ± 3.7 mg ($n = 18$) for pupae from planidia placed on 4th instars.

Female flies lived 18.1 ± 1.7 ($n = 17$) days while males lived 13.1 ± 1.5 ($n = 19$) days (sig. diff., $P < 0.05$). These females began to larviposit 8–13 days after eclosion. Of 133 planidia deposited during a 24 hr period, 85.7%, 64.7%, 25.6%, and 2.3% were alive 1, 2, 3, and 4 days after deposition, respectively.

All developmental tests were conducted at 27 ± 1°C and 60 ± 10% RH with a 16 hr photoperiod.

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Footnotes

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A NEW NORTH AMERICAN CHRYSIDID GENUS AND REDESCRIPTION OF THE GENUS *PSEUDOLOPYGA* KROMBEIN (ELAMPINAE, HYMENOPTERA)

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The genera *Minymischa* and *Pseudolopyga* are tiny desert dwelling chrysidids. They are typical members of the Elampinae based on the three exposed terga; reduced wing venation, with a short radial sector and absent cubital and discoidal cells, and tarsal claws with one or more subsidiary teeth. Both genera are closely related to *Holopyga* having similar tarsal claw dentition and facial sculpture. Females can be recognized by the apical v-shaped swelling of sternum III. In males sternum III is flat. The structure of the female tarsomeres of *Minymischa* superficially resemble those of *Muesebeckidium* (also a close relative of *Holopyga*). Abbreviations used are: RS for radial sector, and F-I, II and X for flagellomeres.

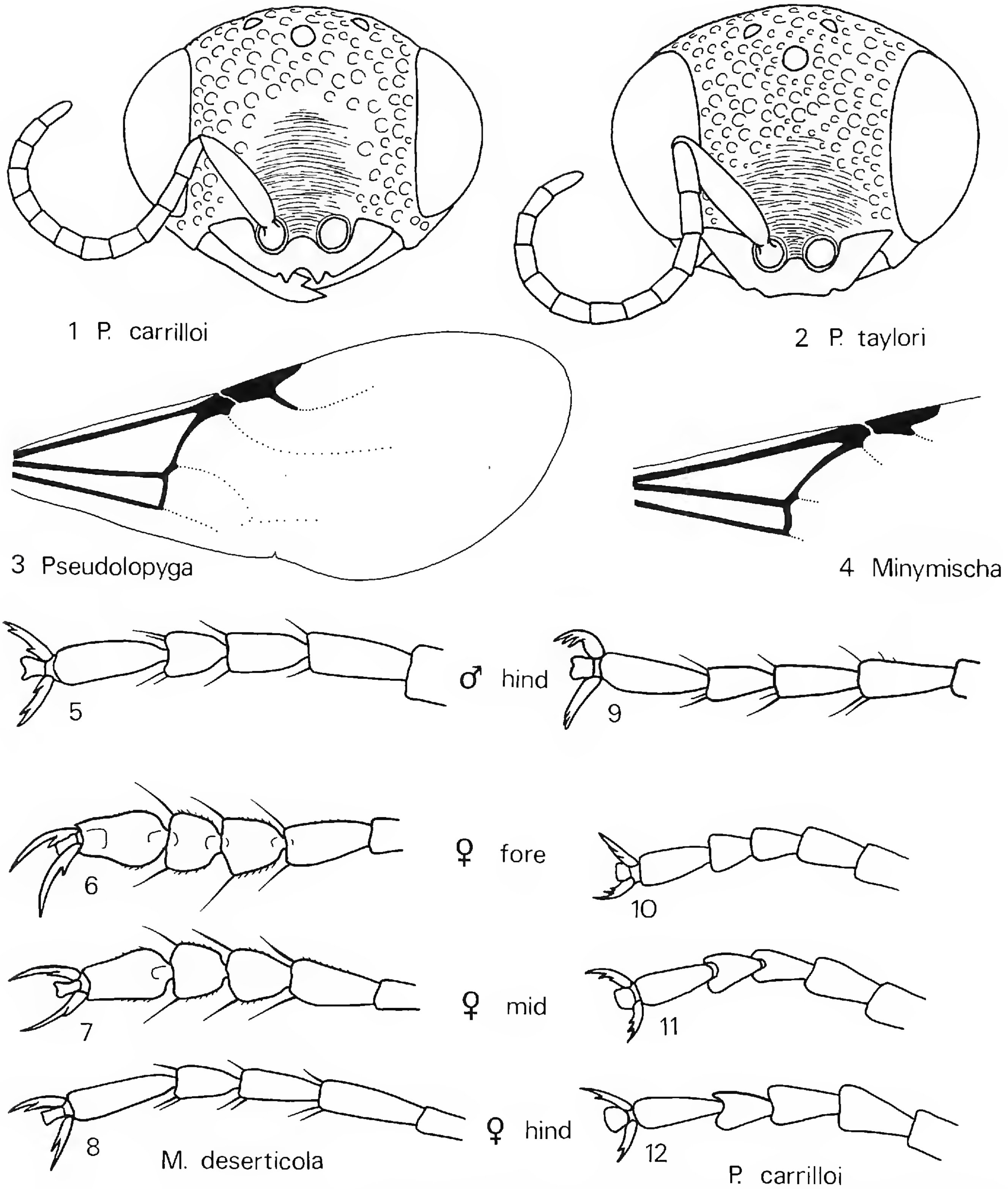
Minymischa can be identified using the key to the North American chrysidid genera (Bohart and Kimsey, 1980). Material that runs out to *Pseudolopyga* in that key should then be run through the first couplet in the following key.

I would like to thank Drs. R. M. Bohart and K. V. Krombein for their help and F. D. Parker for providing specimens and host records. Specimens were seen from the following institutions: U.S. National Museum (USNM), University of California at Davis (UCD) and Berkeley (UCB), California Department of Food and Agriculture and Utah State University at Logan.

Key to the Species of *Pseudolopyga* and *Minymischa*

1. RS stub about half as long as medial vein (Fig. 3); female fore and midtarsi not laterally expanded and flattened (Figs. 10, 11); male hindtarsal claws apically tridentate (Fig. 9) .... *Pseudolopyga* Krombein 2

   RS stub one-fifth or less as long as medial vein (Fig. 4); female fore and midtarsi laterally expanded and flattened, appearing prehensile (Figs. 6, 7); male hindtarsal claws apically bidentate (Fig. 5) .... *Minymischa* Kimsey 3
2. Clypeal apex strongly emarginate (Fig. 1); mesopleural face with large circular punctures, little or no microstriae .... *P. carrilloi* (Bohart & Brumley)



Figs. 1–12. Figs. 1–2. Front view of face of male *Pseudolopyga*. Figs. 3–4. Forewings. Figs. 5–12. Tarsi. 5–8. *Minymischa*. 9–12. *Pseudolopyga*.

Clypeal apex not emarginate (Fig. 2); mesopleural face without discrete large circular punctures, covered with microstriae .... *P. taylori* (Bodenstein)

3. F-II longer than wide and terga brassy to bright green, in strong contrast with rest of body .... *M. deserticola* Kimsey

F-II about as long as wide or wider and terga black, dark blue or purple not contrasting with rest of body 4

4\. F-X as long as wide or wider; forewing without brown stained vein remnants .... *M. arenicola* Kimsey

F-X longer than wide; forewing with brown stained vein remnants .... *M. ventura* Kimsey

Minymischa, new genus

Type-species.—Minymischa arenicola new species.

Generic diagnosis.—Forewing with RS stub one-fifth or less as long as medial vein (Fig. 4); female fore and midtarsi laterally expanded and flattened (Figs. 6, 7); hindtarsal claws bidentate (Figs. 5, 8); volsella undivided into digitus and cuspis, less than five times as long as broad and with stout spine-like setae (Figs. 15–17).

Both *Minymischa* and *Pseudolopyga* are sympatric through the drier parts of the western United States. In a cursory examination they are easily confused, but can be immediately separated by the very short RS stub of *Minymischa*. No host is known for *Minymischa*. The name *Minymischa* refers to the "short stub" of the radial sector of the forewing.

Minymischa arenicola, new species
(Fig. 15)

Holotype male.—Length 3 mm; entire head, thorax and abdomen dark metallic green; rest of body black; wings slightly brown tinted; pubescence sparse and pale; head and thorax with large shallow punctures becoming deeper and closer on propodeum and mesopleuron; tergal punctures much smaller, separated by one puncture diameter or less; malar space as long as pedicel; clypeal margin subtruncate; F-I and II very slightly longer than broad and little more than half as long as pedicel; F-X as broad as long; volsella 5.4 times as long as broad and 0.7 as long as paramere (Fig. 15).

Female.—Same as male except F-I length 0.6 pedicel length; F-II length 0.8 times width and 0.8 F-I length; F-X 1.2 times as broad as long.

Holotype male (UCD), 5 mi N Barstow, San Bernardino Co., California, May 13, 1979 (R. M. Bohart). *Paratypes,* 15 males and 38 females, from CALIFORNIA, San Diego Co.: Borrego Springs, Campo; Inyo Co.: Death Valley, Eureka Valley, Deep Springs, Darwin Falls; Riverside Co.: Thousand Palms, Gavilan; Napa Co.: Monticello Dam; Monterey Co.: Arroyo Seco; Imperial Co.: Glamis; San Bernardino Co.: Kelso, 5 mi N Barstow, Cronise Wash, Cajon Pass; Contra Costa Co.: Antioch; Los Angeles Co.: Claremont; NEVADA, Churchill Co.: 12 mi NE Stillwater; White Pine Co.: Dolly Varden Valley; Washoe Co.: Wadsworth; Lyon Co.: Fernley; Clark

Co.: 10 mi N Las Vegas; ARIZONA, Pima Co.: Sahuarita, 10 mi N Tucson; Cochise Co.: 7 mi SE Pierce. Additional specimens have been seen from Lynndyl and Hurricane, Utah; Mt. Milton, Lincoln Co., Oregon; 20 mi N Eltopia, Washington; 23 mi N Van Horn, and El Paso, Texas; Hollister and McCall, Idaho; and Green Mountain Reservoir, Summit Co., Colorado. Specimens were collected from March to July.

Systematics.—Found throughout the drier parts of the western United States, *arenicola* is the commonest species in *Minymischa*. Distinguishing characters are the dark color, weakly stained wings and F-II and X as broad or broader than long.

Minymischa deserticola, new species
(Figs. 5–8, 16)

Holotype male.—Length 3 mm; head, pronotum and thoracic pleura greenish blue, black on scutum, scutellum, propodeum and sterna I–III; terga dark with strong bronze to brass reflections; wings water clear; pubescence pale and sparse; head and thorax with medium, shallow punctures becoming larger and deeper on propodeum and mesopleuron; tergal punctures small and deep, separated by one or two puncture diameters; malar space subequal to pedicel length; clypeal margin subtruncate; F-I slightly longer than wide; F-II length 1.4 times width; F-X somewhat longer than wide; volsella 4.6 times as long as broad and 0.6 times as long as paramere (Fig. 16).

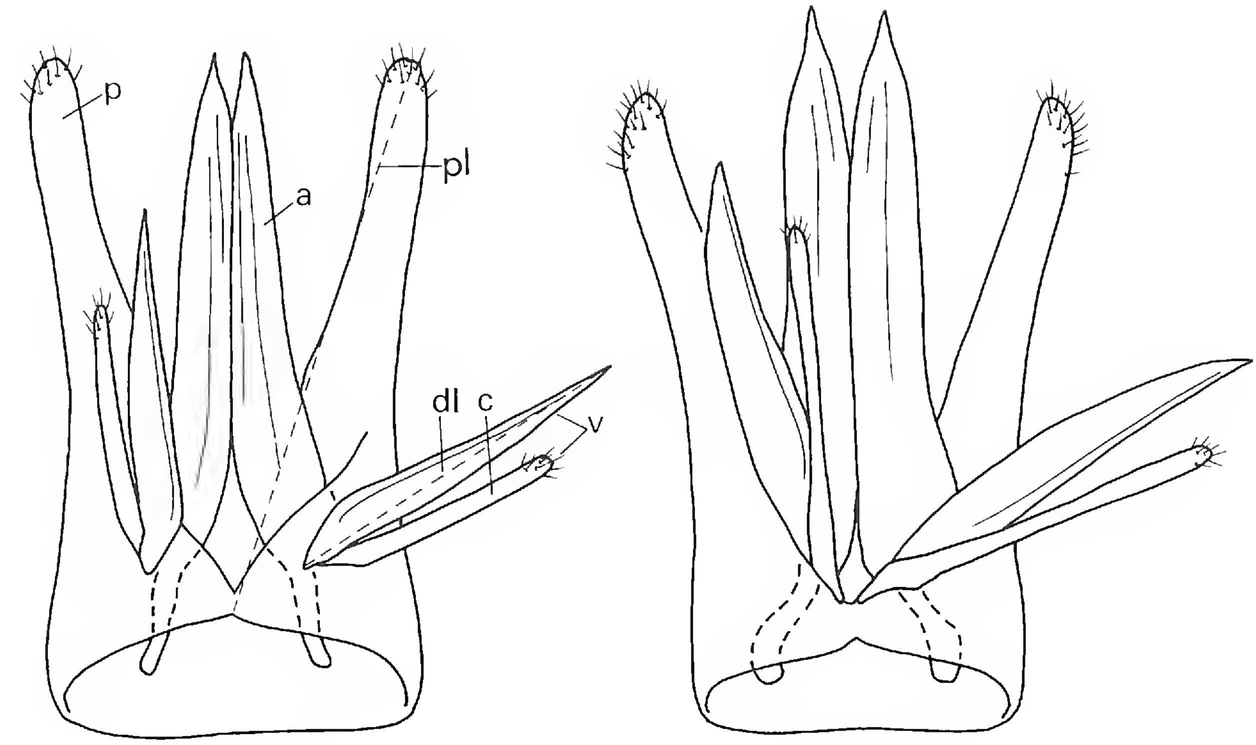
Female.—Same as male, except F-X as long as broad.

Holotype male (UCD), Borrego Springs, San Diego Co., California, March 30, 1960 (M. Wasbauer). *Paratypes,* 2 males and 12 females, from CALIFORNIA, Riverside Co.: Thousand Palms, 18 mi W Blythe; San Bernardino Co.: Kramer Junction; San Diego Co.: Borrego Springs, Split Mountain, N end Borrego Clark Lake; Imperial Co.: Fish Creek; ARIZONA, Yuma Co.: 5 mi W Dateland, McVay; NEVADA, Clark Co.: 10 mi N Las Vegas. Specimens were collected in March and April.

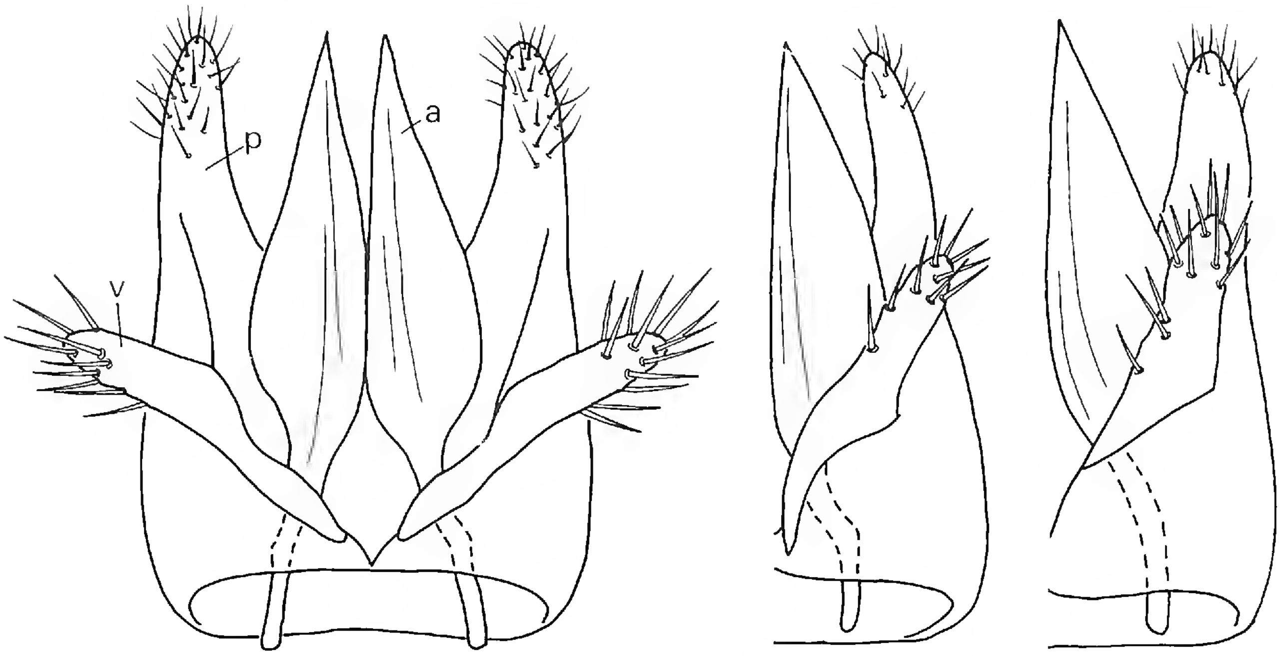
Systematics.—Minymischa deserticola is the most distinctive of these three species because of the highly colored terga that contrast with the thoracic color. Other distinguishing characteristics are F-II longer than wide, and F-I slightly longer than wide.

Minymischa ventura, new species
(Fig. 17)

Holotype male.—Length 3.5 mm; head, thorax and terga, black with some greenish reflections and sterna dark brown; wings brown stained with darkly stained vein remnants; pubescence pale and scattered; head and thorax with irregular large to small punctures becoming deeper on propodeum; tergal



13 P. carrilloi 14 P. taylori



15 M. arenicola 16 M. deserticola 17 M. ventura

Figs. 13–17. Genital capsule, ventral view: aedeagus (a), cuspis (c), digitus length (dl), paramere (p), paramere length (pl), volsella (v). Figs. 13–14. *Pseudolopyga*. Figs. 15–17. *Minymischa*.

punctures small, deep and 0.5 to 1.0 puncture diameter apart; malar space 0.8 length of pedicel; clypeal margin subtruncate; F-I slightly longer than broad and 0.5 times as long as pedicel; F-II as long as broad, slightly shorter than F-I; F-X length 1.6 times width; volsella 3.5 times as long as broad and 0.5 times as long as paramere (Fig. 17).

Female.—Unknown.

Holotype male (UCD), Quatal Canyon, Ventura Co., California, April 29, 1968 (D. Veirs). *Paratype male:* Bend, Oregon, May 27, 1964 (K. Goeden).

Systematics.—*Minymischa ventura* can be distinguished by the dark color, stained vein remnants, F-II as long as broad and F-X longer than broad.

Pseudolopyga Krombein

Type-species.—*Pseudolopyga taylori* (Bodenstein).

Generic diagnosis.—Forewing RS stub one-half or more as long as medial vein (Fig. 3); female fore and midtarsi not laterally expanded and flattened (Figs. 10, 11); hindtarsal claws apically tridentate (males) or medially bidentate (females) (Figs. 9, 12); volsella divided into digitus and cuspis, cuspis length nine or more times breadth, with sparse hairlike setae apically (Figs. 13, 14).

Systematics.—*Pseudolopyga* Krombein (1969) contains two species, found only in the Nearctic region. Both species are small, less than 3 mm, dark and easily confused. *P. carrilloi* was synonymized with *taylori* by Krombein (1969). When I examined the holotypes, I found *carrilloi* to be a distinct species based on clypeal and integumental sculpture and male genitalia. The *Pseudolopyga* reported by Carrillo and Caltagirone (1970) as a parasite of *Solierella* is *carrilloi* and not *taylori*.

Pseudolopyga carrilloi (Bohart and Brumley)

(Figs. 1, 9–13)

Hedychridium carrilloi Bohart and Brumley 1967:232. Male holotype, Arbuckle, Colusa Co., California, UCD.

Male holotype.—Length 2–3 mm. Head, thorax and abdomen black; tegula brown; wings brown-tinted; pubescence on body sparse and pale; punctures on head, pronotum, scutum and scutellum shallow and weakly defined with polished interspaces becoming larger, denser and well-defined on propodeum and mesopleuron, tergal punctures small, shallow and dense; malar space as long as pedicel; clypeal margin deeply notched apically (Fig. 1); F-I twice as long as broad and as long as pedicel; F-II shorter than F-I and 1.3 times as long as broad; F-X length 1.8 times breadth; volsella 0.6 times as long as paramere (Fig. 13).

Female.—As in male, except pedicel 1.4 times as long as F-I, F-I length 1.6 times breadth and F-X length subequal to breadth.

Distribution.—CALIFORNIA: Yolo, San Diego, Riverside, Colusa, Imperial, Inyo, San Luis Obispo, Kern, Contra Costa and San Bernardino counties; ARIZONA: Cochise, Maricopa, Pima, Pinal, Yavapai, Graham, Gila and Coconino counties; IDAHO: Cassia County; TEXAS: Brewster County; NEVADA: Storey, Elko, Churchill and Washoe counties, and UTAH: Cache County. Specimens were collected from March through October. A total of 70 males and 49 females were seen.

Discussion.—Pseudolopyga carrilloi is found in dry areas west of the 100th meridian. It is reared in large numbers from twig nesting *Solierella* (Carrillo and Caltigirone, 1970 and Parker, pers. comm.). Superficially *carrilloi* resembles *taylori* but it can be immediately distinguished by the strongly notched clypeus and almost complete lack of microstriae on the gena and thorax. Specimens vary in color from brown (old specimens), to blackish, dark purple or blue-black, with slight bronze reflections in some.

Pseudolopyga taylori (Bodenstein)
(Figs. 2, 14)

Holopyga taylori Bodenstein 1939:11. Male holotype, Hollister, Idaho, USNM.

Holotype male.—Length 2.3 mm; head, thorax and abdomen dark brown with greenish highlights; tegula brown; wings brown tinted; pubescence on body sparse and pale; punctures shallow and dense on head becoming sparse on pronotum, scutum and scutellum, deeper and more well-defined on propodeum and anterior half of mesopleuron; gena, propleuron, posterior half of mesopleuron, metapleuron and lateral wall of propodeum microridged; tergal punctures small and shallow; malar space slightly shorter than pedicel; clypeal margin subtruncate apically (Fig. 2); F-I twice as long as broad and as long as pedicel; F-II shorter than F-I and length 1.3 times breadth; F-X 1.8 times as long as broad; digitus length 0.8 times length of paramere (Fig. 14).

Female.—As in male, except F-II length 1.4 times breadth and F-X length 1.4 times breadth.

Distribution.—CALIFORNIA: San Bernardino, Sierra, Yolo, San Diego, Inyo, Riverside and Contra Costa counties; IDAHO: Cassia County; ARIZONA: Yavapai and Cochise counties; NEVADA: Washoe County; collected in the months of March through August; 13 males and 11 females were seen.

Discussion.—Although not as common as *P. carrilloi, taylori* is found throughout the West in desert areas. It can be distinguished from *carrilloi* by the relatively straight apical margin of the clypeus and extensive microridges on the gena, mesopleuron and metapleuron. The host of *taylori* is unknown. Coloration is variable, from all black to dark purple or blackish with strong purple highlights, or even brown (old specimens).

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THE STATUS OF THE COLUMBIA TIGER BEETLE (*CICINDELA COLUMBICA* HATCH) IN IDAHO (COLEOPTERA: CICINDELIDAE)

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Frank M. Beer (1971) reported the apparent extermination of the Columbia Tiger Beetle (*Cicindela columbica* Hatch) from a rather large segment, if not all, of its habitat due to dam construction on the Columbia and Snake Rivers in Oregon, Washington and Idaho. Originally described by Melville Hatch (1938), this species was reported to be locally abundant on sandbars of those rivers from The Dalles, Oregon eastward to just west of Lewiston, Idaho. Beers found no evidence of the beetles after flooding of the habitats by dam backwaters. However, he did find all of the Tiger Beetles that had been associated with the Columbia Tiger Beetle prior to flooding. Those species found to have re-established themselves on the shores of the new reservoirs were *Cicindela oregona* LeConte, *repanda* Dejean, *hirticollis* Say, *tranquebarica* Herbst, and *cinctipennis* LeConte.

Vernon Clifford (1979), a well-known Tiger Beetle collector from Washington, reported that he was not aware of any existing populations of *C. columbica* as all former sites to his knowledge had been flooded by backwaters. Leffler and Pearson (1976) reported the species in their work on the Tiger Beetles of Washington. However, they made citations from the literature and made no observations of living populations. They noted, "Dr. L. Rogers reported no populations (of *C. columbica*) in the Columbia on river islands above Pasco. Construction of dams along the Columbia and Snake Rivers appears to be having an adverse effect on the species."

The first known literature citation of the Columbia Tiger Beetle in Idaho was by Norman L. Rumpp (1967), who found the beetle on August 10, 1962 at two locations along the Salmon River. The first site was 2 miles south of Whitebird, Idaho County, and the second site was 1 mile southwest of Slate Creek (8.4 mi N Lucile), also in Idaho County.

It was feared that subsequent construction on realignment of U.S. Highway 95 near the sandbars on which *C. columbica* had been found may have harmed those populations. During August 1977, Gary Shook visited all major sandbars on the easterly side of the Salmon River from Riggins north to Whitebird. *C. columbica* was found at two locations: 1 mi SW Slate Creek, Idaho County and 2.4 mi SW Slate Creek, Idaho County. Thus the presence of the Columbia Tiger Beetle in Idaho was confirmed.

No investigation for *C. columbica* had been made between the Salmon River locations in Idaho downriver to the former locations near Clarkston, Washington. Much of the approximately 161 km (95 mi) of intervening river is generally inaccessible except by raft or kayak.

During the last two days of July and the first two days of August, 1979, a raft trip was made down the Lower Salmon River and the Snake River. The trip started just below the Rice Creek bridge in Idaho County, Idaho, and ended at Heller's Bar near Rogersburg, Washington, a distance of 95 km (56 mi) by river.

The Trip

On July 30, 1979, the trip down the two rivers began with the launching of two inflated rafts and an aluminum dory. During the next four days forty-nine (49) sandbars were inspected for Tiger Beetles. Figure 1 grapically illustrates the collection site locations.

Sandbars inspected were at least 30 m in length. Many smaller bars were noted, but were recently emerged due to the natural seasonal drop in the rivers' flows or were otherwise deemed inappropriate to inspect. Not all bars 30 m or over were investigated, but the 49 observed represented at least 40% of the larger sandbars seen.

Inspection generally consisted of a boundary or perimeter transect: walking the shoreline at the moist sandwater interface, then up and around the dry outer boundary inshore. Extensive grid transects were made at the White House Bar (Site No. 111) and Maloney Creek Bar (Site No. 117) in an effort to estimate the rather large populations of *C. columbica* found there.

After tentative identification, random specimens were netted for in-hand verification. Two hundred and four specimens of all species were collected and retained as vouchers. They were represented by 80 *C. oregona,* 51 *C. repanda,* 31 *C. hirticollis,* and 42 *C. columbica.* All voucher specimens were retained in the author's collection or were deposited in the entomological collection of the California Academy of Science, Golden Gate Park, San Francisco, California.

The elevation near the Rice Creek Bridge was 4251 m (1296 feet) above sea level. The Rogersburg, Washington, elevation was 2706 m (825 feet) above sea level. That represented a drop of 1545 m (471 feet) in the total trip length.

The Salmon River canyon has slopes generally in excess of 30%, with many areas, especially the Blue Canyon, of vertical walls. Hackberry, Mountain Mahogany, with some Ponderosa and Jack Pine and Doulgas Fir represented the major trees.

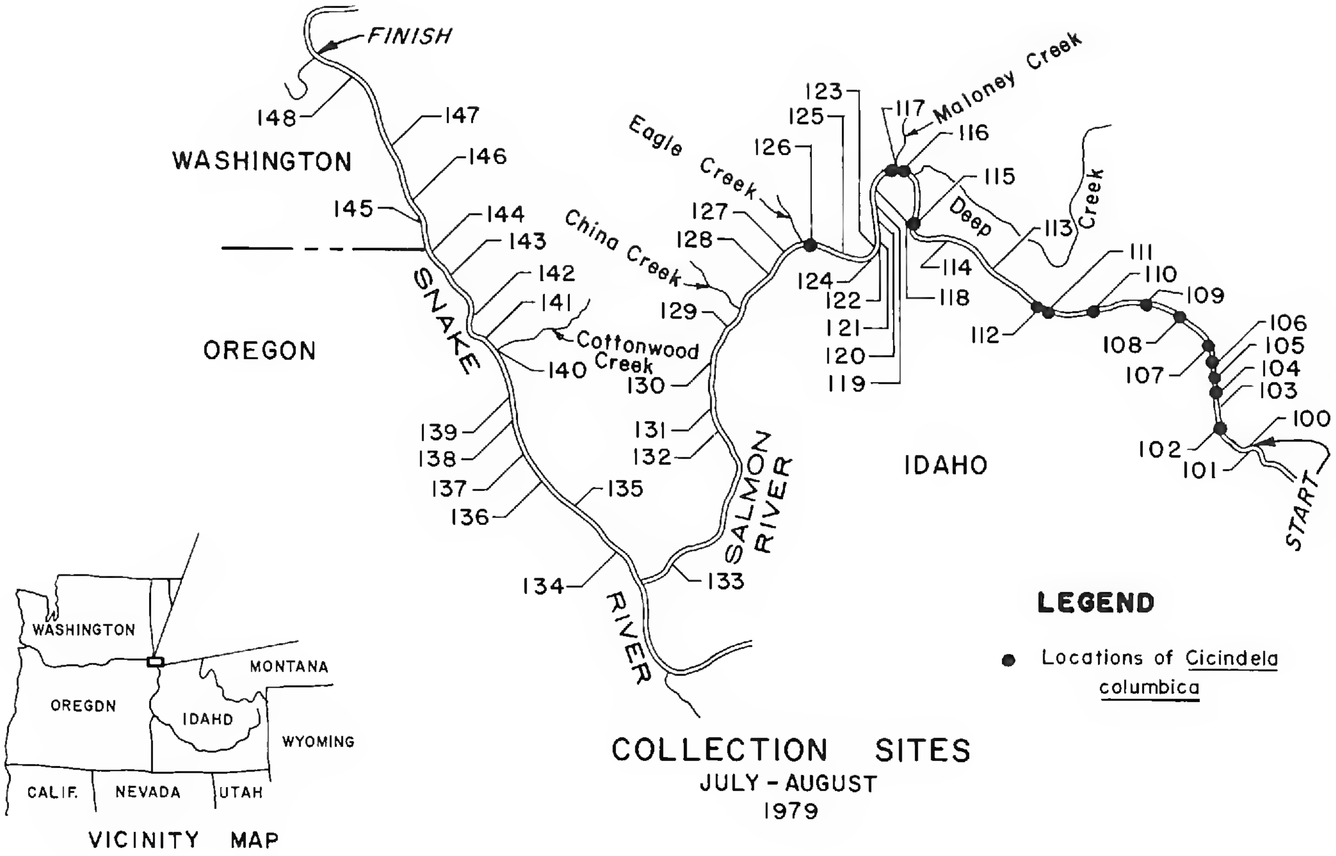

Fig. 1.

The Hells Canyon of the Snake River had similar slope configurations, although the river bed was considerably wider than that of the Salmon River. Trees and vegetation in general were much less than that noted on the Lower Salmon River, decreasing downstream.

Observations

Periodically, the air, water and sand surface temperatures were recorded with the following observed results (in degrees Celsius, °C): All temperatures were taken with a dial-type metal thermometer that had been previously calibrated between 4° and 60°C. The sand temperatures were of dry sand and were taken 6 to 18 mm below the actual sand surface. Moist sand near the waterline tended to follow the air temperature and did not exceed 26° to 27°C.

Although *C. hirticollis* and *C. repanda* were observed on sand with surface temperatures of 44° to 47°C, they would occasionally fly onto the hotter 60°C sand. There they would remain but a second or two in one place, making short hops until cooler sand was attained.

C. columbica was commonly found seeking food on sands ranging in temperature from 26° to 42°C. They were not seen to fly onto the hotter sands as did the other species. When disturbed, the Columbia Tiger Beetle often flew out over the river or up or down the moist area of the sandbar.

One interesting note was the extended period of activity observed of *C.*

columbica and *C. repanda* after sandbars had been completely shaded and after sunset. At Collection Site No. 110 near Mile 10, the sandbar was completely shaded by 7:30 PM MDST as the sun had dropped below the surrounding mountain tops at that time. *C. repanda* persisted in activity on the sand until after 9:00 PM when seeing was becoming difficult. On the Maloney Creek Bar (Site No. 117), complete shading occurred at 7:30 PM. *C. columbica* was observed still active until 8:45 PM.

The largest significant populations of *C. columbica* occurred at White House Bar (Site No. 111) and at Maloney Creek Bar (Site No. 117). These bars were quite extensive, being approximately 400 m long and extending back from the river over 100 m. They were generally not entirely flooded during the spring run-off in May, June and early July. However, it was felt by the boatmen that the sandbars may receive periodic total inundation during those infrequent years of very high run-off, such as 1974.

The population of *C. columbica* at White House Bar was estimated at greater than 200 beetles. The population at Maloney Creek Bar was estimated at greater than 400 beetles. Estimates were based on observing four grid transect areas equal to $^1/_{10}$ the total estimated sandbar area. The great difficulty in population estimates of this very active, winged beetle can be appreciated by anyone who has collected it. The degree of confidence, therefore, has been placed with the lowest observation numbers.

Ten (10) of the forty-two (42) *C. columbica* collected from all sites were obviously teneral.

Where *C. columbica* was found it was generally gregarious within the species and, although mixing with the other tiger beetle species did occur, it tended to be more isolated from those other beetles.

C. tranquebarica was observed at only three sites, but this wide-ranging species is often found more abundantly earlier in the season. The specimens found may have represented the last of the spring populations which had moved onto the cooler, moister sandbars from the surrounding area.

The Oregon Tiger Beetle (*Cicindela oregona* LeConte) was by far the most abundant species observed, being found on 94% of the sites inspected.

Conclusion

The Columbia Tiger Beetle, *Cicindela columbica* Hatch, is generally found in large, viable populations in Idaho within the Lower Salmon River canyon from near Slate Creek to Eagle Creek. It was not found below Eagle Creek on the Salmon River and was found nowhere on the Snake River to Heller's Bar. It generally occupies older, well-established bars that extend back from the river sufficiently to generally not be inundated by spring run-off waters. Although the beetle is generally intraspecifically gregarious, it does share its area with four other species of Tiger Beetles: *Cicindela oregona, C. repanda, C. hirticollis* and *C. tranquebarica.*

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A NEW SPECIES OF *COSCINOPTERA* LACORDAIRE FROM CALIFORNIA (COLEOPTERA: CHRYSOMELIDAE)

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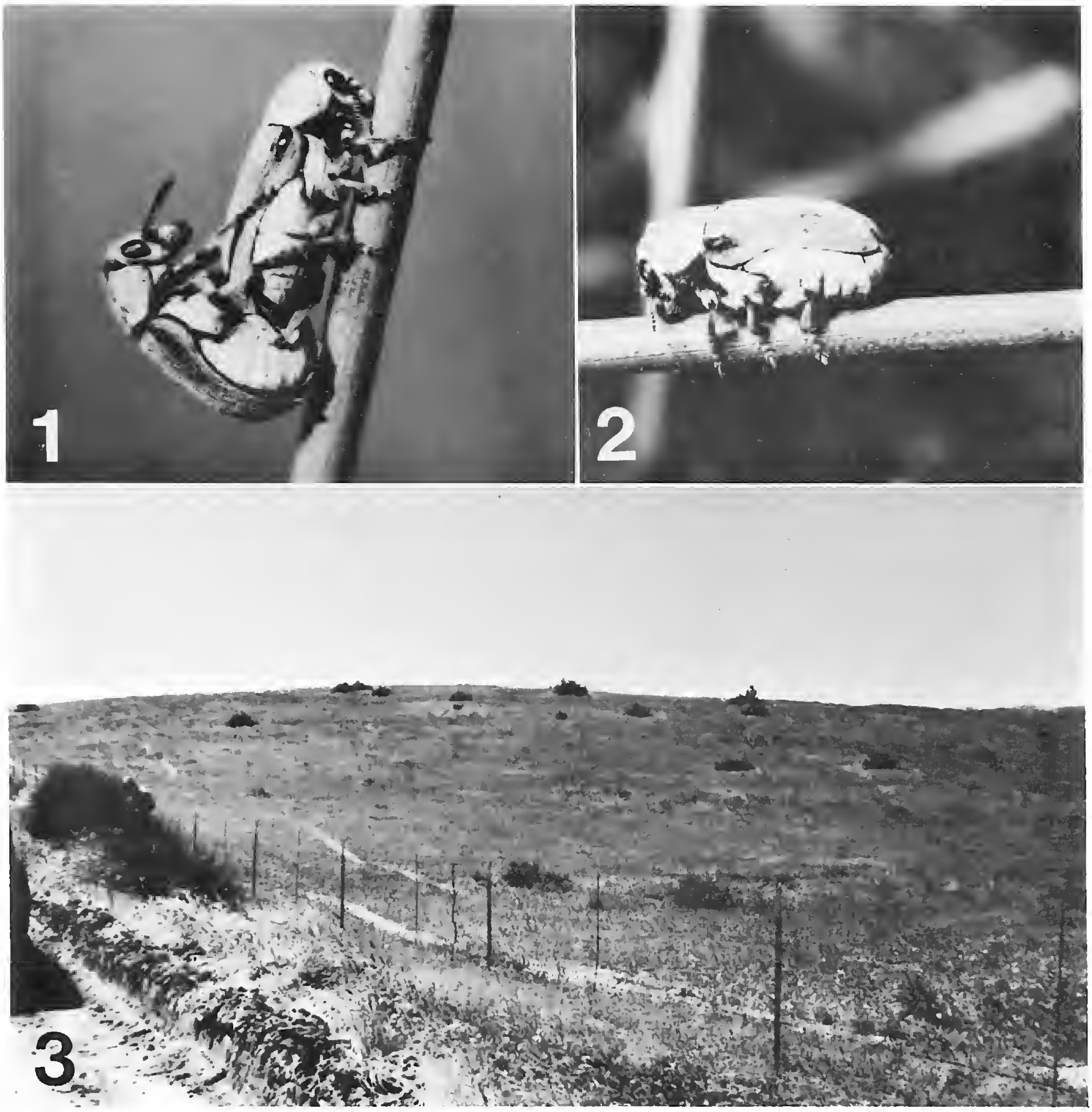
In California, the State and County departments of agriculture annually perform various surveys aimed at detecting new plant pest introductions, the primary goal being early detection and possible eradication. Entryway surveys covering the routes of transportation, i.e. roads, canals, railroads, etc., are generally for detection of introduced plant species. However, in June of 1977, two Fresno County Department of Agriculture inspectors performing an entryway survey in the area along Panoche Road near the Fresno-San Benito County line collected a pair of chrysomelids from *Ephedra californica* Wats. Knowing my interest in this group, the beetles were submitted to me for identification. These were recognized as an undescribed Clytrinae and recollection the following year yielded numerous additional specimens and biological data.

The genus *Coscinoptera,* to which this new species belongs, is represented in North America by seven species and fourteen subspecies (Moldenke, 1970). Only one of these can be found in California, north of the Tehachapi Mountains of southern California and west of the Sierra Nevada Mountains. For a North American representative, this new species is one of the largest to be found.

Coscinoptera panochensis, new species
(Figs. 1, 2, 4)

Holotype male.—Length 7.10 mm, width 3.45 mm. *Head* shiny black, punctation of vertex and frontal area obscured by thick, white pubescence. Eyes black, oval and entire. Antennae not attaining hind margin of pronotum; basal segment black, globose and thickly pubescent; segments 2–4 testaceous, clavate and sparsely pubescent, becoming darkened towards apex. Clypeus broadly emarginate and black, narrow lateral and anterior margins lacking pubescence. Labrum alutaceous with scattered setigerous punctures along anterior margin, lateral margins rufo-testaceous graduating to black in center and lacking pubescence. Mandibles black and enlarged; pubescent basally. *Pronotum* widest basally, transverse (approx. 1.5× wid-



Figs. 1–3. Fig. 1. *C. panochensis* mating pair in situ on leaf of *E. californica*. Fig. 2. *C. panochensis* male with clearly defined glabrous humeral area. Fig. 3. *Ephedra californica* (large plants) at type locality.

er than long), black, thickly pubescent except for a median, smooth, longitudinal impunctate area which on the anterior half is narrow and obscured by the pubescence, the posterior half is wider and exposed; hind angles distinctly angulate, nearly 90°. *Elytra* black, covered with thick, white, appressed pubescence except humeral callus; widest anteriorly; tapering slightly posteriorly. *Scutellum* black and pubescent. *Venter and pygidium* black, copiously pubescent, much more so than the dorsum or the legs. *Legs* black, coxae pubescent only distally, remaining segments intermediate in pubescence between elytra and venter; tarsal claws widened basally forming a very indistinct obtuse tooth.

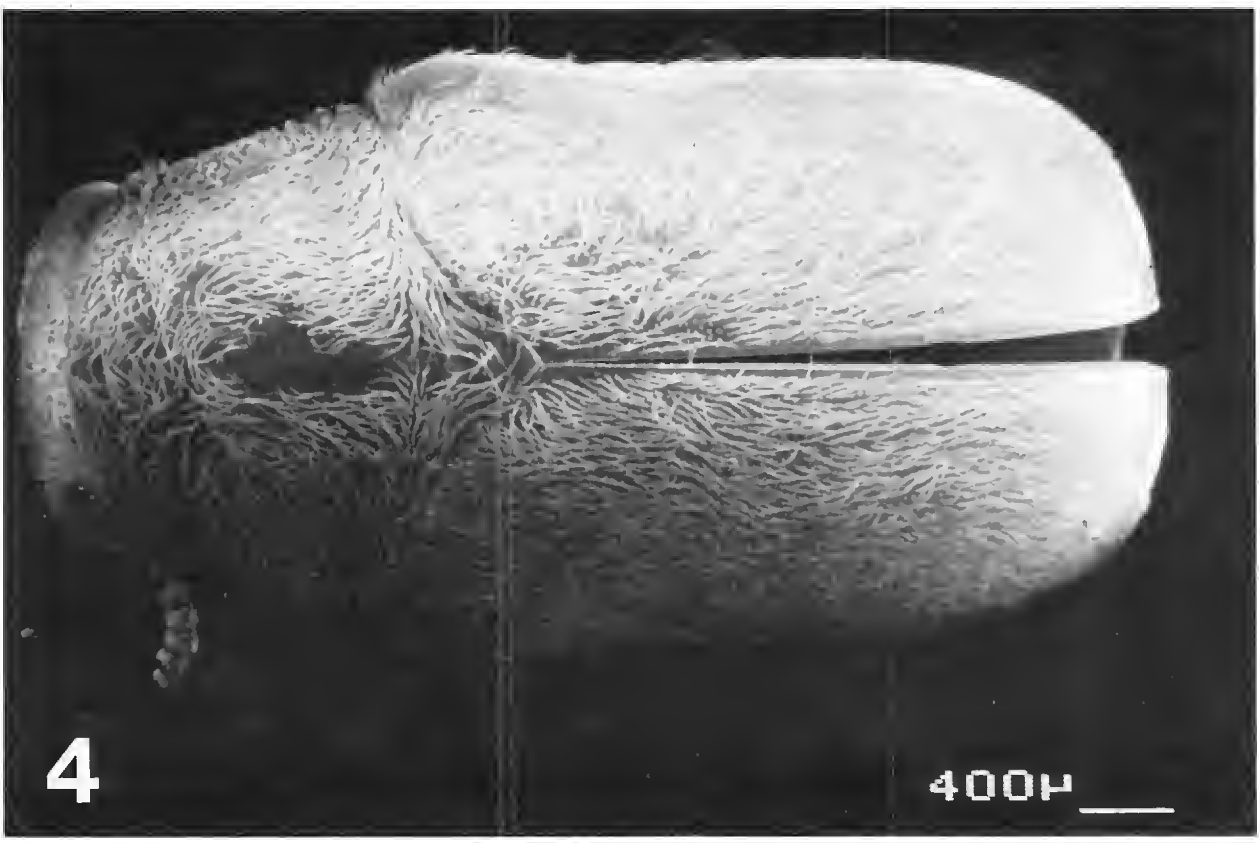


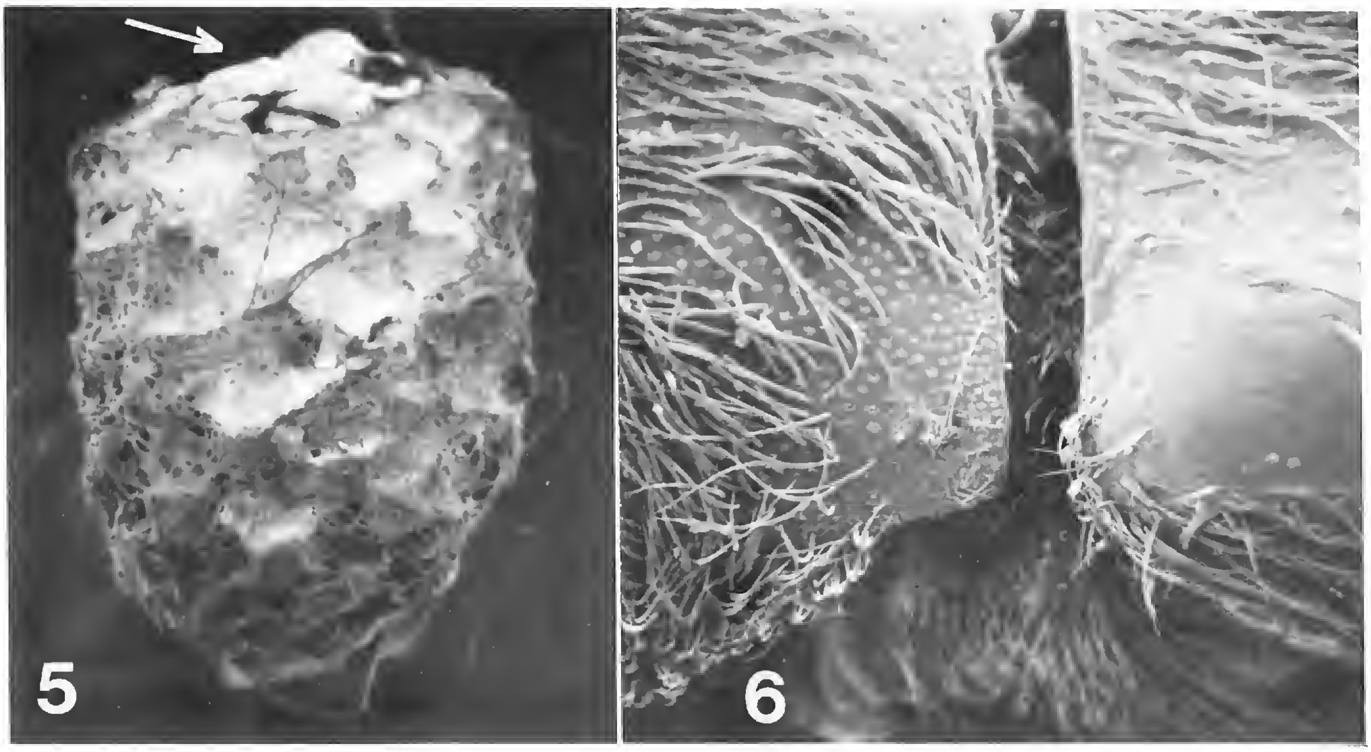
Fig. 4. SEM of *C. panochensis* viewed dorsally with five clearly defined black, glabrous areas (eyes, pronotum and humeri) in contrast to overall grayish appearance.

Males range in size from 6.25–7.50 mm in length and from 3.05–3.65 mm in width.

The female differs from the male in the following characters: size larger, 6.55–7.95 mm in length and 3.20–4.00 mm in width. Mandibles not enlarged, not extending laterally much beyond the anterior corners of the clypeus when closed. Venter with an oval, median, glabrous depression on the fourth and fifth segments, which is punctured on the periphery and terminates midway on the fourth segment. Antennae shorter reaching posteriorly to about middle of pronotum.

Holotype.—Male (CAS #13400): California, San Benito Co., 8.2 mi on Panoche Rd. W from I-5 (Interstate Highway), V-21-1978, collected from *Ephedra californica* Wats., A. J. Gilbert, F. G. Andrews, S. Kuba.

Paratypes.—15 males, 18 females same data as holotype. All other specimens are from the type locality and host, only the dates and collectors vary as noted. 1 male, 1 female, VI-19-1977, W. Peregrin, D. Haines; 4 males, 4 females, V-13-1978, A. J. Gilbert, D. A. Burdick, G. Caseri, W. Peregrin; 10 males, 5 females, V-21-1978, S. Kuba, F. Andrews; 41 males, 42 females, V-30-1978, A. J. Gilbert, D. A. Griffin; 1 female, V-14-1979, A. J. Gilbert, D. A. Griffin; 9 males, 10 females, V-19-1979, A. J. Gilbert, D. A. Griffin; 8 males, 5 females, V-23-1979, A. J. Gilbert, D. A. Griffin. Specimens are deposited in USNM, CAS, Calif. Dept. Food and Agric., Brit. Mus. Nat. Hist., MCZ, Univ. Calif., Davis, Fresno Co. Dept. Agric. and A. J. Gilbert.

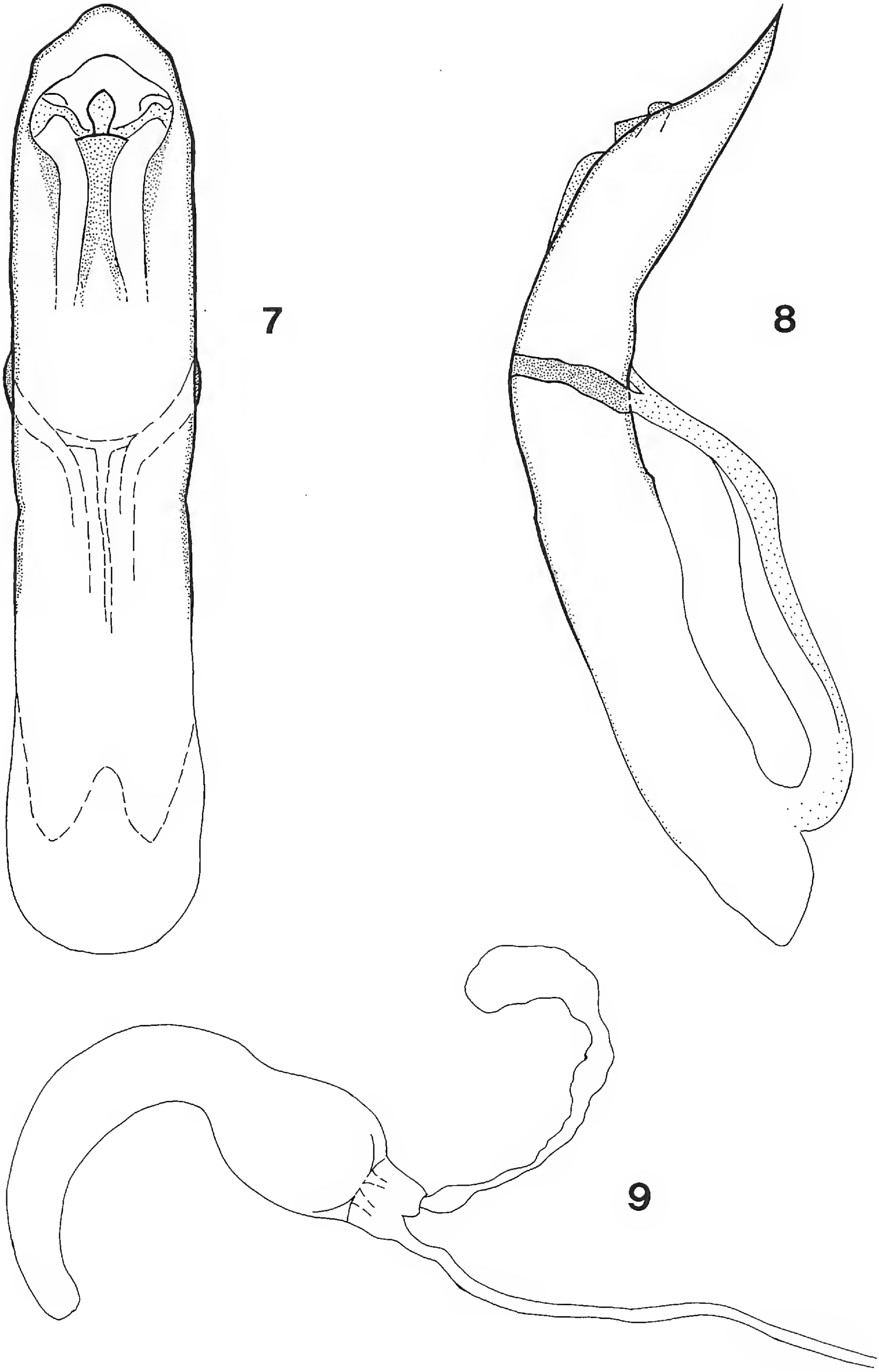


Figs. 5–6. Fig. 5. SEM of hatched egg minus the stalk. First instar larva partially exposed at top. Fig. 6. SEM of angulate posterior corner of pronotum.

Additional specimens.—1 male, V-21-1978, A. J. Gilbert, S. Kuba, F. Andrews; 1 male, V-21-1978, S. Kuba, F. Andrews; 1 female, V-30-1978, A. J. Gilbert, D. A. Griffin; 1 male, V-30-1978, A. J. Gilbert, D. A. Griffin. The last specimen cited possesses an aberrant left antenna with an enlarged sixth segment from which emanates two four-segmented continuations.

Distribution.—Efforts to collect *C. panochensis* at other *Ephedra* sites in Fresno and San Luis Obispo counties were unproductive. However, as this paper was being submitted for publication, two specimens (1 male, 1 female), were discovered in a drawer of unsorted material in the collection of the California Department of Food and Agriculture. The data are as follows: California, Riverside County, Whitewater Canyon, 26 May 1976, on *Ephedra,* Larry Bezark collector. They agree in all respects with the Panoche specimens. The determined and unsorted material in the collection at the University of California, Riverside has been examined. There were no specimens of *C. panochensis* in the material, including that from the Boyd-Deep Canyon Research Station, an area which has received a great deal of attention and is very near Whitewater Canyon. Apparently the range of this beetle is not restricted to the Panoche area.

Of the six species groups in the genus *Coscinoptera* mentioned by Moldenke (1970), *C. panochensis* would be best placed in the *dominicana* group. Except for the distinctly angulate posterior pronotal corner (Fig. 6), morphological features and geographical distribution align closely with other members of this group. The adult host *Ephedra californica* Wats. (Gymnospermae: Gnetaceae) is an unusual host for members of the genus, which



Figs. 7–9. Fig. 7. Dorsal aspect of the aedeagus. 40×. Fig. 8. Lateral aspect of the aedeagus. 40×. Fig. 9. Spermatheca. 100×. The spermathecal pump has a lateral twist and does not lie in the same plane as the rest of the structure.

are usually associated with various flowering plants (Angiospermae) including the Mimosaceae, Polygonaceae, Leguminosae and Anacardiaceae (Moldenke, 1970).

Moldenke (1970) presents a key to the *Coscinoptera* of North America. *Coscinoptera panochensis* would run to couplet 9A, as *C. mucorea inornata* Fall. However, *C. panochensis* can be easily differentiated from this species (which belongs to the *axillaris/mucorea* group) by *panochensis*' larger size, enlarged mandibles in the male, glabrous humeral and pronotal areas, denser pubescence, nearly parallel sides, by distinct black coloration and the bicolored antennal segments 5–11 which are entirely black in *C. m. inornata*. Most of these features will also readily separate *C. panochensis* from other members of the *dominicana* group.

Biology.—The following subjective observations should be noted. Adult beetles are active fliers not showing preference for any time of day. Most specimens were found clinging to the outer extremities of the host. When approached they would attempt to hide by circling the stem (leaf), or take flight. Mating was observed on the host, with the male mounting the female from the rear and assuming an almost perpendicular orientation to the female (Fig. 1). Mating pairs were docile and were not as readily disturbed as were individuals. Eggs were laid individually on a stalk of approximately 5 mm in length. The female would orient in a head to the ground position while laying and the rear legs were active tools in the egg laying process, apparently guiding, pulling or supporting the stalk as it emerged from the abdomen. As many as 13 eggs were found on a single branch (a hatched egg without the stalk is pictured in Fig. 5). Eggs collected V-21-1978 and held at room temperature hatched in about 7 days. First instar larvae emerged from one of the long ends of the ovate egg and used the remainder of the egg as living quarters. When in motion the larvae would extend far enough out of the case for the legs to be used. When disturbed they would retract completely within the case. Larvae that emerged lived only a few days and none developed beyond the first instar.

Attempts were made to collect the larval stage by sweeping the host plant throughout the summer of 1978, by taking berlese samples under *Ephedra* periodically and by deploying anti-freeze pit traps near the plants. The pit traps were serviced monthly and inspected for larvae. All efforts were negative.

Acknowledgments

I would like to thank Wayne Peregrin and Dennis Haines for bringing the original specimens to my attention and for guiding me to the exact locality. Appreciation is also extended to Dennis Haines for the determination of the host plant. I am also indebted to Denis Griffin for field assistance in re-collections and in taking pit trap and berlese samples in search of larval specimens. I would also like to thank Alan Hardy, Paul Tuskes, and Terry Seeno for their constructive reviews and Rose Niino and Joanne Shimada for typing the paper.

Special appreciation is extended to Fred Andrews for untiring guidance in insect systematics and for many helpful suggestions and review of this paper.

The drawings of the male and female genitalia were prepared and drawn by Iris Savage for which I am grateful.

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TWO NEW SPECIES OF *POGONOMYRMEX* HARVESTER ANTS FROM TEXAS (HYMENOPTERA: FORMICIDAE)[1]

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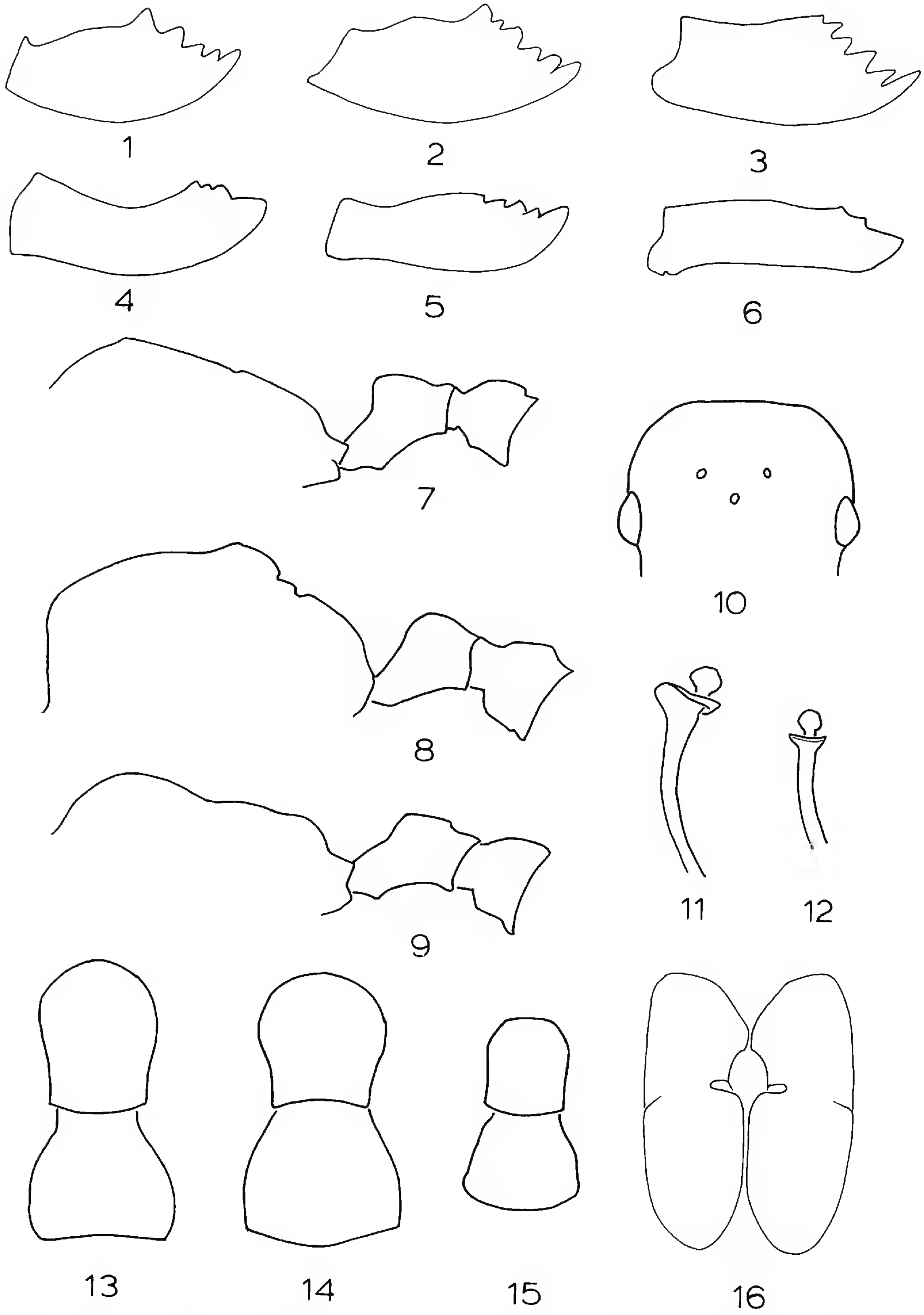
Harvester ants of the genus *Pogonomyrmex* Mayr are among the most conspicuous members of the formicid fauna of the arid and semiarid regions of the southwestern United States. In the most recent revision of the North American harvester ants, Cole (1968) recognized 23 species grouped in two subgenera; two species occurring only in Mexico, and 21 present in the United States, nine of which occur in Texas. A faunistic survey of the ants of Texas west of the 100th meridian was initiated in 1978 by several members of the Department of Entomology, Texas Tech University. We have accessioned slightly over 8000 nest series representing about 40 genera and 140 species. Harvester ants represent approximately 17.5% of the samples in our collection (n = 1400 nest series), and all the species reported from Texas by Cole (1968) are adequately represented. In addition, however, we have identified two new species, whose descriptions follow. For the sake of continuity, and ease of identification, the terminology used and the measurements provided follow Cole (1968).

Pogonomyrmex (Pogonomyrmex) bigbendensis, new species
(Figs. 1, 2, 9, 12, 15)

Worker.—Measurements of holotype followed, in parenthesis, by the ranges observed in paratypes: Head length 1.75 mm (1.49–1.75 mm), head width 1.85 mm (1.61–1.87 mm), cephalic index 105.7 (105.2–108.7), scape length 1.20 mm (1.08–1.22 mm), scape index 71.35 (71.35–73.78), maximum eye length 0.40 mm (0.34–0.41 mm), maximum eye width 0.28 mm (0.26–0.30 mm), ocular index 22.86 (22.82–23.26), Weber's length 1.82 mm (1.56–1.85 mm), petiolar node length 0.48 mm (0.44–0.49 mm), maximum width of petiolar node 0.36 mm (0.30–0.40 mm), postpetiolar length 0.39 mm (0.35–0.40 mm), postpetiole width 0.51 mm (0.45–0.54 mm).

Head slightly broader than long; eye small, weakly convex, not extending beyond lateral margin of head. Mandible with five or six teeth (Figs. 1–2): ultimate basal tooth distinctly offset from basal mandibular margin, forming a rounded angle; penultimate basal tooth greatly reduced or aborted; third basal tooth very broad basally, somewhat pointed apically, with lateral margins deeply excised; second basal tooth apparently aborted; first basal, sub-



Figs. 1–16. North American *Pogonomyrmex*: Figs. 1–3, right mandible of worker; 1, *P. bigbendensis*, n. sp., with five teeth, 2, *P. bigbendensis* with six teeth, 3, *P. anzensis* Cole with six teeth (redrawn from Cole, 1968): Figs. 4–6, right mandible of male; 4, *P. texanus*, n. sp., 5, *P. desertorum* Wheeler, 6, *P. apache* Wheeler: Figs. 7–9, lateral profile of thorax, petiole, and

apical, and apical teeth broad basally, blunt apically. Apical margin of mandible broadly convex, basal margin somewhat sinuous. Antennal scape moderately curved on basal one-half, area of bend compressed. Base of antennal scape (Fig. 12) similar to that of *P. bicolor* Cole: with very narrow basal flange; superior and inferior lobes subequal; impression on lateral surface of basal enlargement small and shallow, the longitudinal peripheral carina very narrow and not ending in a distinct point. Lateral lobes of clypeus produced in front of antennal insertions, projecting anteriorly beyond level of median clypeal lobe; frontal lobes ascending moderately steeply from clypeal lobe, not forming a deep impression for median clypeal lobe and adjoining frontal triangle. Median cephalic rugae longitudinal, widely spaced, extremely fine; interrugal spaces strongly shiny; in lateral view rugae reduced to very indistinct striae, either parallel or somewhat concentric behind eyes. Posterior corner of head smooth and shiny.

Contour of thorax, petiole, and postpetiole, in lateral view, as in Fig. 9. Dorsum of thorax flat, epinotal declivity short and distinct, epinotal armature absent. Thoracic rugae coarse, transverse and widely spaced on anterior of pronotum, transverse to longitudinal on posterior of pronotum; transverse and more closely set on mesonotum and epinotum; interrugal spaces strongly shiny on all segments. Dorsal portions of metasternal flanges fused, forming a single arcuate carina across posterior declivity of epinotum. Contours of petiolar and postpetiolar nodes, in dorsal view, as in Fig. 15. Ventral peduncular process of petiole distinct, thick, rounded, with 0–5 erect hairs. Petiolar and postpetiolar nodes shagreened, rugae when present confined to posterior half; anterior declivity of petiolar node short, meeting peduncle in broad, well rounded angle. First gastric segment slightly broader than long. Body color medium to dark ferrugineous red.

Male.—Unknown.

Female.—Unknown.

Type data.—Type nest series (workers only) from Rio Grande Village (565 m), Big Bend National Park, Brewster Co., Texas, 30 July 1978 (J. V. Moody, O. F. Francke). Holotype worker deposited at the California Academy of Sciences, San Francisco.

Distribution.—Known only from Big Bend National Park, Brewster Co., Texas.

Comparisons.—*Pogonomyrmex bigbendensis* belongs in the *barbatus*

←

postpetiole; 7, *P. texanus* worker, 8, *P. texanus* male, 9, *P. bigbendensis* worker: Fig. 10, frontal view of *P. texanus* male head: Figs. 11–12, base of antennal scape; 11, *P. texanus* worker, 12, *P. bigbendensis* worker: Figs. 13–15, dorsal profile of petiolar and postpetiolar nodes; 13, *P. texanus* worker, 14, *P. texanus* male, 15, *P. bigbendensis* worker: Fig. 16, dorsal view of parameres of *P. texanus* male.

complex as defined by Cole (1968). The following characters, diagnostic of the *barbatus* complex, are also present in *P. bigbendensis*: (1) not polymorphic, (2) lateral lobes of clypeus projecting anteriorly beyond the level of the median clypeal lobe, (3) head broader than long, (4) eye small and weakly convex, not extending beyond sides of head with head in full-face view, (5) longitudinal cephalic rugae nearly straight and parallel, (6) venter of petiolar peduncle with a few, long, erect hairs extending downward from the peduncular process, and (7) first gastric segment broader than long. *P. bigbendensis* differs from all other species in the *barbatus* complex in mandibular dentition: the seven species known from workers have seven teeth on the mandible, and the ultimate basal tooth is not offset from the basal mandibular margin; whereas in *P. bigbendensis* the mandible bears 5–6 teeth, and the ultimate basal tooth is distinctly offset from the basal mandibular margin.

The mandibular dentition of *P. bigbendensis* appears to be unique among the North American species in the subgenus *Pogonomyrmex,* and thus can be used to identify this species readily. The only other North American species known to have six mandibular teeth is *P. anzensis* Cole (Fig. 3), a member of the *occidentalis* complex, but in this taxon the ultimate basal tooth is not offset from the basal mandibular margin. On the other hand, *P. occidentalis* (Cresson) which has the ultimate basal mandibular tooth distinctly offset from the basal margin, as occurs in *P. bigbendensis,* has seven mandibular teeth and can thus be readily separated.

Within the *barbatus* complex, *P. bigbendensis* will key out to *P. apache* Wheeler in Cole's (1968) key, the species to which it also appears to be most closely related. *P. bigbendensis* shares with *P. apache* the following characters: (1) cephalic rugae extremely fine and closely set, (2) posterior corner of head without rugae, smooth and strongly shiny, (3) epinotum generally unarmed, and (4) dorsal portions of metasternal flanges fused so as to form a single arcuate carina across posterior declivity of epinotum. These two species differ as follows: (1) base of antennal scape, as in Fig. 11 for *P. bigbendensis,* and very similar to Fig. 12 in *P. apache* (see Cole, 1968, p. 190, fig. 18); (2) mandibular dentition, with 5–6 teeth in *P. bigbendensis* and with ultimate basal tooth offset from margin, and with seven teeth in *P. apache* with ultimate basal tooth not offset from margin; (3) clypeal excision, with anterior margin of clypeal lobe straight or only broadly and shallowly excised in *P. bigbendensis,* and with the clypeal lobe deeply excised, often to the level of the frontal lobes, in *P. apache*; and (4) size, with a Weber's length range of 1.56–1.85 mm in *P. bigbendensis,* versus a range of 1.90–2.51 mm in *P. apache* (after Cole, 1968).

The base of the antennal scape in *P. bigbendensis* is very similar to that of *P. bicolor* Cole, another species in the *barbatus* complex. These two taxa differ significantly in a number of characters, among which the presence of: (1) epinotal armature, (2) seven mandibular teeth with ultimate basal tooth not offset from margin, and (3) bicolored body with head and thorax red, and gaster black, in *P. bicolor* readily separate it from *P. bigbendensis*.

Specimens examined.—All specimens examined are from Big Bend National Park, Brewster Co., Texas, as follows: Rio Grande Village (565 m, level terrain, nest under rock), 30 July 1978 (J. V. Moody, O. F. Francke; type nest series, 16 workers); Burro Mesa Pouroff (1076 m, 2° SW slope, nest with 10 × 13 cm pebble tumulus), 9 August 1979 (J. V. Moody, O. F. Francke, F. W. Merickel; 9 workers). Paratypes deposited in the following collections: California Academy of Sciences, American Museum of Natural History, Museum of Comparative Zoology, Los Angeles County Museum, and Texas Tech University.

Pogonomyrmex (Pogonomyrmex) texanus, new species
(Figs. 4, 7, 8, 11, 13, 14, 16)

Worker.—Measurements of holotype followed, in parenthesis, by the ranges observed in paratypes: Head length 2.15 mm (2.05–2.35 mm), head width 2.45 mm (2.15–2.56 mm), cephalic index 113.95 (104.88–113.95), scape length 1.65 mm (1.45–1.75 mm), scape index 74.08 (74.08–75.49), maximum eye length 0.45 mm (0.40–0.48 mm), maximum eye width 0.35 mm (0.32–0.38 mm), ocular index 20.93 (19.51–20.93), Weber's length 2.65 mm (2.30–2.75 mm), petiolar node length 0.75 mm (0.65–0.80 mm), maximum width of petiolar node 0.60 mm (0.49–0.60 mm), postpetiolar length 0.65 mm (0.60–0.68 mm), postpetiole width 0.80 mm (0.65–0.80 mm).

Head broader than long; eye small and weakly convex, not extending beyond lateral margin of head. Mandible with seven subequal, blunt teeth. Apical margin of mandible broadly convex, basal margin straight. Base of antennal scape (Fig. 11) similar to *P. apache* Wheeler: with superior lobe considerably stronger than inferior lobe; basal flange very weak on superior lobe, developed as a strongly recurved lip on inferior lobe; longitudinal peripheral carina very strong, point absent. Lateral lobes of clypeus produced in front of antennal insertions, margin of clypeal lobe broadly and shallowly excised; frontal triangle deeply impressed. Median cephalic rugae longitudinal, parallel; extremely fine and closely set, producing a silky luster; interrugal spaces shiny; in lateral view rugae not forming whorls behind eye; posterior corner of head without rugae, smooth, strongly shiny.

Contour of thorax, petiole, and postpetiole, in lateral view, as in Fig. 7. Thoracic rugae dense, fine, and shiny; transverse throughout. Epinotum unarmed; posterior epinotal declivity short, smooth. Dorsal portions of metasternal flanges fused, forming a single arcuate carina across posterior declivity of epinotum. Venter of petiolar peduncle with a few long, erect hairs in vicinity of peduncular process. Petiolar node flattened dorsally; with faint, transverse striae. Postpetiolar node dorsally with faint, transverse striae. Contour of petiolar and postpetiolar nodes, in dorsal view, as in Fig. 13. First gastric segment broader than long. Body color uniformly reddish brown.

Male.—The two known males are of similar size, the measurements for one of them are as follows: Head length 1.62 mm, head width 1.95 mm, cephalic index 120.00, scape length 0.75 mm, scape index 42.31, maximum eye length 0.54 mm, maximum eye width 0.36 mm, ocular index 33.84, Weber's length 2.70 mm, petiolar node length 0.70 mm, maximum width of petiolar node 0.75, postpetiolar length 0.70 mm, postpetiole width 0.82 mm.

Head with lateral outline between eye and occipital corner evenly, rather strongly convex; eye not strongly convex, not strongly protruding from lateral margin of head (Fig. 10). Basal margin of mandible strongly concave, apical margin broadly convex; both margins subparallel to each other; with four teeth, broad, blunt and robust (Fig. 4). Antennal scape with outer surface of base evenly convex; antennal scape longer than combined lengths of first two segments of flagellum, shorter than combined lengths of first three segments of flagellum; apical segment of flagellum less than twice length of subapical segment, which is distinctly longer than wide. Anterior margin of median clypeal lobe broadly, very shallowly excised. Upper surface of head unstriated, smooth and shiny. Interocellar area with very faint longitudinal, parallel striae. Posterior corner of head smooth, shiny. Clypeus vestigially striate. Mandibles feebly rugose, shiny. Entire head with moderately dense, long, white, very fine erect hairs.

Contour of thorax, petiole, and postpetiole, in lateral view, as in Fig. 8. Epinotum unarmed. Entire thorax shiny; scutum, scutellum, and basal face of epinotum very shiny. Nota smooth; pleura vestigially striate to smooth, shiny. Forewing with one cubital cell. Petiolar and postpetiolar nodes, in dorsal view, as in Fig. 14; smooth and shiny throughout. Venter of petiolar peduncle with poorly developed, blunt tooth, bearing numerous erect hairs. Paramere as in Fig. 16. Head and thorax black, gaster reddish brown; body hairs fine and silky, mostly pure white.

Female.—Unknown.

Type data.—Type nest series (workers, males, brood) from Lubbock (Farm Road 2641 at Blackwater Draw, 990 m), Lubbock Co., Texas, 2 July 1973 (J. V. Moody). Holotype worker and paratype male deposited at the California Academy of Sciences, San Francisco.

Distribution.—Known from 13 counties in western Texas.

Comparisons.—*Pogonomyrmex texanus* belongs to the *barbatus* complex of Cole (1968). Workers of *P. texanus* share with other members of this complex the seven characters listed above in the comparisons of *P. bigbendensis*. The following characters of males, diagnostic of the *barbatus* complex, are also present in males of *P. texanus*; (1) head with the lateral outline between the eye and the occipital corner evenly and rather strongly convex, (2) eye not strongly convex, not protruding from side of head, (3) mandible with teeth broad, blunt, and robust, (4) forewing generally with one cubital cell, and (5) venter of petiolar peduncle with numerous long, erect, ventrally directed hairs.

Within the *barbatus* complex, *P. texanus* appears to be most closely related to *P. apache* and *P. bigbendensis,* and workers of these three species share the four characters listed above under comparisons between *P. apache* and *P. bigbendensis.* Workers of *P. texanus* differ from those of *P. bigbendensis* as follows: (1) mandibular dentition, with seven teeth in *P. texanus* and with the ultimate basal tooth not offset from margin, but with 5–6 teeth in *P. bigbendensis* and with the ultimate basal tooth distinctly offset from margin; (2) base of antennal scape, as Fig. 11 in *P. texanus,* and as Fig. 12 in *P. bigbendensis*; (3) shape of petiolar and postpetiolar nodes, in dorsal view, as Fig. 13 in *P. texanus,* and as Fig. 15 in *P. bigbendensis*; and (4) size, with a Weber's length of 2.30–2.75 mm in *P. texanus* versus 1.56–1.85 mm in *P. bigbendensis.* Workers of *P. texanus* differ from those of *P. apache* as follows: (1) clypeal excision, with anterior margin of clypeal lobe broadly and shallowly excised in *P. texanus,* but with the clypeal lobe deeply excised, often to the level of the frontal lobes, in *P. apache*; (2) posterior epinotal declivity, smooth in *P. texanus,* and transversely rugose in *P. apache*; (3) ventral process of postpetiole, very weakly developed in *P. texanus,* moderately developed in *P. apache*; and (4) size, with a Weber's length range of 2.30–2.75 mm in *P. texanus* versus a range of 1.9–2.51 in *P. apache.*

The males of *P. texanus* differ from those of *P. apache* as follows: (1) clypeal excision, with anterior margin of clypeal lobe broadly and shallowly excised in *P. texanus,* and rather deeply and broadly excised in *P. apache*; (2) shape of mandible, as Fig. 4 in *P. texanus,* as Fig. 6 in *P. apache*; (3) proportions of the last two segments of antennal flagellum, in *P. texanus* the apical segment is distinctly less than twice the length of the subapical segment, whereas in *P. apache* the apical segment is about twice the length of the subapical segment; (4) paramere morphology, as Fig. 16 in *P. texanus,* whereas in *P. apache* the terminal lobe is proportionately shorter, more angular and with a deeper excision on the inner margin (see Cole 1968, pl. X, fig. 12); and (5) color, *P. texanus* is distinctly bicolored with the head and thorax black and the gaster reddish brown, whereas *P. apache* is concolorous shiny black.

In Cole's (1968) key to males of the *barbatus* complex, *P. texanus* will key out to *P. desertorum* Wheeler because of its bicolored nature. The males of these two species, however, can be easily separated by the following characters: (1) mandibles, as Fig. 4 in *P. texanus,* and as Fig. 5 in *P. desertorum*; (2) epinotal armature, absent in *P. texanus,* but with two weak tubercles in *P. desertorum,* and (3) parameres, as Fig. 16 in *P. texanus,* whereas in *P. desertorum* the terminal lobe is proportionately shorter and almost semicircular in outline (see Cole, 1968, pl. X, fig. 13). Workers of these two species are only superficially similar because of the fineness of the cephalic rugae and the broadly, shallowly emarginate clypeal lobe. They can be separated as follows: (1) epinotal armature, absent in *P. texanus,* and present as two long, sharp spines in *P. desertorum*; (2) base of antennal scape, as Fig. 11 in *P. texanus,* and more like Fig. 12 in *P. desertorum,* with the superior and inferior lobes subequal; (3) metasternal flanges, with dorsal portions fused in *P. texanus,* forming a single arcuate carina across posterior declivity of epinotum, whereas the dorsal portions are not fused in *P. desertorum,* and thus do not form an arcuate carina across the epinotal declivity; and (4) size, with a Weber's length range of 2.30–2.75 mm in *P. texanus* versus 1.60–2.28 mm in *P. desertorum.*

Remarks.—We have collected and studied 21 nest series of *P. texanus.* All the nests were found in open situations, mostly in level terrain (16 of 21; greatest slope exposure noted 20°). The altitudinal range is 580–1645 m (1900–5400 ft), with most (n = 15) coming from 610–915 m (2000–3000 ft). Soil characterization of the nests is as follows: clay 8, sandy clay loam 4, clay loam 3, silty clay loam, sandy, and sandy clay 1 each. Conical craters with a central depression, ranging from 5 cm diameter and 2.5 cm high to 25 cm × 10 cm (predominantly about 10 cm × 6 cm), were present on 16 nests; relatively flat discs were present on two (30 cm and 12 cm diameter, respectively); and on three occasions no excavated material about the nest entrance was observed.

The workers move slowly and at a steady gait, in contrast to the erratic, hesitant gait of *P. apache* (see Cole, 1954, 1968; pers. obs.). The gaster is usually held parallel to the substrate, in contrast to *P. desertorum* which frequently forages with the gaster turned downward (Cole, 1968; pers. obs.). Colonies are usually small (less than 100 workers), and there is no aggressive response when the nest is disturbed.

To crudely determine the relative potency of the venom of *P. texanus,* the senior author allowed one worker to sting him on the forearm. The symptoms experienced are very similar to those resulting from envenomation by *P. barbatus* or *Pogonomyrmex rugosus* Emery.

Specimens examined.—In addition to the type nest series we have examined workers (designated paratypes) from the following localities in Texas: Brewster Co., 29.2 km NE Marathon (1265 m), 27 July 1978 (T. B. Hall, J. V. Moody, O. F. Francke); 6.5 km W Marathon (1250 m), 27 July 1978 (T. B. Hall, J. V. Moody, O. F. Francke: two nest series). Coke Co., 22.7 km NW Robert Lee (610 m), 25 July 1978 (T. B. Hall, J. V. Moody, O. F. Francke). Crane Co., 8.1 km W Crane (750 m), 5 June 1979 (J. V. Moody, O. F. Francke, F. W. Merickel). Crosby Co., 17.6 km N Crosbyton (880 m), 15 June 1978 (D. P. Bartell, R. Beckham, G. Henderson, K. Neece).

Culberson Co., Guadalupe Mountains National Park, mouth of McKittrick Canyon (1540 m), 14 June 1978 (J. V. Moody, O. F. Francke). Dickens Co., 21.9 km N Dickens (790 m), 11 June 1979 (W. D. Sissom, J. V. Moody, O. F. Francke). Hall Co., 24 km S Estelline (580 m), 8 June 1978 (D. P. Bartell, R. Beckham, G. Henderson, K. Neece). Midland Co., 48.6 km SW Midland (880 m), 5 June 1979 (J. V. Moody, O. F. Francke, F. W. Merickel: two nest series); 27.5 km S Midland (820 m), 12 August 1979 (J. V. Moody, O. F. Francke. F. W. Merickel). Pecos Co., 6.5 km SE Sheffield (670 m), 10 August 1978 (T. B. Hall, J. V. Moody, W. D. Sissom, O. F. Francke). Presidio Co., 34.7 km SW Marfa (1645 m), 8 August 1979 (J. V. Moody, O. F. Francke, F. W. Merickel). Reagan Co., 21 km W Big Lake (850 m), 10 August 1978 (T. B. Hall, J. V. Moody, W. D. Sissom, O. F. Francke: two nest series). Terrell Co., 53 km N Dryden (655 m), 21 October 1978 (E. L. Meeks, J. V. Moody). Upton Co., 11 km N Rankin (670 m), 11 August 1978 (T. B. Hall, J. V. Moody, W. D. Sissom, O. F. Francke: two nest series); 37.3 km NW Rankin (870 m), 5 June 1979 (J. V. Moody, O. F. Francke, F. W. Merickel). Paratypes deposited in the following collections: California Academy of Sciences, American Museum of Natural History, Museum of Comparative Zoology, Los Angeles County Museum, and Texas Tech University.

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Footnotes

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COURTSHIP AND DIET OF THE NEOTROPICAL ROBBER FLY *MALLOPHORA SCHWARZI* CURRAN (DIPTERA: ASILIDAE)[1]

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Except for Curran's (1934) original description of the species based on specimens from Barro Colorado Island in the Panama Canal, and reports of individuals from Cerro Campana, Panama, and Madden Forest, former Canal Zone (E. Fisher, pers. comm.) there are no published accounts on the biology of *Mallophora schwarzi*. The present observations were made 3 km northwest of Gamboa, former Canal Zone, on a hillside that had been largely cleared by the U.S. Army. Although occasionally seen on tall grass blades, individuals of *M. schwarzi* were most regularly seen on branch tips of shrubs and trees that bordered the cleared space.

All observations were made between February 20 and April 21, 1979. No *M. schwarzi* were seen prior to February 20 during weekly visits to the site conducted since October 1978 (M. Greenfield, pers. comm.). Peak abundance was noted on March 11 when 20–25 mating pairs and numerous solitary individuals were observed in a 2 hr period. Following this mid-March peak, numbers declined steadily. On April 21 we saw only 1 individual, and on June 18 no *M. schwarzi* were seen. Thus the flight period of *M. schwarzi* appears limited to the 2 months from mid-February to mid-April.

Mallophora schwarzi is a robust species whose members resemble certain euglossine bees of the genus *Eulaema* (E. Fisher, pers. comm.). Individuals vary from 20 to 23 mm in length. Dense, orange pile on abdominal segments 2–7 contrasts sharply with the shiny, black face and black pile of the thorax, the first abdominal segment, and the anterior pair of legs. The sexes exhibit dimorphism in that the hind legs of the female are totally black-haired, whereas in the male the venter of the apical half of the hind femora and the venter and side of the basal ⅔ of the hind tibiae are covered with relatively long, white hairs.

Males of Curran's type series (from Barro Colorado) also possessed abundant white hairs on the metatarsi and males observed near Gamboa, although similar to the type series, lacked such white hairs. In addition, a male recently captured on Barro Colorado (March 1980) also lacked these white, metatarsal hairs. Consequently, *M. schwarzi* males are here considered to be polymorphic with respect to the presence or absence of white, metatarsal hairs.

Courtship

Courtship and mating occurred with greatest frequency between approximately 0900 hr and 1200 hr. Individuals were seldom active before 0800 hr at which time they were first seen perching on branches exposed to full sunlight. Individuals rarely exhibited mating behavior in the afternoon but during this time appeared to be primarily engaged in foraging activity.

Courtship proceeded as follows. A flying male approached a perching female and hovered approximately 7 to 15 cm above and behind her. From this position the male made repeated approaches to and withdrawals from the stationary female. Thus, the male appeared to be bobbing up and down slightly above and behind the female. Throughout this movement, the male's anterior pair of legs were held against the thorax, while the hindlegs were widespread. In the majority of the male's approaches no contact was made with the female. However, in some approaches the male contacted the female's wings (which were resting directly over her abdomen) with a forward movement of his hindlegs, flicking her wings away from her body into a spread position. This wing flick was extremely rapid, since the male withdrew immediately and continued the bobbing behavior. Sometimes, before approaching the female, the male hovered and rubbed his hindlegs over its posterior abdominal segments. Following 2–4 such grooming actions, the male resumed approach-withdrawal activity. This bobbing behavior with occasional wing flicking lasted 3–4 minutes at the longest and was interrupted only by the male grooming behavior. All observed courtship behavior ended with the female suddenly flying away and the male following. Thus, although copulating pairs were observed, not one observed courtship display was seen to result directly in copulation.

Diet

Mallophora schwarzi are sit and wait predators that attempt aerial capture of passing, flying insect prey. Individuals perch in open, conspicuous sites on grass blades and woody branch tips at heights of 50–310 cm. Although most foraging flights were less than 1.0–1.5 m long, several flights of 2–3 m were observed.

M. schwarzi is a dietary specialist on Apidae, Vespidae, and Sphecidae (Table 1). These 3 families alone comprised 90% of the recorded diet. Apidae constituted the major prey taxon (49%), and within the family 53% were members of the genus *Trigona*. The remaining prey included 2 ants, 1 reduviid, and 1 stratiomyid.

Mean length and wet weight values for all prey were 9.94 mm and 24.6 mg, respectively. Individual prey lengths varied 3.5 fold (17.6/5.0), and individual wet weights varied 119 fold (178.2/1.5). Distribution of prey lengths was not significantly skewed ($t = 1.74$; $P < .1$) but was highly leptokurtotic

Table 1. Prey of *Mallophora schwarzi*, February 20–April 21, 1979, near Gamboa, former Canal Zone.

Prey family	% diet (number recorded)	Length (mm) mean (range)	Wet weight (mg) mean (range)
Sphecidae	15 (6)	9.1 (5.0–17.6)	21.0 (1.5–59.2)
Vespidae	26 (10)	11.4 (8.1–15.5)	27.8 (2.5–58.8)
Apidae	49 (19)	9.0 (6.5–13.8)	22.5 (5.3–78.2)
Formicidae	5 (2)	11.8 (10.6–13.0)	32.4 (11.9–53.0)
Reduviidae	2.5 (1)	12.5	26.7
Stratiomyidae	2.5 (1)	8.5	29.0
Total	100 (39)	9.9 (5.0–17.6)	24.6 (1.5–78.2)

(t = 9.18; $P < .001$). Conversely, distribution of prey wet weights was significantly skewed to the right (t = 2.9; $P < .01$) but did not differ significantly from normality with respect to kurtosis (t = 0.13; $P < .9$).

Discussion

The importance of courtship behavior in robber fly reproductive behavior varies greatly among species; for details of particular species see Lavigne and Holland (1969), Rogers and Lavigne (1972), Dennis and Lavigne (1975) and references therein. Certain species exhibit no recognizable courtship behavior. Males simply overtake females in the air, and the grappling pair falls to the ground and mates. In other species courtship may only involve male searching flights for females. More complex behavior may involve either (1) males hovering above females, (2) males hovering above females and making contact with them, (3) males palpating their fore legs on the substrate directly before the female, or (4) males performing intricate "dances" involving leg, wing, and abdominal movement.

In the 2 previous accounts of courtship in *Mallophora,* both Alcock (1974) and Copello (1922) described hovering, back-and-forth movement of males behind perched females for *M. fautrix* Osten Sacken and *M. ruficauda* (Wiedemann), respectively. In addition, Copello (1922) noted a movement (no further description is provided) of the female's wings in synchrony with a forward movement of the bobbing male's hind legs. Copello (1922) proposed that the female moved its wings as an annoyance signal to discourage the male. In observing *M. schwarzi,* however, we clearly saw that female wing movement was actually induced by the forward movement of the male's hind legs. Given our observations and the observed synchrony in female wing movement and male leg movement in *M. ruficauda,* we suggest that male wing flicking behavior occurs in *M. ruficauda* as well.

Male contact with the female during courtship has been noted for only a few asilid species. In these previous accounts, males were always noted to make contact by touching their fore legs to either the female's eyes, *Stichopogon trifasciatus* (Say) (Lavigne and Holland, 1969), wings, *Heteropogon wilcoxi* James (Lavigne and Holland, 1969) or head and thorax, *Cyrtopogon auratus* Cole (Wilcox and Martin, 1936). The wing flicking action described here for *M. schwarzi* males (and presumably for *M. ruficauda* males) is the first account of such courtship behavior in the Asilidae.

As E. Fisher (pers. comm.) has noted, unlike most asilid species, *M. schwarzi* (and all other *Mallophora* species) possess wings which are significantly longer than the abdomen. Access to a perching *M. schwarzi* female may thus require that the wings be spread. Wing flicking behavior could serve to provide the male with access to the female.

The tendency for *Mallophora* species to feed primarily (if not exclusively) upon bees and wasps has been observed in a variety of species (Bromley, 1930, 1946, 1950; Carrera, 1945, 1947; Carrera and Vulcano, 1961; Alex, 1947; Linsley, 1960; Clements and Bennett, 1969). With bees and wasps constituting 90% of its recorded diet, *M. schwarzi* clearly conforms to this generic pattern. Although no data were collected regarding available prey, the leptokurtotic distribution of prey lengths further reveals that *M. schwarzi* feeds upon a relatively narrow length range (62% of recorded prey were between 7–11 mm). In part, this result reflects the relatively high proportion (26%) of *Trigona* spp. in the diet. *Trigona* are slow-flying bees, and *M. schwarzi* may have relatively little difficulty capturing them. *Trigona* prey were all between 7–11 mm. The skewed distribution of prey wet weights, however, indicates that within this narrow length range, prey varied considerably in weight and that *M. schwarzi* was capable of capturing the heavier items. These comments upon prey selection are preliminary, however, and a detailed analysis obviously requires monitoring of available prey.

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July 1981, Vol. 57, No. 3, pp. 385–396

OROBITTACUS OBSCURUS, A NEW GENUS AND SPECIES OF BITTACIDAE (MECOPTERA) FROM CALIFORNIA

Baldomero Villegas[1] and George W. Byers[2]

Genera in the Bittacidae have traditionally been differentiated primarily on the basis of wing characters—fusion of veins, number of costal cross-veins, reduction or loss of wings, etc. Descriptions of most genera have included little about other structural details. Probably this has been due largely to the fact that most genera, when described, were monotypic so that the difference between generic and specific significance of taxonomic characters was not yet clear. Their authors observed greater differences in characters of antennae, legs and genital structures within the large genus *Bittacus* Latreille than between *Bittacus* and the new genera. Rarely, there has been an exception, for example, *Pazius* Navás, distinguished by large, contiguous compound eyes. Byers (1972) discussed this problem in relation to *Kalobittacus* Esben-Petersen, *Nannobittacus* Esben-Petersen and *Issikiella* Byers.

Accordingly, Smithers' (1973) discovery of the remarkable Australian *Tytthobittacus macalpinei*, which differed from other Bittacidae more in male genitalia than in venation, came as a surprise. Two characteristics of this species are striking: the cerci are greatly enlarged, extending beyond the apices of the basistyles, and the ninth abdominal tergum is a medially notched, horizontally-oriented plate (rather than two vertically-aligned lobes, as in all other bittacids).

An even more surprising species, recently discovered in central California, also has greatly lengthened and widened cerci in the male. Its ninth abdominal tergum is more modified than that of *Tytthobittacus*, being produced backward as a single median lobe with terminal, claw-like spines, and solidly fused to the ninth sternum at the sides. The dististyles in this species are not small and simple, as in Bittacidae generally, but large, bilobed and of complex structure. In both sexes the antennae are conspicuously long, and the wings have no pterostigmal cross-veins.

Except for the cerci, these characteristics recalled *Anabittacus iridipennis* Kimmins of southern Chile. This led to a re-examination of males of that species, dissection revealing that the supposed lobes of the ninth tergum are in fact enlarged cerci, arising close beneath the inconspicuous, downturned tergum (cf. Byers, 1965:136, figs. 1, 5). *Anabittacus* turns out to be, in several respects, intermediate between *Tytthobittacus* of eastern Australia and the new genus from California, a circumstance that agrees well with our current concept of continental drift as a factor in zoogeography of Mecoptera.

Orobittacus, new genus

This genus includes bittacids in the wings of which vein R_{2+3} is unbranched, pterostigmal cross-veins are absent but a single cross-vein connects R_1 and R_{2+3} far before the stigma, and M_4 branches from M_3 beyond the m-cu cross-vein; in which the antennae are nearly as long as the body or slightly longer and have 34 or more flagellomeres; and in males of which the ninth abdominal segment is a continuously sclerotized ring with a single, median, dorsal projection, the cerci are longer than the basistyles and broadly spatulate, and the dististyles are large, complex and two-branched.

Type species.—Orobittacus obscurus, new species.

The generic name is derived in part from both Greek and Spanish (Greek *oros* = mountain, Spanish *oro* = gold, + *Bittacus*), referring to the occurrence of the type species in the Sierra Nevada, particularly in the region where gold was discovered in 1848 on the American River, not far below the type locality.

Orobittacus can be differentiated from other genera of Bittacidae in the Western Hemisphere by the following key:

Key to Genera of Bittacidae of the Western Hemisphere

1\. Antennae nearly as long as body or slightly longer; cross-vein between R_1 and R_{2+3} far before pterostigma, approximately opposite level of tip of Cu_1; ninth abdominal tergum and sternum of male fused into continuous ring; cerci of male projecting farther caudad than any part of ninth tergum 2

Antennae less than half as long as body; one or two cross-veins between R_1 and R_{2+3} behind pterostigma (or wings absent); ninth abdominal tergum and sternum of male separated laterally by membranous pleura; cerci of male usually much shorter than caudal prolongations of ninth tergum 3

2\. Vein M trifurcate at first fork (M_{1+2}, M_3 and M_4 having single origin); R_2 and R_3 separated before wing margin, Rs thus with four branches; in male, ninth abdominal tergum with two short, downturned submedian lobes, ninth sternum with narrowly triangular median projection (southern Chile and Argentina) .... *Anabittacus* Kimmins

Vein M bifurcate at first fork (M_4 originating from M_3 well beyond first fork of M); R_2 and R_3 coalesced to wing margin, so Rs has only three branches; in male, ninth abdominal tergum with one median projection directed caudad, posterior margin of ninth sternum entire, without median projection (California) .... *Orobittacus,* new genus

3. Wings absent (California) .... *Apterobittacus,* MacLachlan
   Wings present 4
4. In front wing, vein 1A short, extending at most to level of origin of M, often only slightly beyond level of humeral cross-vein 5
   In front wing, vein 1A extending approximately to level of first fork of M, i.e., far beyond origin of M 8
5. Vein 1A in front wing extending approximately to level of origin of M; two pterostigmal cross-veins (Pcv) (México and Central America) .... *Kalobittacus* Esben-Petersen
   Vein 1A in front wing extending only slightly past level of humeral cross-vein; only one Pcv 6
6. Compound eyes enlarged, touching on front of head beneath antennae; abdomen extremely long and slender, extending far beyond tips of wings (Central America and northern South America) ... . *Pazius* Navás
   Compound eyes not touching on front of head; abdomen not extending beyond wing tips, or only slightly beyond them 7
7. Subcosta ending in costa (C) before level of first fork of radial sector (FRs); subcostal cross-vein (Scv) near level of origin of Rs; vein Cu_2 in front wing ending opposite first fork of M (Brasil and Bolivia) .... *Issikiella* Byers
   Subcosta ending in C well beyond FRs; Scv well beyond origin of Rs; in front wing, Cu_2 ending well beyond level of first fork of M (Panamá, Colombia, Venezuela, Brasil) .... *Nannobittacus* Esben-Petersen
8. Costal cell with 4 or 5 cross-veins beyond humeral cross-vein (h); wings broadly banded and spotted with brown (Brasil) .... *Neobittacus* Esben-Petersen
   Costal cell with 0 to 3 cross-veins, usually 0 or 1, beyond h; wings not extensively banded but may be spotted or have narrow darkened zones along some cross-veins or veins 9
9. Wings hyaline with smoky gray or black spot at apex; only one Pcv (eastern United States, possibly México) .... *Hylobittacus* Byers
   Wings usually tinged with yellow or yellowish brown, without darkened apex; usually two Pcv (one in some South American species) (United States, southeastern Canada, México, Central America, South America) .... *Bittacus* Latreille

Orobittacus obscurus, new species

Description based on 191 ♂♂, 122 ♀♀ pinned and 86 ♂♂, 76 ♀♀ preserved in alcohol.

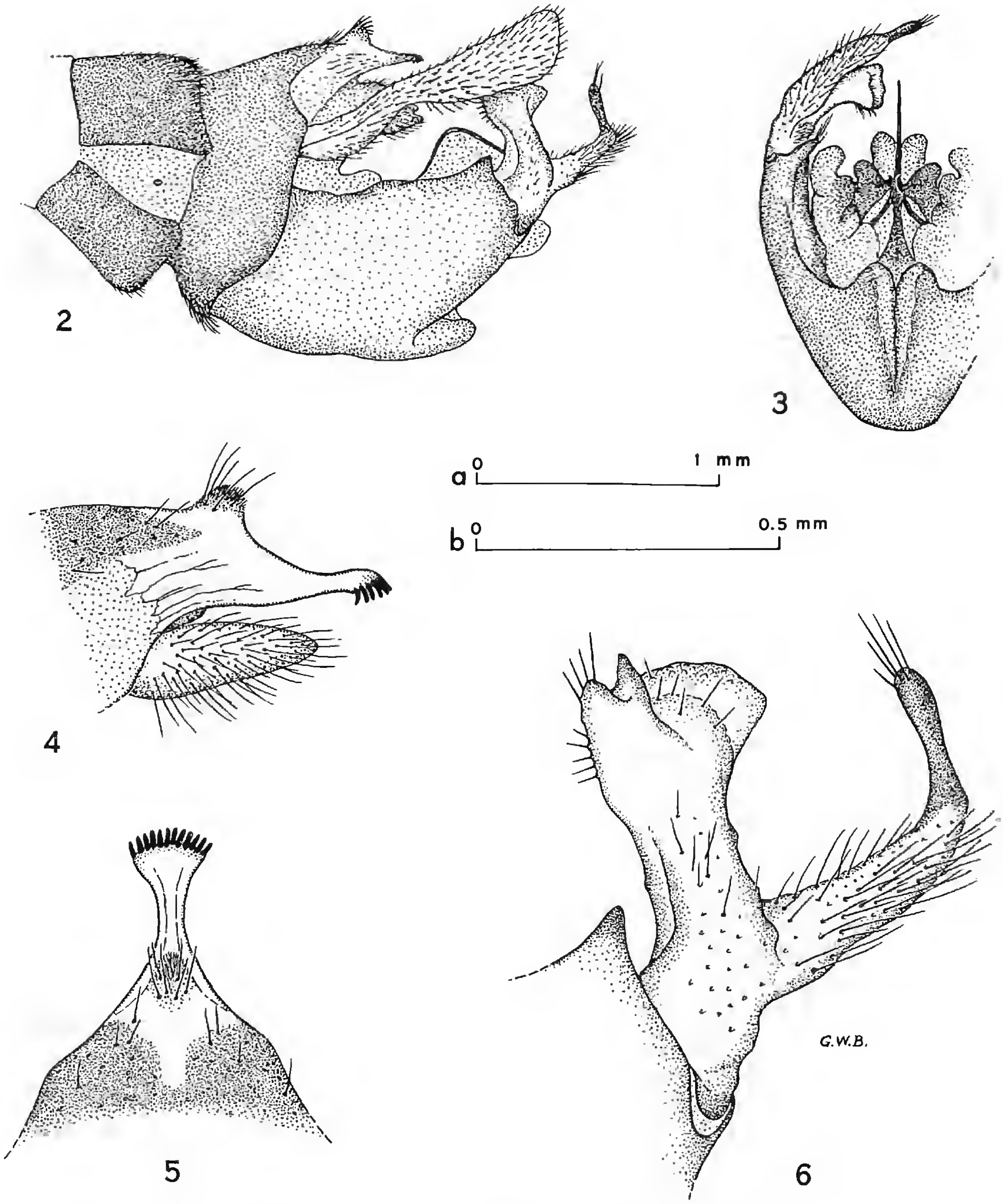
Head.—Dorsal occiput, vertex and frons above antennal bases shining black, grading into blackish brown on occipital-postgenal surfaces behind eyes and on small median swelling immediately below and between antennal sockets. Rostrum and palps generally dark yellowish brown, labrum slightly darker. Eyes dark plum colored, slightly convergent below antennal bases. All three ocelli of approximately same diameter, on prominent elevation. Anterior tentorial pits conspicuous but epistomal suture otherwise obliterated. Rostrum slender but short; labrum only a little more than twice as long as width at base. Mandible with a single subterminal tooth; maxillary lacinia bearing brush of hairs at apex, fifth segment of maxillary palp shorter than fourth, without hairs. Antennae long (about 16 mm in both sexes), if drawn out along costal wing margin extending to mid-length of pterostigma, comprising thick subcylindrical scape, pedicel, and 38–39 distinct flagellomeres in male, 34–37 in female.

Thorax.—Pronotum shining black with thin, pale hairs along anterior margin, hairs increasing in length from mid-line toward sides. Mesonotum and metanotum shining black to brownish black with sparse, fine hairs; two longer, thicker hairs on each scutellum. Pleural surfaces unevenly blackish brown to brown, glossy, with few scattered, very thin, pale hairs; coxae yellowish brown ventrally, grading into brown dorsally, front and middle coxae bearing long, pale hairs on anterior surfaces; mera brown. Femora not noticeably enlarged in either sex, yellowish brown, covered with closely-set rings of tiny setae but without spines. Tibiae dark yellowish brown basally, darkening to brown at apex, with rings of tiny setae throughout; no spines on fore tibia, 4–6 on middle tibia, and several on hind tibia, particularly on apical half; tibial spurs long, slender. Tarsi brown at base grading to dark brown distally, narrowly paler at joints; tarsomere 4 with 0–2 pairs of lateral spines; tarsomere 5 without spines; basitarsus of front leg about 7 times length of fifth tarsomere (more than twice as long as hind basitarsus) in both males and females; basitarsus of hind leg only about 3 times as long as fifth tarsomere in male, 4 times as long in female. Tarsomeres 3, 4 and 5 finely toothed along their opposing edges; pretarsal claws slender, nearly straight in basal three-fourths, gently curved near tip.

Wings (Figs. 1, 7) moderately iridescent, evenly darkened with smoky yellowish brown, stigma only slightly darker; diffuse gray clouding along cross-veins in radial and medial fields. Subcosta in forewing ending in costa slightly beyond first fork of radial sector (FRs), subcostal cross-vein (Scv) opposite FRs. No pterostigmal cross-veins, but a single cross-vein between R_1 and R_{2+3} about half-way between Scv and proximal end of stigma. Vein R_1 with short transverse branch to C near base of stigma, in many individuals an indication (concentrated row of setae) of diagonal second branch near mid-length of stigma. Vein R_{2+3} unbranched; Rs, R_{4+5} and R_5 nearly in alignment; usually only one cross-vein between R_{2+3} and R_4 but two or

Fig. 1. *Orobittacus obscurus*, new genus and species, dorsolateral aspect of individual suspended from spiderweb in typical resting posture. Photograph by B. Villegas.

rarely three present in one or more wings of some individuals; R_4 rarely forked. Conspicuous thyridium at first fork of media; only one cross-vein between M_1 and M_2, none between M_3 and M_4; vein M_{3+4} branching well beyond m-cu cross-vein. Small thyridium at junction of M_{3+4} and m-cu, another on short cross-vein between Cu_2 and 1A near base of wing. Vein 1A extends to level of origin of Rs; 2A extends almost to level of origin of

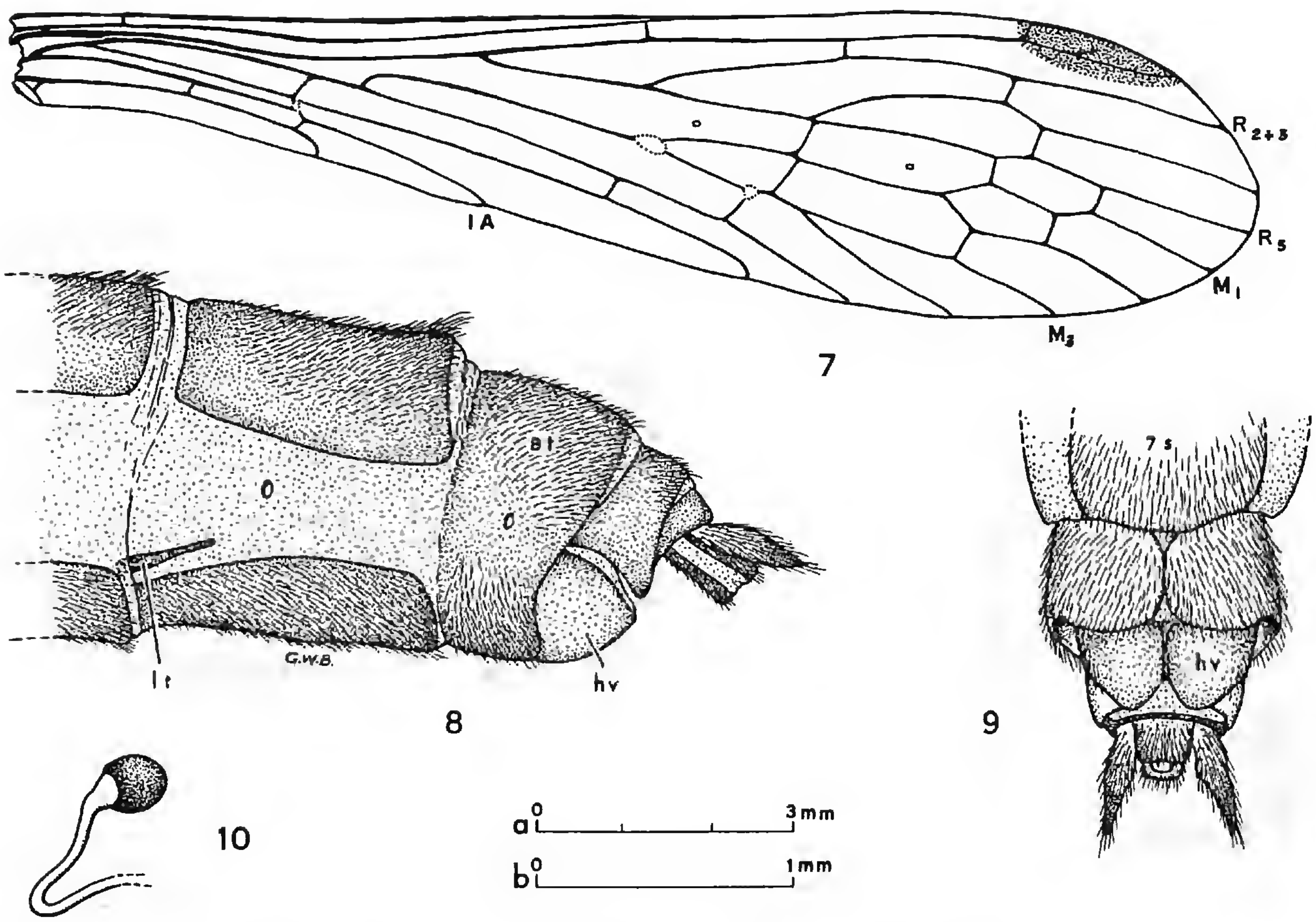


Figs. 2–6. *Orobittacus obscurus*, n. sp., details of terminal abdominal segments of male paratype. Fig. 2, terminal abdominal segments, left lateral aspect. Fig. 3, basistyle, dististyle, aedeagus and associated structures, posteroventral aspect; most of right side omitted. Fig. 4, ninth abdominal tergum and epiproct, left lateral aspect. Fig. 5, posterior process of ninth abdominal tergum, dorsal aspect. Fig. 6, left dististyle, left lateral aspect. Scale a, Figs. 2–3; scale b, Figs. 4–6.

M; 3A short, inconspicuous. In hindwing, Sc ends in C well before FRs, Scv opposite mid-length of Rs or slightly more proximal; veins 2A and 3A fused with 1A except for short terminal segments.

Abdomen of male.—Terga 2–5 dark brown, 6–8 shining black; corresponding sterna similarly colored. Segment 9 a continuously sclerotized ring, abruptly paler than 8, brown dorsomedially paling to sordid yellowish brown at sides, dark yellowish brown ventrally. Basistyles, most of dististyles, and cerci pale yellowish brown. Slender, wedge-shaped laterosternite at each side of sterna 2–7, attached very narrowly to anterolateral corner of sternum on segments 3–7 (attachment usually concealed by fold of pleural membrane), attached more broadly to separate anterior portion of sternum 2. No spines on sides of anterior terga. Tergum 9 totally lacking epiandrial lobes, produced caudad as a complex median lobe (Figs. 2, 4, 5) with darkened, dorsal, setiferous prominence and more ventral, slender process abruptly widened at apex and bearing about 12 thick, downcurved, black spines. Proctiger not conspicuous, but cerci arising from its sides (Fig. 2) greatly enlarged, flattened (compressed), gradually expanded toward diagonally truncate apex, slightly bent and constricted near mid-length, with subapical hairs on mesal surface directed cephalad. Basistyles deeply separated, connected ventrally by membranous cuticle, each with submedian ventral protuberance, acute, blade-like point just above base of dististyle and slender, setiferous projection directed mesad below base of dististyle (Fig. 3). Conspicuous membranous structure, appearing as inflated, four-chambered pouch in specimens preserved in fluid (Fig. 3), adjacent to inner surface of each basistyle (may be homolog of pheromone sac of Panorpidae; tergal pheromone sacs not evident). Dististyles (Figs. 3, 6) large and complex (as compared to those of Bittacidae in general), deeply divided, comprising a stout anterodorsal arm with shallow mesal concavity at apex and a more slender, curved, posteroventral arm with pale basal portion bearing numerous dark setae, and darkly sclerotized, mostly glabrous distal portion with small tuft of setae at apex. Aedeagus (Fig. 3) a slender filament with basal membranous pouch at each side, median dorsal sclerotized band above pouches, and pair of flattened, sclerotized ventrolateral appendages (possibly homologs of ventral parameres of Panorpidae) each with broad, rounded subterminal lobe and sharp, curved tip.

Abdomen of female.—All terga and sterna unevenly brown to dark brown, terga 2 and 3 somewhat darker than others. Laterosternites on segments 2–7, shaped and attached as in male. Segment 8 continuously sclerotized except along ventral mid-line (Figs. 8, 9); hypovalves subtriangular, hinged to each other and to basal eighth sternum by lightly sclerotized cuticle. Ninth tergum saddle-like, sternum 9 lightly sclerotized, pale except for slender dark ring around aperture of bursa (spermathecal duct). Tenth segment



Figs. 7–10. *Orobittacus obscurus,* n. sp., wing of male and details of abdomen of female paratype. Fig. 7, right front wing of male paratype; A—anal vein, M—media, R—radius. Fig. 8, terminal abdominal segments of female, left lateral aspect; hv—hypovalve of ovipositor, lt—laterosternite, t—tergum. Fig. 9, terminal abdominal segments of female, ventral aspect; hv—hypovalve, s—sternum. Fig. 10, spermatheca and portion of spermathecal duct. Scale a, Fig. 7; scale b, Figs. 8–10.

mostly membranous ventrally but caudal margin sclerotized, forming continuous ring with tergum; tergum and sternum of segment 11 moderately sclerotized; cerci pale at base, darkened toward acute apex. Spermatheca (Fig. 10) darkly sclerotized except around attachment of short, thick spermathecal duct. Nearly mature eggs oval in outline, ends equally rounded; chorion dark yellowish brown.

Body length, male, about 14.5–16.8 mm (M = 15.7; holotype 16.0 mm); female, 14.0–15.7 mm (M = 15.0; allotype 14.0 mm). Length of front wing, male, 16.2–17.9 mm (M = 16.9; holotype 17.9 mm); female, 16.5–17.0 mm (M = 16.8; allotype 16.6 mm).

Types.—Holotype, male, labelled "California, El Dorado Co. #3, American Riv., 11.4 mi. W. of Kyburz, 6 June 1976, 3040 ft., G. W. Byers, B. Villegas." Allotype, female, and 15 ♂, 8 ♀ paratypes, same label data as for holotype. Additional paratopotypes, 211 ♂, 156 ♀, various dates from 10 May to 4 July, most early June 1976–1979. Additional paratypes, 50 ♂, 33 ♀, Shirttail Creek, 6.4 km northeast of Foresthill, Tahoe National Forest, Placer Co., California, 27 May and 7 June 1976. The type locality is the vicinity of a U.S. Forest Service picnic area near Bridal Veil Falls, El Dorado National Forest, between U.S. Highway 50 and the South Fork of the American River, about 18 miles east of Placerville. Holotype, allotype and initially 331 paratypes in the Snow Entomological Museum, University of Kansas, Lawrence, Kansas; 142 paratypes in the collection of the University of California at Davis. Paratypes will be distributed from the Snow Museum to other entomological collections, including the California Academy of Sciences, the Los Angeles County Museum, the California Insect Survey, the U.S. National Museum of Natural History, the Museum of Comparative Zoology at Harvard University, the Illinois Natural History Survey, Cornell University, the University of Michigan, the Florida State Collection of Arthropods, the British Museum (Natural History), and the Australian Museum.

Habitat

At the type locality, the American River flows generally westward between steep (50–60°), rocky but largely forested slopes. The river flows among huge boulders (Fig. 11), and the lower slopes are strewn with boulders and rocks of all sizes broken from the outcrops above. Soil trapped on the slopes and forming the short, narrow floodplain at this site is sandy but humous. The forest is dominated by three conifers, Ponderosa Pine (*Pinus ponderosa*), Incense Cedar (*Calocedrus decurrens*) and Douglas-Fir (*Pseudotsuga menziesii*). It also includes Big-leaf Maple (*Acer macrophyllum*), dogwood (*Cornus sessilis*), hazelnut (*Corylus cornuta*), occasional oaks, and, along the stream, White Alder (*Alnus rhombifolia*) and willow (*Salix* sp.). Particularly on the north-facing slope, a variety of mosses are common on outcropping rocks, boulders, fallen logs and soil, where these substrates are more or less continuously moist and shaded. The herb-grass-fern stratum is generally well developed. Elevation at the floodplain is approximately 935 meters, or 3040 feet.

The habitat at the Shirttail Creek site is much the same, differing chiefly in the much narrower stream, the somewhat steeper slopes along it, and generally slightly drier conditions. In addition to the three dominant conifers, Jeffrey Pine (*Pinus jeffreyi*), California Black Oak (*Quercus kelloggii*) and Canyon Live Oak (*Q. chrysolepis*) are common on the slopes. Dogwoods, hazelnuts, alders and willows are common nearer the stream. Elevation is approximately 1060 meters, or 3440 feet. Shirttail Creek flows generally southwestward to join the North Fork of the American River.

During the day, *Orobittacus* usually seeks darkly shaded crannies in which the humidity is high. Often, such resting places are beneath tree roots

Fig. 11. Habitat of *Orobittacus obscurus*, n. sp., on left bank of South Fork of the American River, 11.4 miles west of Kyburz, El Dorado County, California. Dominant forest trees are Ponderosa Pine, Incense Cedar and Douglas Fir. Photograph by B. Villegas.

in overhanging banks, below rock outcrops and in deep shade beneath fallen logs, and along streams beneath large boulders even near the water's edge.

Habits

In their day-time hiding places, individuals of *Orobittacus* will be found ordinarily hanging by their more or less outspread front and middle legs, with the hind legs held close together along the ventral side of the abdomen, the tarsi curving dorsad around the tips of the folded wings (Fig. 1). Because of their dark color, they are not easily seen when thus suspended motionless in darkened crannies; hence their specific name, *obscurus*.

Places where *Orobittacus* hides by day are often inhabited by spiders, and it is common for the hanging-flies to suspend themselves from spiderwebs when at rest. Occasionally they become entangled, however, and are preyed upon by the spiders. Fungus gnats (Mycetophilidae) abound in many of the niches occupied by *Orobittacus* and constitute the main prey of the bittacids; they are also frequently trapped in the spiderwebs. Male and female *Orobittacus* captured with prey were carrying fungus gnats; one was also seen feeding on a small crane fly (Tipulidae).

Courtship and mating have not been observed, either in natural surroundings or when the insects were caged. This behavior is presumed to occur at night, when *Orobittacus* has been seen leaving its day-time retreats.

Geographical and Seasonal Distribution

Orobittacus obscurus is known from only the two localities mentioned above, both on the western slopes of the central Sierra Nevada and only about 50 km apart. The abruptly increasing elevation of the mountains to the east and the relatively dry, hot and treeless central valley to the west would seem to be natural barriers to the spread of the species. We have sought *O. obscurus* in apparently suitable habitats both to the north and south of El Dorado and Placer counties but without success.

Since the earliest and latest collections of *Orobittacus* (10 May and 4 July) yielded only small numbers of individuals while those made near the middle of this period (29 May to 9 June) were most productive, we judge that the type series more or less correctly indicates the seasonal distribution of the species.

Acknowledgments

We are indebted to the administrative officers of the El Dorado National Forest, Placerville, California, for permission to collect specimens and for other assistance. R. F. Denno and W. C. Fields, Jr., respectively, provided us with ecological information on the type locality near Bridal Veil Falls

and on the Shirttail Creek localities. Chen-Wen Young, N. J. Smith and R. W. Brooks assisted in the collection of specimens.

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Footnotes

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THREE NEW SPECIES OF *AMBRYSUS* FROM MEXICO (HEMIPTERA: NAUCORIDAE)

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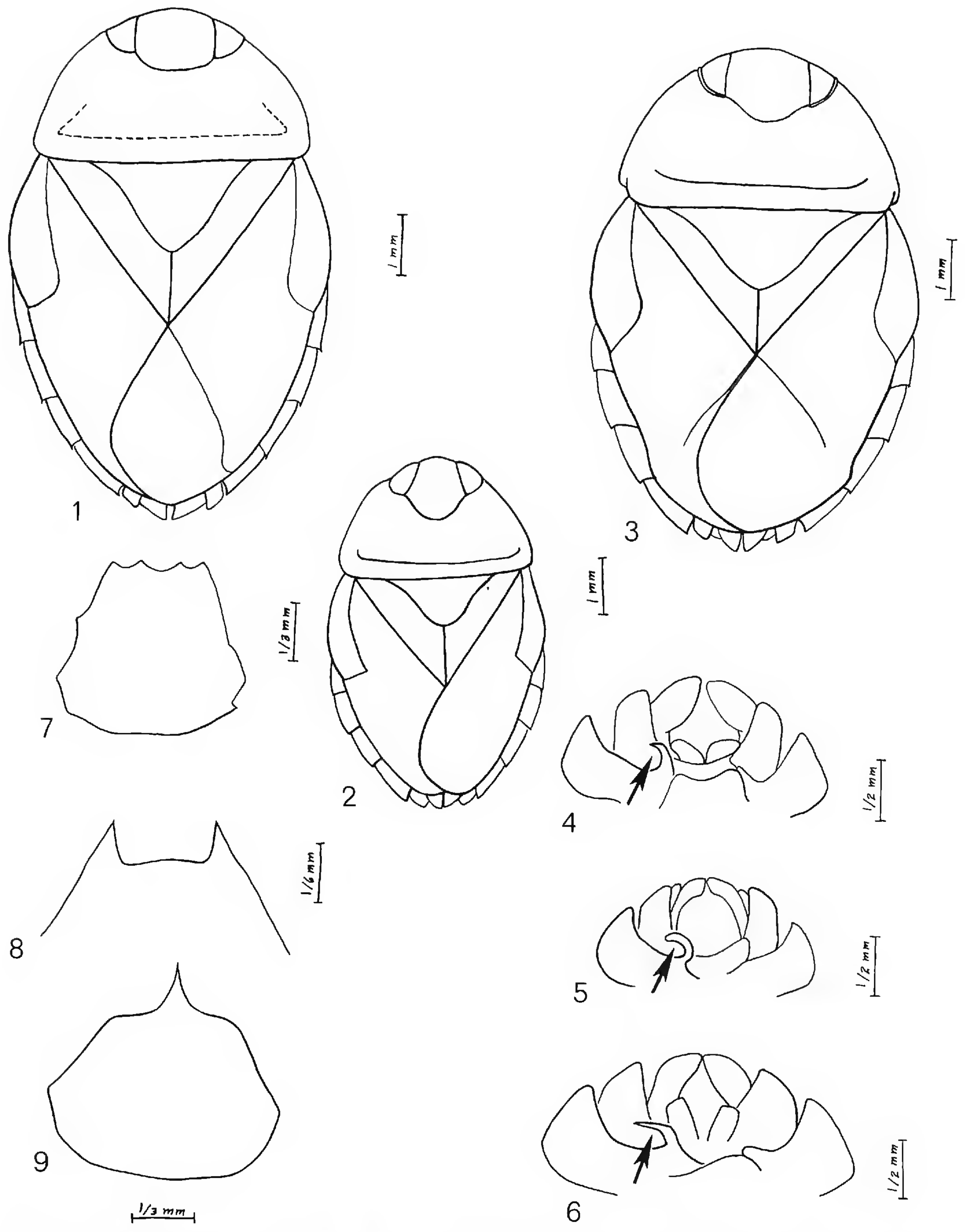
The following new species of Naucoridae, along with others, have been in manuscript for some time. This publication is one result of a long term study on centers of speciation of Nepomorpha in America north of the Isthmus of Panama. During our many expeditions to Mexico and Middle America we have studied and collected most of the naucorids known from the region and a number of undescribed taxa. The late Ira LaRivers regularly described species from this area but did not utilize our extensive material. The authors would welcome naucorid material from the Americas for study and determination.

Most material reported here is in the J. T. Polhemus Collection (JTP); additional material from the California Academy of Sciences (CAS) has been made available for study through the kindness of Dr. Paul Arnaud. For all measurements, 40 units = 1 mm unless otherwise noted.

Ambrysus colimanus, new species
(Figs. 1, 4, 7)

General appearance.—Of moderate size, ovate, shape as in Fig. 1. Ground color yellowish, dorsum with strongly contrasting dark markings similar to *Ambrysus lunatus* Usinger; faintly shining; head and pronotum shallowly rugose and punctate; scutellum finely rugulose. Venter and legs yellow brown to luteus, spines on legs golden brown.

Structure.—Head with eyes not raised above surface dorsally; vertex moderately produced behind eyes; labrum shallowly triangular in shape, width/length = 23/13, bluntly rounded apically; eyes convergent anteriorly, posterior/anterior interocular space = 54/41. Pronotum with lateral margins slightly convex, smooth; posterolateral angles rounded; width/length (midline) = 167/57. Scutellum wider than long, width/length = 130/50; sinuate along lateral margins. Hemelytra fully developed; embolium weakly expanded, not sinuate posteriorly; entire surface set with minute white nodules, denser and more obvious on darkened portions. Connexival margins weakly serrate; posterolateral angles weakly spinose. Foreleg femur length/width = 73/43; tarsi slightly exceeding adjacent proximal part of femur. Middle and posterior femora with a close-set row of small spines posterodorsally; middle and posterior tibia set with numerous stout spines; distally



Figs. 1–9. *Ambrysus* n. spp. Figs. 1–3. Dorsal view of body, legs not shown. 1. *A. colimanus* n. sp. 2. *A. baeus* n. sp. 3. *A. spiculus* n. sp. Figs. 4–6. Dorsal view of male abdominal tergites V–VII showing male genital process (arrow) on right side (left in figures) of tergite V. 4. *A. colimanus* n. sp. 5. *A. baeus* n. sp. 6. *A. spiculus* n. sp. Figs. 7–9. Ventral view of female subgenital plate, hairy vestiture not shown. 7. *A. colimanus* n. sp. 8. *A. baeus* n. sp. 9. *A. spiculus* n. sp.

with two transverse rows of small spines. Propleura not contiguous with prosternum; propleura separated slightly medially, widely separated there from mesosternum.

Male genital process as in Fig. 4; female subgenital plate shape as shown in Fig. 7.

Length 7.8 mm, width 5.0 mm (male holotype).

Material.—Holotype, male, and allotype, female, MEXICO, Colima, Ameria (River), CL1229, XI-26-68, J. T. Polhemus (JTP). Paratypes, 6 ♂♂, 3 ♀♀, same data as holotype (JTP).

Etymology.—The name *colimanus* is derived from Colima, the Mexican state of origin. Masculine.

Discussion

The male genitalia of *Ambrysus colimanus* are very similar to *Ambrysus signoreti* Stal; the female subgenital plate is also similar to *signoreti,* but not flared laterally as in the latter. *A. colimanus* differs from *signoreti* in having a different coloration, eyes more convergent anteriorly over all their length, and body length only about half that of *signoreti.* The coloration of *colimanus* is quite similar to that of *Ambrysus lunatus* Usinger, but the latter has a more rugose dorsum and different genital structures.

Ambrysus baeus, new species

(Figs. 2, 5, 8)

General appearance.—Small, ovate, shape as in Fig. 2. Ground color yellowish to yellow brown; dorsal markings not strongly contrasting, scutellum and hemelytra marked with dark brown, similar to *Ambrysus pygmaeus* LaRivers; faintly shining, many specimens encrusted and dull; head and pronotum shallowly punctate and shallowly rugose; scutellum and hemelytra finely rugulose. Venter and legs yellow to yellow brown, spines on legs golden brown.

Structure.—Head with eyes moderately raised above surface dorsally; lateral margin narrow, not reflexed; vertex strongly produced behind eyes (see Fig. 2); labrum not produced anteriorly, broadly rounded apically, twice as broad as long, width/length = 16/8; eyes convergent anteriorly over all their length, posterior/anterior interocular space = 37/27. Pronotum with lateral angles convex, smooth, straight or faintly sinuate just anterad of posterolateral angles; latter sharply rounded; width/length (on mid-line) = 120/39. Scutellum wider than long, width/length = 80/36; sinuate along lateral margins. Hemelytra fully developed; membrane not clearly differentiated, coriaceous; embolium weakly expanded; entire surface thickly set with tiny round pits appearing white against dark background. Connexival angles not serrate; posterolateral angles forming a right angle, not spinose.

Foreleg femur length/width = 57/39; tarsi clearly reaching beyond adjacent proximal part of femur. Middle and posterior femora each with a close-set row of tiny almost invisible spines posterodorsally. Middle and posterior tibia with numerous short spines; distally set with two transverse rows of close-set spines. Propleura contiguous with prosternum, both on same plane; propleura contiguous medially, contiguous there with mesosternum.

Male genital segments as in Fig. 5; female genital segments as in Fig. 8.

Length 5.75 mm; width 3.65 mm (male holotype).

Material.—Holotype, male, and allotype, female, MEXICO, Nayarit, Aticama, CL727A, VI-7-1975, J. T. Polhemus (JTP). Paratypes: 19 ♂♂, 19 ♀♀, 12 nymphs, same data as holotype (JTP); 2 ♂♂, 5 ♀♀, 1 nymph, MEXICO, Nayarit, 15 mi E San Blas, CL1026, J. T. & M. S. Polhemus (JTP); 2 ♂♂, 5 ♀♀, MEXICO, Colima, Ameria (River), CL1229, XI-26-1968, J. T. Polhemus (JTP); 3 ♂♂, 1 ♀, MEXICO, Jalisco, 300 ft (91 m), Rio Tomatlan, CL736, VI-9-1975, J. T. Polhemus (JTP).

Etymology.—The name *baeus* is derived from the Greek *baios,* meaning small. Masculine.

Discussion

Ambrysus baeus belongs to the same group as *Ambrysus circumcinctus* Montandon and *Ambrysus pygmaeus* LaRivers. *A. baeus* is similar to the latter in appearance and coloration but is much smaller than either *circumcinctus* or *pygmaeus* and has very different male and female pregenital structures. The male process of *pygmaeus* is greatly expanded distally, spatulate, and almost straight; the male process of *circumcinctus* is slender as in *baeus,* but curved only at the base and straight distally; the process in *baeus* is strongly curved over the entire length as shown in Fig. 5. The female subgenital plates of *pygmaeus* and *circumcinctus* are truncate caudad or slightly excavate, but without the strong lateral angulate projections seen in *baeus* (Fig. 8).

Ambrysus spiculus, new species

(Figs. 3, 6, 9)

General appearance.—Of moderate size, ovate, shape as shown in Fig. 3. Ground color brownish yellow, dorsum with extensive dark markings, especially on hemelytra, moderately contrasting; markings similar to those of dark specimens of *Ambrysus vanduzeei* Usinger; faintly shining; head, pronotum and scutellum shallowly punctate; pronotum faintly rugose, scutellum rugulose. Venter brown, abdominal venter thickly clothed with very fine appressed golden pubescence obscuring venter to certain light angles; legs luteus to yellow brown.

Structure.—Head with eyes barely raised above dorsal surface, lateral edge reflexed, carinate; vertex produced behind eyes (see Fig. 3); labrum broadly rounded apically, twice as broad as long, width/length = 20/10; eyes convergent anteriorly over all their length, posterior/anterior interocular space = 56/40. Pronotum with lateral margins slightly convex, smooth, posterolateral angles rounded; width; length (mid-line) = 178/60. Scutellum wider than long, width/length = 120/50, sinuate along lateral margins. Hemelytra fully developed; embolium weakly expanded, not sinuate posteriorly, rugose; entire surface with tiny round pits, appearing white, thicker and most obvious on darker portions. Connexival margins weakly serrate; posterolateral angles sharply angulate, not spinose. Foreleg femur length/width = 80/48; tarsi just reaching adjacent proximal part of femur. Middle and posterior femora each with a close-set row of small spines posteroventrally and a close-set row of stouter spines posterodorsally. Middle and posterior tibia with numerous stout spines; distally with two transverse rows of close-set spines. Propleura not contiguous with prosternum; propleura contiguous medially, not contiguous there with mesosternum.

Male genital process as in Fig. 6; female subgenital plate as in Fig. 9.

Length 8.2 mm, width 5.4 mm (male holotype).

Material.—Holotype, male, and allotype, female, MEXICO, Durango, La Palmita, CL1018, 20 April 1964, J. T. & M. S. Polhemus (JTP). Paratypes; 8 ♂♂, 7 ♀♀, 10 nymphs, same data as holotype (JTP); 1 ♂, 1 ♀, MEXICO, Zacatecas, 61 mi W of Fresnillo, Alt. 8100 ft (2469 m), pool, stream bed, 25 June 1954, R. H. Brewer (CAS); 5 ♂♂, 7 ♀♀, MEXICO, Durango, La Palmita, CL721, VI-6-1975, J. T. Polhemus (JTP); 1 ♀, MEXICO, Sonora, Rancho Los Banos, CL709, El. 3400 ft (1036 m), VI-3-1975, J. T. Polhemus (JTP).

Etymology.—The Latin name *spiculus* pointed, refers to the shape of the female subgenital plate. Masculine.

Discussion

Ambrysus spiculus is closely related and similar in appearance to *Ambrysus tridentata* LaRivers from Puebla, Mexico. *A. spiculus* differs from the latter in the more convergent eyes, less explanate lateral margins and less rugose dorsum of the pronotum, thinner process on the male fifth tergum, and very different female subgenital plate. The male process in *tridentata* has the shank erect compared to the sloping shank of *spiculus* seen in Fig. 6. The female subgenital plate of *tridentata* has a blunt median projection flanked by two acute shorter angulate projections, whereas *spiculus* has only one thin median projection caudad as shown in Fig. 9.

Footnote

[1] Contribution from the University of Colorado Museum, Boulder 80309 and Martin Marietta Corp., Denver 80201.

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LIFE HISTORY OF THE GALL-FORMING MOTH, *CAROLELLA BEEVORANA* COMSTOCK, ON THE RAGWEED, *AMBROSIA DUMOSA* (GRAY) PAYNE, IN SOUTHERN CALIFORNIA (LEPIDOPTERA: COCHYLIDAE)

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Native, southern California ragweed insects include a diversity of noneconomic, little-studied, stenophagous species. We herein describe field, laboratory, and insectary studies on a heretofore little-known, gallicolous moth. Insectory conditions were 27 ± 1°C, 40–70% relative humidity, and a 12/12-hr (light/dark) photoperiod.

Taxonomy.—*Carolella beevorana* adults first were described and the female moth pictured by Comstock (1939b). The larva was described from *Ambrosia dumosa* by Comstock (1939b) as being similar to, but darker than that of *C. busckana* Comstock, which forms galls on the stems of the composite shrub, *Encelia californica* Nuttall (Comstock, 1939a). A brief comparison of the pupae of *C. beevorana* and *C. busckana* and photographs of the former pupa also were provided by Comstock (1939b).

Distribution and host plant.—*Carolella beevorana* apparently occurs in small demes discontinuously distributed throughout the range of its sole host plant, *A. dumosa,* in southeastern California (Goeden and Ricker, 1976) and, probably, adjacent parts of Arizona, Nevada, and Mexico. Comstock (1939b) described this moth from specimens collected at Ludlow and Yermo, San Bernardino County, in the high elevation Mojave Desert. Our study site was located in a Creosote Bush Scrub-type community (Munz, 1974) in the low elevation Sonoran Desert, ca. 3 km southeast of Niland, Imperial County. The only other record for *C. beevorana* from our faunistic survey of *A. dumosa* (Goeden and Ricker, 1976) involved a single plant bearing old, empty galls observed on the east shore of the Salton Sea, ca. 3 km south of the Riverside/Imperial County line.

Biology.—*Egg.*—The egg (Fig. 1A, B) is lustrous, translucent, ivory colored, sub-ovoid, but flattened and smooth-surfaced along one side where loosely glued to the plant surface. The chorion is transversely, irregularly, but smoothly ridged or wrinkled. This type of sculpturing also was reported for eggs of *Carolella sartana* (Hübner) by Peterson (1967). Ten, newly deposited, infertile eggs averaged (±S.D.) 0.72 ± 0.043 mm, 0.48 ± 0.036 mm, and 0.32 ± 0.036 mm in length, width, and greatest thickness, respectively.

In insectary cagings on potted *A. dumosa,* most eggs (ca. 80%) were

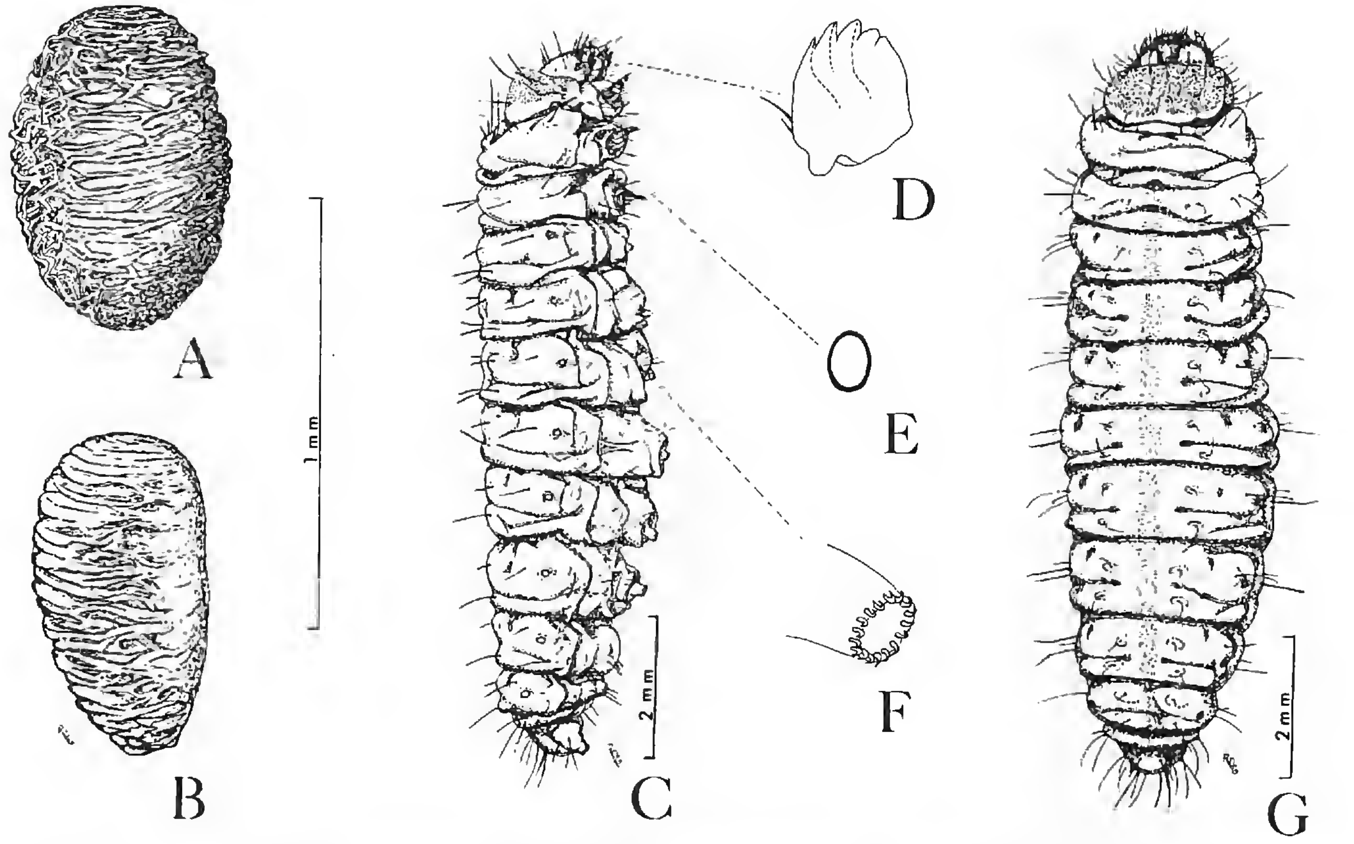

Fig. 1. Egg and mature larva of *Carolella beevorana*. A. egg, top view, B. egg, side view, C. larva, lateral view, D. right mandible, enlarged (semidiagrammatic), E. prothoracic spiracle, enlarged, F. proleg, ventral lateral view (semidiagrammatic), G. larva, dorsal view.

attached singly to the undersides of leaf laminae along the midribs and veins; the remainder, to leaf petioles, branches near axils, or cage surfaces. No eggs of *E. beevorana* were observed in nature, but such individual egg placement on foliage agrees with observed post-eclosion larval behavior described below, as well as with ovipositional behavior described for *C. sartana* by Peterson (1967).

Larva.—The first instar (Fig. 2A) differs markedly from the last instar (Figs. 1C, 1G, 2B) in gross appearance. The heart-shaped head capsule of the first instar is black, the prothoracic shield is prominent and dark brown, and the cylindrical body is a translucent, dirty pale yellow-green color principally derived from the chlorenchyma in its gut. The mature larva, in contrast, has a light reddish-brown head capsule, a much less sclerotized and prominent prothoracic shield, a dorsoventrally flattened body, and a soiled whitish-yellow color derived from the copious fatty tissue accumulated internally.

The number of larval instars was not determined with certainty because of their endophytic habit and the broad variation encountered in widths of head capsules sampled, which included those of starved larvae held for emergence in excised galls. Six instars were indicated.

The newly hatched larva crawled to and entered a herbaceous, photosyn-

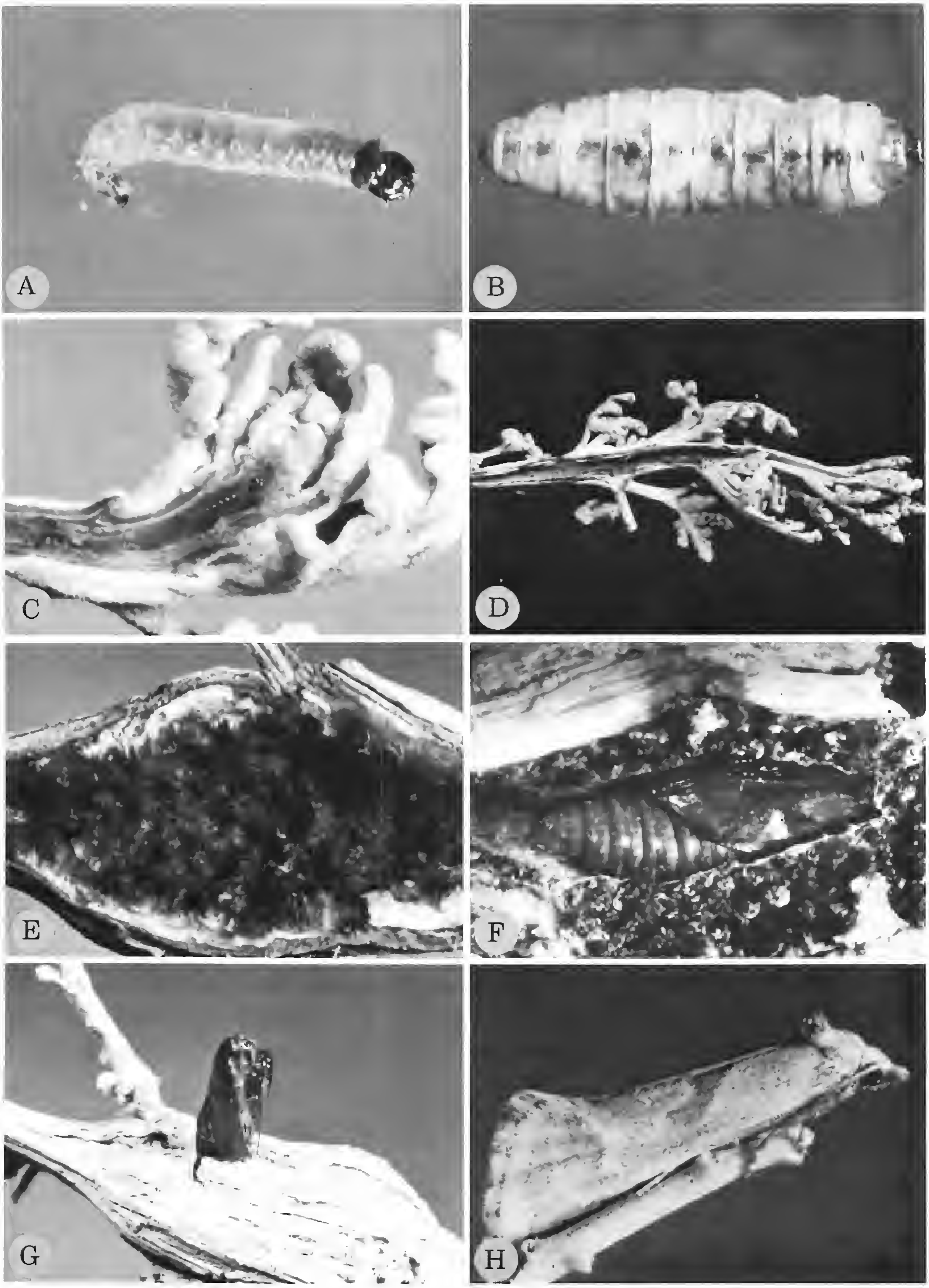

Fig. 2. Life stages of *Carolella beevorana*. A. first instar, 20×, B. mature larva, 5.3×, C. young larva tunneling near apical meristem, 7×, D. young gall in cross-section, 1.5×, E. inner, pitted surface of mature gall, 3×, F. pupa in cocoon, 5×, G. pupal exuvium projecting from exit hole in gall, 2.5×, H. adult at rest, 3.7×.

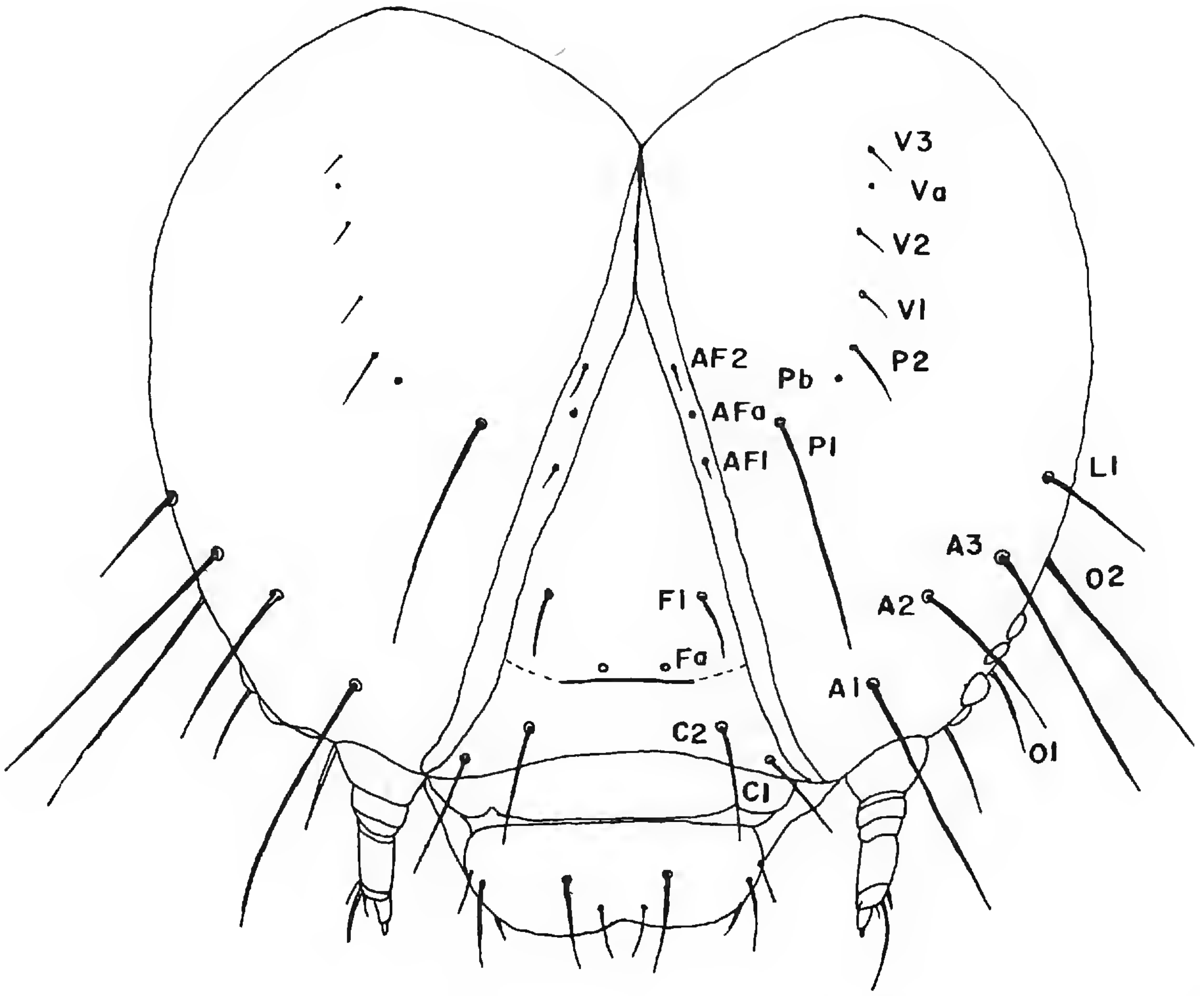

Fig. 3. Dorsal view of head of *Carolella beevorana* last instar (semidiagrammatic). Nomenclature and abbreviations after Hinton (1946) and format after Common (1970).

thetic, terminal branch basally, usually tunneling into the smooth epidermis just distal to a petiole base. A transverse, 2-lipped, entrance hole (0.4 to 0.8-mm wide), usually plugged with feces, marked this point of entry. The larva tunneled directly into the central pith, and then within the pith towards the branch apex (Fig. 2C). The open lumens of 10 young galls, initially comprised of excavated pith (Fig. 2D), began 10 ± 2.8 (range: 6–15) mm distal to the entrance holes. External recognition characters for these incipient galls were chlorotic and slightly swollen apical branches that bore fully expanded leaves along their entire lengths, reflecting slowed branch elongation resulting from reduced apical meristem activity. Although the infested terminal branches usually remained alive, the apical meristems occasionally were killed by the young larvae (Fig. 2C). This prematurely halted the elongation of the infested branch and led to the formation of subspherical galls. Of the first 100, fully formed galls containing larvae collected for laboratory measurement on March 9–17, 1976, at Niland, 21 were subspherical; the remainder, the more typical, fusiform shape (Figs. 2E, 2G).

The young larvae defended their galls against intruding, younger larvae of their own species. Combat usually resulted in the death of the younger

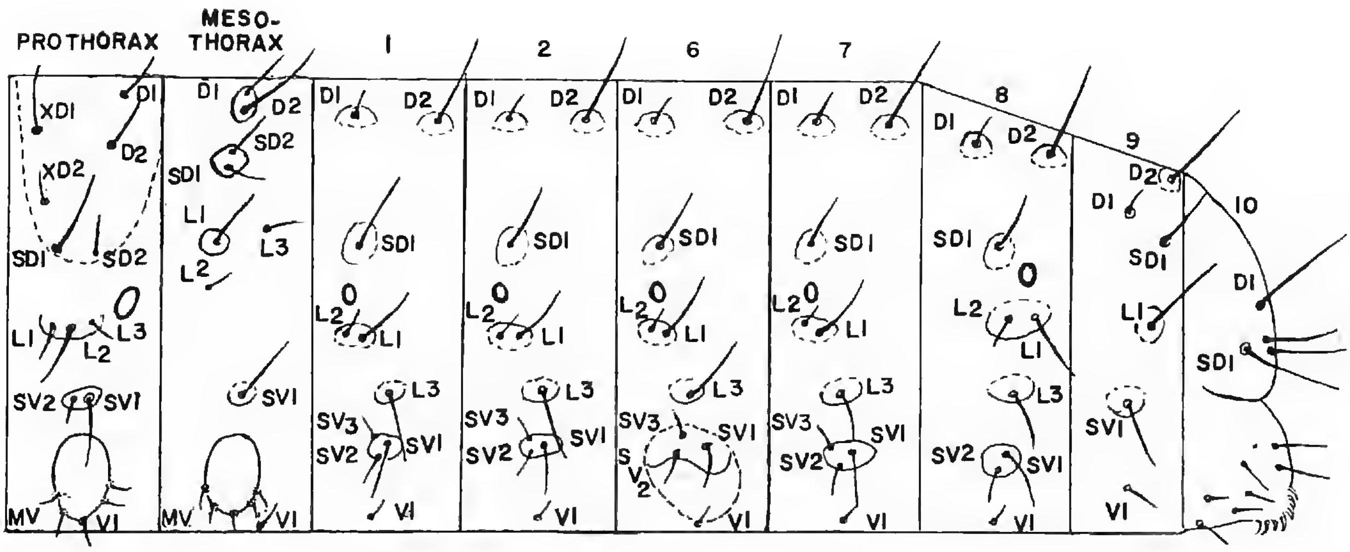

Fig. 4. Setal map of *Carolella beevorana* last instar. Nomenclature and abbreviations after Hinton (1946) and format after Common (1970).

invader and the ejection of its corpse, as with feces and exuviae, through one of up to 3, 0.3 to 0.5-mm diameter, frass ejection holes chewed in the gall walls. These holes usually were located in the basal half of the gall in expanded ray tissue. The larvae pick up and thrust fecal pellets through these ejection holes by means of their mouthparts. The lumens of galls that contained developing larvae were kept free of debris in this manner. Ejection holes in disuse were covered with a silken web sealed by impregnation with an oral secretion that dried hard and black. The covered holes provide translucent windows to the outside through which the larvae apparently perceive photoperiodic stimuli. Small, externally caused breaks in the gall walls were repaired in the same manner.

Only 1 larva developed per gall. The gall expanded in width mainly through the proliferation of parenchyma comprising the longitudinally directed rays, a wound reaction by the host plant to the constant erosion of the inner gall wall by the feeding larva. The inner surface was pitted with concave feeding scars (Fig. 2E) in the expanded rays located between longitudinally directed fibrous ribs. The larva left a silken trail as it moved about and fed within the gall, and completely covered the inner surface with a thin layer of silk as a measure of its activity. The gall thus provided a humid, protected, nutritionally fully supportive microhabitat in an otherwise harsh, arid environment.

The mature larva expanded the gall lumen to its ultimate dimensions and partly filled this space with its coarse feces. It then spun a fusiform, thin-walled, white, silken, centrally located cocoon surrounded by loose fecal pellets (Fig. 2F). The cocoon extended distally as a short, tubular "exit channel" (terminology of Comstock, 1939a) that ended in an exit hole cut laterally in the apical third of the gall wall. The exit hole remained covered by a thin remnant of bark. A few exit channels were directed proximally,

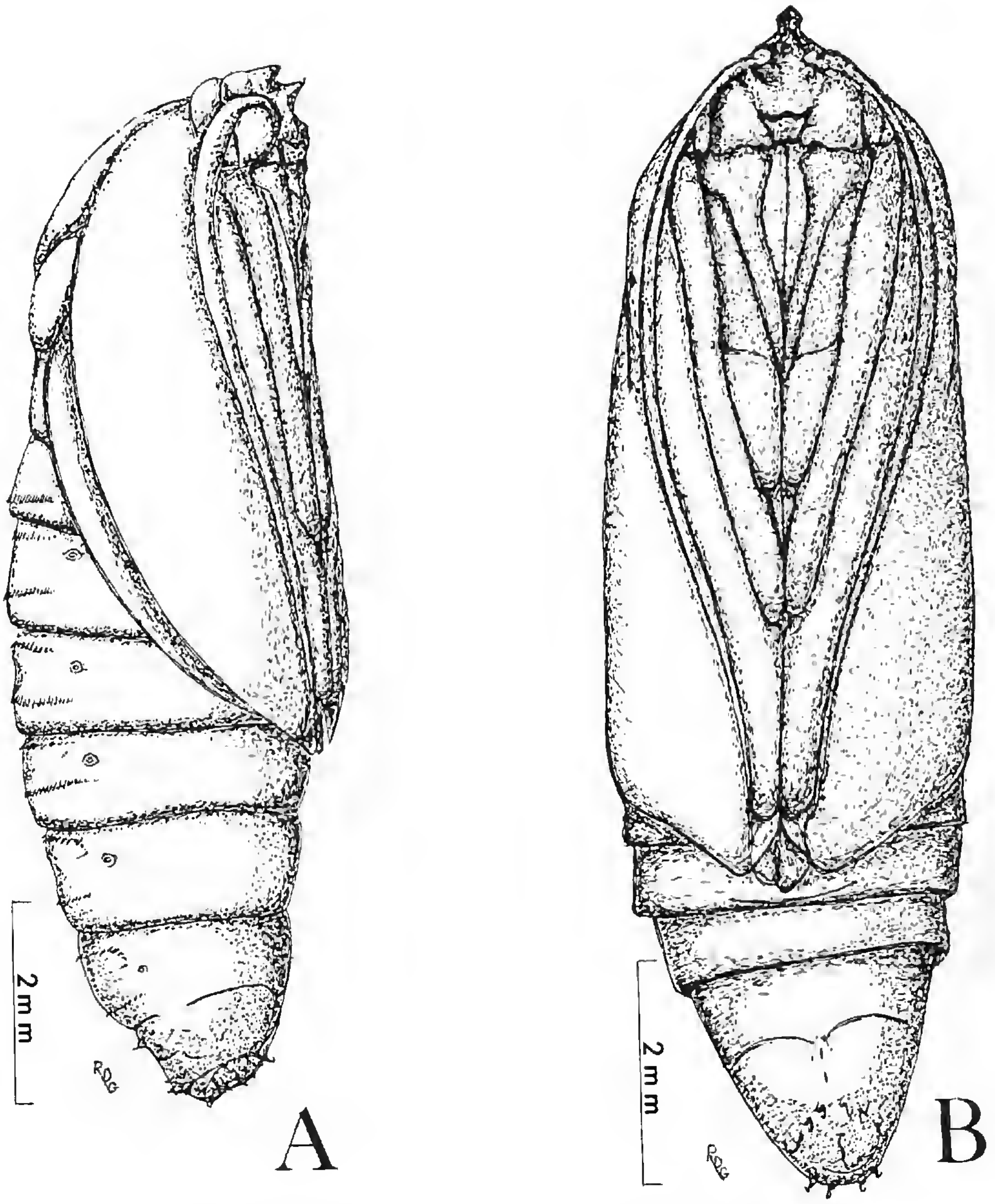

Fig. 5. Pupa of *Carolella beevorana*. A. lateral view, B. ventral view.

and the exit holes thus were located basally. *Carolella busckana* showed similar prepupal behavior (Comstock, 1939a).

The mature larva, which measured 9–12 mm in length, is illustrated in Figs. 1C–G, 2B, 3, and 4. The setal maps (Figs. 3 and 4) employ the nomenclature and abbreviations of Hinton (1946) and the format used to illustrate *Epiphyas* sp. (Lepidoptera: Tortricidae) in Common (1970, pp. 774 and 776).

Mean dimensions of 79 mature fusiform galls were: external length, 29.8 ± 6.29 (range: 18–45) mm; external maximum width, 9.4 ± 2.47 (range: 5–18) mm; and lumen length, 24.5 ± 6.08 (range: 11–38 mm). Sixteen of the 100 fully developed galls containing larvae, noted above, bore no live terminal or lateral branches, 29 bore live lateral branches only, 3 bore live terminal branches only, and 52 bore live terminal and lateral branches. Exit

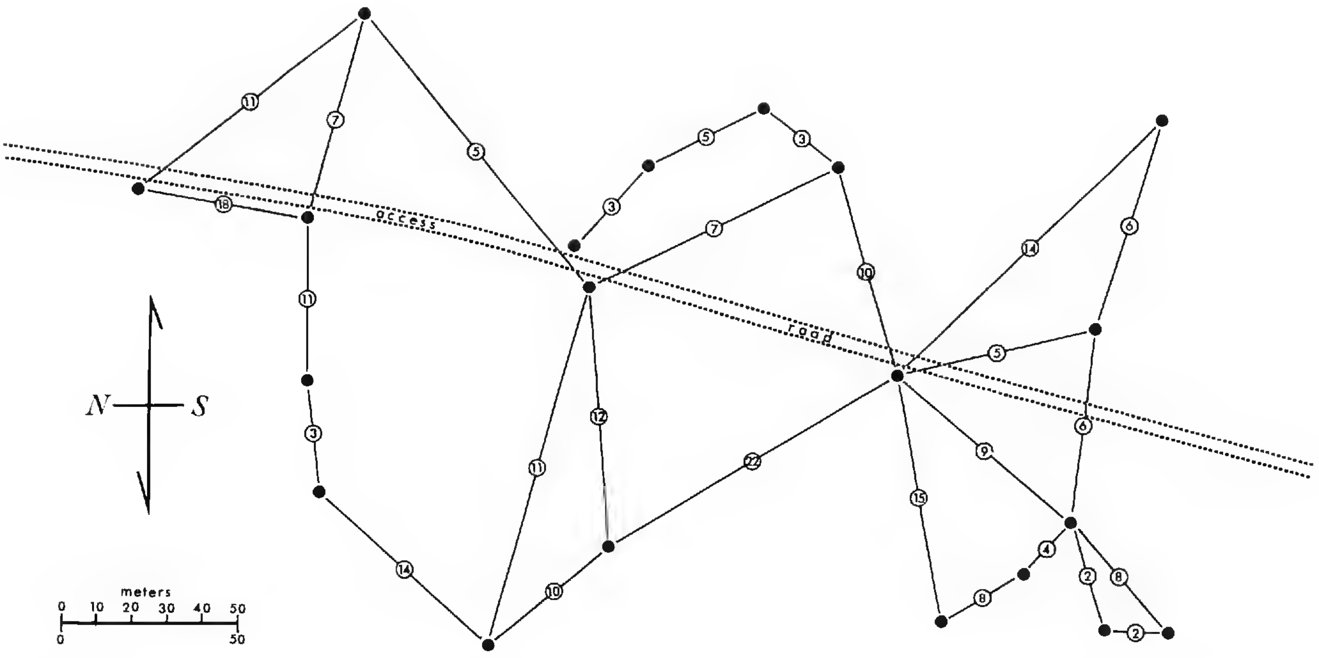

Fig. 6. Map of locations of 20 *Ambrosia dumosa* that bore galls of *Carolella beevorana* (black dots) at the Niland, California, study site in 1976. The numbers of gall-free *A. dumosa* located between selected gall-bearing plants are encircled.

channels in cross-section approximated the shape and diameter of the exit holes, 35 of which ranged from circular to elliptical and measured 3.3–3.8 mm across. The long axes of 24 galls measured on 2 plants in nature pointed to all quarters of the compass. Only 3 of 24 (12.5%) galls formed descending angles of 20° and 30° with the horizon; the remainder formed ascending angles that averaged ca. 14° and ranged from 0° to 80°.

Pupa.—Forty-four pupae averaged 9.2 ± 1.18 (range: 6.5–11.6) mm in length, apparently slightly larger than pupae of *C. busckana,* as well as darker and more cylindrical, according to Comstock (1939a, 1939b). The pupa is illustrated in Fig. 5.

Pupation occurred in the central cocoon (Fig. 2F), with the head directed towards the exit hole. The abdomen moved freely. The emerging pupa worked its way out of the cocoon and through the exit channel using the 2 rows of short, serrate, posteriorly-directed spines on the dorsum of each abdominal segment for traction (Fig. 5A). With the aid of the sclerotized, 2-pronged process on its vertex (Fig. 5), it broke through the bark window and projected from the exit hole, with its head, thorax, and upper abdomen free, anchored by the cremasteric hooklets at the tip of the abdomen (Fig. 5).

Adult.—Adults (Fig. 2H) were not observed in nature. The fragile pupal exuviae remained projecting for a few days from the exit holes as evidence of adult field emergence (Fig. 2G).

In the insectary, the preovipositional periods of 8 females caged on potted

A. dumosa averaged 4.4 ± 1.65 (range: 2.0–6.5) days. These females laid an average of 54 ± 29.9 (range: 7–106) eggs during an average ovipositional period of 5.5 ± 3.26 (range: 1.5–10.5) days and lived an average of 11.6 ± 1.6 (range: 9–13.5) days. A single female laid as many as 29 eggs and an average of ca. 10 eggs during a 12-hr photoperiod. Three non-ovipositing females and 5 males also lived ca. 12 days in the same cagings.

Host-plant relations.—The 20 plants attacked by *C. beevorana* represented only ca. 0.5% of the potential host individuals contained in the part of the study area mapped in Fig. 6. Five gall-bearing plants were located along an unpaved access road. No obvious differences were noted in the location, crown size, and vigor of these plants compared to uninfested *A. dumosa*.

When surveyed during March 9–16, 1976, the 20 galled plants averaged 62 ± 8.8 (range: 50–80) cm in height and ca. 134 ± 19.4 (range: 100–175) cm in diameter. They bore an average total of 80 ± 96.6 (range: 1–357) galls, of which an average of 7 ± 11 (range: 0–45) were nearly fully formed, intact, and contained mid-instar larvae. Of the 1603 galls excised from these 20 plants, 1463 (91.3%) were old and empty. Galls were distributed throughout the crowns, with 22%, 28%, 27%, and 23% found in the north, east, south, and west quadrants, respectively. More galls occurred in the lower (52%) and middle (41%) thirds of the crowns.

Seasonal history.—Only 11 of the 20 (55%) gall-bearing plants (Fig. 6) bore current generation galls, indicating that not all plants were re-attacked during successive years. *Carolella beevorana* usually is a univoltine species, with overlapping generations that principally result from a protracted, winter, emergence period. Comstock (1939b) reported the occurrence of mature galls along with immature galls, containing very young larvae. This, he suggested, indicated a 2-year period of development or a protracted emergence period. Both interpretations were correct. Field observations and insectary cagings of excised galls indicated that most adult emergence at Niland occurred in mid-December 1976 and 1977, following pupation in late November and early December that apparently coincided with the first winter rainfall, which also re-initiated host-plant growth. A smaller segment of this population pupated, emerged, and oviposited during January and February. A still smaller segment, i.e., 3 individuals in labelled galls, took 2 years to emerge as adults. Comstock (1939a) reported adult emergence during December 4–31 from excised galls collected at Ludlow and the trapping of 2 adults near Yermo on January 28.

Natural enemies.—Intraspecific, internecine combat accounted for some early-instar, larval mortality, as noted above. *Spilochalcis* sp., nr. *mariae* (Riley) and *Spilochalcis* sp., nr. *flavopicta* (Cresson) (Hymenoptera: Chalcididae) were reared as solitary, larval-pupal endoparasites from galls collected at Niland during November 1976–January 1977. Larvae and pupae of *C. beevorana* were preyed upon by larvae of *Cymatodera fuchsii* Schaeffer (Coleoptera: Cleridae).

Acknowledgments

Carolella beevorana was identified by Dr. D. C. Ferguson, Systematic Entomology Laboratory, IIBII, USDA, %U.S. National Museum of Natural History, Washington, D.C. Mr. R. J. LaSalle, Division of Biological Control, Department of Entomology, University of California, Riverside, identified the chalcidids.

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NONARTHRA CYANEUM BALY (COLEOPTERA: CHRYSOMELIDAE: ALTICINAE), A PAN-PACIFIC FLEA BEETLE[1]

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A gift of insects in December 1978, to the North Dakota State Insect Reference Collection by Captain Mike Knutson, U.S. Army, included 9 specimens of an unusual species of flea beetle (Fig. 1) having only 9 antennal segments (Fig. 2). Collection data are: "Ft. Sherman, Panama C.Z. Feb. 1976", "Mike Knutson Collector".

No alticines previously known from the western hemisphere have such reduced antennae—the majority of genera have 11 segments and a few genera have 10 (Arnett, 1962; Scherer, 1962). Dr. G. Scherer,[2] a world authority on the Alticinae, informed me that to his knowledge, only the genus *Nonarthra* Baly, known from the Orient, contains species with 9 segments per antenna. I therefore compared our specimens with the literature describing this genus and was convinced that the beetles from Panama were a *Nonarthra* species.

Heikertinger and Csiki (1940) listed 29 species of *Nonarthra* valid at that time which are distributed from Australia (Queensland) and the Celebes [the Australian Faunal Zone], Borneo, Viet Nam, India, Burma, the Philippine Islands, Southern China [the Oriental Faunal Zone] to China, Korea, and Japan [the Palearctic Faunal Zone]. Maulik (1926) included 8 species in his keys to the species of India, Ceylon and Burma; and Scherer (1969), who later revised Maulik's treatment, reduced this number through synonymy to 4. Gressitt and Kimoto (1963) listed 7 species for China and Korea, also further reducing through synonymy the earlier list of Heikertinger and Csiki (1940). Kimoto (1965) included 5 species for Japan and Samuelson (1973) listed one species, *N. cyaneum* Baly, for Oceania.

In attempting to identify the Panamanian specimens to species I used the papers of Maulik (1926), Scherer (1969), Gressitt and Kimoto (1963) and Kimoto (1965). The beetles keyed to *N. cyaneum* Baly (1874) in the publications of the latter two authors. Through the kindness of Dr. Richard E. White[3] I obtained the loan of 3 specimens of this species, collected in Szechuan Province, China, and which now belong to the U.S. National Museum. I also compared the Panama specimens with one labeled "Suhara [Japan] Gifu Prcf. 13·5·1951" and one labeled "Erzendjanzcy Mai 1938 Mandschurei" [Manchuria], both determined as *N. cyaneum* Baly by Dr. G. Scherer, to whom I am grateful for the gift of these two specimens. I

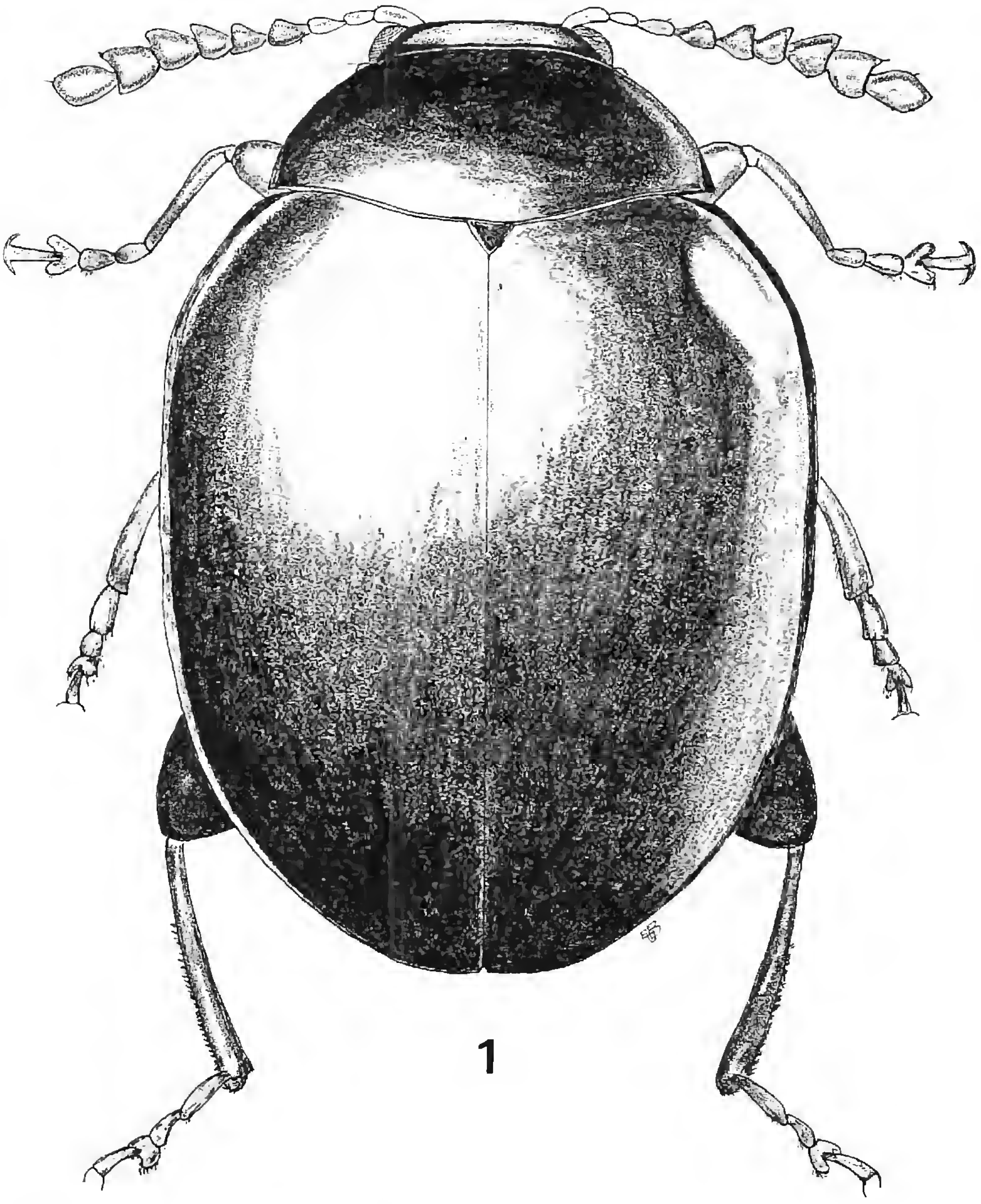

Fig. 1. *Nonarthra cyaneum* Baly.

believe that the recent specimens from Panama are representatives of *N. cyaneum* Baly. They agree very closely with the determined specimens I have seen but differ slightly in that 2 of the 3 China specimens of the USNM are slightly more brownish on the dorsum, rather than the normal blackish blue. I suspect that these 2 brownish specimens were teneral when collected—which is also indicated by their soft, distorted shapes. They differ from *N. tibiale* Jacoby, which is similar in appearance. *N. cyaneum* has the fourth antennal segment triangular (Fig. 2), rather than elongate (Kimoto, 1965). The aedeagus, however, compares favorably with that of *N. cyaneum* as illustrated by Samuelson (1973).

The previously known distribution for *N. cyaneum* Baly, 1874 (type-lo-

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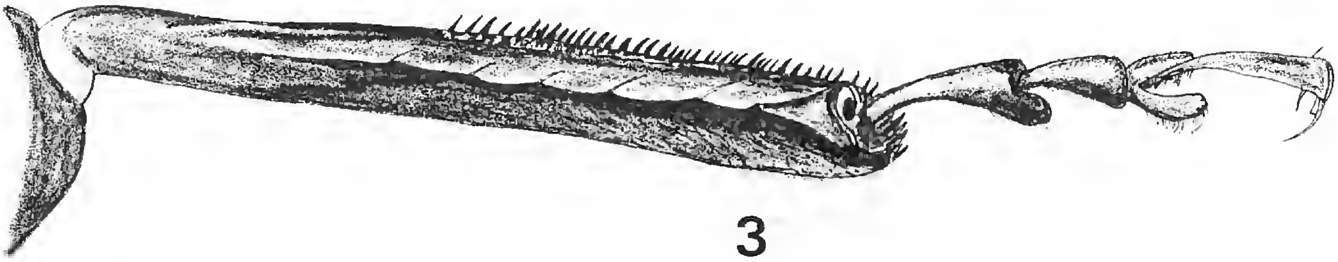

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Figs. 2–3. Fig. 2. Right antenna of *N. cyaneum* Baly. Fig. 3. Right hind tibia and tarsus of *N. cyaneum* Baly.

cality Nagasaka—type depository BMNH, London) includes Japan, China (Hopei, Szechuan, Sikang, Hupeh, Anhwei, Chekiang, Kweichow, Kiangsi, Kwangtung, Fukien), Taiwan (Gressitt and Kimoto, 1963), and Bonin Islands, Micronesia (Samuelson, 1973). The specimen from Manchuria listed in this paper represents a new regional record for China. The specific Old World source for the Panamanian beetles is not known.

The 9 flea beetles from Panama therefore represent a New World record, both for genus and species and are now even more truly pan-Pacific in distribution. They also have possible economic significance. Gressitt and Kimoto (1963) recorded beets, *Beta vulgaris* L. var. *altissima* Rossig, and a rose, *Rosa Wichuraiana* Crep. as host plants. I reconfirmed the accuracy of the collection data for the Panama specimens from Captain Knutson, the collector. He does not recall specific host plants but commented that his collection efforts while in the Canal Zone included gardens. In as much as the Panama Canal serves as a major highway for commerce, it is not surprising to learn of new introductions for that territory which may have been imported via ships.

Because these beetles are new immigrants, a reiteration of how they can be distinguished from other New World fauna would be of some value. An additional, new initial couplet can be amended to the key to "Groups" of Scherer (1962), which would distinguish this unique new "Group" having only 9 antennal segments. A brief description of the species *N. cyaneum* Baly, follows:

Ovate, convex, dark metallic blue; ventrally the pro-, meso-, and metathorax pitchy black—abdominal sternites vary from all black to all yellowish brown—the yellowish brown occurring on apical segments in specimens having both colors. Antennae pubescent, pitchy black on segments 4–9, basal 3 segments shining black on ectal surface and yellowish brown on ental surface. Head smooth, shining; sparsely, very finely punctate. Frontal calli contiguous, a slight transverse depression immediately dorsad of the calli. Prothoracic coxal cavities closed behind. Hind femora broad—width ½ the length. Apex of hind tibia rounded and edged with a row of short teeth (Fig. 3). Hind tarsus inserted in tibia on dorsal side before apex. Length of Panamanian specimens 3.3–3.9 mm. Mean 3.6 mm [3.5–4.5 mm for Oriental specimens (Gressitt and Kimoto, 1963)].

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A REVIEW OF THE GENUS *ROEDERIODES* COQUILLETT WITH THE DESCRIPTION OF A NEW SPECIES (DIPTERA: EMPIDIDAE)

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J. G. Chillcott revised the genus *Roederiodes* in 1961, describing five new species. Since that time, more material has been collected and now some of the species can be better defined. The purpose of this paper, the first of a series seeking to revise all the clinocerine empidid genera, is to review the genus *Roederiodes* and update Chillcott's 1961 paper.

Adults of *Roederiodes junctus* Coquillett have been observed capturing and feeding on adult blackflies. Peterson and Davies (1960) reported adult *R. junctus* feeding on adults of *Simulium venustum* Say in Algonquin Park, Ontario. The blackflies were captured from swarms by flying *R. junctus* individuals, and from the water surface by females skimming on the surface film. Needham (1901) reported larvae and pupae of the same species associated with simuliid pupae and empty pupal cases, the *Roederiodes* pupae being found in empty simuliid pupal cases.

Large numbers of *R. junctus* adults have been found beneath pieces of board which were positioned just above the water surface (Needham, 1901). I have observed *R. wirthi* adults resting in a similar manner on the lower surfaces of rocks which closely overhang clear, fast-flowing streams. Mating was observed to take place in these assemblages.

The sharp, piercing mouthparts of *Roederiodes* adults differ from those of most other clinocerines, which are short and relatively haustellate. Adults of such genera as *Clinocera* and *Wiedemannia* feed on small, soft-bodied insects which they capture from thin water films flowing over rocks. It is possible that the more robust mouthparts of the *Roederiodes* adults are adapted for feeding on heavier bodied insects like blackflies. Careful observation is necessary in areas of abundance of these flies to elucidate their feeding habits and prey preferences.

Representatives of the genus occur throughout North America. Frey (1940) described a species from Madeira Island and herein one is described from Cocos Island. This peculiar distribution almost certainly reflects a lack of collecting. Clinocerine empidids in general are not commonly collected because of their tendency to stay close to the substrate and to make only short, low flights along the water surface when they are disturbed. Collecting on emergent rocks with an aspirator while wading streams is the only effective way to capture most species. *Roederiodes* adults are even more secretive than typical clinocerines, resting beneath overhanging surfaces where they are constantly moistened by water spray. Only an occasional specimen can be collected with a net or flight trap. For this reason, I believe that the genus probably has a much wider distribution than present material indicates.

The name *Roederiodes* was chosen for the genus because of the supposed similarity of its members to the European *Roederia,* now considered to be a subgenus of *Wiedemannia.* The specific epithet of the type species, *juncta,* had the feminine ending. The name was used in that form until Melander's 1927 revision, when it was spelled, without explanation, *Roederioides.* Curran (1934) also adopted this spelling, and it was generally used in that form, even by Chillcott in 1961, until Melander (1965) again used the original spelling, *Roederiodes.* At that time the endings on the specific epithets were changed to the masculine. This is in accordance with the ICZN Article 30(a).(ii).

Key to the Species of *Roederiodes* Coquillett
(Modified from Chillcott, 1961)

1. Proboscis longer than head height .... *longirostris* Frey
   Proboscis at least slightly shorter than head height 2
2. Doroscentrals 5, strong; ocellar and vertical bristles strong 3
   Dorsocentrals 7–8, weak; ocellar and vertical bristles weak; small median ocellar bristle present .... *wirthi* Chillcott
3. Acrostichals present and well-developed, numerous; mc crossvein present and distinct .... *distinctus* Chillcott
   Acrostichals, if present, not occurring posterior to second dorsocentral; mc crossvein absent or very short 4
4. Antennal style twice as long as third antennal segment; basal costal bristle subequal in length to second basal cell ..... *wigginsi* n. sp.
   Antennal style less than twice as long as third antennal segment; basal costal bristle much shorter than second basal cell 5
5. Hind tibia with distinct median ventral bristles; hypopygium with surstylus long, slender and curved anterad .... *recurvatus* Chillcott
   Hind tibia without distinct median ventral bristles; hypopygium with surstylus short and broad 6
6. Dorsal lobe of hypopygium broad and truncate at apex; tip of aedeagus with truncated lateral arms .... *junctus* Coquillett
   Dorsal lobe of hypopygium more slender, not distinctly truncate; tip of aedeagus with pointed lateral arms .... *vockerothi* Chillcott

Fig. 1. Wing of *Roederiodes wigginsi*, holotype.

Roederiodes wigginsi, new species
(Figs. 1–2)

Description.—Small body size, 1.8 mm in length; with brown coloration.

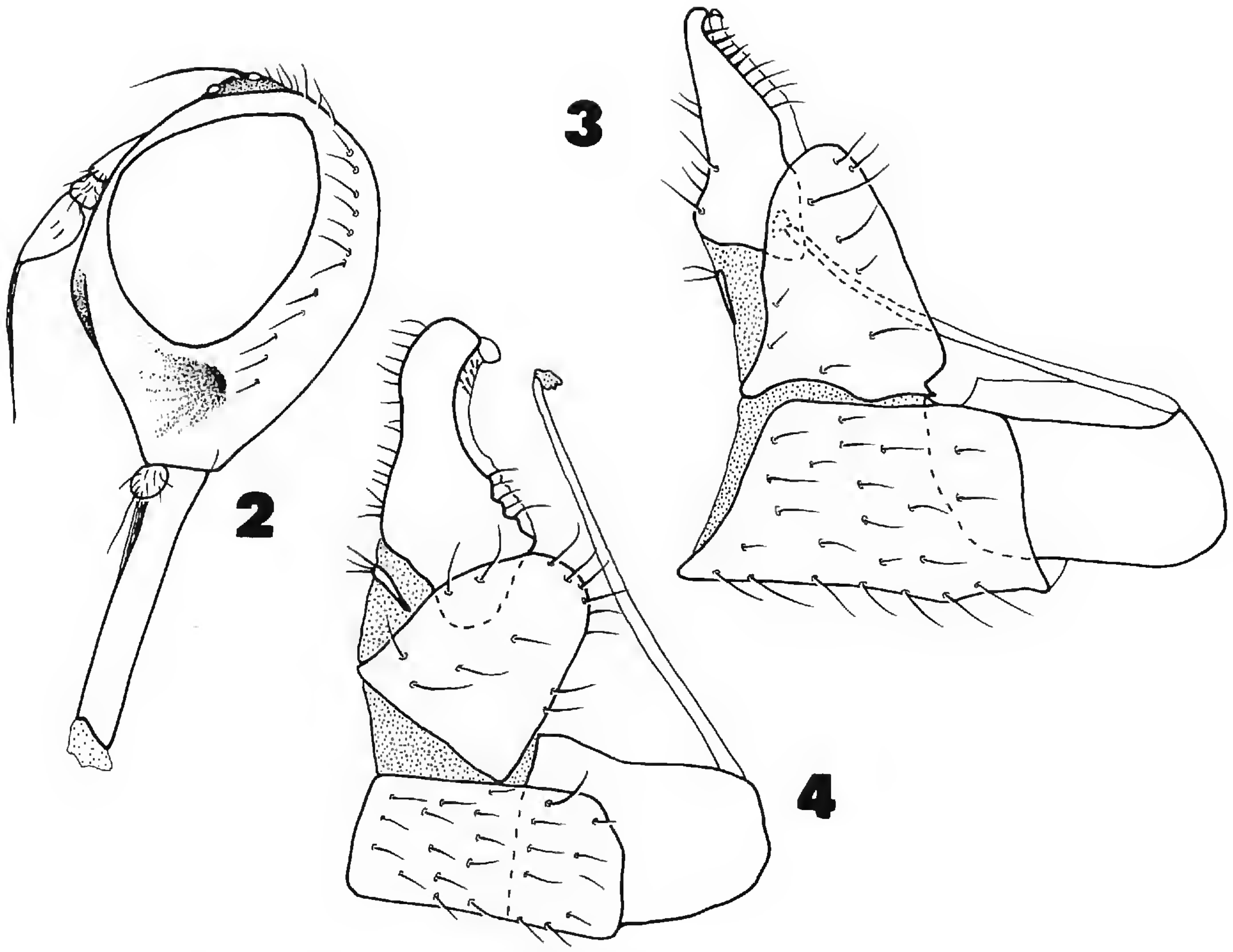
Head (Fig. 2).—In profile widest at lower eye margin, strongly receding to oral margin. One pair of strong vertical bristles present; no setulae present on lower two-thirds of head between eye and postoccipital bristles; one pair of weak genal bristles present. Third antennal segment short ovate, style twice as long as third segment. Proboscis .70 of head height.

Thorax.—Acrostichals absent; dorsocentrals five, strong; two small anterior notopleural setulae. Mesonotal depression concolorous with rest of thorax.

Wing (Fig. 1).—Length 2.3 mm, slightly infuscated. Basal bristle longer than second basal cell. Humeral crossvein not visible, costal cell distinctly darkened. Second submarginal cell four times as long as broad. Medial and cubital veins distinctly coalesced for a distance one eighth the length of the second submarginal cell. Anal vein indicated by a short spur; dorsal half of anal cell infuscated.

Legs.—Uniform brown, slightly paler than thorax. Anterior femora slender; tibiae without distinct median ventral hairs.

Hypopygium.—Male unknown.



Figs. 2–4. Fig. 2. Head of *Roederiodes wigginsi,* holotype. Fig. 3. Hypopygium of *R. distinctus*. Fig. 4. Hypopgium of *R. wirthi*.

Type material.—Holotype ♀, "COSTA RICA: ISLA DEL COCO, Bahia de Chatham, 22-I-1967. Ira L. Wiggins" "California Academy Sciences Type No. 13622." "Holotype Roederiodes wigginsi Wilder 1980."

Discussion.—This species may be distinguished from other known species of *Roederiodes* by the small size, long proboscis, long antennal arista, and the long basal costal bristle. *Roederiodes wigginsi* is named in honor of the distinguished botanist, Ira L. Wiggins, who collected the unique specimen.

The holotype was collected in a flight trap, but despite subsequent flight trap collections, no additional specimens have been found. No blackflies are recorded from Cocos Island, but numerous ceratopogonid midges live in the streams and could serve as a food source for these tiny flies (C. L. Hogue, in litt.).

Roederiodes junctus Coquillett

Roederiodes juncta Coquillett, 1901:585. Holotype ♀, USNM Type No. 5345. Type locality: Saranac Inn, Adirondack Forest Preserve, New

York. Needham (1901:581, figs. 5–8); Melander (1902:239); Coquillett (1903:257); Coquillett (1910:601); Engel (1918:264); Johannsen (1935:20); Peterson and Davies (1960:9, 10, 12).
Roederioides juncta: Melander (1927:225, pl. 2, fig. 9); Chillcott (1961:422, figs. 1, 5, 13, 16, 21, 26).
Roederiodes junctus: Melander (1965:467).
Roederoides juncta: Knutson and Flint (1971:316). (lapsus calami).

Discussion.—Adults vary in length from 2.0 to 3.3 mm; there is little additional intraspecific variation. Members of *R. junctus* are easily distinguished from those of *R. recurvatus* by the structure of the hypopygium (Chillcott, 1961:421), the silvery mesonotal depression, a more rounded head profile, longer antennal style, and the absence of tibial bristles. Chillcott stated that adults of this species differ from those of *R. vockerothi* Chillcott (1961:424) only in minor genitalic characters. The characters used in this comparison are not consistent within other species, however. More material of *R. vockerothi* must be examined before a decision on its status can be made.

Roederiodes junctus occurs in the northeastern U.S. and southeastern Canada. *Roederiodes vockerothi* is represented by one specimen taken in Gainesville, Florida (Type ♂, CNC No. 7185).

Roederiodes recurvatus Chillcott

Roederioides recurvata Chillcott, 1961:424, figs. 3, 6, 12, 14, 17, 22, 25. Holotype ♂, CNC Type No. 7186. Type locality: Old Chelsea, Quebec.
Roederioides juncta: Vaillant (1960:117, figs. 1a–b) (misidentification).
Roederiodes recurvatus: Melander (1965:468).

Discussion.—Adults vary in body length from 2.0 to 3.25 mm; the leg color varies from yellow to dark brown. *Roederiodes recurvatus* adults are generally smaller than those of *R. junctus,* and can be distinguished from them by the distinctive genitalia (Chillcott, 1961:421; Vaillant, 1960:119), the mesonotal depression concolorous with the rest of the mesonotum, the elongate head profile, the shorter antennal style and the presence of ventral bristles on the hind tibia. Examination of new material indicates that the dorsal lobe of the hypopygium is "elbowed" in macerated specimens, but appears to be uniformly curved anterad in dried, unprepared material.

This species occurs throughout eastern North America from Quebec to Virginia and Tennessee.

Roederiodes distinctus Chillcott
(Fig. 3)

Roederioides distincta Chillcott, 1961:425, figs. 4, 8, 23. Holotype ♀, USNM Type No. 65091. Type locality: South Vrain Creek, Boulder Co., Colorado.

Roederiodes distinctus: Melander (1965:468).

Discussion.—Adults vary in length from 2.7 to 3.0 mm; leg color varies from brown to black. Members of this species can be separated from other *Roederiodes* by the distinct mediocubital crossvein, the tuberculate facial profile, the anteriorly inclined eye, and the presence of well-developed acrostichal setae.

Type material did not include males. Subsequent collections have produced a male from Trail River, Northwest Territories (CNC). It conforms exceptionally well with Chillcott's description of the female. The hypopygium (Fig. 3) has the surstylus long, narrow, evenly tapering to a pointed, mesally inclined tip, the inner surface with numerous spines.

At present, this species is known from only the two above-mentioned localities.

Roederiodes wirthi Chillcott
(Fig. 4)

Roederioides wirthi Chillcott, 1961:426, figs. 2, 9, 11, 15, 19, 24, 28. Holotype ♂, USNM Type No. 65092. Type locality: Catron Co., 5 mi E of Glenwood, New Mexico.
Roederioides retroversa Chillcott, 1961:427, figs. 10, 20, 29. Holotype ♂, USNM Type No. 65093. Type locality: St. Helena Creek, Lake Co., California. **NEW SYNONYMY.**
Roederiodes retroversus: Melander (1965:467).
Roederiodes wirthi: Melander (1965:467).

Discussion.—Chillcott's concept of this species was based on a few specimens from widely separated areas. Currently available material from intermediate areas gives a clearer idea of the intraspecific variation.

Roederiodes wirthi adults are easily separated from those of other species by the weak head bristles, the presence of a weak median ocellar hair and the weak and more numerous dorsocentrals.

The head profile of these flies varies considerably, from smooth to tuberculate among individuals of the same series. This was one of the principal characters originally used to separate *wirthi* from *retroversus*. The other significant character used to distinguish the two was the structure of the hypopygium. There is remarkably little variation in the terminalia. The differences which Chillcott mentioned were due to differences in the degree of maceration of the genitalic structures of the specimens. The hypopygium has the surstylus strongly tapering on the basal half, then parallel sided to a rounded-truncate, mesally directed apex (Fig. 4).

The length of the proboscis rarely varies from two thirds (.63–.70) the head height. The number of genal hairs varies from 0–3. The distance for which the medial and cubital veins are coalesced varies considerably from not at all to distances up to three times the length of the radiomedial crossvein. Leg color varies from yellow to black, the usual color being brown.

Additional material shows that this species ranges from New Mexico into California from San Diego to Lake County. Adults are found associated with small, clear fast-flowing streams.

Acknowledgments

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A REVISION OF THE GENUS *NIPHOGENIA* MELANDER (DIPTERA: EMPIDIDAE)

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A. L. Melander erected the genus *Niphogenia* for the single species, *eucera,* in 1927. Since that time, nothing has been written about these unusual flies, and until recent years very few have been collected. The purpose of this paper is to better define the genus, to make available some behavioral observations, and to describe one new species.

Niphogenia adults are readily distinguished from other empidids belonging to the subfamily Clinocerinae by the remarkably lengthened third antennal segment (Fig. 1). *Ceratempis longicornis* adults also have the third antennal segment elongate, but they lack an antennal style and acrostichal setae.

Most clinocerines are associated with water, the larvae being aquatic and the adults occurring on rocks in or at the edge of streams. In these genera, prey is taken from the water in some way. *Niphogenia,* a primitive clinocerine, is not aquatic.

I have observed *N. eucera* adults on various occasions at elevations from 1150 to 1830 m on alpine meadows in the Cascades. These flies are often abundant, but not easily collected with a sweep net because they rest, feed, and mate on the surface of the soil or on very low-growing vegetation. Only in areas of extreme abundance are specimens seen on taller vegetation. They are found on moist soil, sometimes associated with small streams from melting snow, but are not as intimately associated with the water as are most other clinocerines.

Individuals of *N. eucera* feed on insect larvae (and perhaps other soft-bodied arthropods) which they unearth from the soil. They move the loose soil with their tarsi until an individual unearths a larva. Other adults immediately converge on the prey, pull it from the ground, and tear it to pieces, each individual eventually devouring its own small portion (Fig. 2). I have observed feeding behavior only in localities where the flies were present in large numbers, and it is likely that such dividing of food does not take place where the density of individuals is not as great.

Despite the large number of females I have collected and observed, the males are represented by only a few specimens. The males may emerge earlier and mate with the females when they are still teneral, passing their

Figs. 1–2. Fig. 1. *Niphogenia eucera,* female, habitus. Fig. 2. *N. eucera* females feeding.

peak density at a time earlier than the dates of collection. Mating behavior in this species was observed only once, the coupling taking place on a low-growing leaf in a locality where many *N. eucera* were present. The female was teneral.

The following generic description is an expansion of Melander's (1927) original description of the genus.

Niphogenia Melander

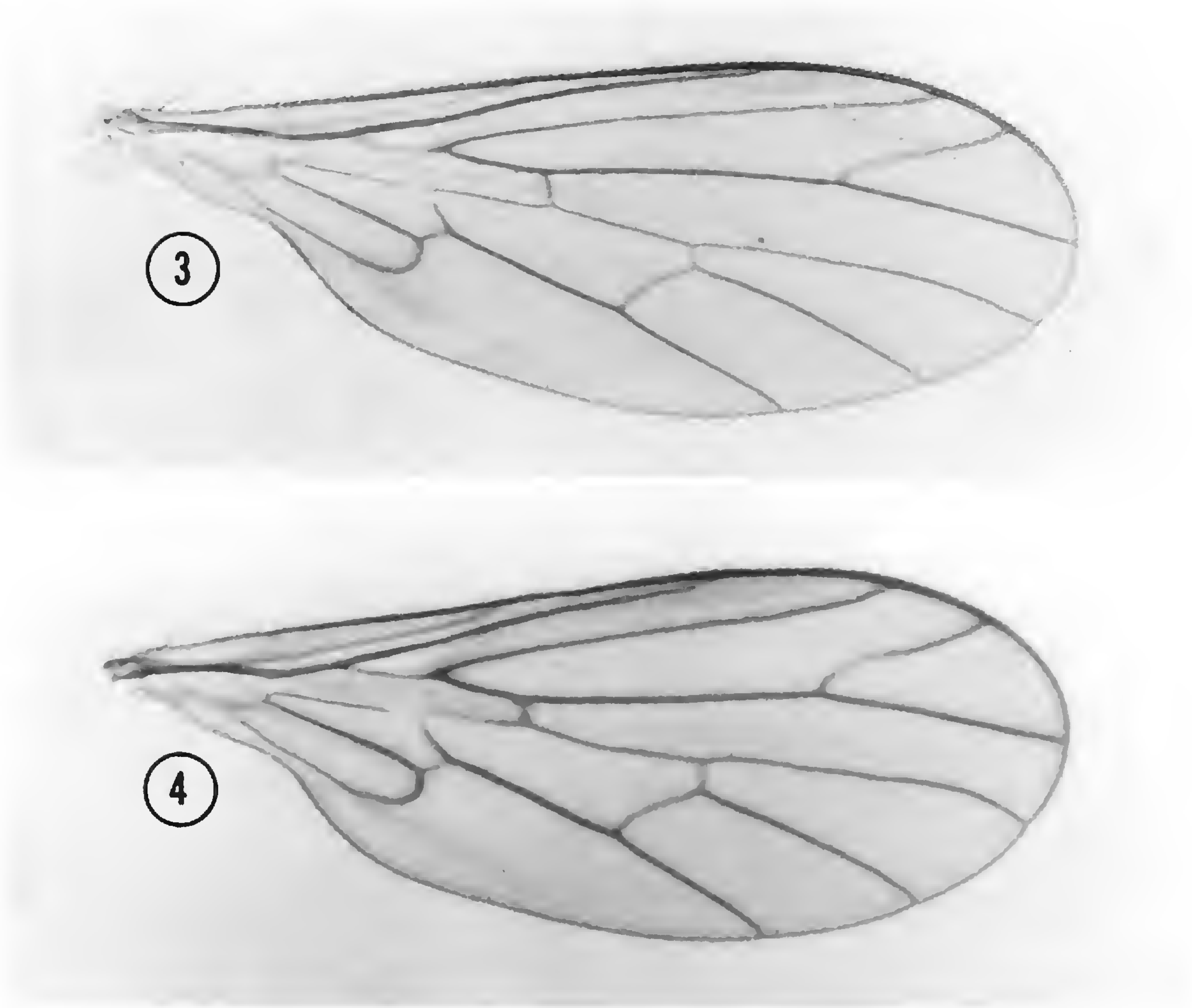
Niphogenia Melander, 1927:217. Type-species, *eucera* Melander (by original designation).

Description.—Delicate empidids with lengthened antennae (Fig. 1). *Head* round; eyes round, bare, facets uniform. Face wide, convex, protruding in female, continuous with the small genae, its lower edge straight; front broad, more so in female, diverging from antennae to ocellar triangle, a small excision in the eyes at antennae, a few small setae on front above excision. Ocellar triangle slightly elevated with one pair of strong ocellar and several small post-ocellar bristles. Two to three poorly defined rows of strong occipital bristles, one row of strong setae ringing occipital foramen laterally and ventrally. First antennal segment cylindrical, more than twice as long as the globose second segment, both with a few small setae; third segment more than twice as long as the first two, slightly tapering, shorter and strongly tapering in female, loosely pubescent, tipped with a small bristle. Proboscis short, sharp, with fleshy labella, palpi elongate oval, with a few setae; oral opening ringed with hairs laterally and ventrally. *Thorax:* Pronotum with a row of short, stiff bristles; mesonotum with two rows of dorsocentrals and a single median row of acrostichals, 2–3 humerals, 1–2 posthumerals, 2–3 notopleurals, one each prealar, supraalar, postalar, two scutellars; metapleuron with a cluster of hairs; proepisternum with bristles above coxal bases. *Legs* slender, not bristly, coxae setose; tarsi longer than their tibiae, pulvilli small, empodium microscopic. Hind tibia with dorsal bristles; middle tibia of males with small, thorn-like flexor spines on apical portion. *Wings* with anal angle projecting only slightly, costa encompassing wing, costal bristle present, small; subcosta weak, complete; R_{4+5} forked, discal cell complete, emitting three veins; the first basal cell considerably longer than the second; anal crossvein curving into lower side of anal cell, no anal vein, anal cell subequal to second basal cell. Calypters with a nearly straight edge and weak fringe. *Abdomen* cylindrical, segments loosely setose with small pittings along base of second segment and with two visible (three total) laterally on segments 3–7. Pygidium with lateral valves elongate, but usually folded mesally and ventrally, appearing globular; dorsal process of lateral valve long, slender and pointed; aedeagus erect with a long, slender basal appendage; cerci large and erect. Female with seventh sternite polished apically.

Key to the Species of *Niphogenia* Melander

1. General body color brown, legs light brown to yellow; males with comb on apical half of middle tibia strongly differentiated (Fig. 6); hypopygium with dorsal process of lateral lobe not reaching apex of lateral lobe (Fig. 10), not crossing or crossing only at tips in folded hypopygium (Fig. 8); females with proboscis a broad triangle, setose, narrowed to a rounded apex (Fig. 13) .... *eucera* Melander

General body color black, legs brown to dark brown; males with comb on apical third of middle tibia weakly differentiated (Fig. 5);

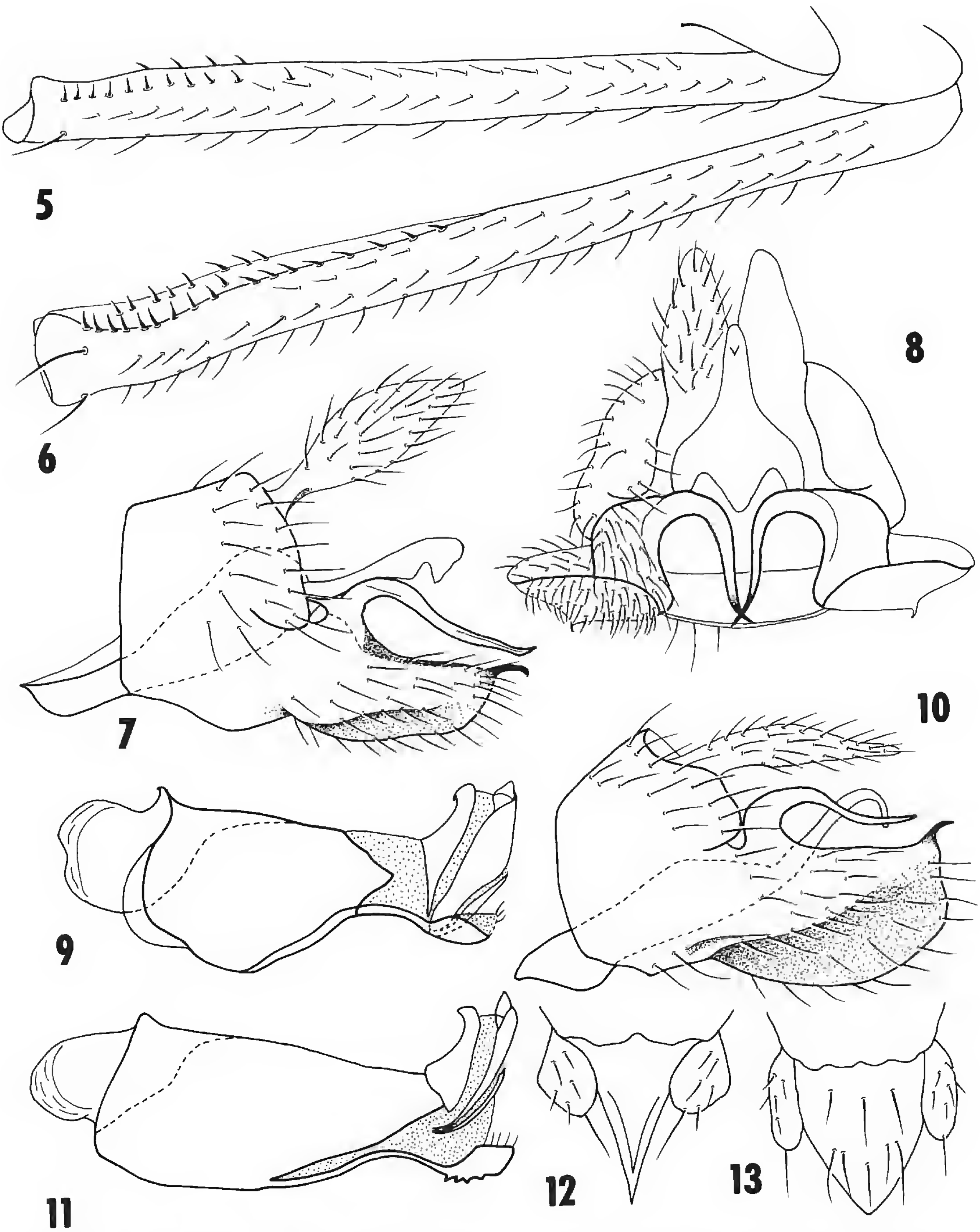


Figs. 3–4. Fig. 3. Wing of *N. eucera* male. Fig. 4. Wing of *N. turneri* holotype.

hypopygium with dorsal process of lateral lobe surpassing apex of lateral lobe (Fig. 7), crossing at bases in folded hypopygium; females with proboscis a narrow triangle with a sharp, pointed apex (Fig. 12) .... *turneri,* new species

Niphogenia eucera Melander
(Figs. 1–3, 6, 8–10, 13)

Description.—Body length 2.5 to 4.0 mm, females usually larger than males; coloration brown to dark brown, covered with brownish grey tomentum. *Head:* One pair of ocellar bristles subequal in length to first antennal segment. Antennae brown, with first two segments often lighter than third; third with loose, pale pubescence; ratio of segments 2:1:10. Oral margin ringed laterally and posteriorly with stiff hairs. *Thorax:* One long posthumeral bristle, two or three notopleurals; pleural suture and halteres pale. A clump of setae on proepisternum above front coxa, setae stronger than those of front coxae. Coxae yellow; legs concolorous light brown or yellow,



Figs. 5–13. Fig. 5. Middle tibia of *N. turneri*. Fig. 6. Middle tibia of *N. eucera*. Fig. 7. Hypopygium of *N. turneri* holotype. Fig. 8. Folded hypopygium of *N. eucera*. Fig. 9. Female genitalia of *N. eucera*. Fig. 10. Hypopygium of *N. eucera*. Fig. 11. Female genitalia of *N. turneri* allotype. Fig. 12. Proboscis of *N. turneri* female. Fig. 13. Proboscis of *N. eucera* female.

tarsi sometimes darker. Middle tibia slightly swollen apically; a row of 14–17 short setae on anteroventral surface of apical half; a few thorns present on ventral surface. Wings brown, yellowish at base, venation as in Fig. 3. *Abdomen* brown, lightly tomentose, shining. Terminalia with pointed dorsal processes of lateral lobe not reaching apex of lateral lobe, not crossing at all or crossing only at tips in folded hypopygium. Female: Generally the same as male. Proboscis wide, spade-shaped, setose, narrowed to a rounded apex. Genitalia as figured (Fig. 9).

Type material.—Holotype male, Paradise Park, Mt. Rainier National Park, Washington, August 1917, A. L. Melander. Allotype female with the same data. These specimens are deposited in NMNH.

Diagnosis.—Members of this species can be distinguished from those of *N. turneri* by the following combination of character states: Color light brown, tomentum weak, legs and coxae distinctly lighter than rest of body; comb of middle tibia strongly differentiated, male and female genitalia distinctive (Figs. 8–10).

Specimens examined.—(DDWC indicates specimens in my personal collection, other acronyms are listed in acknowledgments.) Total number of specimens examined was 362. CALIFORNIA: Plumas Co., 8 mi. [12.8 km] S.E. Mt. Lassen, 8 July (WSUC). OREGON: Clackamas Co., Mt. Hood, Lost Lake, 3000 ft. [ca. 910 m], 10 July; Still Creek Campground, 1150 m, 23 June, 27 June (CASC, CNCI, DDWC, NMNH, WSUC). Hood River Co., Mitchell Creek near Sahalie Falls, 1400 m, 27 June; Mt. Hood Meadows, 1350 m, 27 June (DDWC). WASHINGTON: Clallam Co., Olympic Nat. Park, Hurricane Ridge, 21 July; nr. Hurricane Ridge Lodge, 4 August; Meadow below Sunrise Ridge, Mt. Angeles, 1550 m, 22, 23, 24 July (CASC, CNCI, DDWC, WSUC). Mt. Rainier Nat. Park, along creek draining E end Yakima Park, 1830 m, 3 August; Eagle Peak, 19 July; Edith Creek at Paradise Park, 1650 m, 2 August; Frog Pond, Paradise Valley, 20 July; Paradise Park, August; Van Trump Creek, 1 September (CASC, DDWC, NMNH, WSUC).

Remarks.—This species is found in moist areas in the Cascades at elevations from 1150 to 1830 m. Adults occur on the surface of the soil or on low-growing vegetation and may be quite abundant at times.

Niphogenia turneri, new species
(Figs. 4, 5, 7, 11, 12)

Description.—Body length 2.5 to 4.0 mm, females usually larger than males; coloration dark brown to black covered with heavy grey tomentum. *Head:* One pair of ocellar setae slightly shorter than first antennal segment. Antennae with all segments concolorous dark brown to black; third with loose grey pubescence; ratio of segments 2:1:9. Oral margin ringed laterally and posteriorly with a few fine hairs. *Thorax:* One posthumeral, two notopleural bristles; pleural suture concolorous with rest of thorax. A clump of setae on proepisternum above front coxae, setae about as strong as those of front coxae. Coxae light to dark brown, sometimes darker dorsally; legs brown to black. Middle tibia with a row of 8 to 10 weakly-differentiated setae on the anteroventral surface of the apical third; a few small setae on ventral surface. *Wings* brown, yellowish at base, venation as in Fig. 4. *Abdomen* dark brown to black with heavy greyish or greenish tomentum, shining. Terminalia (Fig. 7) with pointed dorsal processes of lateral lobes surpassing apex of lateral lobe, crossing at bases in folded hypopygium. Female: Generally the same as the male, proboscis an elongate triangle, narrowed to a sharp, pointed apex (Fig. 12). Genitalia as figured (Fig. 11).

Type material.—Holotype male, IDAHO: Idaho Co., South Lone Lake, 13.5 airline miles NNE of Selway Falls. R10E/T33N/Sec. 11. 6480 ft. [ca. 1975 m]. 17 July 1979. Sweep. W. J. Turner. Allotype, a female with the same data. The holotype and allotype are deposited in the California Academy of Sciences (Type No. 13638).

Diagnosis.—Members of this species can be distinguished from those of *N. eucera* by the following combination of character states: Body color dark, legs and coxae dark; comb on middle tibia weak, male and female genitalia distinctive; females have a narrowly triangular, sharp proboscis.

Specimens examined.—(23.) 3 male, 14 female paratypes from the same locality and date as the holotype. 6 female from IDAHO: Idaho Co., East Peak Lake, 12.7 airline mi. NNE Selway Falls R10E/T33N/Sec. 14, 6360 ft. 16 July 1979, W. J. Turner (WSUC, NMNH).

Remarks.—Nothing is known of the habits of this species. *Niphogenia turneri* is named in honor of its collector, Dr. William J. Turner.

Acknowledgments

The following institutions and curators kindly loaned the specimens upon which this study was based: L. V. Knutson, National Museum of Natural History (NMNH), H. J. Teskey, Canadian National Collection (CNCI), and William J. Turner, Washington State University (WSUC). I am indebted to Dr. D. H. Kavanaugh, California Academy of Sciences, for providing space, facilities, and encouragement.

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DESCRIPTIONS OF THE IMMATURE STAGES OF *STOBAERA TRICARINATA* (SAY) (HEMIPTERA-HOMOPTERA: DELPHACIDAE)

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Kramer (1973) revised the genus *Stobaera* based in part on specimens of 4 species, including *S. tricarinata,* collected from southern California ragweeds by Goeden and Ricker (1974a, 1974b, 1975, 1976a, 1976b, 1976c). No immature stages of Nearctic Delphacidae apparently heretofore have been described. The eggs and nymphs of *S. tricarinata,* the most widely encountered member of this genus in North America (Kramer, 1973), collected from western ragweed, *Ambrosia psilostachya* Decandolle (Compositae), herein are described using terminology from Hassen (1939) and Vilbaste (1968).

Egg (Fig. 1A).—Smooth, fusiform-ellipsoidal, slightly curved along its long axis, initially white, becoming hyaline with age. Mean lengths and widths (±S.D.) of 32 eggs were 0.80 ± 0.03 mm and 0.21 ± 0.02 mm, respectively.

Nymphs (Fig. 1).—Measurements of 11, 12, 12, 17, and 14 first–fifth instars, respectively, yielded the following averages: body length (excluding appendages), 0.80 ± 0.10 mm, 0.98 ± 0.14 mm, 1.25 ± 0.19 mm, 1.64 ± 0.17 mm, and 2.44 ± 0.24 mm, respectively; antenna length (including apical seta), 0.33 ± 0.03 mm, 0.35 ± 0.08 mm, 0.44 ± 0.06 mm, 0.61 ± 0.07 mm, and 0.86 ± 0.05 mm, respectively; and maximum head width, 0.22 ± 0.04 mm, 0.26 ± 0.03 mm, 0.36 ± 0.05 mm, 0.49 ± 0.03 mm, and 0.67 ± 0.04 mm, respectively.

First instar (Fig. 1B).—Opaque white, with beige mottling on abdominal segments 2 and 5; eyes red; tarsal claws black; abdominal segments 6, 7, and 8, light orange.

Antenna with small, plate-like scape rising in genal region; pedicel cylindrical, comprising most of antenna; flagellum hemispherical, ca. half pedicel length and with a long, setaceous bristle extending from apex.

Vertex and frons with carinae; median carinae parallel from vertex to frons, gradually diverging laterally to post-clypeus; thus, interfrons narrower than laterofrons.

Wing pads and thorax without carinae; hind tibia without teeth or spur.

Second instar (Fig. 1C).—Nearly all white, with beige mottling on abdominal segments 3, 4, and 5. Antenna with flagellum and pedicel light

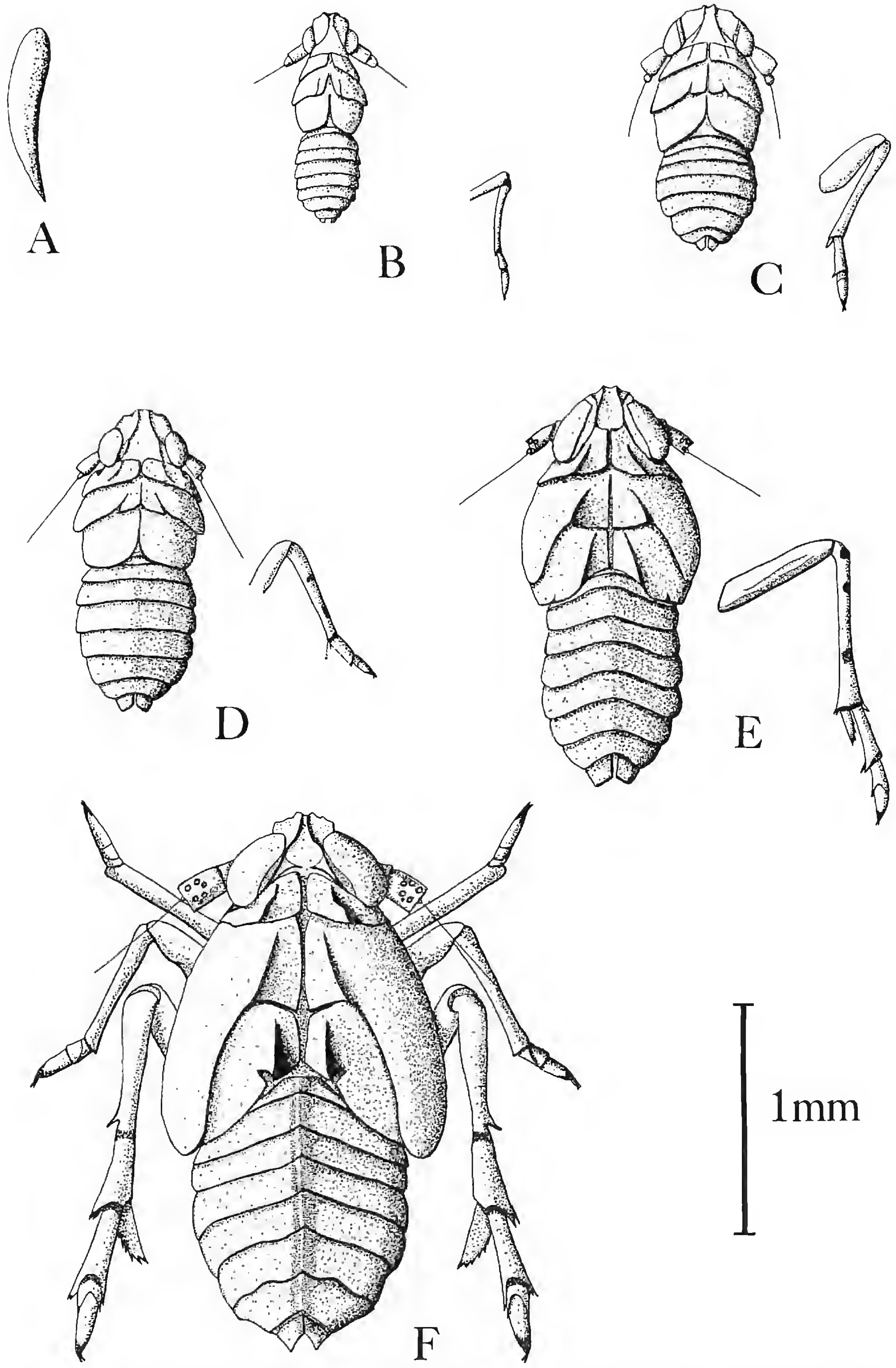

Fig. 1. Immature stages of *Stobaera tricarinata*. A. egg, B. first instar, C. second instar, D. third instar, E. fourth instar, F. fifth instar.

brown; flagellum reduced to small knob at pedicel apex. Compound eyes with dark red facets; each facet ringed with white, imparting a pinkish eye color.

Hind tibia with distal spur on calcar; calcar smooth, pointed distally, and 0.04 ± 0.01 mm (N = 12) long. Wing pads present, 0.16 ± 0.02 mm long.

Third instar (Fig. 1D).—Body mostly white, with light brown, slightly more pronounced, medial and lateral carinae on head. Mesonotal wing pad 0.33 ± 0.04 mm long, smooth, with light brown distal third; metanotal pad, with light brown, rectangular marking on mesal half.

Hind tibia with 2 small teeth, 1 each on mid-anterior and distal end; calcar 0.10 ± 0.01 mm long, with 2 distinct teeth on inner margin; tibia with light brown, annular markings at ⅓ and ⅔ its length.

Fourth instar (Fig. 1E).—Body coloration like third instar, but with white compound eyes surrounded by membranous areas. Antenna in groove on ventral part of eye; scape enlarged and cylindrical; flagellum very much reduced, but still with long, setaceous bristle.

Mesonotal wing pads 0.60 ± 0.05 (N = 17) mm long; metanotal pads, only slightly elongated. Mesonotum and metanotum with pair of longitudinal carinae lateral to meson; longitudinal carina also laterad on pronotum.

Calcar 0.15 ± 0.01 mm long (N = 17), with row of teeth along inner edge.

Fifth instar.—Sensory pits present on many parts of the body were only studied in fifth instar *S. tricarinata* (Figs. 1F, 2) but also occur in the other instars. Vilbaste (1968) stated that the number and arrangement of these pits in delphacid nymphs is constant in all but the first instar. On the head of *S. tricarinata,* these pits are limited to the lateral frons and vertex, 9 pits to each side of the median carinae (Fig. 2A). The European delphacids that Vilbaste (1968) studied also had 9 pits to each side of the median carinae, but these were arranged in 3 pairs on the laterofrons, 1 pit near the lateral keel and vertex, and another pair on the vertex near the medial keel. In *S. tricarinata,* the pits are unpaired and alternately placed along the length of the lateral and medial cariane from the vertex to the anteclypeus (Fig. 2A). The upper pit is always located nearest the lateral carina of the vertex. The remaining 8 pits are located on the laterofrons. Another pair of pits lie dorsal to the anteclypeus and lateral to the medial carina.

Pronotum with 2 lateral carinae, each carina with 3 pits, 2 medial to keel, and a caudal pit laterad to keel; pronotum with 2 additional pits at posterior base of each eye (Fig. 2B).

Mesonotal wing pads, 1.09 ± 0.10 mm (N = 17) long, covering metanotal pads; wing pads with carinae well developed, a pair of pits on opposite sides of carinae, 1 mesal, 1 lateral, and 3 more pits laterad to these: 1 near outer edge of mesonotal pad, the other 2 pits in center of pad ca. ⅔ distance from pronotum to distal end of pad (Fig. 2B).

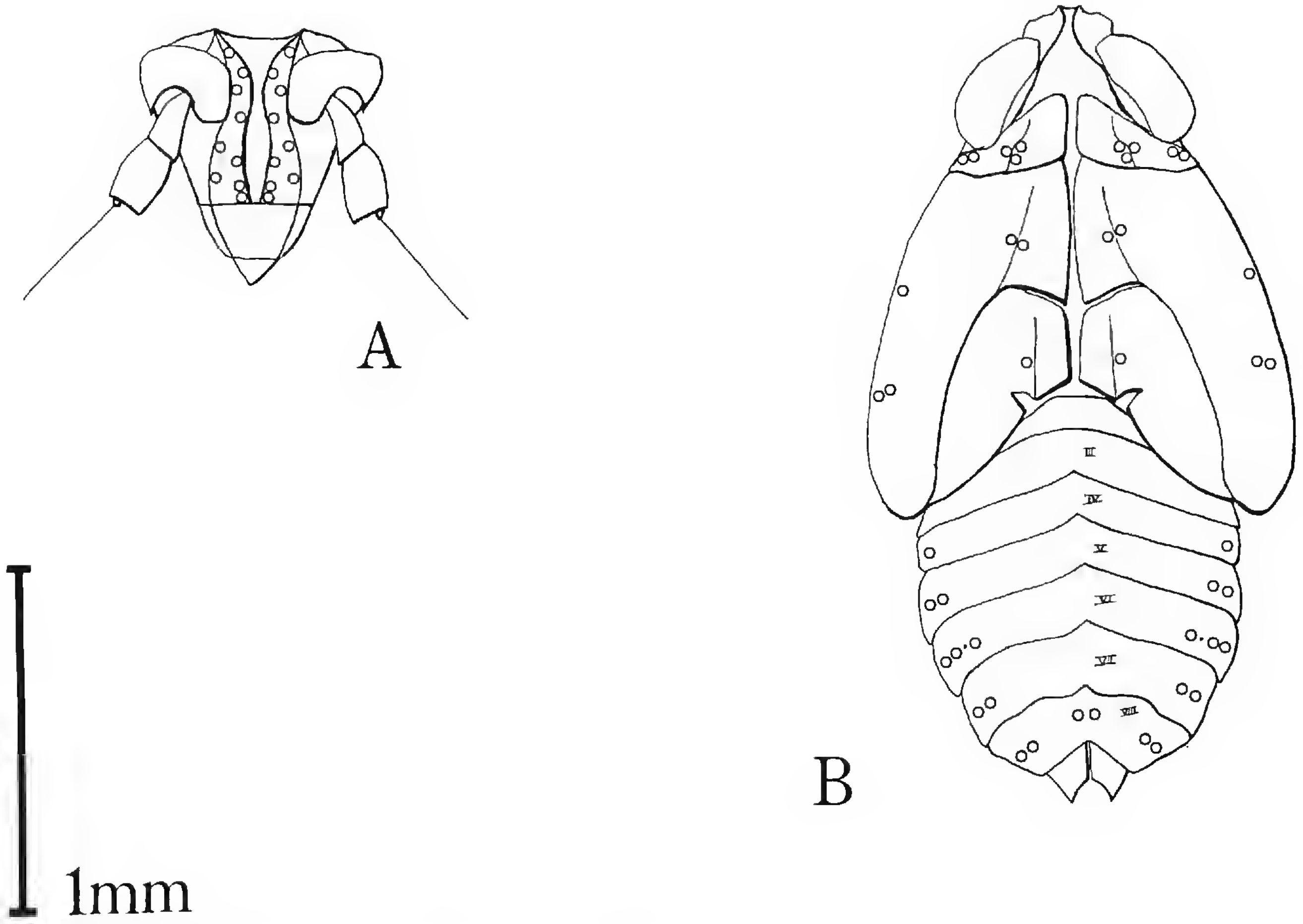

Fig. 2. A. location of sensory pits on the head of a fifth instar *Stobaera tricarinata*. B. location of sensory pits on the dorsum of this instar.

Metanotal wing pads reach abdominal segment 3; marginal slit present just behind medial ridge; sensory pit laterad to medial ridge (Fig. 2B).

Legs mostly white, with 3 dark brown annular markings on each tibia; calcar 0.27 ± 0.03 mm (N = 14) long, with row of teeth on inner edge (Fig. 2E).

Abdomen with 9 apparent segments; sensory pits on terga 4–9 (Fig. 2B): terga 4 and 9 with 0 + 1 pits (number of medial pits + number of lateral pits; after Vilbaste, 1968) laterally, terga 5 and 7 with 0 + 2 pits, terga 6 and 8 with 1 + 2 pits; ridge on dorsum along meson. Abdomen, like rest of body, mottled dark brown and white.

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RECORDS OF PLECOPTERA (INSECTA) FROM SOUTHEASTERN ALASKA

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Southeastern Alaska is that portion of the state extending from Dixon Entrance near the City of Ketchikan to Cape Yakutaga near the village of Yakutat and bounded by the Gulf of Alaska on the west and the glaciated coast range on the east. The region is heavily forested with Sitka Spruce and Western Hemlock and has a maritime climate with some areas receiving over two meters of precipitation annually. The region contains over 10,000 stream and lake systems and four main rivers that originate in British Columbia and Yukon Provinces of Canada. Streams and lakes are generally low in productivity due to low mineral content (Schmidt, 1979).

Plecoptera were first recorded in Southeastern Alaska by Nathan Banks during the Harriman-Alaska Expedition (Banks, 1900). Since then, records of stoneflies have been infrequent except for those found in Jewett (1959) in his treatment of the Pacific Northwest fauna, Bauman and Gaufin (1970), and Ellis (1975).

Knowledge of stonefly distribution in the Pacific Northwest was enhanced when Ricker and Scudder (1975) published a checklist of stoneflies of British Columbia. This paper presents collection records from Southeastern Alaska gathered since 1968 and should serve to further extend the northern range of many species discussed by Ricker and Scudder.

Materials and Methods

Specimens were captured with aerial nets, stream drift nets, or obtained from fish stomachs. Specimens were stored in 70% ethanol and are maintained in a reference collection located at the Alaska Department of Fish and Game in Juneau, Alaska.

Nomenclature and arrangement follows Zwick (1973).

Family Perlodidae

Isogenoides colubrinus (Hagen)

Alaska (Ricker, 1952).
Taku River, 2 mi. S. of Canyon Island, VII-15-72, 1 ♂.

Kogotus nonus (Needham and Claassen)

Hood Bay Creek, 6 mi. S. of Angoon, Admiralty Island, VIII-21-69, 1 ♂; Blossom River, near North Creek, 50 mi. S.E. of Ketchikan, D. Hubartt, 1 ♂.

Megarcys signata (Hagen)

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Davidoff Lake, Baranof Island, 50 mi. S. of Sitka, VII-26-77, A. Schmidt, 1 ♂, 2 ♀; Falls Creek, South Arm of Hood Bay, 6 mi. S. of Angoon, Admiralty Island, VII-1-70, 1 ♀; North inlet stream, Turner Lake, Taku Inlet, VIII-5-70, 2 ♀; Turner Lake, North inlet stream, Taku Inlet, VII-11-77, A. Schmidt, 1 ♂ (dissected from nymph).

Isoperla petersoni Needham and Christenson

Reitze's Pond, Chilkat River, near Haines, VI-10-77, J. Koerner, 2 ♂.

Isoperla sordida Banks

Swan Lake, Cascade Creek Inlet, 15 mi. N.E. of Petersburg, VIII-28-74, A. Schmidt, 1 ♂.

Family Perlidae

Hesperoperla pacifica (Banks)

Ella Lake, inlet stream, 50 mi. E. of Ketchikan, VI-8-77, A. Schmidt, 1 nymph; Lake Kathleen, Admiralty Island, 30 mi. S. Juneau, VIII-28-79, R. Vineyard, 3 nymphs; Inlet stream, Patching Lake, Naha River, 15 mi. N.E. of Ketchikan, VI-19-75, A. Schmidt, 2 nymphs; VII-29-75, 1 nymph; Sarkar Lake system, Prince of Wales Island, 8 mi. N. of Tuxekan, VII-9-76, A. Schmidt, 1 nymph; Ward Cove Creek, 7 mi. N. of Ketchikan, IV-21-78, D. Hubartt, 3 nymphs.

Family Chloroperlidae

Kathroperla perdita Banks

Sitcha [sic] (Needham and Claassen, 1925).

Inlet Stream, DeBoer Lake, 15 mi. N.E. of Petersburg, IX-4-74, A. Schmidt, 2 nymphs; Haska Creek, 6 mi. W. of Haines, VII-11-72, 1 nymph; Keta River, near Hill Creek, 50 mi. S.E. of Ketchikan, VI-4-78, 2 ♂; VII-24-78, M. Anderson, 1 ♀; Kook Lake, Chichagof Island, VI-6-72, 1 ♀; Sheep Creek, 5 mi. S. of Juneau, VII-2-72, 3 ♂, 3 ♀.

Alloperla serrata Needham and Claassen

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975); Alaska (Zwick, 1973).

Osprey Lake, Little Port Walter, Baranof Island, VIII-7-74, A. Schmidt, 1 ♂.

Hastaperla brevis (Banks)

Sitka, as *Isopteryx cydippe* (Banks, 1900).

Neaviperla forcipata (Neave)

Alaska (Jewett, 1959).

Eagle River, head of estuary, 28 mi. N. of Juneau, IX-9-72, 1 ♀; IX-11-72, 1 ♂, 1 ♀; Kadashan River, Tenakee Inlet, Chichagof Island, VIII-25-72, 2 ♀; VIII-8-72, 3 ♂, 1 ♀; VIII-22-72, 1 ♂; Keta River, near Hill Creek, Boca de Quadra, 50 mi. S.E. of Ketchikan, IX-2-77, D. Magnus, 1 ♂, 3 ♀; VII-22-78, M. Anderson, 3 ♀; VII-29-78, 1 ♂.

Suwallia pallidula (Banks)

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975); Alaska (Jewett, 1959).

Dog Salmon Creek, Skowl Arm, Prince of Wales Island, VIII-18-71, 10 ♂, 3 ♀; inlet stream, Jordan Lake, Naha River, 15 mi. N.E. of Ketchikan, VII-16-75, A. Schmidt, 1 ♂; Kadashan Creek, Tenakee Inlet, Chichagof Island, VIII-8-72, 2 ♂, 5 ♀; Mile 28 Creek, Petersburg road system, Mitkof Island, VII-27-71, 1 ♂, 3 ♀; Osprey Lake inlet, Little Port Walter, Baranof Island, IX-5-74, A. Schmidt, 1 ♂; Saginaw Creek, Saginaw Bay, Kuiu Island, VIII-3-71, 1 ♀; Sheep Creek, 5 mi. S. of Juneau, IX-19-72, 1 ♀; Starrigavan Creek, 8 mi. N. of Sitka, VIII-7-73, 1 ♂; VIII-9-73, 2 ♂, 4 ♀; VIII-24-73, 2 ♀; VIII-2-73, 1 ♂, 1 ♀; St. Johns Harbor, Zarembo Island, VII-28-71, 1 ♂, 3 ♀.

Sweltza borealis (Banks)

Sitka (Banks, 1900); Sashin Cr., Little Port Walter, Baranof Is. (Ellis 1970; Ellis, 1975).

Redoubt Lake, Baranof Island, VIII-29-74, A. Schmidt, 1 ♂, 2 ♀.

Sweltza coloradensis (Banks)

Fish Bay, Peril Straits, Baranof Island, VII-7-71, 4 ♀.

Sweltza exquisita (Frison)

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Fick Cove, South Arm Hoonah Sound, Chichagof Is., VI-25-71, 1 ♀; Fish Bay Creek, Peril Straits, Baranof Island, VII-17-71, 1 ♀; Kadashan River, Tenakee Inlet, Chichagof Island, VI-25-72, 7 ♂; VI-22-72, 1 ♂, 3 ♀; 2 mi. S. of Little Basket Bay, Chichagof Island, VII-7-72, 1 ♂, 1 ♀; Klawock Lake outlet, Prince of Wales Island, VII-13-73, A. Schmidt, 1 ♂; Whiterock Creek, Chichagof Island, VII-6-72, 2 ♂, 2 ♀; Whitewater Bay Creek, Admiralty Island, VI-29-71, 1 ♂.

Sweltza fidelis (Banks)

Alaska (Jewett, 1959).

Sheep Creek, 5 mi. S. of Juneau, at tidewater, VII-3-74, D. Kirchhofer, 1 ♂.

Sweltza oregonensis (Frison)

Auke Cr., 12 mi. Glacier Highway, Juneau (Ellis, 1970); Harris River, 35 mi. E. of Ketchikan (Ellis, 1970); Traitors River, 20 mi. N. of Ketchikan (Ellis, 1970); Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1970; 1975).

Corner Bay Creek, Tenakee Inlet, Chichagof Island, VI-9-72, 8 ♂; inlet stream, Heckman Lake, Naha River, 15 mi. N.E. of Ketchikan, VI-12-75, A. Schmidt, 4 ♂; inlet stream, Jordan Lake, Naha River, 15 mi. N.E. of Ketchikan, VII-15-75, A. Schmidt, 4 ♂; Kadashan River, Tenakee Inlet, Chichagof Island, VI-20-72, 10 ♂, 9 ♀; VI-22-72, 10 ♂, 8 ♀; Keta River, near Hill Creek, 50 mi. S.E. of Ketchikan, VI-9-78, 1 ♂, 2 ♀; VI-22-78, M. Anderson, 1 ♂, 4 ♀; VII-29-78, 1 ♀; King Salmon River, Seymour Canal, Admiralty Island, VII-28-72, 4 ♀; inlet stream, Patching Lake, Naha River, 15 mi. N.E. of Ketchikan, VI-18-75, A. Schmidt, 4 ♂; VII-9-75, 4 ♂; Starrigavan Creek, 8 mi. N. of Sitka, VI-13-74, 2 ♀; Whiterock River, Chichagof Island, VII-6-72, 4 ♂, 6 ♀.

Sweltza pacifica (Banks)

Sitka and Juneau as *Chloroperla pacifica* (Banks, 1900).

Sweltza revelstoka (Jewett)

Corner Bay Creek, Tenakee Inlet, Chichagof Island, VI-9-72, 1 ♂ nymph; Kook Lake, Basket Bay, Chichagof Island, VI-8-72, 4 ♂; Rodman Creek, Peril Straits, Baranof Island, VII-22-71, 1 ♂; Seal Bay, Peril Straits, Baranof Island, VII-23-71, 1 ♀; Switzer Creek, 5 mi. N. of Juneau, IV-25-78, D. Hubartt, 1 ♀.

Triznaka diversa (Frison)

Alaska (Jewett, 1959).

Fick Cove, Peril Straits, Baranof Island, VI-25-71, 1 ♂; Kadashan River, Tenakee Inlet, Chichagof Island, VI-22-72, 1 ♂; Porcupine Creek, 13 mi. E. of Klukwan, on Haines Highway, VII-24-73, 1 ♂; Turner Lake, Taku Inlet, from kokanee stomach sample taken near cabin inlet, VII-11-77, D. Hubartt, 1 ♂ (dissected from nymph).

Family Taeniopterygidae

Doddsia occidentalis (Banks)

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975); Alaska (Jewett, 1959).

Gold Creek, Juneau, IV-5-73, 4 ♂; II-23-73, 1 nymph; Keta River, 50 mi. S.E. of Ketchikan, IV-13-78, 21 ♂, 11 ♀; Switzer Creek, 5 mi. N. of Juneau, VI-2-72, 1 ♀.

Taenionema pacificum (Banks)

Stikine River, near Kakwon Point, V-5-78, J. Koerner, 5 ♂, 1 ♀.

Taenionema pallidum (Banks)

Sheep Creek, 5 mi. S. of Juneau, VII-3-74, D. Kirchhofer, 1 ♂.

Family Nemouridae

Podmosta decepta (Frison)

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Kook Lake, main inlet stream, Chichagof Island, VI-8-72, 2 ♂; Mendenhall River, Brotherhood Bridge, Juneau, V-30-72, 5 ♂; VI-1-74, 2 ♂; VI-13-74, 6 ♂, 1 ♀; Seal Bay, Tenakee Inlet, Chichagof Island, VII-23-71, 1 ♀; Starrigavan Creek, 8 mi. N. of Sitka, VI-13-73, 1 ♀.

Podmosta delicatula (Claassen)

Mendenhall River, Brotherhood Bridge, Juneau, V-30-74, 1 ♂.

Visoka cataractae (Neave)

Starrigavan Creek, 8 mi. N. of Sitka, IV-19-73, 1 ♂, 1 ♀; West fork of Bear Creek, Mitkof Island, IV-23-73, 1 ♀; West Mendenhall Glacier Trail, Juneau, IV-20-75, D. Kirchhofer, 1 ♂; Spurt Lake, Thomas Bay, 20 mi. N.E. of Petersburg, IX-8-74, A. Schmidt, 1 ♂, (dissected from nymph).

Zapada cinctipes (Banks)

Sitka and Yakutat (Banks, 1900); Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Fish Bay Creek, Peril Straits, Baranof Island, VII-7-71, 2 ♀; Fod Creek, tributary to Starrigavan Creek, 8 mi. N. of Sitka, I-22-74, 1 ♂; Herbert River, 29 mi. N. of Juneau, V-16-74, 10 ♂; Jordan Lake, Naha River system, 15 mi. N.E. of Ketchikan, specimen obtained from cutthroat trout stomach sample, VII-15-75, A. Schmidt, 1 ♀; Mendenhall Lake, on West Glacier Trail, 10 mi. N. of Juneau, IV-20-75, D. Kirchhofer, 1 ♀; Osprey Lake, Little Port Walter, Baranof Island, V-31-74, A. Schmidt, 1 ♂; Patching Lake, Naha River system, 15 mi. N.E. of Ketchikan, obtained from cutthroat trout stomach sample, VI-19-75, A. Schmidt, 3 ♀; Seal Bay, Tenakee Inlet, Chichagof Island, VII-23-71, 3 ♀; Starrigavan Creek, 8 mi. N. of Sitka, Baranof Island, IV-23-72, 4 ♂; IV-18-73, 3 ♂, 6 ♀; IV-18-74, 2 ♀; Switzer Creek, 5 mi. N.W. of Juneau, III-23-72, 1 ♂, 2 ♀; III-24-72, 6 ♂, 6 ♀; IV-23-72, 4 ♂; West Fork of Bear Creek, Mitkof Highway, Mitkof Island, IV-23-73, 5 ♂.

Zapada columbiana (Claassen)

Southern Alaska (Ricker, 1952).

Gold Creek, near Juneau, IV-5-74, 2 ♂, 3 ♀; VI-27-74, 1 ♀; Starrigavan Creek, 8 mi. N. of Sitka, III-19-74, 1 ♂; Switzer Creek, 5 mi. N. of Juneau, III-24-72, 1 ♂; West Glacier Trail, Mendenhall Lake, 8 mi. N. of Juneau, III-23-75, 1 ♀; III-31-75, 2 ♂, 1 ♀.

Zapada frigida (Claassen)

Sitka (Claassen, 1923); Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Fish Bay, Peril Straits, Baranof Island, VII-7-71, 1 ♂.

Zapada haysi (Ricker)

Herbert River, 29 mi. N. of Juneau, V-16-74, 1 ♀, 1 nymph; Gold Creek, near Juneau, VI-27-74, 1 ♀; Keta River, near Hill Creek, 50 mi. S.E. of Ketchikan, IV-29-79, L. McVey, 1 ♂; Manzanita Lake inlet, 25 mi. E. of Ketchikan, V-25-77, A. Schmidt, 1 ♂; Sheep Creek, 5 mi. S. of Juneau, VII-2-72, 2 ♀; IV-5-73, 2 ♀, reared material; Starrigavan Creek, 8 mi. N. of Sitka, IV-19-73, 1 ♀.

Zapada oregonensis (Claassen)

Sashin Creek, Little Port Walter, Baranof Is. (Ellis, 1975); Alaska (Jewett, 1959).

Corner Bay Creek, Tenakee Inlet, Chichagof Island, VI-9-72, 16 ♂, 6

♀; Eagle River, 28 mi. N. of Juneau, near tidewater, V-17-74, 1 ♀; IX-17-74, 1 ♀; Keta River, Hill Creek, 50 mi. S.E. of Ketchikan, VI-4-78, 1 ♀; Starrigavan Creek, 8 mi. N. of Sitka, VI-3-73, 1 ♀; Stikine River, Kakwon Point, V-15-78, J. Koerner, 1 ♀; Switzer Creek, 5 mi. N. of Juneau, IV-22-72, 1 ♀.

Family Capniidae

Capnia confusa Claassen

Eagle River, 28 mi. N.W. of Juneau, V-17-74, 3 ♂; Gold Creek, near Juneau, VI-27-74, 1 ♂, 2 ♀; Herbert River, 29 mi. N.W. of Juneau, V-16-74, 2 ♂, 1 ♀; Keta River, near Hill Creek, 50 mi. S.E. of Ketchikan, VI-6-78, 1 ♂, 2 ♀; VI-16-78, M. Anderson, 1 ♂; Lisianski River, North Chichagof Island, V-18-73, A. Schmidt, 1 ♂; Mendenhall River, Juneau, V-17-73, 14 ♂; V-16-74, 2 ♂, 1 ♀; IX-17-74, 13 ♂; Redoubt Lake, 10 mi. S. of Sitka, Baranof Island, VI-19-74, A. Schmidt, 1 mature nymph; Sister Lake, Chichagof Island, VI-9-73, A. Schmidt, 1 ♂; Sheep Creek, 5 mi. S. of Juneau, VI-13-74, 10 ♂, 5 ♀; V-30-74, 2 ♂, 2 ♀; Stikine River, Kakwon Point, V-16-78, J. Koerner, 4 ♂, 8 ♀; Switzer Creek, 5 mi. N. of Juneau, VI-2-72, 1 ♂, 4 ♀.

Capnia excavata Claassen

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Kadashan Creek, Tenakee Inlet, Chichagof Island, VI-22-72, 1 ♂, 3 ♀; VI-25-72, 1 ♂; Keta River, 50 mi. S.E. of Ketchikan, IV-13-78, 9 ♂, 2 ♀; VI-10-78, 2 ♂, 2 ♀; Kook Lake, south inlet stream, Chichagof Island, VI-6-72, 1 ♂, 1 ♀; Mendenhall River, Brotherhood Bridge, near Juneau, IV-11-73, 14 ♂, 4 ♀; V-17-73, 6 ♂; V-30-73, 5 ♂; IX-17-74, 6 ♂; Steep Creek, 16 mi. N. of Juneau, VI-13-73, D. Kirchhofer, 1 ♂; Whiterock Creek, Chichagof Island, VII-6-72, 1 ♂.

Capnia melia Frison

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Starrigavan Creek, 8 mi. N. of Sitka, Baranof Island, I-22-74, 1 ♂; Switzer Creek, 5 mi. N. of Juneau, III-7-73, 1 ♂, 2 ♀.

Capnia nana Claassen

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Starrigavan Creek, 8 mi. N. of Sitka, IV-18-73, 2 ♂; III-19-74, 1 ♂, 3 ♀; Steep Creek, 16 mi. N. of Juneau, III-27-72, D. Kirchhofer, 6 ♂, 6 ♀; III-24-75, 3 ♂, 2 ♀; West Mendenhall Glacier Trail, 8 mi. N. of Juneau, III-

23-75, D. Kirchhofer, 1 ♂; III-24-75, 3 ♂, 2 ♀; III-31-75, 2 ♂, 2 ♀; IV-20-75, 1 ♂, 1 ♀; Windfall Lake Inlet, 28 mi. N. of Juneau, III-25-72, D. Kirchhofer, 1 ♂, 3 ♀.

Isocapnia agassizi Ricker

Keta River, near Hill Creek, 50 mi. S.E. of Ketchikan, R. Vineyard, V-4-79, 1 ♂, 1 ♀.

Isocapnia spenceri Ricker

Keta River, near Hill Creek, 50 mi. S.E. of Ketchikan, IV-29-79, R. Vineyard, 1 ♂, 1 ♀.

Mesocapnia autumna (Bauman and Gaufin)

Ideal Cove, Mitkof Is. (Bauman and Gaufin, 1970); Ohmers Slough, Kupreanof Is. (Bauman and Gaufin, 1970).

Lower Situk River, 12 mi. S.E. of Yakutat, X-21-72, 2 ♂, 3 ♀.

Family Leuctridae

Despaxia augusta (Banks)

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975); Alaska (Jewett, 1959).

Dog Salmon Creek, Prince of Wales Is., VIII-5-71, 1 ♂; Kadashan Cr., Tenakee Inlet, Chichagof Is., VIII-8-72, 1 ♂; Osprey Lake, Little Port Walter, Baranof Is., VIII-24-75, A. Schmidt, 2 ♂; IX-16-75, 4 ♂, 4 ♀; Pat's Creek, 12 mi. N. of Wrangell, VIII-28-71, 1 ♂; Sarkar Lake inlet, 10 mi. N. of Tuxekan, Prince of Wales Island, VII-16-76, A. Schmidt, 1 ♂; St. Johns Harbor, Zarembo Is., VIII-3-71, 1 ♂; Starrigavan Creek, 8 mi. N. of Sitka, VIII-7-73, 1 ♂; VIII-24-73, 1 ♂; Spurt Lake, inlet stream, Thomas Bay, 20 mi. N. of Petersburg, IX-8-74, A. Schmidt, 1 ♂.

Paraleuctra forcipata (Frison)

Alaska (Zwick, 1973).

Corner Bay Creek, Tenakee Inlet, Chichagof Is., VI-9-72, 1 ♀; Exchange Cove Cr., Prince of Wales Is., VII-12-72, R. Reed, 1 ♀; Kadashan Cr., Tenakee Inlet, Chichagof Is., VI-20-72, 11 ♂, 6 ♀; Kook Lake, inlet stream, Chichagof Is., VI-22-72, 4 ♂, 2 ♀; Osprey Lake, Little Port Walter, Baranof Is., V-29-74, A. Schmidt, 1 ♂.

Paraleuctra occidentalis (Banks)

Sashin Cr., Little Port Walter, Baranof Is. (Ellis, 1975).

Kook Lake, inlet stream, Chichagof Is., VI-6-72, 1 ♂; Sheep Creek, 5 mi. S. of Juneau, VII-2-72, 1 ♂, 1 ♀; Starrigavan Creek, 8 mi. N. of Sitka, Baranof Is., V-10-73, 1 ♀; West fork of Bear Creek, near Petersburg, Mitkof Is., IV-23-73, 1 ♀.

Paraleuctra vershina Gaufin and Ricker

Sashin Cr., Little Port Walter, Baranof Is., as *Paraleuctra sara* (Ellis, 1975).

Corner Bay Creek, Tenakee Inlet, Chichagof Is., VI-9-72, 1 ♀; Patching Lake, Naha River, 15 mi. N. of Ketchikan, VI-18-75, A. Schmidt, 3 ♂, 1 ♀.

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PAN-PACIFIC ENTOMOLOGIST
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THE EFFECTS OF AN OUTBREAK OF *TRIDEPIA NOVA* (SMITH) (LEPIDOPTERA: NOCTUIDAE) ON FOUR-WING SALTBUSH, *ATRIPLEX CANESCENS* (PURSH) NUTT.

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From 24 August 1977 to 30 August 1977 large numbers of *Tridepia nova* (Smith) larvae were observed on Wupatki National Monument in northern Arizona. The monument is located 42 km north of Flagstaff, Arizona at an elevation of 1432 m. During the outbreak, the moth larvae were observed feeding only on Four-wing saltbush, *Atriplex canescens* (Pursh) Nutt., which is abundant throughout the Cold Desert Shrub community of the monument. Comstock (1929) and Tietz (1972) have reported that a related species, *Trichoclea antica*, feeds solely on *A. canescens*. Although weekly sampling indicated that the outbreak apparently lasted only six to nine days, damage to many of the plants in certain areas of the monument was extensive. Damages included almost complete defoliation of the shrubs and considerable damage to many of the saltbush seeds.

Tridepia nova was first described as *Trichoclea nova* (Smith, 1903). Later, McDunnough (1938) placed it in *Tridepia*. Smith (1903) described adults as having a pale grayish ground color due to the mixing of white and smoky scales. The last instar larvae are light green to pale yellow in color and about 20 mm in length. These features resemble other closely related species (Comstock, 1929; Benjamin, 1932).

Observations

There is some uncertainty as to the area covered and exact time span of the outbreak, but the larvae were seen consuming Four-wing saltbush on 24 August 1977. Observations after 30 August 1977 indicated that few, if any, larvae remained on the saltbush. Several park rangers noticed the outbreak on 25 and 26 August, but none reported seeing *T. nova* larvae before 24 August 1977. Thus, the outbreak probably lasted from six to nine days.

The range of the outbreak probably included Antelope Mesa as the western boundary because of the scarcity of saltbush west of the mesa. Due to the brevity of the outbreak and sampling restrictions, the exact boundaries of the outbreak were not determined. However, observations near the Wupatki visitor center indicated that the area immediately around the visitor center could have been the eastern limit of the outbreak. The northern and southern limits of the outbreak were not determined.

During the outbreak, *T. nova* larvae were observed feeding not only on Four-wing saltbush leaves, but also on the four enlarged bracts that constitute the wings of the saltbush seeds. Interestingly, some saltbush plants were left relatively untouched by the moth larvae during the 1977 outbreak.

Larvae collected from saltbush plants pupated in soil in the laboratory and commenced emergence several weeks later on 13 September 1977. The emergence of adult moths in the lab corresponded to the few black-light captures in the field. Although *T. nova* individuals were collected by sweeping, pitfall trapping, and by a black-light trap in 1977, not one individual was captured in 1978 using the same methods in the same area.

The larvae expressed several possible defense mechanisms although no predation by vertebrates or arachnids was observed. First, the larvae resembled the leaf color of the Four-wing saltbush. Behaviorally, the larvae moved little while on the saltbush, presumably to enhance concealment. Secondly, when the larvae were touched they quickly dropped to the ground under the dense growth of the shrub, where they were extremely difficult to locate. Third, when handled the larvae secreted a brown substance that was probably repugnatorial.

Discussion

Four-wing saltbush is named for the four enlarged bracts that surround the saltbush seeds. Since the wings on these seeds aid in seed dispersal, any factor that would remove the bracts would tend to reduce seed dispersal. As mentioned, the larvae attacked not only the saltbush leaves but also the wings of the saltbush seeds. Thus, it is possible that the 1977 *T. nova* outbreak may have reduced the seed dispersal and slowed the growth of existing saltbush plants in succeeding years. During the summer of 1978, much less rain fell than during the summer of 1977. The resulting xeric conditions of 1978 suppressed much of the saltbush growth. Therefore, it was impossible to conclude what effect the 1977 outbreak of *T. nova* had on the saltbush in succeeding years, if any, since the dry 1978 spring and summer obscured any effects of the 1977 larval feeding damage.

Some saltbush plants were not fed upon by *T. nova* larvae in 1977, and it is possible that these plants were missed due to chance. However, the high larval densities throughout the outbreak area probably precludes this as an explanation. More likely, chemical differences between plants may have accounted for the absence of *T. nova* larvae on certain saltbush plants. Sharma et al. (1972) have found that sodium and chloride concentrations increase progressively with corresponding decreases in rainfall. If certain plants were located in soil with relatively low moisture retention, they may have had electrolyte concentrations above the tolerance levels of the larvae, and the plants would not have been palatable to the moths.

The appearance of *T. nova* larvae in late August may be an adaptation to low electrolyte levels in the *Atriplex*. The Cold Desert Shrub community of Wupatki National Monument usually receives heavy rainfall in the form of summer thunderstorms from mid-July to late August. Upon hatching in late August, the larvae would find both adequate moisture and the lowest electrolyte concentrations, resulting from the summer rains.

Although the 1977 outbreak area was sampled in 1978 using the same collecting methods that had detected *T. nova* individuals in 1977, no adults or larvae were seen. Possibly, intense predation or disease reduced the population dramatically. The larvae did apparently possess defense measures, such as cryptic coloration, avoidance behaviors, and the secretion of a probable repellent.

Summary

An outbreak of *Tridepia nova* was observed on Wupatki National Monument, Arizona, during the last week of August 1977. The moth larvae fed exclusively on Four-wing saltbush (*Atriplex canescens*) within part of the Cold Desert Shrub community of the monument. Both saltbush leaves and seed bracts were consumed. With many plants, almost complete defoliation occurred. The removal of the seed wings by the larvae probably decreased overall seed dispersal in 1977. Some saltbush plants were not fed upon by these larvae in 1977, and it is speculated that higher sodium and chloride concentrations in spared plants may have deterred the larvae from feeding on them. The *T. nova* larvae possessed several defenses, which included cryptic coloration, various behavioral adaptations for concealment, and the secretion of a brown substance that probably served as a predator repellent.

Acknowledgments

I especially wish to thank Dr. C. D. Johnson of Northern Arizona University for his encouragement and guidance. Moth larvae and adults were identified by Don Weismann, and Dr. James Rominger contributed information about the Four-wing saltbush on the monument. Funds that were provided to Northern Arizona University as grants 950189 and 950236 by the National Park Service to help in this study are gratefully acknowledged.

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PAN-PACIFIC ENTOMOLOGIST
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SCIENTIFIC NOTE

AGGREGATION IN TWO SYMPATRIC SPECIES OF CRANE FLY (DIPTERA: TIPULIDAE)

Tipula acuta Doane and *Tipula simplex* Doane are two sympatric species of crane fly, the larvae of both inhabiting the soil of unirrigated pastures in Tulare County, California during the winter months, often aggregated under the same cowpads. Previous investigations (Hartman & Hynes, 1977, Pan-Pac. Entomol., 53:118–123; Hartman, Surfleet & Hynes, 1978, Pan-Pac. Entomol., 54:305–310) have shown that *T. simplex* larvae release a fecal pheromone that acts as a locomotory inhibitor, hence aiding aggregation.

The purpose of this research is to determine if *T. acuta* also produces a fecal pheromone or if it aggregates in response to the pheromone produced by *T. simplex.*

The apparatus used was modified from the one reported by Reeve and Berry (1976, Environ. Entomol., 5:961–963). Two 9 cm petri dishes were cut and joined together to make a choice-cage with a 4.5 cm opening between the two sections. Filter paper was placed in each side, and one side was moistened with 1.1 ml of an extract made by grinding the inestinal tract of one crane fly and diluting with 2.0 ml of distilled water, while the other was moistened with 1.1 ml of distilled water. Five larvae were placed in each side of the cage. The position of each larva was recorded after 24 hours.

Each species was tested for reaction to its own extract, and for reaction to the extract of the other, and each test was replicated six times. The data were analyzed using Chi Square.

Results are shown in Table 1. *T. simplex* shows a definite aggregation to extract of its own intestinal tract, confirming the presence of the aggregation pheromone previously detected by Hartman & Hynes (1977) and Hartman, Surfleet & Hynes (1978). However, *T. simplex* does not respond to the feces of *T. acuta. T. acuta* does not appear to have a fecal aggregating pheromone, nor does it respond to the one produced by *T. simplex.*

Table 1.

Test animal	Test extract	# Observed on extract	# Observed on H_2O	Significance
T. simplex	*T. simplex*	40	20	0.01
T. acuta	*T. acuta*	26	34	n.s.
T. simplex	*T. acuta*	29	31	n.s.
T. acuta	*T. simplex*	24	36	n.s.*

* Not significant at $P = 0.05$.

The aggregation of *T. simplex* is due not only to chemical communication, but also to its response to light and moisture as demonstrated by Hartman & Hynes (1977). The limited data we have gathered suggest that the responses to light and moisture in *T. acuta* are similar to the responses of *T. simplex*. The aggregation of *T. acuta* under cowpads, therefore, probably is due to the darker, moister environment found there, rather than to chemical communication among individuals in the population.

We would like to thank the Tulare County Agricultural Commission for their continued assistance and the J. G. Boswell Company for their monetary support.

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MAYFLIES OF THE SOUTHWEST: NEW RECORDS AND NOTES OF SIPHLONURIDAE (EPHEMEROPTERA)

RICHARD K. ALLEN[1] AND ESTHER S. M. CHAO[2]

A recent study of mayfly collections from Arizona and New Mexico has revealed undescribed nymphs, and new distributional records of the family Siphlonuridae. In the accounts dealing with the species, collections made by the senior author are indicated by the initials RKA, and all specimens are deposited in the California Academy of Sciences, San Francisco.

Genus *Ameletus* Eaton

Ameletus is composed of 31 described species in North America, 25 from western North America and 6 from eastern North America. Western North America is defined as all land area west of the eastern edge of the Rocky Mountains. The distributional range of the genus in western North America is from southern Arizona (32°40′ north latitude) in the MIDDLE NORTH TEMPERATE ZONE to central Alberta (53°31′ north latitude) in the UPPER NORTH TEMPERATE ZONE. In eastern North America the range is from northern Alabama (33°45′ north latitude) in the MIDDLE NORTH TEMPERATE ZONE to southern Quebec (50°19′ north latitude) in the UPPER NORTH TEMPERATE ZONE. *Ameletus falsus* McDunnough, 1938, *A. velox* Dodds, 1923, and three undescribed nymphs are the only *Ameletus* presently known to occur in the Southwest. The nymphs herein treated as *Ameletus* sp. "A," "B," and "C" have not been reared and cannot be associated with described male imagoes and hence the use of informal epithets.

Ameletus falsus McDunnough

Ameletus falsus McDunnough 1938:30.

This species was described from a male imago collected in Arizona.

Type locality.—Greer, Arizona.

Type deposition.—No. 4293, Canadian National Collection, Ottawa, Ontario.

Distribution.—This species is known only from the type locality.

Remarks.—It is probable that one of the unnamed nymphs described below will eventually be found to be the immature stage of this species. All three nymphs have been collected near the type locality of *A. falsus*.

Ameletus velox Dodds

Ameletus velox Dodds 1923:105; Dodds and Hisaw 1924:139; Needham and Christenson 1927:11; Seemann 1927:47, McDunnough 1928:9; McDunnough 1929:174; McDunnough 1934:163; Traver 1935:459; Edmunds 1954:64.

Dodds (1923) described this species from adults and nymphs collected in Colorado. Seemann (1927) reported specimens from southern California, and Needham and Christenson (1927) collected it in Utah. McDunnough (1928) reported it from Alberta, and Edmunds (1954) reported additional specimens from Utah. The nymphal stage is redescribed below.

Nymph.—Length: body 12.0–13.0 mm; caudal filaments 6.0–7.0 mm. General color brown with dark brown markings. Head dark brown, light brown at sutures. Thoracic nota brown with light brown markings; pronotum brown, with light brown midline and sublateral markings; pronotum dark brown anteriorly; mesonotum brown with light brown midline, dark brown anteromedian triangular-shaped macula, and light brown posterior and sublateral markings; metanotum brown with light brown midline; thoracic sterna pale; legs brown. Abdominal terga brown to dark brown with light brown sublateral maculae on terga 1–2; terga 3–8 brown with light brown median diamond-shaped and sublateral markings on each tergum; tergum 9 dark brown with elongate median light brown macula; tergum 10 light brown; abdominal terga with smoky web-like tracheations; abdominal gills pale with numerous dark tracheations; gills 1–7 with subdorsal band one-third from dorsal margin; gills with distinct band on ventral margin; ventral margin gill 4 with 8–9 spines (Fig. 1); abdominal sterna brown, posterior sterna darker; sterna 4–8 with dark brown median macula. Caudal filaments dark brown, light brown basally, without distinct transverse band (Fig. 5).

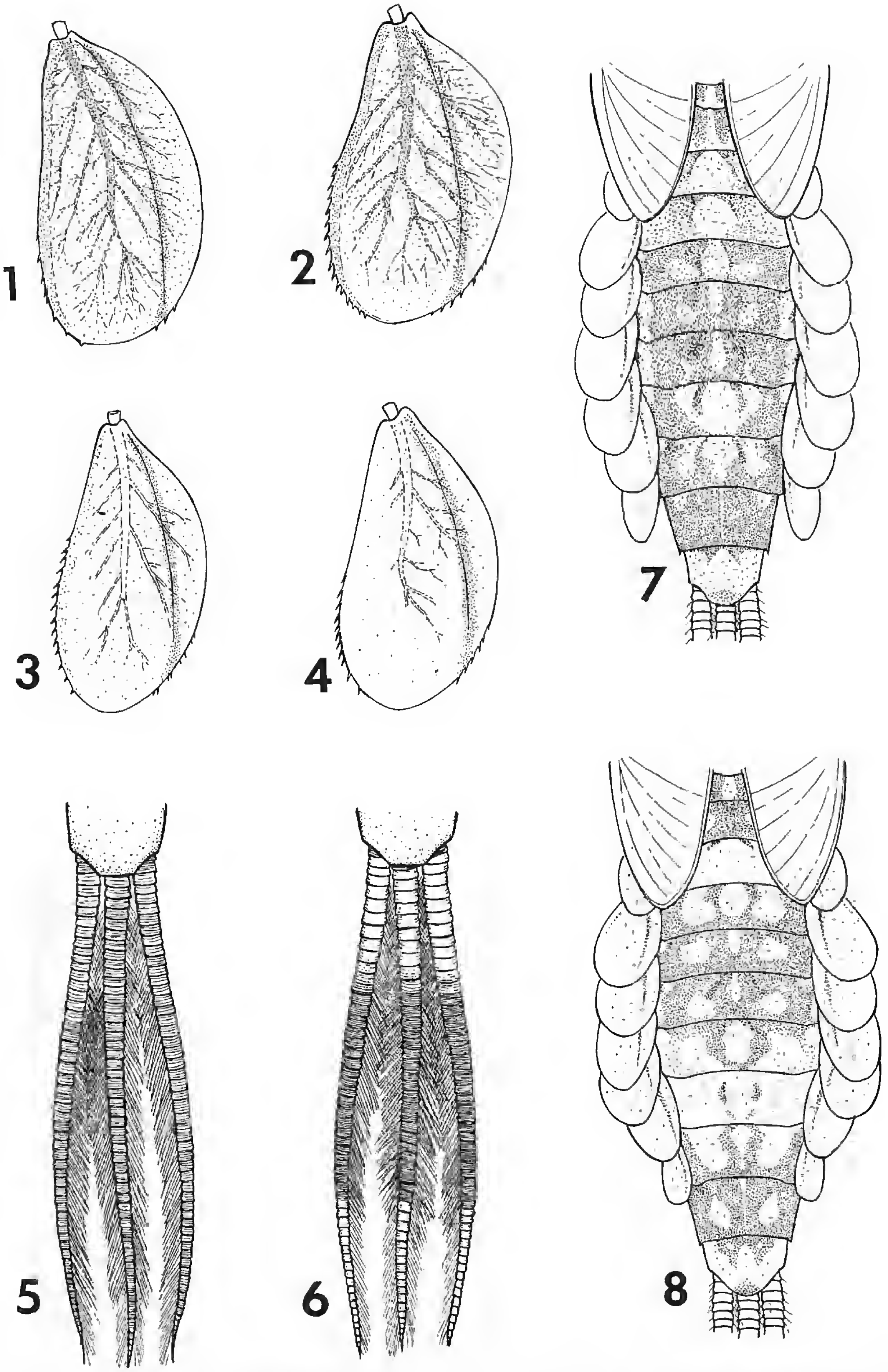
Remarks.—The numph of *A. velox* can be distinguished from all others by the following combination of characters: (1) abdominal gills with distinct dorsal and ventral bands; (2) gills with numerous, dark tracheations (Fig. 1); (3) caudal filaments without a wide transverse band (Fig. 5); (4) ventral margin of gill 4 with 8–9 spines (Fig. 1); (5) abdominal terga with numerous smoky web-like tracheations; and (6) abdominal sterna 4–8 with a median brown macula.

Type locality.—Tolland, Colorado.

Type deposition.—Unknown.

Distribution.—This species has been reported previously from Colorado, Utah, Alberta, and southern California, and this study extends the known range into southern Arizona.

New records.—ARIZONA: *Apache Co.* Stream at Greer, 27-VI-66,



Figs. 1–8. Figs. 1–4. Nymphal gills. Fig. 1. *A. velox*; Fig. 2. *Ameletus* sp. "A"; Fig. 3. *Ameletus* sp. "B"; Fig. 4. *Ameletus* sp. "C." Figs. 5–6. Nymphal caudal filaments. Fig. 5. *A. velox*; Fig. 6. *Ameletus* sp. "A." Figs. 7–8. Nymphal abdomens, dorsal view. Fig. 7. *Ameletus* sp. "B"; Fig. 8. *Ameletus* sp. "C."

RKA. *Graham Co.* Moonshine Cr. on Hwy. 366, Pinaleno Mtns., 20-VII-70, RKA; Wet Cr., Wet Cr. Canyon Camp, Pinaleno Mtns., 20-VII-70, RKA.

Biology.—Nymphs were collected during June and July from streams between 5900–8500 feet elevation, and with a water temperature range between 58°–66°F.

Ameletus sp. "A"

Nymph.—Length: body 12.0–13.0 mm; caudal filaments 5.0–6.0 mm. General color brown to dark brown with light brown markings. Head dark brown, light brown at sutures. Thoracic nota brown with light brown markings; pronotum brown with light brown midline and sublateral markings; mesonotum brown with light brown midline, submedian and sublateral markings; legs brown. Abdominal terga brown with light brown markings; terga 1–3 with light brown median oval-shaped macula; terga 4–5 brown; terga 6–7 with light brown diamond-shaped macula; terga 8–10 with light brown elongate macula; terga with paired submedian light brown spots; abdominal terga with few smoky web-like tracheations; abdominal gills with wide ventral band (Fig. 2); ventral margin gill 4 with 15–16 spines (Fig. 2); abdominal sterna pale, sterna 3–8 with purplish median macula. Caudal filaments pale with distinct dark brown transverse band (Fig. 6).

Remarks.—*Ameletus* sp. "A" nymph can be distinguished from all others by the following combination of characters; (1) abdominal gills with distinct subdorsal and ventral bands (Fig. 2); (2) gills with numerous dark tracheations; (3) caudal filaments with distinct wide, dark, transverse band (Fig. 6); (4) ventral margin gill 4 with 15–16 spines (Fig. 2); (5) abdominal terga with sparse smoky web-like tracheations; and (6) abdominal sterna 3–8 with median purplish macula.

Distribution.—This species is known only from Arizona.

Records.—ARIZONA: *Apache Co.* Stream at Greer, 27-VI-66, RKA. *Graham Co.* Grant Cr. on Hwy. 366, Pinaleno Mtns., 20-VII-70, RKA; Wet Cr., Wet Cr. Canyon Camp, Pinaleno Mtns., 20-VII-70, RKA.

Biology.—Nymphs were collected during the months of June and July from streams between 5900–8500 feet elevation, and in water with a temperature range between 56°–66°F.

Ameletus sp. "B"

Nymph.—Length: body 10.0–11.0 mm; caudal filaments 3.0–4.0 mm. General color brown with light brown markings. Head brown, light brown at sutures. Thoracic nota brown with indistinct light brown markings; legs brown. Abdominal terga brown; terga 2–8 with light brown median diamond-shaped macula; terga 1–9 with paired light brown sublateral markings (Fig.

7); tergum 10 light brown; abdominal gills with faint ventral band; ventral margin gill 4 with 14–15 spines (Fig. 3); gills with pale tracheations; abdominal sterna 2–8 brown with paired light brown sublateral markings. Caudal filaments pale with distinct wide, dark, transverse band.

Remarks.—*Ameletus* sp. "B" can be distinguished from all others by the following combination of characters: (1) abdominal gills with a faint ventral band; (2) gills with sparse, pale tracheations; (3) ventral margin of gill 4 with 14–15 spines (Fig. 3); (4) caudal filaments with a distinct, wide, dark transverse band; abdominal terga without smoky web-like tracheations (Fig. 7).

Distribution.—This species is known only from New Mexico.

Record.—NEW MEXICO: *Rio Arriba Co.* Canjilon Cr. on Hwy. 110, Carson Nat. For., 29-VI-64, RKA.

Biology.—Nymphs were collected during June from a stream with a water temperature of 66°F.

Ameletus sp. "C"

Nymph.—Length: body 10.0–11.0 mm; caudal filaments 3.0–4.0 mm. General color brown to dark brown with pale markings. Head dark brown, pale at sutures. Thoracic nota pale with brown markings; pronotum pale with pale midline, dark brown sublateral markings, and dark brown at anterior margin; mesonotum brown with pale midline, submedian, and sublateral markings; metanotum brown with pale midline; thoracic sterna pale; legs pale with brown markings. Abdominal tergum 1 brown with paired pale sublateral spots; tergum 2 pale with paired, brown, submedian, oblique markings and brown posterolateral markings; terga 3–6 brown with median pale elongate to diamond-shaped macula and paired pale sublateral and submedian markings; tergum 7 pale with paired brown submedian markings; terga 8–10 brown with pale median markings; tergum 10 usually pale, often with submedian macula (Fig. 8); abdominal gills pale with sparse, pale tracheations; gills with subdorsal band, without ventral band (Fig. 4); ventral margin gill 4 with 11–12 spines; abdominal sterna pale with paired brown anterolateral spots; sterna 7–9 or 8–9 with paired brown, sublateral bands, sternum 9 often with brown inverted U-shaped macula. Caudal filaments pale with distinct, wide, dark brown transverse band.

Remarks.—*Ameletus* sp. "C" can be distinguished from all other nymphs by the following combination of characters: (1) abdominal gills with a subdorsal band only; (2) gills with sparse, pale tracheations; (3) ventral margin gill 4 with 11–12 spines (Fig. 4); (4) caudal filaments with a distinct wide, dark transverse band; and (5) abdominal terga without smoky web-like tracheations (Fig. 8).

Distribution.—This species is known only from Arizona.

Records.—ARIZONA: *Apache Co.* E. Fk. Little Colorado Riv., E. Fk.

Campground, Apache Nat. For., 3-VII-64, RKA; Stream at Greer, 27-VII-66, RKA.

Biology.—Nymphs were collected during June and July from streams between 8500–8700 feet elevation with a water temperature range between 62°–66°F.

Genus *Siphlonurus* Eaton

Siphlonurus is composed of 17 North American species, five of which are found in western North America. The distributional range in western North America is from southern Arizona (31°70′ north latitude) in the MIDDLE NORTH TEMPERATE ZONE to central Alberta (53°31′ north latitude) in the UPPER NORTH TEMPERATE ZONE. In eastern North America the range is from northern Georgia (33°29′ north latitude) in the MIDDLE NORTH TEMPERATE ZONE to northern Ontario (52°15′ north latitude) in the UPPER NORTH TEMPERATE ZONE. *Siphlonurus occidentalis* Eaton, 1885, is the only species in the genus known from the Southwest.

Siphlonurus occidentalis Eaton

Heptagenia brunnea (in part) Hagen 1875:581.
Siphlurus occidentalis Eaton 1885:218 (=*H. brunnea,* in part); Dodds 1923:104; Dodds and Hisaw 1924:138.
Siphlonurus occidentalis, Clemens 1915:248; Ulmer 1920:135; Needham and Christenson 1927:12; McDunnough 1928:9; Traver 1935:473; Spieth 1941:92; Edmunds 1954:64; Allen and Edmunds 1956:85; Edmunds 1960:73; Edmunds and Musser 1960:114; Peters and Edmunds 1961:108; Argyle and Edmunds 1962:181; Edmunds 1962:vii (=*inflatus*).
Siphlurella occidentalis, Bengtsson 1930:10.
Siphlonurus inflatus McDunnough 1931:90; Traver 1935:470.

Hagen (1875) proposed the name *Heptagenia brunnea* based on a male and a female imago from California. Eaton (1885) examined the type material and discovered that the female imago represented a separate species and named it *Siphlurus occidentalis.* Needham and Christenson (1927) reported specimens from Utah, and McDunnough (1928) reported it from Alberta. Bengtsson (1930) discussed the species under the name *Siphlurella occidentalis.* McDunnough (1931) described *S. inflatus* from Alberta and British Columbia, and Edmunds (1962) synonymized it with *S. occidentalis.* Traver (1935) published records from Montana, Washington, Utah, Colorado, Wyoming, Oregon, and New Mexico. Edmunds (1954) reported the species from Utah, and Allen and Edmunds (1956) collected it in Oregon. Edmunds and Musser (1960) cited records from Wyoming and Utah, Peters and Edmunds (1961) from New Mexico, and Argyle and Edmunds (1962) from Colorado.

Spieth (1941) stated that Eaton, in 1885, had other individuals from Washington, Nevada, and "Mt. Hood," he designated a Colorado male imago as the lectotype, and labeled all the other specimens, except the "Mt. Hood" females, as syntypes.

Type locality.—"Colorado."

Type deposition.—McLachlan Museum, British Museum (Natural History), London.

Distribution.—*Siphlonurus occidentalis* is widely distributed in western North America and it is known from every western state in the United States and British Columbia and Alberta in Canada.

New records.—ARIZONA: *Apache Co.* N. Fk. White Riv., Hawley Lake Rd., 27-VI-66, RKA; Stream at Greer, 27-VI-66, RKA. *Coconino Co.* Pond ca. 8 mi. S. Flagstaff. *Cochise Co.* Herb Martyr Lake, Chiricahua Mtns., 28-VI-66, RKA; E. Fk. Turkey Cr., Chiricahua Mtns. 28-VI-66, RKA.

Biology.—Nymphs were collected during June and July from streams and ponds between 5530–8500 feet elevation and a water temperature between 64°–66°F.

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Footnotes

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[2] 1420 Lightview Avenue, Monterey Park, California 91754.

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A NEW SPECIES OF *AMMOPHILA* FROM NORTH AMERICA (HYMENOPTERA: SPHECIDAE)

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A recent study of the subfamily Sphecinae has revealed the presence of a new species in the genus *Ammophila* W. Kirby from the coniferous woodland areas of the western United States. The name for this new species is being proposed to make it available for use in a forthcoming faunistic work on the sphecine wasps of Idaho.

Ammophila silvestris Kirkbride, new species

Holotype male.—Length 17 mm.

Color.—Black; tegula brown, red posteriorly; petiole tergum and gastral terga I and II red laterally, gastral sterna I and II entirely red; wing veins dark brown.

Vestiture.—Head with erect white hairs; mesopleura with faintly indicated band of appressed silver hairs ventrally along mesopleural suture (Fig. 1); metapleura with evenly distributed appressed silver hairs in area below transmetapleural line, and without such hairs in area above transmetapleural line; propodeal enclosure without erect hairs, but with sparsely placed appressed hairs.

Structure.—Clypeus with free margin arcuate, moderately emarginate medially; pronotal collar rounded longitudinally, smooth; scutum slightly rugose, with weakly developed irregular transverse ridges; episternal sulcus long; metapleural flange not lamellate (Fig. 2); propodeal enclosure with closely spaced transverse ridges laterally, interspaces smooth; penis valve with long basal spine.

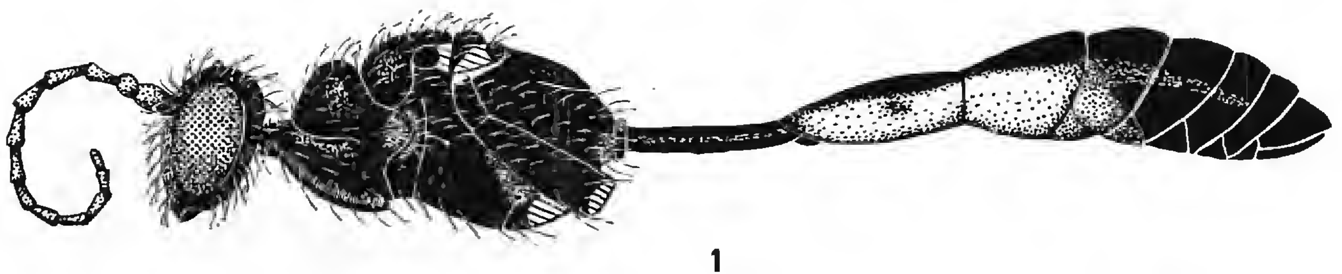
Allotype female.—Length 18 mm.

Color.—Black; tegula dark brown, red posteriorly; petiole tergum and gastral tergum and sternum I entirely red, tergum II red laterally; wing veins dark brown.

Vestiture.—Similar to holotype.

Structure.—Clypeus with disc moderately bulging, median free margin vaguely distinct, bounded laterally by a tooth; scutum with weakly developed, irregular transverse ridges; pronotal collar, episternal sulcus, metapleural flange, and propodeal enclosure similar to holotype.

Types.—Holotype from: 21 mi. W. Lolo Pass, Idaho Co., Idaho, VII-28-



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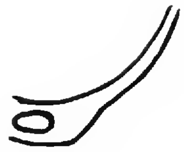

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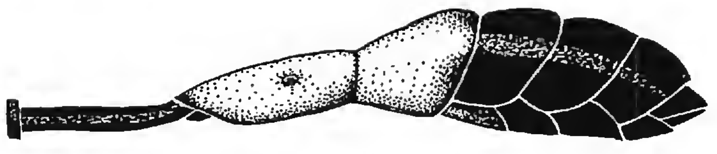

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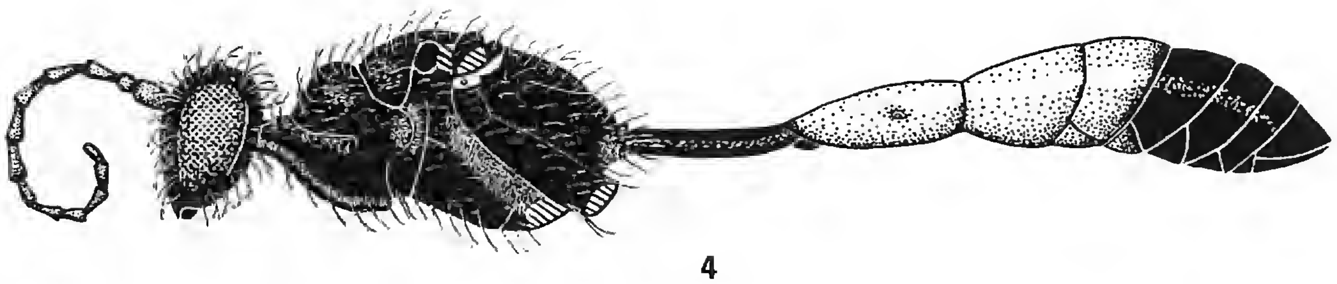
Figs. 1–3. *Ammophila silvestris* Kirkbride, new species. Fig. 1. Male, lateral view. Fig. 2. Metapleural flange. Fig. 3. Female abdomen, lateral view.

1976, D. M. Kirkbride. Allotype from: 0.2 mi. S. Plummer, Benewah Co., Idaho, VII-16-1976, D. M. Kirkbride.

Paratypes (33 males and 23 females) from the following localities: IDAHO: BEAR LAKE CO., 1 mi. N. Emigration Campgrnd., VIII-4-1976, D. M. Kirkbride. BLAINE CO., 15 mi. NW. Ketchum, VII-22-1961, A. R. Gittins. BONNER CO., 2 mi. SW. Granite, VII-21-1977, D. M. Kirkbride; Granite Lk., VII-4-1977, D. M. Kirkbride. BOUNDARY CO., 0.5 mi. W. MacArthur Reservoir, VIII-31-1976, D. M. Kirkbride. CAMAS CO., 13.3 mi. N. Fairfield, VI-18-1966, A. R. Gittins. CARIBOU CO., 1 mi. N. Gravel Crk. Campgrnd., VII-1-1976, D. M. Kirkbride. CLEARWATER CO., Elk River, VII-9-1962, A. R. Gittins; 3.5 mi. upstrm. frm. Washington Crk., N. Fork Clearwater Riv., VII-11-1977, D. M. Kirkbride; Skull Crk., N. Fork Clearwater Riv., VII-11-1977, D. M. Kirkbride; Elk River Reservoir, VII-9-1963, G. B. Hewitt. CUSTER CO., Redfish Lk., VII-21-1964, A. R. Gittins; 3 mi. E. Trail Crk. Summit, Pioneer Mts., VIII-17-1977, D. M. Kirkbride; Bonanza, VII-22-1965, W. F. Barr. FRANKLIN CO., 1 mi. SW. Emigration Campgrnd., VIII-2-1976, D. M. Kirkbride; 1.6 mi. SW. Emigration Campgrnd., VIII-2-1976, D. M. Kirkbride. IDAHO CO., 21 mi. W. Lolo Pass, VII-28-1976, D. M. Kirkbride; 25 mi. E. Lowell, VII-19-1964, A. R. Gittins. KOOTENAI CO., Cottonwood Crk., VII-21-1976, D. M. Kirkbride; Lane, VI-27-1962, A. R. Gittins. LATAH CO., Moscow, VII-20-1928. LEMHI CO., Meadow Lk., VIII-15-1977, D. M. Kirkbride. SHOSHONE CO., 7 mi. E. Clarkia, VII-18-1962, A. R. Gittins; Freeze Out Hill,



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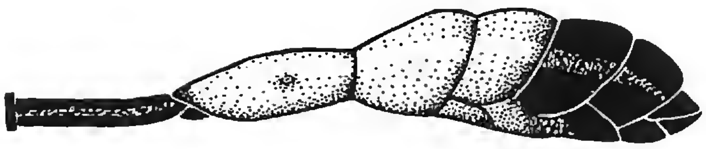

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Figs. 4–6. *Ammophila azteca* Cameron. Fig. 4. Male, lateral view. Fig. 5. Metapleural flange. Fig. 6. Female abdomen, lateral view.

VII-18-1962, A. R. Gittins; 8 mi. N. Avery, VII-20-1969, D. S. Horning; 5 mi. W. Avery, VII-13-1958, A. R. Gittins; Roundtop, St. Joe Nat. For., VII-7-1960, A. R. Gittins; Wallace, VI-27-1918, O. Huelleman. TETON CO., 3.4 mi. SE. Victor, VIII-7-1976, D. M. Kirkbride; 3.2 mi. SE. Victor, VIII-6-1976, D. M. Kirkbride; 2.9 mi. SE. Victor, VIII-6-1976, D. M. Kirkbride. VALLEY CO., Boulder Mt., VIII-21-1952, S. E. Knapp; Yellow Pine, VIII-22-1955, H. C. Manis. MONTANA: MISSOULA CO., Lolo Hot Sprgs., VII-19-1963, W. F. Barr. WYOMING: TETON CO., Teton Cyn., West Side, Teton Range, VII-19-1964, R. L. Westcott. Holotype, allotype, and paratypes are deposited in the collection at the University of Idaho, Moscow.

Discussion.—An examination of the paratypes listed above has shown that gastral segment II is sometimes entirely black in males, while in females, the sternum of this segment may infrequently be entirely red. Furthermore, in both sexes, the band of appressed silver hairs along the mesopleural suture is not always visible, and the metapleural flange is rarely narrowly lamellate.

An initial examination of specimens in the U.S. National Museum of Natural History, and consultation with A. S. Menke clearly placed *Ammophila silvestris* in the complex of species associated with *Ammophila azteca* Cameron. The specific status of *silvestris* was subsequently determined by an examination of types, paratypes, and descriptions of the species in this complex.

Ammophila silvestris is most similar to *Ammophila azteca* Cameron, to which it is probably very closely related. In fact, in the revision of the North American *Ammophila* by Menke (1965), *silvestris* keys out to *azteca*. The absence of erect hairs on the propodeal enclosure of *silvestris,* along with the generally non-lamellate condition of the metapleural flange (Fig. 2) will usually, however, distinguish it from *azteca,* which has erect hairs on the propodeal enclosure and a broadly lamellate metapleural flange (Fig. 5). In addition, the band of appressed silver hairs along the mesopleural suture is either absent or only faintly visible on *silvestris* (Fig. 1), but is usually distinct on *azteca* (Fig. 4). These two species can also be separated by differences in gastral coloration. Males of *silvestris* usually have the first and second gastral terga red laterally and black dorsally, while in males of *azteca* these terga are usually entirely red. Females of *silvestris,* on the other hand, generally have the second gastral tergum black dorsally, whereas in *azteca* females this tergum is entirely red.

Habitat preferences are different between these two species. While *silvestris* has only been collected from habitats associated with coniferous forests, *azteca* is abundant in both the coniferous forest and desert habitats alike. The possible sympatric occurrence of these two species in forested areas has been verified by collections made from a number of localities in Idaho. Although the similarity in gross anatomy might imply that *silvestris* is simply a subspecies of *azteca,* their sympatric occurrence in forested areas indicates that these are in fact separate species.

Acknowledgments

My thanks to Dr. C. D. Johnson of Northern Arizona University for his advice in the preparation of this description.

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PLEOCOMA SPP. IN WESTERN OREGON CONIFEROUS FORESTS: OBSERVATIONS ON ADULT FLIGHT HABITS AND ON EGG AND LARVAL BIOLOGY[1] (COLEOPTERA: SCARABAEIDAE)

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In the early 1960's, I studied the feeding habits of *Pleocoma* larvae in some old-growth coniferous forests in western Oregon (Fellin, 1975). The study began shortly after Stein (1963) confirmed that *Pleocoma* larvae feed on the roots of forest trees. Five species of *Pleocoma* were studied—primarily *P. dubitabilis dubitabilis* Davis[2] (hereafter referred to merely as *P. dubitabilis*), *P. carinata* Linsley, *P. simi* Davis, and to a lesser extent *P. minor* Linsley, and *P. crinita* Linsley.

Incidental to that study, other studies were conducted and/or observations made on the biology, ecology, behavior, and distribution of Oregon *Pleocoma* spp. Many new localities were recorded and described. Based on these and other locality descriptions, the geographic distribution of all species of *Pleocoma* in Oregon was summarized and the habitats for *P. simi* and *P. carinata* were described (Fellin and Ritcher, 1967). Observations also were made on trapping male *Pleocoma* with female-baited traps (Fellin, 1968). Results of studies on the movement and distribution of *Pleocoma* larvae will be presented elsewhere.

Adult Flight

Since the earliest published record on the flight habits of *Pleocoma* males (Ricksecker 1887, 1888), entomologists have observed the flight habits of many species of *Pleocoma,* oftentimes incidental to collecting specimens for taxonomic study. Many observations have been made of environmental conditions or circumstances existing during male flight, especially with the species occurring in California.

These observations frequently have been interpreted as reflecting patterns of behavior of a particular species associated with a particular environmental condition, when, in fact, they may have been merely artifacts of collecting. For example, under certain circumstances, individual males or groups of males of some species may behave in a particular manner, while under another set of circumstances, they might behave altogether differently. One entomologist, who has observed and collected all known (and some "unknown") species and subspecies in California has concluded, in concert with two of his colleagues, that, ". . . thus far, the only real piece of information to emerge is that *Pleocoma* males will fly (or can fly but might *not*) at any time of day, during every conceivable climatic condition (appropriate to the season), and will exhibit nearly every form of behavior physically feasible in the process." (F. T. Hovore, personal communication.)

Concerning the Oregon species, Ellertson and Ritcher (1959) observed the flights of *P. crinita, P. minor,* and *P. oregonensis* Leach, and Ritcher and Beer (1956) published a few notes on the adult activity of *P. dubitabilis.* Nothing has been published until now concerning the flight of the two southwestern Oregon species, *P. simi* and *P. carinata.* The only known reference to *P. carinata* flight is a statement of Linsley's (1941) that three *P. carinata* "were captured in a rainstorm."

The observations presented in this paper on the flights and the factors associated with flights of some Oregon species, are not to be interpreted as an indication of a species-specific response to some environmental condition. Rather, they are presented merely to document the conditions that existed while I or others observed flights of *P. dubitabilis, P. simi* or *P. carinata.*

Flight Habits

Description of flight.—The most detailed observation of the flight of an Oregon species was made 11 October 1960 on the Umpqua National Forest, about 28 km northwest of Union Creek in Douglas County, at an elevation of approximately 850 m. W. I. Stein (personal communication) describes the flight of a series of *P. simi* as follows:

> "Beetles were flying in the timber at the same time as in the open. When flights were at a maximum, several beetles could be seen at once within sight in any direction. Flights were both low among the weeds and over head high, or a combination thereof. Some beetles circled, others flew in relatively straight flights either up or down hill. Beetles did not fly too fast, but it took a good trot to keep up with them when they made straight flights."

Many species of *Pleocoma* males differ greatly in their flight behavior (Davis, 1934a); this variability in flight behavior is often explained by whether males are "tracking" a pheromone or merely "dispersing," not yet having picked up the female scent (F. T. Hovore, personal communication).

Males of *P. hirsuta* have been observed to fly stronger, swifter, or more "purposefully" when (a) disturbed or frightened by collectors or predators

Table 1. Date, time of day and weather conditions for flights of *Pleocoma dubitabilis, P. simi,* and *P. carinata* in western Oregon coniferous forests in 1960 and 1961.[1]

Date	Time of day	Weather conditions[2]
	Pleocoma dubitabilis	
12 October 1960	0620–0655	Drizzling during period of flight, but hard rain earlier in morning
12 October 1960	1400–1600	—
21 October 1961	1300–1500	Overcast
22 October 1961	1400–1630	Light rain
29 October 1961	1300–1500	Clear sky, sunny
31 October 1960	1330	Occasional drizzles and windy
1 November 1961	1100–1215	Partly cloudy with intermittent sun
12 November 1960	1315–1445	—
19 November 1960	1330–1500	Raining
	Pleocoma carinata	
11 October 1960	1630–1745	Light drizzle (observer reported it was dark when some of flight was seen)
11 October 1960	1530	Drizzling rain
15 October 1960	1½ hours before daylight	Not raining
16 October 1960	1640–1700	Just beginning to rain
27 October 1961	0730	Overcast
2 November 1960	1400	Very light rain
12 November 1960	1200	Raining
20 November 1960	1500	Light rain just beginning
1 December 1960	—	—
16 December 1960	—	—
	Pleocoma simi	
11 October 1960	1400	Rainy and foggy
11 October 1960	1250–1600	Intermittent rain, overcast
11 October 1960	1200–1600	Raining lightly
14 October 1960	0300–0600	Clear, air temperature 5°C
14 October 1961	1700–1800	Not raining
23 October 1961	1015	Heavy shifting fog with rain
25 October 1961	1330	Overcast, occasional light mist
25 October 1961	0930	Overcast, air calm and mild, occasional drops of rain

Table 1. Continued.

Date	Time of day	Weather conditions[2]
28 October 1960	1100–1200	Foggy with light rain
October 1960	after 1500	Light rain
2 November 1960	1300	Overcast, fog and very light rain
2 November 1960	1115–1145	Overcast with light rain
16 November 1960	1355–1430	Overcast, light fog, heavy drizzle, 2 inches of snow on ground yesterday, ground bare today
17 November 1960	0820–1400	Overcast, raining
13 December 1961	afternoon	Fairly heavy rain

[1] All flights of *Pleocoma dubitabilis* were observed by the author in a Douglas-fir stand at McDonald Forest, 8 km north of Corvallis, Oregon, Benton County. Flights of *Pleocoma simi* and *Pleocoma carinata* were seen by various people in mixed coniferous forests primarily on the Umpqua and Rogue River National Forests in Douglas, Jackson, and Josephine Counties in southwestern Oregon.

[2] The subjectivity of such terms as "drizzle, light rain, drizzling, rain" etc., is recognized. Although each can mean different intensities of precipitation to different people, the terms are presented in the words of the individuals making the observations.

and (b) near the end of a given activity period (F. T. Hovore, personal communication).

Time of day of flight.—Males of *P. dubitabilis, P. simi,* and *P. carinata* were observed flying from predawn until late afternoon and early evening (Table 1). The earliest flights observed were those of *P. simi* at 0300 14 October 1960 and *P. carinata,* 1½ hours before daylight 15 October 1960. The latest flights were about 1745–1800 11 October 1960 and 14 October 1961 for *P. carinata* and *P. simi,* respectively. Though the data in Table 1 indicate periods during the day when beetles were observed flying, they do not preclude the possibilities of flights occurring from late evening until early morning when observers were not likely to be in the forest.

An unconfirmed, but reliable, report of an adult male *Pleocoma* (*carinata*?) captured in flight at 2330 is substantiated by reports that males of other species of *Pleocoma* fly at night. In November 1949, males of *P. conjungens* were taken almost continually from 2200 to 0600 hrs. during a steady light rain and a nearly full moon (Hazeltine, 1950). *Pleocoma fimbriata* males are reported to fly at dusk (Hopping, 1920), and *P. marquai* males will fly throughout the night while rain or snow is falling and at dusk for several days thereafter (Hovore, 1972). F. T. Hovore (personal communication) also reports that an increase in rain intensity initiated small flights of *P. conjungens lucia* and *P. blaisdelli* at 2330 and 0200 hrs., respectively.

Time of year of flight.—In 1960 and 1961, males of all three species, *P. dubitabilis, P. carinata,* and *P. simi,* flew for the first time on 11–12 October. The last *P. dubitabilis* flight was observed on 19 November 1960 and most major flights of *P. simi* and *P. carinata* were last observed between 17–20 November. However, some *P. carinata* males were still flying as late as 1 and 16 December 1960 and a *P. simi* flight was reported by Bureau of Land Management foresters near Myrtle Creek in Douglas County on 13 December 1961.

As far as *P. dubitabilis* is concerned, observations presented in Table 1 generally support earlier ones. In 1954, Ritcher and Beer (1956) report *P. dubitabilis* began flying on 16 October (at Forest Grove) and continued, when conditions were favorable, through the second week in November. In 1955, males first flew on 3 October (at McMinnville). That year, at the McDonald Forest study area, flight began shortly before 8 October and continued until 4 November (Ritcher and Beer, 1956).

The peak of male activity for *P. oregonensis* occurs in October and November (Ellertson, 1956).

Other species of *Pleocoma* are known to fly late into the winter. *Pleocoma crinita* is reported to have sporadic flights as late as March (Ellertson and Ritcher, 1959). *Pleocoma hoppingi* males have been collected in flight as late as 5 February (Linsley, 1941) and 16 March (F. T. Hovore, personal communication) in Yosemite National Park in California. Flight of *P. marquai* males usually begins in early October and can continue until early December in years of relatively low rainfall (Hovore, 1972). Two males of this species were taken in flight on 6 January 1979 (F. T. Hovore, personal communication). Specimens of *P. rubiginosa* Hovore have been collected in blacklight traps from January to April, and *P. reflexa* males are known to fly from late November to mid-January (Hovore, 1972).

I have an additional unconfirmed report of *Pleocoma* males flying as early as late August. On 8 November 1961, I received a letter from Gordon Walker (personal communication) describing several collections he had made of *Pleocoma* males that fall. The letter read, in part, as follows:

> "Also around the week of the 24th of August, I caught one about 11:30 one night while on a fire in the Neil Creek area. The exact location is T40S, R1E, SE¼NE¼ section 12. I didn't have any place to put the thing so I took the head off a flashlight and put it in behind the reflector. It would have worked fine, but I put the flashlight with several others and couldn't locate it after that."

Although I did not see the specimen for positive identification (which could make this record somewhat suspect), I consider this a reliable report since Walker had forwarded specimens from several collections to me in the fall of 1960 and 1961. He reportedly caught the beetle 9 km south-southeast of

Ashland (Jackson County) and a similar distance from the California border, at a site between the known distributions for *P. carinata* and *P. simi*. It could have been either one of these species or *P. shastensis* or one of the other northern California species.

The time of year of flight may also be influenced by certain weather conditions, particularly fall rains. Hovore (personal communication) indicates that in the mid-1970's when fall rains were late, he observed species (*P. australis, P. marquai,* and *P. tularensis*), which normally fly from late September to early November, flying from January to March. The following year was characterized by unusually early heavy rains, and he took the same species in flight in mid-September. He concludes that ". . . under 'normal' circumstances, one can safely 'predict' the approximate flight seasons of various species according to their usual levels of responsiveness to precipitation . . . ," but in years of very early, very late, or particularly cold seasons, flight times can often be off as much as 2 or 3 months.

Environmental Factors Associated with Flights

Moisture.—Probably the greatest single factor affecting flight of adult male *Pleocoma* is rainfall. As noted by Ellertson and Ritcher (1959), "The autumn and winter seasons with their rain and saturated atmosphere have long been associated with flight of *Pleocoma* males." However, as Hovore observed (personal communication), "The actual presence of falling rain though 'preferred' by certain species (such as *puncticollis, australis, marquai*) is not entirely necessary."

The first flights of the year seem to follow general fall rains and subsequent flights are often, but not always, associated with day to day precipitation. At a study site at McDonald Forest, 8 km north of Corvallis (Benton County) the first *P. dubitabilis* flights were observed in 1960 on 12 October; two flights were observed, one between 0600–0700 and another between 1400–1600 hrs. Although 4 cm of rain had fallen at that site between 1 September and 12 October, these and subsequent flights probably were triggered by the 3.60 cm of rain that fell between 6 and 12 October, as shown below:

Date	cm
1 September–5 October	0.40
6–8 October	2.55
9 October	0.15
10–11 October	0.00
12 October	0.90

Ellertson and Ritcher (1959) note that at least 2.5 cm of rain falls between 1 September and first flights of *P. crinita* males at Hood River.

Adult males of *P. simi* and *P. carinata* flew for the first time in 1960 on

11 October when flights at five localities were documented by as many observers on the Umpqua and Rogue River National Forests in Jackson and Douglas Counties. The distance between the two furthermost observed flights was about 112 km.

These five flights occurred after the third general rain in western Oregon. A general rain fell in western Oregon between 1–4 September (U.S. Weather Bureau, 1960a). The next general rain fell 6 October and lasted for 3 days (U.S. Weather Bureau, 1960b). On 9 October, rain was scattered and, on 10 October, no rain or a trace was reported. On 11–12 October, a general rain fell again. Two factors were common to all five flights: (1) each flight was observed at some period between 1200 hrs. and dark and (2) rain was falling at the time each flight was observed.

Observations by four individuals who observed and collected *P. simi* in flight show how closely—after the first general fall flights—male flights appear to be related to precipitation. (1) A collector at a site 29 km northwest of Union Creek (Douglas County) reported that rain began falling at 1300 2 November 1960 and beetles became abundant locally; none had been seen earlier in the day. (2) In October, another collector (D. J. Tandy, personal communication) reported that, at a site 26 km west-northwest of Diamond Lake (Douglas County), when a sprinkling rain began falling at 1500, beetles came out and many were in flight almost immediately. (3) On 11 October 1960 a third collector (Jerry Conner, personal communication) working on the Rogue River National Forest 11 km north of Prospect (Jackson County) reported that a few beetles were seen shortly after noon and that the number increased the longer it rained. (4) The fourth flight was described (W. I. Stein, personal communication) as follows:

> "Arrived at Falls Unit (27 km northwest of Union Creek, Douglas County) shortly before 12 o'clock (noon, 11 October) weather first was calm, chilly and overcast with brief interludes of diluted sunshine. Then breeze came up which made it colder and more uncomfortable. Shortly after 12:30 p.m. overcast became complete rapidly. Some wind developed, and a few drops of rain started falling. Simultaneously beetle (*P. simi*) activity became evident. The first one was sighted and captured at 12:50 p.m. Captures averaged nearly one a minute for the next half hour, then flights waned as did the rain. Within another half hour rain began again but beetle flights did not increase. Occasional beetle flights were seen until about 4:00 p.m. when heavy rain began."

The fall flights of these three Oregon species following the onset of fall precipitation are similar to those reported for many California species. Adult males of *P. linsleyi,* at least at the type locality, appear to begin flight only after the area has received over 7.5 cm of rain (Hovore, 1971). Hazeltine

(1952) reported that *P. puncticollis* males usually fly during the second or third general rain and that *P. fimbriata* males begin flying after the first few soaking rains (Hopping, 1920). Recently, Page and Fisher (1976) caught four males of *P. hirticollis vandykei* one day after the second rain of the season south of San Jose, California. According to Hovore (1972), adult activity of *P. marquai* in the vicinity of the type locality begins during or shortly after the first precipitation of the fall season, usually in early October. Males of *P. reflexa* have been collected only after an area has received several cm of precipitation (Hovore, 1972).

Although the above reports document the close association of beetle flights with rain, males of some Oregon species have been observed to fly in clear weather. On 29 October 1960, I observed about ½ dozen *P. dubitabilis* males flying between 1300–1500. It was a perfectly clear, cloudless day with air temperature 12°C. In the preceding 2 days, however, more than 2 cm of rain had fallen at that study site. On another clear day, 11 November 1960, no beetles were observed flying although rain had fallen all day on the 10th. On 14 October 1960, another collector observed *P. simi* males flying between 0300–0600 in clear weather in a forested area 8 km south of Eugene in Lane County.

Similarly, many of the California species are also known to fly in clear weather. A male *P. sonomae* was observed flying at sunset in clear cool weather in Marin County, California (Hazeltine, 1952). Smith and Potts (1945) reported *P. hirticollis vandykei* flying in late afternoon sunshine. Rivers (1889) mentions that it is the habit of *Pleocoma* to travel both by day and night, in sunshine or rain. Hovore (1971) reports that *P. nitida* Linsley does not require immediate precipitation for flight activity. He collected specimens, "... approximately 4 hours after rain had ceased and under clearing sky conditions." Hovore (1972) also reports that *P. marquai* will fly at dusk (for several days after a rain or snow) during weather conditions varying from heavy overcast to bright afternoon sunlight. He also collected a male *P. reflexa* shortly after dusk following a day of clear cold weather.

Male adult *Pleocoma* are also reported to be attracted to pools of water (Davis, 1934a), small streams and water-filled ditches or puddles (Ellertson, 1958; Linsley, 1957). Light reflected from the surface of the water apparently attracts the beetles. On 14 October 1961, Frank Wilson (personal communication) wrote that he "creamed" 37 *P. simi* males from the surface of puddles of water in the center of a clearcut on the Umpqua Forest east of Idleyld Park. Hovore (personal communication) has taken males of at least seven species from the surface of puddles, pools, and forebays in California.

Temperature.—I observed flights of *P. dubitabilis* when temperatures were as low as 6°C and as high as 15°C. On 5 November 1954, Ritcher and

Fig. 1. *Pleocoma* female with some of her eggs showing how they were laid in spiral fashion as she moved upward through the soil. (The eggs fell from their niches when collected and had to be replaced for the photograph.) (actual size)

Beer (1956) observed *P. dubitabilis* males flying when air temperatures were 10.5°C. One *P. simi* flight was observed in clear weather when the air temperature was 5°C.

On at least three occasions, adult males of Oregon species have been collected in areas where forest residue (slash) was being burned or where natural forest fires were being controlled. On 14 October 1961, *P. simi* males were flying in a clearcut area, 35 km east of Idleyld Park, Douglas County, where burning forest residue was accompanied by considerable smoke. It was not raining at the time. Later, on 23 October, *P. simi* males were flying

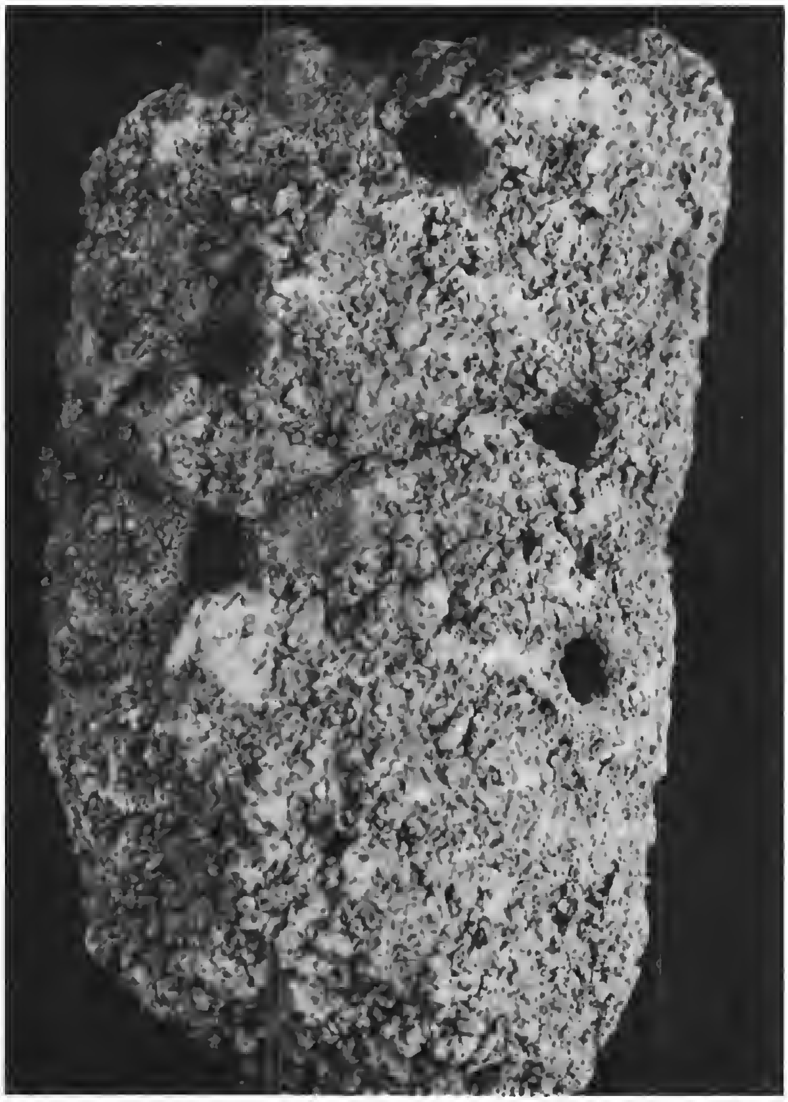

Fig. 2. Portion of vertical core of packed and pulverized soil. Burrows in the soil were made by second stage *Pleocoma dubitabilis* larvae moving outward from egg niches. Larvae were still in the burrows when the core was collected on 12 November 1960 (2×).

in another clearcut area, 14 km northeast of Tiller, Doulgas County, where slash had recently been burned. During this flight there was heavy shifting fog with rain. I have already mentioned the adult male reportedly caught by an individual fighting a forest fire on 24 August 1961. Whether increased air or soil temperatures during these fires had any relationship to the respective beetle flights is not known. It is possible that heat produced by the fires could have stimulated adult male beetles to emerge and fly, particularly if flights have already occurred and/or if males were in the litter close to the soil surface.

Egg and Larval Biology

With the exception of the studies of Ellertson (Ellertson and Ritcher, 1959) of *P. crinita, P. minor,* and *P. oregonensis* in Hood River and Wasco County orchards, little ecological information exists or has been published concerning the soil-inhabiting stages, particularly for *P. simi, P. carinata,* or *P. dubitabilis* in the coniferous forest environment. My observations, though fragmentary, on the egg and larval biology for these three species are presented here.

In the laboratory, all eggs and larvae collected in the field and larvae developing from eggs laid in the laboratory were reared in small salve tins lightly packed with sifted soil. The tins were kept in a temperature cabinet equipped with a fan and heating unit to maintain constant temperature. Cabinet temperature was periodically adjusted to conform to soil temperature 75 cm deep at a study site at McDonald Forest, 8 km north of Corvallis.

Egg Biology

Eggs of *P. simi* and *P. carinata* are dull white in color and ellipsoidal in shape similar to eggs of *P. dubitabilis* (Ritcher and Beer, 1956), but they do not have the yellowish tinge characteristic of eggs of *P. crinita, P. minor,* and *P. oregonensis* (Ellertson, 1958).

Manner of deposition.—Other biologists have described how *Pleocoma* females deposit their eggs. Eggs are deposited individually beginning at the bottom of a burrow and moving upward in a spiral fashion within a vertical core of pulverized soil (Ritcher and Beer, 1956; Ellertson, 1958; Ellertson and Ritcher, 1959). The process has never been illustrated, however. Figure 1 shows an expired female with a portion of the clutch of eggs she has laid. The core of soil within which eggs are laid is often so tightly packed that it can be removed from the ground intact (Fig. 2).

Size of eggs.—All field-collected and laboratory-reared eggs were measured to the nearest 0.15 mm with a stereo microscope, one ocular of which was equipped with a calibrated micrometer. Laboratory-reared eggs of both *P. simi* and *P. carinata* are larger than those of *P. dubitabilis,* and 1-week-old *P. simi* eggs seem to be a bit longer than those of *P. carinata,* but about the same width (Table 2).

As with other insects (Counce, 1961), *Pleocoma* eggs enlarge during development. Eight-week-old eggs of both *P. carinata* and *P. dubitabilis* were both longer and wider than they were when they were 1 week old.

It appears that laboratory-deposited eggs are generally smaller than those laid under natural conditions in the field. This is due, no doubt, to the artificial conditions of the laboratory and the periodic handling of the females. Ninety field-collected *P. dubitabilis* eggs of unknown age averaged 5.33 and 4.31 mm in length and width, respectively. These field-collected eggs are larger than 8-week-old eggs laid in the laboratory (Table 2).

Number of eggs laid.—The total number of eggs deposited by single *P. dubitabilis* females in the field and in the laboratory was as follows:

Field	Laboratory
64	41
63	39
41	21

Table 2. Size of laboratory-reared *Pleocoma* eggs shortly after oviposition (1 week) and just before producing larvae (8 weeks).

Species	One week old			Eight weeks old		
	Number of eggs	Average (mm)		Number of eggs	Average (mm)	
		Length	Width		Length	Width
Pleocoma dubitabilis	96	4.53	3.00	84	4.99	3.89
Pleocoma carinata	67	4.95	3.24	56	5.36	4.18
Pleocoma simi	83	5.06	3.24	—	—	—

In the laboratory, two *P. carinata* females laid 34 and 33 eggs, respectively, and two *P. simi* females deposited 45 and 42 eggs, respectively. Two *P. oregonensis* females deposited 35 and 48 eggs, respectively, in the laboratory (Ellertson, 1956); however, Ellertson (1958) found considerable variation in the number of eggs deposited by *P. crinita, P. minor,* and *P. oregonensis*. Ritcher and Beer (1956) found that the total egg capacity of five *P. dubitabilis* females was 61, 59, 53, 51, and 33 eggs, respectively.

Depth of oviposition.—Six egg clutches of *P. dubitabilis* females exhumed from the soil indicate the depth at which oviposition took place as follows:

Date observed	Depth of eggs or small larvae[3]	
	Uppermost (cm)	Lowermost (cm)
7 May 1960	17.5	unknown
8 July 1960	47.5	58.0
15 August 1961	20.0	30.0
12 November 1960	17.5	unknown
12 November 1960	17.5	45.0
12 November 1960	31.0	45.0

Three more females collected on 31 March and 13 and 14 April at depths of 25, 34.5, and 17.5 cm, respectively, later oviposited in jars in the laboratory. Whether oviposition would have occurred at the depths at which the females were collected is unknown. On 23 July 1954, Ritcher and Beer (1956) found a single *P. dubitabilis* female that had deposited 50 eggs at a depth between 30 and 49 cm in the soil.

Table 3. Date and depth that dead adult *Pleocoma* females were collected in the soil in 1960 and 1961.

Species	Date	Depth (cm)
Pleocoma dubitabilis	22 April 1960	40
	7 May 1960	40
	7 May 1960	42.5
	8 July 1960	45
	25 August 1960	37.5
	25 August 1960	27.5
	12 November 1960	27.5
Pleocoma dubitabilis	31 March 1961	27.5
	29 April 1961	35
	29 May 1961	40
	28 June 1961	25
	6 August 1961	32
	21 August 1961	25
	13 September 1961	22.5
	21 October 1961	37.5
	22 December 1961	35
Pleocoma simi	16 June 1960	35
	8 October 1960	17.5
	14 October 1960	25
	7 January 1961	27.5
	7 January 1961	25
	7 December 1961	55
Pleocoma carinata	3 January 1961	52.5
	3 January 1961	52.5
	10 May 1961	15

Dead *P. dubitabilis, P. simi,* and *P. carinata* females were often collected in the soil. These females could have failed to emerge from the pupal cell and died there, or could have emerged from the pupal cell but died before reaching the soil surface. More likely, however, these females died after having spent themselves in oviposition, so the depth at which they were collected probably represents the depth of the uppermost egg laid. The date and depths at which these dead females were collected are shown in Table 3.

Time and rate of oviposition.—Two *P. carinata* females collected in the field on 3 January 1961 and two *P. simi* females collected on 26 May 1961 were removed to the laboratory, placed on packed, sifted soil in Mason jars, and examined periodically after 30 April. They began laying eggs soon after 30 May and continued until about 21 June. Between 14 and 21 June, the two *P. simi* females laid 4.6 and 4.7 eggs per day, respectively, and the two *P. carinata* females laid 3.3 and 4.7 eggs per day, respectively.

Table 4. Earliest and latest dates at which larvae hatch from eggs, for the Oregon species of *Pleocoma*.[1]

Species	Dates of larval hatch		Number of eggs observed
	Earliest	Latest	
Pleocoma dubitabilis	21 August	21 September	145
Pleocoma simi	8 September	15 September	6
Pleocoma carinata	3 September	8 September	43
Pleocoma crinita	21 July	12 September	24
Pleocoma minor	15 July	21 August	16
Pleocoma oregonensis	25 July	27 August	—

[1] Data for *P. crinita, P. minor,* and *P. oregonensis* from Ellertson (1956) and Ellertson and Ritcher (1959).

Three *P. dubitabilis* females began ovipositing in the laboratory just prior to 9 June 1961 and the last eggs were laid between 26 June and 2 July. From 10 to 25 June, these *P. dubitabilis* females laid an average of 1.3 eggs per day per female, considerably less than the number observed for *P. carinata* and *P. simi.* In 1955, Ritcher and Beer (1956) observed *P. dubitabilis* females laying eggs in late May and still in the process on 18 June.

Most adult females die shortly after depositing their last egg. Six females (two each of *P. dubitabilis, P. simi,* and *P. carinata*) deposited their last eggs between 21 June and 2 July in 1961 and died between 2 and 9 days later; however, a third *P. dubitabilis* female lived for 45 days after laying her last egg.

Duration of egg stage.—Laboratory-reared *P. dubitabilis, P. simi,* and *P. carinata* remained in the egg stage for 91, 89, and 81 days, respectively. This compares to 69 and 62 days in the egg stage for *P. crinita* and *P. minor* (Ellertson and Ritcher, 1959).

Larval Biology

Hatching from eggs.—Larvae of the three species studied began hatching from eggs in late August and continued until late September. For comparative purposes, the earliest and latest dates of larval hatch are presented in Table 4 for all six Oregon species of *Pleocoma.* From the table, it appears that: (1) larvae of *P. crinita, P. minor,* and *P. oregonensis* begin hatching more than a month before the other three species; (2) *P. minor* and *P. oregonensis* larvae complete hatching earlier than the other four species; (3) the length of time between earliest and latest larval hatch is considerably less for *P. dubitabilis, P. simi,* and *P. carinata* than for the other three species.

Ritcher and Beer (1956) reported field-collected *P. dubitabilis* eggs produced larvae between 28 August and 8 September in 1954 and between 1 and 24 September in 1955.

Moulting.—In the soil, *Pleocoma* larvae prepare a cell in which to moult. The cell is usually cylindrical, rounded on the ends, and often horizontally oriented; if sloped at all, larvae usually lie with their heads at the upper end. Larvae almost always lie on their dorsa while moulting, often assuming this position a day or two before the moult and remaining on their dorsa for as long as 2 days afterwards.

First stage *Pleocoma* larvae moult about 1 month after hatching. Twenty-three first instar *P. carinata,* hatched in the laboratory from eggs deposited by two field-collected females, moulted for the first time between 5 and 12 October, approximately 33.5 days after hatching. Seventy first-instar *P. dubitabilis* (35 hatching from field-deposited eggs and 35 from laboratory-deposited eggs) moulted approximately 31 days after hatching. Larvae from field-collected eggs moulted between 21 September and 20 October, while those from laboratory-deposited eggs moulted between 30 September and 17 October.

Other than first instars, *P. dubitabilis* usually moult annually shortly before first instars leave the eggs. Of 55 *P. dubitabilis* larvae, field-collected between 24 July and 22 August 1961, the first moulted on 19 August and the last on 25 September. Eighty-four percent moulted between 26 August and 17 September.

Younger larvae seem to be the first to moult. Of 16 larvae that moulted prior to 1 September, 94 percent were fifth instars or younger and 69 percent were fourth instars or younger.

Some *Pleocoma* larvae, particularly first instars and those beyond their seventh year, may not moult each year. Out of 60 *P. dubitabilis* larvae collected between 24 July and 22 August 1961, 14 (23 percent) did not moult between the time they were collected and the time observations were discontinued in the laboratory on 15 October. All but one of these nonmoulting larvae were seventh instars or older, and all were males. First instar *P. dubitabilis* and *P. carinata* were observed daily from eclosion until 30 October and 6 November, 10 and 25 days, respectively, after the last larva of each species moulted. Of 80 first instar *P. dubitabilis* reared in the laboratory, five, or 6.3 percent, failed to moult. Twenty-one of 46, or 45.6 percent, first instar *P. carinata* failed to moult.

Sex ratio.—All larvae were sexed according to techniques described for some Scarabaeid larvae by Menees (1957) and Hurpin (1953). The applicability of their methods with *Pleocoma* larvae was confirmed when sexed larvae pupated, in which stage sex was readily determined (Ellertson and Ritcher, 1959).

Table 5. Sex ratio of three species of field-collected *Pleocoma* larvae.

Species	Number of larvae examined	Number of males	Number of females	Sex ratio males : females
Pleocoma dubitabilis	446	253	193	1.31:1.00
Pleocoma simi	114	64	50	1.28:1.00
Pleocoma carinata	77	43	34	1.26:1.00

Of all larvae collected in the field, males of all three species, *P. dubitabilis, P. simi,* and *P. carinata,* outnumbered females by 31, 28, and 26 percent, respectively (Table 5).

Six groups of first stage larvae, each group representing portions of larger egg clutches of six different females, were sexed to compute the larval sex ratio for progeny of individual females. Male to female sex ratios for first instars of *P. dubitabilis* and *P. carinata* range from a high of 2:22 to 1:00 to a low of 1:09 to 1:00 (Table 6).

Number of instars.—Head capsules of all larvae were measured at the widest portion of the dorsum to the nearest 0.15 mm. All head capsules of preserved specimens were dry when measured; no measurements were made with specimens submerged in preserving medium. Living larvae were anesthetized with a small amount of carbon dioxide while being measured.

The range of head capsule width for first and second instar *P. dubitabilis, P. simi,* and *P. carinata* was established in a manner similar to that used by Ellertson and Ritcher (1959). That is, several larvae were preserved shortly after hatching and measured to establish a range for the first instar. Other larvae were allowed to moult after which they were preserved and the head capsules measured.

Table 6. Larval sex ratio for progeny of individual females of *Pleocoma dubitabilis* and *P. carinata.*

Species	Number of larvae examined	Number of males	Number of females	Sex ratio males : females	Oviposition in:
Pleocoma dubitabilis	25	15	10	1.50:1.00	forest soil
	41	22	19	1.16:1.00	forest soil
	23	12	11	1.09:1.00	laboratory
	29	20	9	2.22:1.00	laboratory
Pleocoma carinata	22	12	10	1.20:1.00	laboratory
	22	14	8	1.75:1.00	laboratory

The range in measurements of head capsule width for first and second stage larvae of three species is shown in the following tabulation:

Species	Range in measurements (mm) First instar	Second instar	No. of larvae
P. dubitabilis	1.95–2.55	2.25–2.55	118 and 92
P. carinata	2.25–2.55	2.55–2.85	44 and 23
P. simi	2.25 —	2.60 —	7 and 13

The range of measurements for *P. dubitabilis* and, to a lesser extent, *P. carinata* so overlap that there is no distinct difference in size of head capsules between the first two instars. The same is probably true for *P. simi.*

Frequency histograms for larval head capsule widths for all instars of all three species are shown in Fig. 3. The peaks for first and second instar *P. dubitabilis* and *P. carinata* are rather obvious; however, other than those peaks, an interpretation from the histogram of the range of any given instar for any of the species, especially *P. carinata* and *P. simi,* would be very subjective. Peaks may characterize some instars, at least with *P. dubitabilis,* but extremes of the range for each instar tend to merge.

With *P. dubitabilis,* it was possible by rearing larvae through a moult, to get two head capsule measurements on individual larvae, one prior to and one after the moult. Following this procedure and using the known range of second instars as a starting point, head capsule measurements have been arranged into reasonably discrete groups for the first eight instars (Table 7). From the data in Table 7 and the frequency histogram (Fig. 3A), minimum and maximum head capsule widths for the first eight instars are suggested as follows:

Tentative instars	Head capsule width (mm) Minimum	Maximum
1	1.95	2.55
2	2.25	2.70
3	2.85	3.45
4	3.60	4.50
5	4.35	5.40
6	5.25	6.00
7	6.00	6.75
8	6.75	7.50

Although the ranges are given here for eight instars, it is obvious from Fig. 3A that *P. dubitabilis* larvae pass through more than eight stages. Moreover, the wide range of head capsule measurements for *P. carinata* and *P. simi*

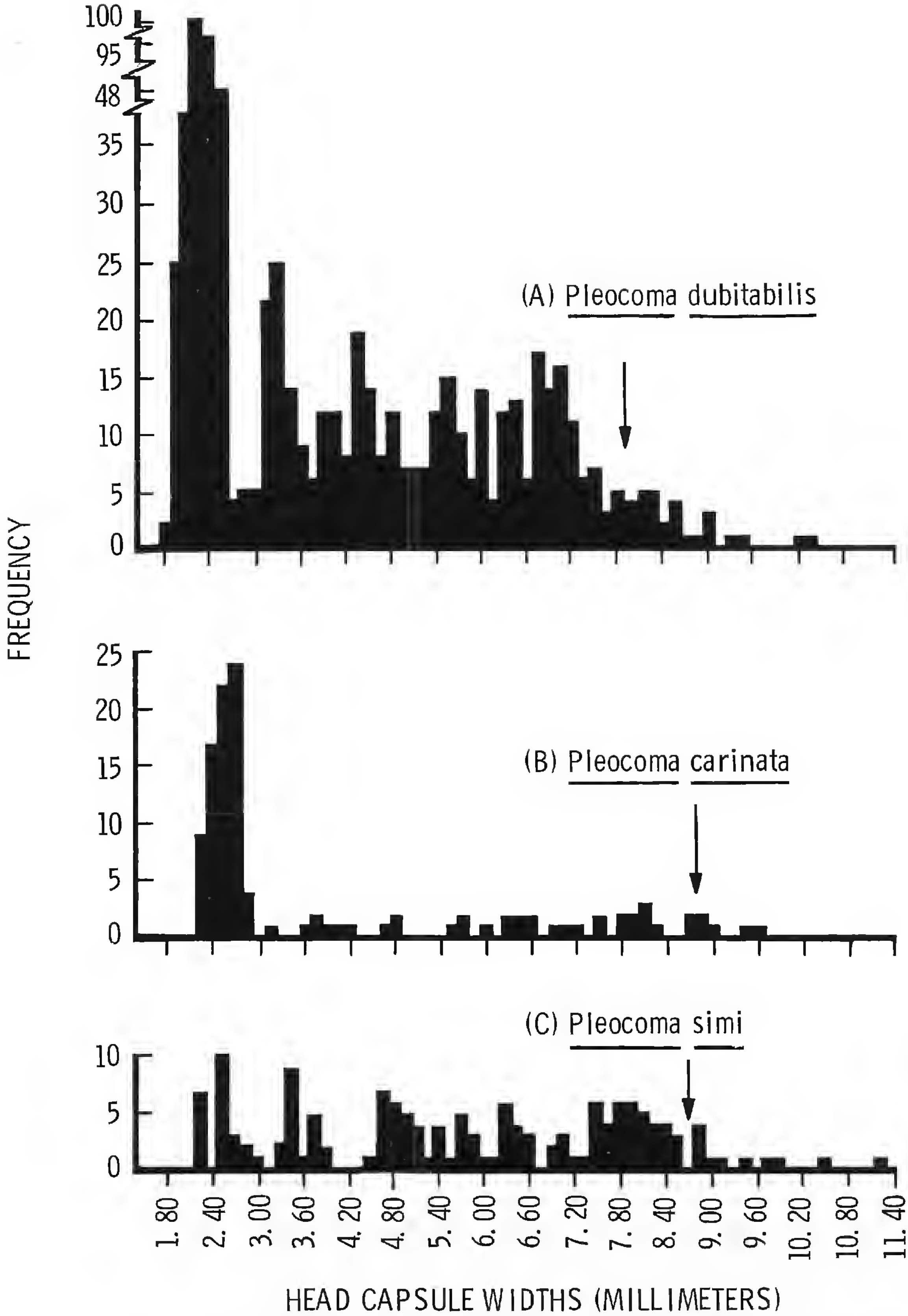

Fig. 3. Frequency histograms of larval head capsule widths for three species of *Pleocoma*. Portions of histograms to left of arrows represent both male and female larvae, portions to right represent females only.

(Fig. 3B, C) indicate that both of these species pass through as many instars as does *P. dubitabilis*.

There appear to be some sexual differences in the number of instars of *P. dubitabilis, P. carinata,* and *P. simi*. All larvae were sexed at the time head capsules were measured and there appeared to be no difference in head capsule widths between sexes through about the eighth instar; however, with *P. dubitabilis,* all larvae with head capsules measuring more than 7.80 mm were females (Fig. 3A). The same phenomenon was observed with *P. carinata* and *P. simi* larvae; larvae of these two species with head capsules larger than about 8.70 mm were all females (Fig. 3B, C). Ellertson and Ritcher (1959) found that the largest *P. crinita* and *P. minor* larvae were all females. They found that three *P. crinita* larvae larger than 7.65 mm (9th or 10th instars) were females and the three largest *P. minor* larvae collected, all with head capsules greater than 7.95 mm, were all females.

Since there appears to be no difference in larval head capsule widths between sexes in the earlier instars, these observations indicate that in at least five species of Oregon *Pleocoma,* female larvae develop through more stages than males before pupating.

Pupation.—Pleocoma dubitabilis larvae appear to pass through at least seven instars before pupating. Six larvae that pupated had head capsules ranging from 6.45 to 8.25 mm as follows:

Sex	Head capsule width (mm)	Instar
Male	6.45	7th
Male	6.75	7th
Male	7.05	8th
Female	7.95	9th–older
Female	8.10	9th–older
Female	8.25	9th–older

P. dubitabilis larvae pupate toward the end of July, becoming inactive several weeks prior to the transformation. In 1961, larvae pupated between 20 and 31 July. Two larvae became completely inactive 41 and 72 days, respectively, before pupating. There are indications that some larvae become inactive as much as 6 months prior to pupating. At the McDonald Forest study area, most *P. dubitabilis* larvae pupated at relatively shallow depths in the soil, as shown in the tabulation:

Date of collection	Depth of pupae (cm)
27 July 1960	13.5
27 July 1960	13.5
25 August 1960	36.0
25 August 1960	50.0
28 January 1961	32.0
28 June 1961	40.0
13 September 1961	15.0

Table 7. Head capsule measurements of *Pleocoma dubitabilis* larvae made before and after moulting.

Head capsule width (mm) and tentative instar			Head capsule width (mm) and tentative instar		
Before moult	After moult	Increase (mm)	Before moult	After moult	Increase (mm)
2nd instars	3rd instars		5th instars	6th instars	
2.40	2.85	0.45	4.35	5.55	1.20
			4.35	5.70	1.35
3rd instars	4th instars		4.35	6.00	1.65
3.00	3.75	0.75	4.50	5.40	0.90
3.00	3.75	0.75	4.50	5.55	1.05
3.15	3.60	0.45	4.50	5.70	1.20
3.15	3.90	0.75	4.50	5.70	1.20
3.15	3.90	0.75	4.65	5.85	1.20
3.15	4.05	0.90	4.95	6.00	1.05
3.15	4.05	0.90			
3.15	4.05	0.90	6th instars	7th instars	
3.15	4.20	1.05	5.55	6.00	0.45
3.15	4.20	1.05	5.55	6.60	1.05
3.30	4.35	1.05	5.70	6.75	1.05
3.30	4.50	1.20			
			7th instars	8th instars	
4th instars	5th instars		6.00	7.50	1.50
3.60	4.65	1.05	6.30	6.90	0.60
3.75	4.50	0.75	6.30	6.90	0.60
3.75	4.80	1.05	6.30	6.90	0.60
3.75	4.95	1.20	6.30	7.05	0.75
3.90	4.65	0.75	6.45	7.05	0.60
3.90	4.80	0.90			
3.90	4.95	1.05			
3.90	4.95	1.05			
3.90	5.10	1.20			
4.05	4.80	0.75			
4.05	4.80	0.75			
4.05	5.40	1.35			
4.20	5.25	1.05			

At McDonald Forest, on 22 July 1954, Ritcher and Beer (1956) found three *P. dubitabilis* pupae at depths of 17.5, 18.5, and 24 cm. Generally, the depth of pupation is shallower in the soil than depths at which most larvae are found.

Natural control factors.—At the time of this study, no parasites or invertebrate predators had been reported from any species of *Pleocoma.*[4] Observations made during the study indicate that a fungus disease and a larval predator account for some larval mortality.

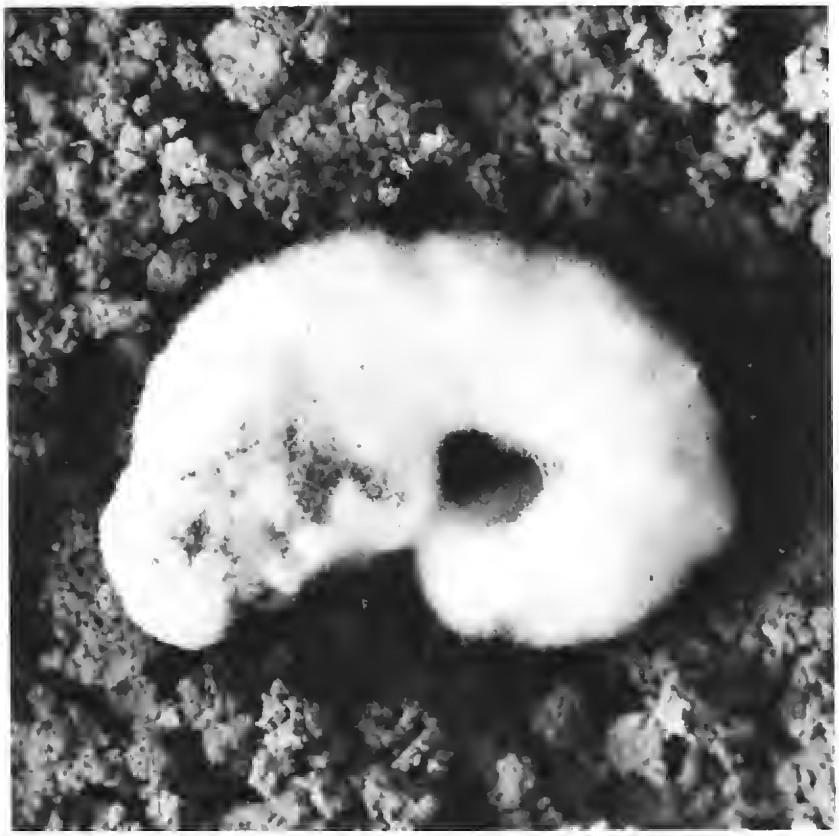

Fig. 4. Second stage *Pleocoma dubitabilis* larva killed by a fungus disease, *Beauveria* sp. (3×).

Five to 22 percent of the *P. dubitabilis* larvae collected in 1961 at the McDonald Forest study site had been killed by a fungus identified[5] as either *Beauveria globulifera* (Spegazzini) Picard or *B. bassiana* (Balsamo) Vuillemin. Infected larvae were collected in their soil burrows throughout the year and at depths ranging from 15 to 95 cm. All instars appeared to be susceptible. It is of interest that no diseased *P. simi* or *P. carinata* larvae were collected.

Observations made during laboratory rearings indicate that the fungus may develop quite rapidly in *Pleocoma* larvae even in relatively cool forest soil. In the laboratory, it took from 3 to 7 days at 9–11°C, for the *Beauveria* infection to progress from a state of apparent noninfection to a condition such as that shown by the larva in Fig. 4. Davis (1934b) reports having collected a number of *P. behrensii* pupae that had been attacked and killed by fungi.

Asilid larvae also kill some *Pleocoma* larvae. Occasionally, *P. dubitabilis* larvae were collected bearing discolored or blackened areas on one or more portions of the abdomen. On two occasions, dead or dying *Pleocoma* larvae were found with an asilid[6] larva in the burrow immediately adjacent to the grub; one grub had a hole in its thorax where the predator had been feeding. In both instances, the *Pleocoma* larva appeared similar to that shown in Fig. 5. Though only two *Pleocoma* larvae were collected that had been killed by asilids, these predators were frequently collected from sample

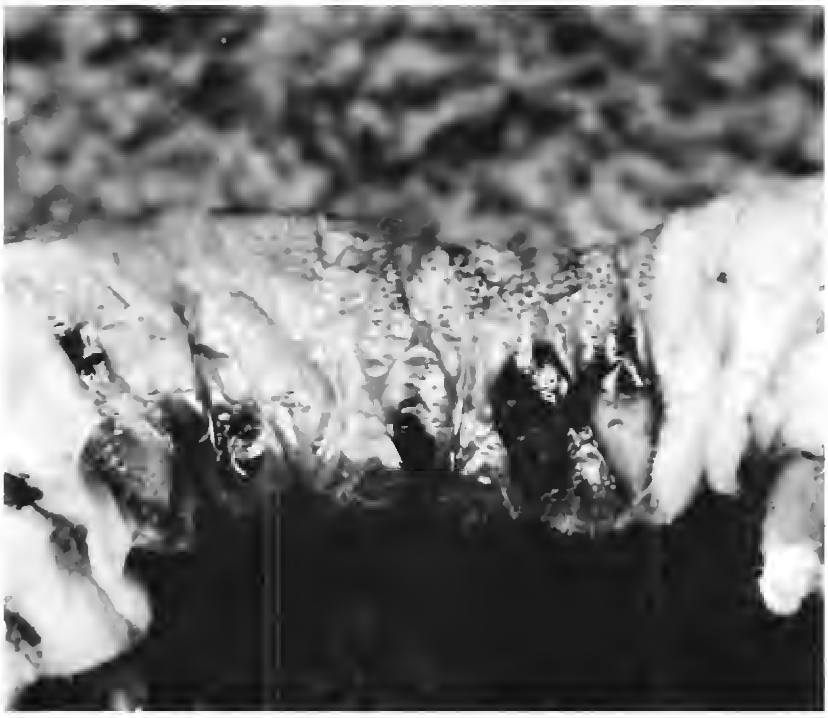

Fig. 5. A seventh instar *Pleocoma dubitabilis* showing discoloration in the abdominal midsection and several blackened areas caused by feeding of a predaceous asilid larva (5×).

holes in the soil in the same general strata where *Pleocoma* larvae were found.

Hovore (1971) reports that *P. linsleyi* is ". . . preyed upon in the larval and pupal stages by a large dipteran larva . . . ." He and his colleagues have tentatively identified the predator as belonging to the family Asilidae, possibly in the genus *Stenopogon* (subfamily Dasypogoninae). He reports (1971) that he has collected these dipteran larvae from grubs and pupae of both sexes of *P. linsleyi* and has taken similar dipteran larvae from the immature stages of *P. badia,* and *P. venturae.* Hovore (personal communication) also reports having taken this asilid "parasitising" *P. fimbriata, P. marquai,* and *P. bicolor.* Asilids are known to be a natural enemy of other white grubs in the genus *Phyllophaga* (Davis, 1919) and, in one case, are reported to have controlled an infestation of *Phyllophaga koehleriana* (Saylor) in the Texas Panhandle (Daniels, 1966).

During this study, both ants and centipedes killed *Pleocoma* larvae that had been placed in the soil for experimentation; however, whether they kill larvae in the soil under natural conditions is not known. Ants do feed on other species of white grubs in the southeast (Anonymous, 1957).

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Footnotes

[1] This investigation was supported chiefly by the Oregon Agricultural Experiment Station and National Science Foundation Grants Nos. G-14296 and G-17935, and partially by the USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah.

[2] According to Hovore (personal communication), the variety *dubitabilis* Davis was described in 1934 as a new variety of *Pleocoma staff* Schaufuss. Later, it was considered by Linsley (1938) to be a distinct species but inadvertently misspelled as *P. dubitalis*. This error has persisted since that time.

[3] The three observations on 12 November 1960 were made after larvae had hatched; however, the larvae had not dispersed from the niches in which the eggs had been laid.

[4] Collembola and mites have been reported to be associated with dead and living *Pleocoma* larvae in the vicinity of Hood River, Oregon, but whether either have acted antagonistically toward the grubs is not known (Ellertson, 1958).

[5] Identified by Clarence A. Thompson, insect pathologist, Forestry Sciences Laboratory, USDA Forest Service, Corvallis, Oregon.

[6] Identification of this asilid larva was confirmed by P. O. Ritcher, former Head, Department of Entomology, Oregon State University, Corvallis, Oregon.

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ADDITIONS TO THE KNOWN SPECIES OF *PSEUDOTYPOCERUS* AND *STRANGALIA* (COLEOPTERA: CERAMBYCIDAE)

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The lepturine genera *Pseudotypocerus* Linsley and Chemsak and *Strangalia* Audinet-Serville have been treated recently by Chemsak and Linsley (1976a, 1976b). In their summary, *Pseudotypocerus*, which was formerly monotypic, was increased to five species, all occurring in Mexico and/or Central America. Although the genus *Strangalia* then consisted of 21 species in these regions, an additional species has since been described from Honduras (Chemsak and Linsley, 1979). Recent collections have now turned up further undescribed species in these genera, some of which are described below.

This study was supported by the National Science Foundation (Grant GB-BM574) for a monograph of North American Cerambycidae. H. F. Howden and R. D. Cave are acknowledged for making specimens available for study, as did the Essig Museum of Entomology, University of California, Berkeley, and the Ohio State University, Columbus.

Key to the Species of *Pseudotypocerus*

1\. Pronotum rather coarsely, separately punctate, punctures dense or very sparse 2

Pronotum finely, very densely punctate, punctures confluent ... 5

2(1). Pronotum densely punctate, punctures larger than those at base of elytra 3

Pronotum very sparsely punctate and pubescent, punctures subequal to those at base of elytra; abdomen sparsely punctate, pubescence short, sparse. Length, 12–14 mm. El Salvador .... *nitidicollis* Chemsak and Linsley

3(2). Elytra with pubescence black under oblique light; head with front broader across genae than length from bases of genae to base of labrum 4

Elytra with pubescence appearing golden in oblique light; head with front measured from bases of genae to base of labrum as long as width across genae. Length, 10–13 mm. Mexico to Nicaragua .... *rufiventris* (Bates)

4(3). Antennae with segments from fifth clothed with golden appressed pubescence. Abdomen black, with last sternite in males impressed over the apical ⅓. Integument with strong metallic overtones. Length, 14 mm. Panama .... *virescens* Chemsak and Linsley

Antennae with outer segments densely clothed with very fine, short, whitish pubescence. Abdomen reddish, with last sternite in males barely impressed at apex. Integument vaguely metallic. Length, 13–16 mm. Costa Rica .... *ater,* new species

5(1). Antennae with outer segments finely black pubescent 6

Antennae with outer segments densely golden pubescent 7

6(5). Elytra more than 2½ times as long as broad, punctures behind scutellum finely granulate, contiguous, apices black. Length, 13–16 mm. Costa Rica and Panama .... *cantharidis* Chemsak and Linsley

Elytra less than 2½ times as long as broad, punctures behind scutellum not granulate, separated, disk with two broad, longitudinal, yellowish vittae. Length, 12 mm. Panama .... *vittatus,* new species

7(5). Abdomen finely, densely punctate and pubescent 8

Abdomen glabrous, almost impunctate; integument yellow and black, elytra with broad black bands over humeri to basal ¼ and less than apical ½ black. Length, 12 mm. Panama ...... *dimidiatus,* new species

8(7). Elytra densely, confluently punctate; pronotum inflated, abruptly narrowed at apex; neck, pronotum and scutellum orange. Length, 11–15 mm. Panama .... *inflaticollis* Chemsak and Linsley

Elytra with punctures separated by more than their diameters; pronotum moderately convex, gradually narrowing to apex; pronotum, scutellum and two narrow, longitudinal vittae of elytra orange. Length, 14 mm. Panama .... *auricornis,* new species

Pseudotypocerus ater, new species

Male.—Form strongly tapering; color black, most shining black parts with faint greenish to bluish metallic overtones, abdomen reddish. Head with front measured from bases of genae to base of labrum wider across genae than long; vertex opaque, finely, confluently punctate; antennae with poriferous areas from segment five, segments from seventh with a double set. Pronotum moderately strongly convex, apex narrowly impressed; disk finely densely punctate, middle with a glabrous longitudinal line; pubescence dark golden and black, depressed; prosternum minutely punctate, finely golden pubescent; meso- and metasternum very finely, densely punctate, densely clothed with golden depressed pubescence. Elytra more than 2½ times as long as broad, strongly tapering; punctures fine, separated; pubescence short, dark, depressed; apices obliquely, shallowly emarginate truncate, outer angle dentate. Legs slender, black and golden pubescent. Abdomen with sternites minutely punctate at bases and middle; last sternite elongate, shallowly impressed at apex. Length, 13–15 mm.

Female.—Form more robust. Antennae extending to second abdominal segment. Abdomen with last sternite dentate at angles; last tergite emarginate at apex. Length, 15–16 mm.

Holotype male, allotype (Canadian National Collection) and 6 paratypes (5 males, 1 female) from 6 km S. Santa Elena, Puntarenas, Costa Rica, 30 May 1979, 2 June 1979, on flowers of *Croton* (H. and A. Howden); one additional female paratype from Turrialba, Costa Rica (E. A. Bottcher).

This species is closely related to *P. virescens* but differs by the reddish abdomen, lack of golden pubescence on the antennae and barely impressed last abdominal sternite. The golden pubescence on the elytra of *P. rufiventris* will separate that species from *P. ater.*

Pseudotypocerus vittatus, new species

Female.—Form moderate-sized, rather short; integument black, prothorax, mesosternum, front tibiae except apically, orange, elytra with two broad, yellowish longitudinal vittae. Head with front from bases of genae to base of labrum longer than width across genae; vertex finely, densely punctate with larger punctures interspersed; pubescence sparse, short; antennae extending to about third abdominal segment, outer segments clothed with fine dark pubescence, segments from fifth with double rows of poriferous areas. Pronotum moderately convex, apex moderately strongly impressed; disk finely, confluently punctate, median line narrow; pubescence depressed, orange; prosternum glabrous, minutely punctate between coxae; meso- and metasternum minutely, densely punctate, densely clothed with short, depressed, golden pubescence. Elytra less than 2½ times as long as broad; basal punctures fine, separated, dense; pubescence short, depressed, mostly golden; apices obliquely emarginate. Legs slender, black and golden pubescent. Abdomen minutely, very densely punctate, densely clothed with appressed golden pubescence; last sternite impressed at apex; last tergite subtruncate at apex. Length, 12 mm.

Holotype female (Ohio State University) from Santa Fe, Darien Province, Panama, 29 May 1967 (D. M. DeLong and C. Triplehorn).

The coloration, black pubescent antennae, and punctation of the elytra will separate this species from other *Pseudotypocerus.*

Pseudotypocerus dimidiatus, new species

Female.—Form moderate-sized, moderately tapering posteriorly; integument yellow-orange, head, neck, antennae, legs except spots at bases of front and middle femora, sides of mesosternum, metasternum, last two abdominal segments, scutellum, apices of elytra and humeri broadly, black. Head with front across genae as broad as length from bases of genae to base of labrum; vertex finely, densely punctate with some larger contiguous punctures present; pubescence fine, pale; antennae extending to second abdominal segment, segments from apex of fifth densely clothed with appressed pubescence which appears golden in oblique light, poriferous areas small. Pronotum moderately convex, gradually narrowing to apex; disk finely confluently punctate, median line vague, pubescence fine, orange, depressed; prosternum subglabrous, meso- and metasternum finely, densely punctate, moderately densely clothed with short, depressed pubescence. Elytra less than 2½ times as long as broad; punctures very fine, dense, lightly granulate; pubescence short, depressed, orange on pale areas, black on dark areas; apices obliquely emarginate. Legs slender, gold and dark pubescent. Abdomen glabrous, almost impunctate; last sternite impressed over apical ½; last tergite emarginate at apex. Length, 12 mm.

Holotype female (California Academy of Sciences) from Cerro Azul, 700 m, Panama Province, Panama, 20 May 1972 (D. Ingleman).

The distinctive coloration and glabrous abdomen make this species readily recognizable. The color pattern of the elytra will probably prove to be variable when more material becomes available.

Pseudotypocerus auricornis, new species

Female.—Form moderate-sized, strongly tapering posteriorly; integument black with vague metallic overtones, prothorax and sides of mesosternum orange, elytra with longitudinal, yellowish vittae at middle extending from behind scutellum to beyond middle. Head broader across genae than length from bases of genae to base of labrum; vertex finely, densely punctate with larger punctures interspersed; pubescence fine, sparse; antennae extending to second abdominal segment, segments from third densely golden pubescent; poriferous areas small. Pronotum moderately convex, rather abruptly impressed at apex; disk very finely, confluently punctate; pubescence orange, depressed; prosternum sparsely pubescent; meso- and metasternum finely, densely punctate, densely clothed with depressed, golden pubescence. Elytra slightly more than 2½ times as long as broad; punctures fine, well separated; pubescence short, dark, depressed; apices obliquely truncate. Abdomen minutely, densely punctate, apical margins of sternites not punctate, pubescence fine, depressed, silvery; last sternite impressed at apex; last tergite notched at apex. Length, 14 mm.

Holotype female (California Academy of Sciences) from Barro Colorado Island, Canal Zone, Panama, 25 May 1972 (J. Irwin).

This species is distinctive by the golden pubescent antennae and well separated punctures of the elytra.

Strangalia cavei, new species

Male.—Form slender, elongate, strongly tapering posteriorly; integument black, part of head, front coxae and femora, midfemora and basal ½ of hind femora yellowish, elytra testaceous, broadly black along lateral margins, narrowly black along suture, apices black. Head with front moderately long, irregularly, sparsely punctate, finely sparsely pubescent; vertex finely, densely punctate, finely pubescent; palpi very unequal, apical segments of maxillary pair large, elliptical; antennae slender, extending to apices of elytra, segments from fifth with poriferous areas, areas very large on segments seven to eleven, segments from apex of fifth opaque. Pronotum with sides slightly sinuous, apex narrowly impressed, disk moderately convex with a rather vague median line; punctures larger than those at base of elytra, subcontiguous; pubescence short, depressed, black at middle, golden at sides; prosternum glabrous at middle; meso- and metasternum finely, densely punctate, densely clothed with short, depressed, golden and grayish pubescence. Elytra more than three times as long as broad, strongly attenuated, moderately dehiscent; punctures fine, separated by at least a puncture diameter; pubescence short, depressed, black and golden; apices obliquely, shallowly emarginate. Legs slender; front tibiae arcuate, hind tibiae noncarinate, tarsi elongate. Abdomen extending two segments beyond elytra; first four segments minutely, densely punctate at bases, punctures becoming larger and sparser toward apex, apical margins glabrous; pubescence fine, depressed; last sternite excavated for its length, glabrous internally, carinate medially at base, sides moderately produced, apices rounded. Length, 18–20 mm.

Holotype male (California Academy of Sciences) and three male paratypes from Bosque El Imposible, Depto. Ahuachapan, 745 meters, El Salvador, 18 June 1979, on flowers of *Croton* (R. D. Cave). One male paratype, Puerta Mayor, 600 meters, Bosque El Imposible, 17 June 1979 (R. D. Cave).

The type series shows little variation in coloration with only the apices of the elytra varying in the extent of black.

In the key to *Strangalia* (Chemsak and Linsley, 1976b) this species will come out in couplet 4 with *gracilis* and *lachrymans*. *S. cavei* differs from *gracilis* by its larger, more robust form, shorter face, larger apical segments of the maxillary palpi and thicker distal antennal segments. From *lachrymans*, it may be separated by the depressed pubescence of the pronotum, more densely punctate elytra, and less strongly inflated sides of the last sternite of the abdomen.

This species is named for R. D. Cave who collected and made the type series available for study.

Since the name, *Strangalia gracilis* Chemsak, 1969, is preoccupied by

Strangalia (*Strangalina*) *gracilis* Gressitt, 1934 from the Loochoo Islands, we here propose *Strangalia sinaloae,* new name for *gracilis* Chemsak.

Strangalia anneae, new species

Male.—Form slender, elongate, strongly tapering posteriorly; integument black, mouthparts, front coxae, femora and undersides of tibiae, middle femora and undersides of tibiae and hind femora brownish orange, elytra dark testaceous, lateral margins narrowly dark at basal ½ and more broadly over apical ½, suture very narrowly dark. Head with front moderately elongate, irregularly, sparsely punctate, very finely, sparsely pubescent; vertex finely, confluently punctate, very sparsely pubescent; palpi very unequal, apical segments of maxillary pair long, shallowly excavated beneath; antennae as long as elytra, segments from sixth moderately enlarged, segments from fifth with large poriferous areas. Pronotum narrow, sides barely sinuate, apex narrowly impressed; punctures larger than those at base of elytra, dense except for glabrous median spot near basal margin; pubescence short, depressed, golden in oblique light; prosternum broadly glabrous at middle; meso- and metasternum finely, densely punctate, densely clothed with short, depressed, golden pubescence, metasternum with a small tubercle on each side of middle. Elytra more than three times as long as broad, strongly attenuated, moderately dehiscent; punctures fine, separated by at least a puncture diameter; pubescence short, depressed, dark and golden; apices obliquely emarginate. Legs slender; front tibiae arcuate; hind tibiae noncarinate; tarsi elongate. Abdomen extending two segments beyond elytra; sternites minutely, densely punctate at bases, punctures becoming larger and sparser toward apices, first two segments glabrous along apical margins, pubescence fine, short; last sternite excavated for most of its length, glabrous at middle, sides moderately produced, apices subacute. Length, 17–20 mm.

Female.—Form more robust, elytra less attenuated. Antennae shorter than elytra, poriferous areas small. Maxillary palpi with apical segments not excavated beneath. Pronotum orange except at apex, shining, very sparsely, irregularly punctate and pubescent; metasternum non-tuberculate. Underside orange, legs black. Abdomen subglabrous; last sternite black, shallowly impressed at apex, sides dentate; last tergite medially impressed, narrowly emarginate, apex bidentate. Length, 16 mm.

Holotype male, allotype (Canadian National Collection) and two male paratypes from 6 km S. Santa Elena, Puntarenas, Costa Rica, 1100 m, 2 June 1979 on flowers of *Croton* (H. and A. Howden).

This species varies in coloration with the elytra often all black except for a broad basal testaceous area. It will also key to couplet 4 (*gracilis* and *lachrymans*) in Chemsak and Linsley's 1976 key. *S. anneae* differs from both of those species by the poriferous areas of the antennae, size and shape of the excavation of the last abdominal sternite and by the presence of metasternal tubercles in the males. From *cavei, anneae* differs by the more slender pronotum and maxillary palpi and by having the last abdominal sternite not excavated for its entire length.

We are pleased to dedicate this species to Anne T. Howden.

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SCIENTIFIC NOTE

ARTEMISIA CALIFORNICA LESS., A NEW HOST FOR *PERARTHRUS VITTATUS* LECONTE (COLEOPTERA: CERAMBYCIDAE)

Several dead or partially dead shrubs of California Sagebrush, *Artemisia californica* Less., were found in March 1979 in the Telegraph Canyon area of San Diego County, California. While attempting to pull up the shrubs to determine cause of death, several limbs, 5–12 mm in diameter broke 30–50 cm above the ground. The breakage was because of cerambycid larval work within the limbs. Four of the seven shrubs examined had larval work in approximately the same sized limbs and at the same height above the ground. The larvae initiated boring in the upper third of the plant in small twigs, the probable oviposition site. They bored down the twigs into larger limbs and remained within the heartwood beneath the thin bark. Several small, oval holes, 1–2 mm in diameter, were cut through the bark by each larva and used to expel excess frass. Each hole was filled with a tight plug of coarse frass when not in use. Gallery walls were coarsely striated, resembling buprestid larval work. Pupal chambers parallel to the grain of the wood were formed within galleries beneath the bark and a thin layer of heartwood. Infested limbs were placed in rearing containers, and a total of 4 male and 7 female *Perarthrus vittatus* adults emerged between 17 and 30 July. No parasitism or predation was noted.

Linsley (1962, Univ. Calif. Publ. Entomol., 20:93) records *Haplopappus venetus vernonioides* (Nutt.) Munz as a host with the emergence period as September and October. The adult emergence in July, an early record, may be a response to more arid rearing conditions in Fresno than found at the collection site. It is likely that Linsleys' host data is based on a "collected from" label rather than an actual rearing. Thus, *A. californica* is probably the first confirmed host association for this cerambycid. That only 60% of the examined shrubs were infested suggests that the cerambycid was not the primary cause of the shrubs condition. Most of the affected 1 meter tall shrubs were either completely dead or appeared dead with a few new basal shoots. The roots and root crowns displayed no evidence of borer or termite damage. Drought conditions which occurred throughout California in 1977–78 may have contributed to the decline and death of the shrubs.

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TWO NEW *DICRANOCENTRUS* FROM NEPAL AND A KEY TO THE INDIAN AND NEPALESE SPECIES (COLLEMBOLA: ENTOMOBRYIDAE)

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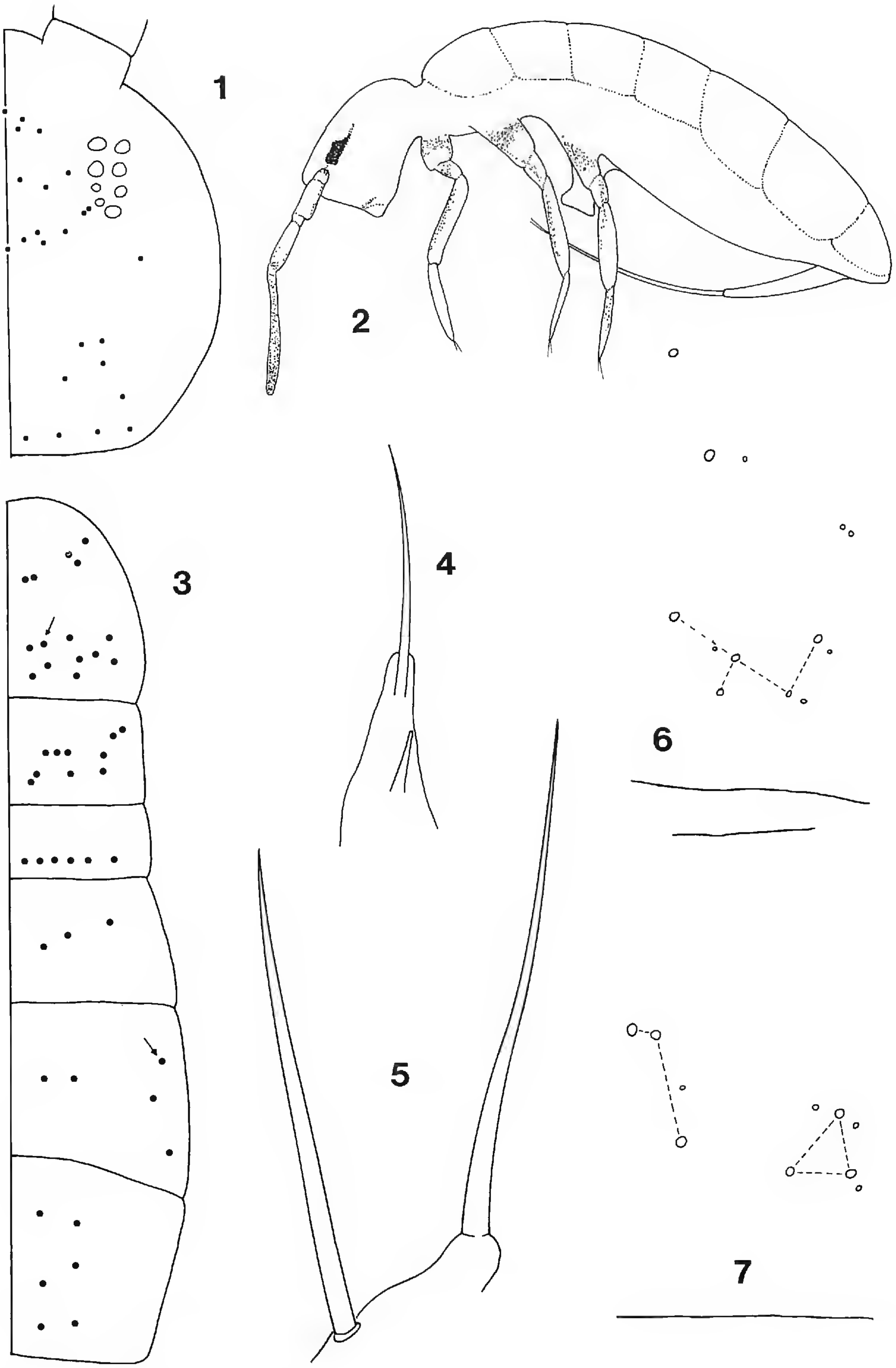
Through the courtesy of Dr. L. Deharveng of the Laboratoire de Zoologie, Université Paul Sabatier, Toulouse, France, I have received part of the Orchesellinae collected by him during a 1977 expedition to Central Nepal. The specimens, which are from an area some 33 km west of the Annapurna Himal and south of Mustang mountain ranges, represent two new species of *Dicranocentrus* closely related to the six species of this genus known from Nepal and Northeast India.

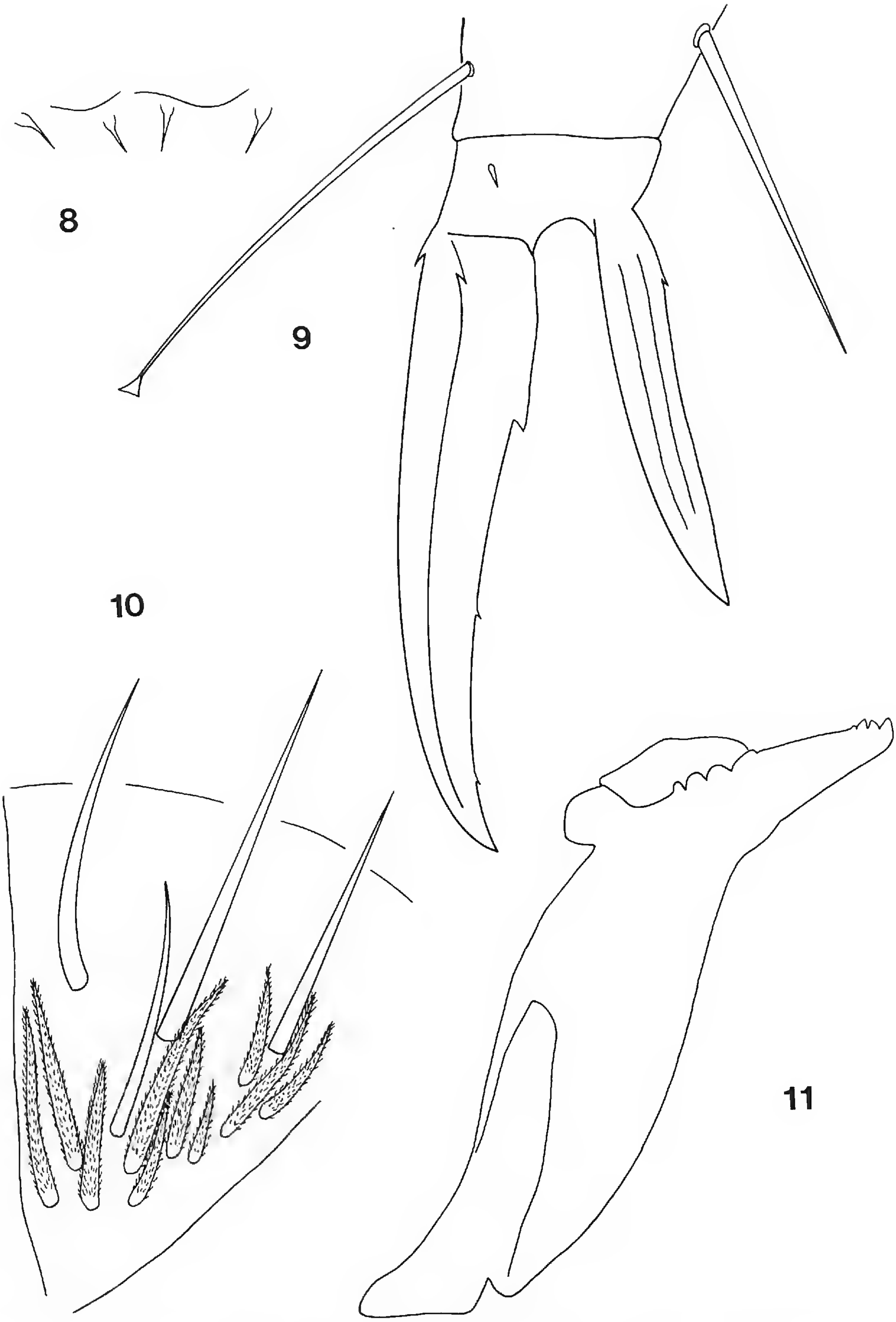
Dicranocentrus deharvengi, new species

Habitus and distribution of violet pigment as in Fig. 2. Length up to 3.0 mm. First 4 antennal segments (Ant. 1–4), head, body, all segments of legs, collophore, and dorsal and ventral sides of manubrium covered by brown, strongly striated oval scales. Ant. 6 missing in all specimens. Pin seta seen on apex of regenerated Ant. 5. Head macrochaetotaxy as in Fig. 1 (note absence of S_2). Eyes 8 + 8 on dark patches, g and h reduced in diameter. Labral papillae (Fig. 8) of type I, rounded with spinelike processes. Chaetotaxy of labial triangle as in Fig. 10; 9–11 setae on posterior row. Some individuals with unequal number of setae on the two triangles; one specimen (Fig. 10) with a smooth seta on left posterior row but all setae ciliated in other specimens and in right triangle of same specimen. Maxillary palp as in Fig. 5. Differentiated seta of outer labial papilla as in Fig. 4, placed far back on its papilla. All setae of venter of head ciliated. Tibiotarsi without smooth setae. Metathoracic claws as in Fig. 9; inner margin of ungues with a pair of well developed teeth and 2 very small unpaired teeth (drawn larger). Unguiculus with a very small basal tooth. Tenent hair long, apically clavate. Body macrochaetotaxy as in Fig. 3, setae indicated by arrows missing in one specimen. No smooth setae on dorsum of manubrium (but most setae have fallen off). Each dental lobe with a long macrochaetalike plumose seta. Dental spines absent. Mucro with 2 teeth and a basal spine.

Diagnosis.—The species is close to the Nepalese *D. janetscheki* (Yosii, 1971) and to *D. fraternus* (Mari Mutt and Bhattacharjee, 1980), a species from the vicinity of Shillong, Northeast India. It may be separated from the



Figs. 1–7. *D. deharvengi* n. sp. Fig. 1. Dorsal head macrochaetotaxy, each dot represents a seta. Fig. 2. Habitus and distribution of violet pigment. Fig. 3. Dorsal body macrochaetotaxy; setae indicated by arrows are missing in one specimen. Fig. 4. Outer labial papilla. Fig. 5. Maxillary palp. Fig. 6. Th. 2-macrochaetotaxy of left side. Fig. 7. Th. 3-macrochaetotaxy of left side.



Figs. 8–11. *D. deharvengi* n. sp. Fig. 8. Labral papillae (type I). Fig. 9. Metathoracic claws. Fig. 10. Chaetotaxy of labial triangle. Fig. 11. Right mandible.

former by the chaetotaxy of Th. 3 and Abd. 1 (see Mari Mutt, 1979:47, Fig. 47) and by the color pattern (compare Fig. 2 with Yosii, 1971:128, Fig. A or Mari Mutt, 1979:29, Fig. 20). From the latter it may be distinguished only by the chaetotaxy of Th. 3, Abd. 1 and Abd. 4.

Comments.—Figures 6 and 7 detail the macrochaetotaxy of the left half of Th. 2 and Th. 3 of a smaller specimen. The sockets left by some of the macrochaetae are distinctly smaller than those left by other macrochaetae. If only the larger sockets are considered, the resulting pattern is very similar or even identical to that of other species. For an example, compare Fig. 7 with the chaetotaxy of Th. 3 of *D. marias,* a Central American and Caribbean species (Mari Mutt, 1979:45, Fig. 77c). The same pattern of Th. 3 is found in the Indian *D. singularis* Mari Mutt and Bhattacharjee (1980).

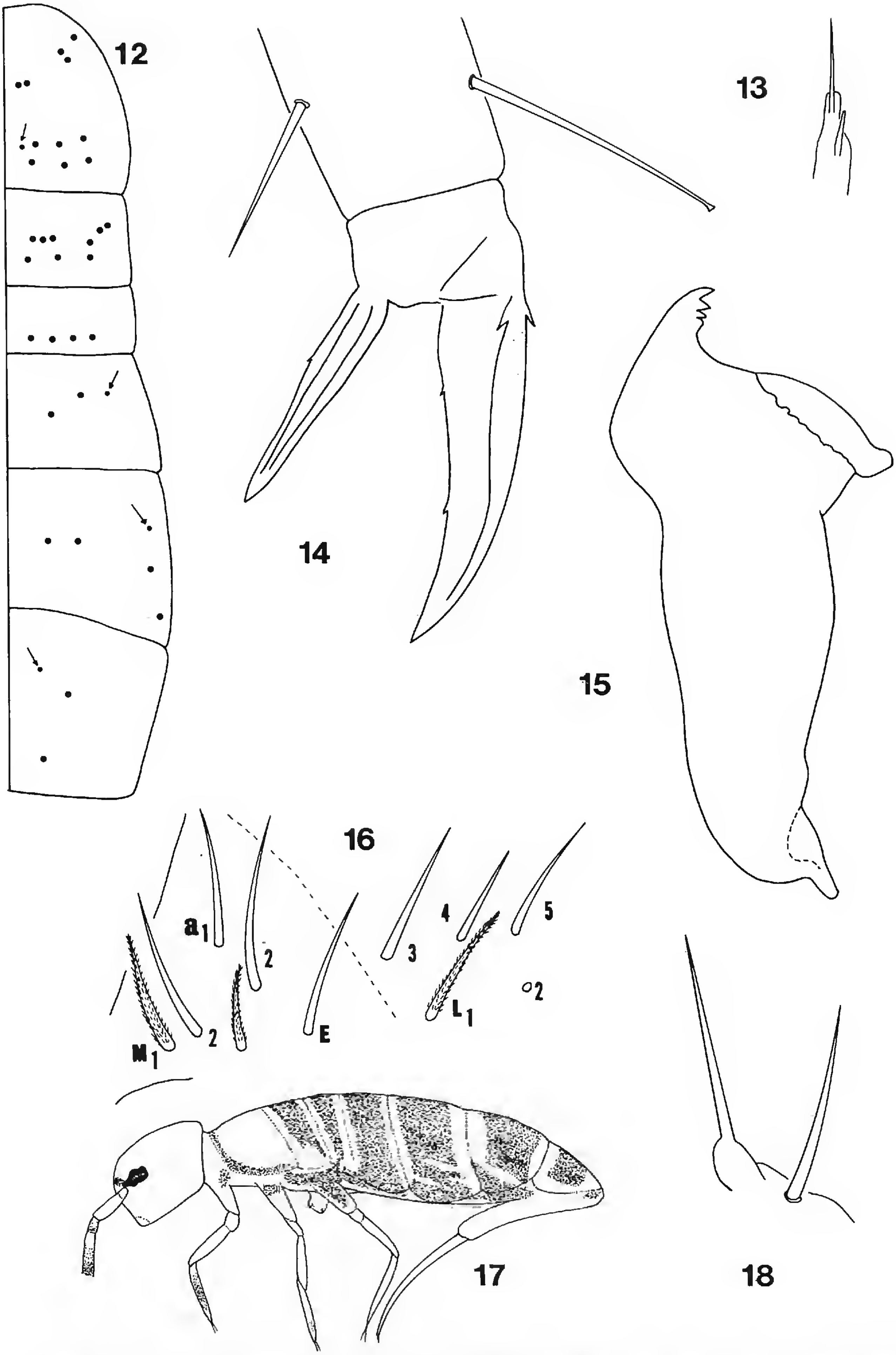
Material examined.—Just beyond Gorges Kali Gandaki, 1900 m, Sept. 27, holotype and 16 paratypes. As preceding but under *Cannabis,* 1 paratype. Tukuche, 2600 m, Sept. 28, 4 paratypes. As preceding but 2500 m, 1 paratype. Kalopani, 2500 m, Sept. 27, under *Cupressus,* 2 paratypes. Tirkedunje, 1500 m, Sept. 24, 4 paratypes.

The holotype and five paratypes are deposited at the British Museum (Natural History). Other paratypes are in the author's collection.

Dicranocentrus violaceus, new species

Habitus and distribution of violet pigment as in Fig. 17. Length up to 1.5 mm. Scales distributed as in preceding species (except impossible to determine presence on dorsum of manubrium). Ant. 5 and Ant. 6 missing. Arrangement of eyes, head macrochaetotaxy, and labral papillae as in *D. deharvengi.* Chaetotaxy of labial base as in Fig. 16, posterior row of triangle with 1 smooth and up to 4 ciliated setae. Maxillary palp as in Fig. 18. Differentiated seta of outer labial papilla (Fig. 13) not placed as far back on its papilla (compare with Fig. 4). Setae of postlabial quadrangle smooth but a ciliated seta located between them; rest of venter of head mostly with ciliated setae. Tibiotarsi without smooth setae. Claws as in Fig. 14, inner margin of ungues with a basal pair and a distal unpaired tooth. Unguiculus with a small outer tooth not placed as proximally as in *D. deharvengi.* Tenent hair clavate. Body macrochaetotaxy as in Fig. 12. No smooth setae seen on dorsum of manubrium but many setae have fallen off. Dental lobe with a long macrochaetalike plumose seta. Dental spines absent. Mucro with 2 teeth and a basal spine.

Diagnosis.—The species comes closest to the micronesian *D. inermodentes* (Uchida) (Uchida, 1944) and to *D. indicus* (Bonet, 1930), sensu Yosii (1966): a widely distributed oriental species occurring in Nepal. From the first it may be readily separated by the color pattern, presence of only smooth setae on venter of the head, and by the chaetotaxy of Th. 3, Abd. 1 and Abd. 4 (see Mari Mutt, 1979:47, Fig. 92). From the latter it may be



Figs. 12–18. *D. violaceus* n. sp. Fig. 12. Dorsal body macrochaetotaxy; setae indicated by arrows are of smaller diameter and length than other setae. Fig. 13. Outer labial papilla. Fig. 14. Metathoracic claws. Fig. 15. Left mandible (see text for comments). Fig. 16. Base of labium; setae named according to Gisin's system. Fig. 17. Habitus and distribution of violet pigment. Fig. 18. Maxillary palp.

distinguished only by the chaetotaxy of Th. 3 and Abd. 1 (see Yosii, 1966:372, Fig. C or Mari Mutt, 1979:47, Fig. 91) and some aspects of the color pattern (compare Fig. 17 with Fig. A in Yosii, 1966:372).

Comments.—Two very unusual mandibles (e.g. Fig. 15) were found while studying a dissected head that had been mounted in Marc Andre II over a year earlier. The head of these mandibles is greatly expanded and the teeth are facing the molar area. Two additional specimens were dissected recently and these possessed normal mandibles like those of *D. deharvengi* (Fig. 11). With so few specimens at hand it was not advisable to continue dissections; I could not determine whether this type of mandible is common, teratological, or caused by preservation in this medium, which tends to deteriorate rapidly in atmospheres with high humidity.

Material examined.—Birethanti, 1000 m, Sept. 23, holotype and 4 paratypes. Tirkedunje, 1500 m, 2 paratypes (*D. deharvengi* was also collected at this locality).

The holotype and 2 paratypes are at the British Museum (Natural History). Other paratypes are in the author's collection.

Key to the Indian and Nepalese *Dicranocentrus*

1. Dental spines present 2
   Dental spines absent 3
2. Spines along inner margin of dentes; Abd. 6 of adults greatly prolonged posteriorly (see Mari Mutt, 1979:27, Fig. 8); Ant. 5 about 1.5 × length of Ant. 6 .... *cercifer* (Imms)
   Spines along inner and outer margin of dentes; Abd. 6 not prolonged posteriorly; Ant. 5 slightly shorter than Ant. 6 ... *spinosus* Prabhoo
3. Abd. 1 with 2 or 3 macrochaetae per side 4
   Abd. 1 with 4 or 6 macrochaetae per side 6
4. Abd. 1 and Th. 2 with 2 and 5 macrochaetae respectively; dental lobe without plumose seta (with a smooth erect seta) .... *singularis* Mari Mutt and Bhattacharjee
   Abd. 1 and Th. 2 with 3 and 9 macrochaetae respectively; dental lobe with an erect plumose seta 5
5. Posterior half of Th. 2 with 7 macrochaetae; body segments with blue band near posterior margins; unguis with an unpaired tooth .... *indicus* Bonet
   Posterior half of Th. 2 with 6 macrochaetae; body unpigmented; unguis with 2 unpaired teeth .... *nepalensis* Mari Mutt
6. Abd. 1 with 4 macrochaetae 7
   Abd. 1 with 6 macrochaetae 9
7. Th. 3 (Fig. 12) with 9 macrochaetae, innermost posterior seta missing (compare with Fig. 3); posterior labial row with up to 4 ciliated

and 1 smooth seta; pigmentation as in Fig. 17 ....
.... *violaceus,* new species

Th. 3 with 10 macrochaetae (e.g. Fig. 3); posterior labial row with more setae (7–9), all of which are ciliated; pigmentation not as above 8

8. Th. 2 and Abd. 2 with 9 and 2 macrochaetae respectively; posterior half of Th. 3 and all of Abd. 1 intensely pigmented while rest of body is practically devoid of pigment resulting in a striking banded pattern (see Yosii, 1971:128, Fig. A or Mari Mutt, 1979:29, Fig. 20) .... *janetscheki* Yosii

Th. 2 and Abd. 2 with 6–7 and 3 macrochaetae respectively; body either thoroughly pigmented or unpigmented ....
.... *fraternus* Mari Mutt and Bhattacharjee

9. Unguis without inner teeth; tenent hair lanceolate, very short (see Mari Mutt and Bhattacharjee, 1980, Fig. 25); head and body with numerous macrochaetae (27 and 65 setae respectively on each side, see Mari Mutt and Bhattacharjee, 1980, Fig. 26, 34) ......
.... *pilosus* Mari Mutt

Unguis (Fig. 9) with a pair of basal and 2 distal unpaired teeth along inner margin; tenent hair clavate, long; head and body with fewer macrochaetae (24 and 45 respectively per side; see Fig. 3)
.... *deharvengi,* new species

Acknowledgment

I wish to thank Dr. Angel Berrios, Department of Biology, University of Puerto Rico at Mayaguez, for preparing Figures 2 and 17.

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NEW SPECIES OF *RHYACOPHILA* FROM CALIFORNIA (TRICHOPTERA: RHYACOPHILIDAE)

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In this paper two new species of *Rhyacophila* and the female of *Rhyacophila spinata* Denning are described. All were collected from the western half of the Foresthill Divide in Placer County, California. The types are in the author's collection and will eventually be deposited in the Entomology collection of the California Academy of Science, Golden Gate Park, San Francisco.

Rhyacophila darbyi, new species
(Figs. 1a–d)

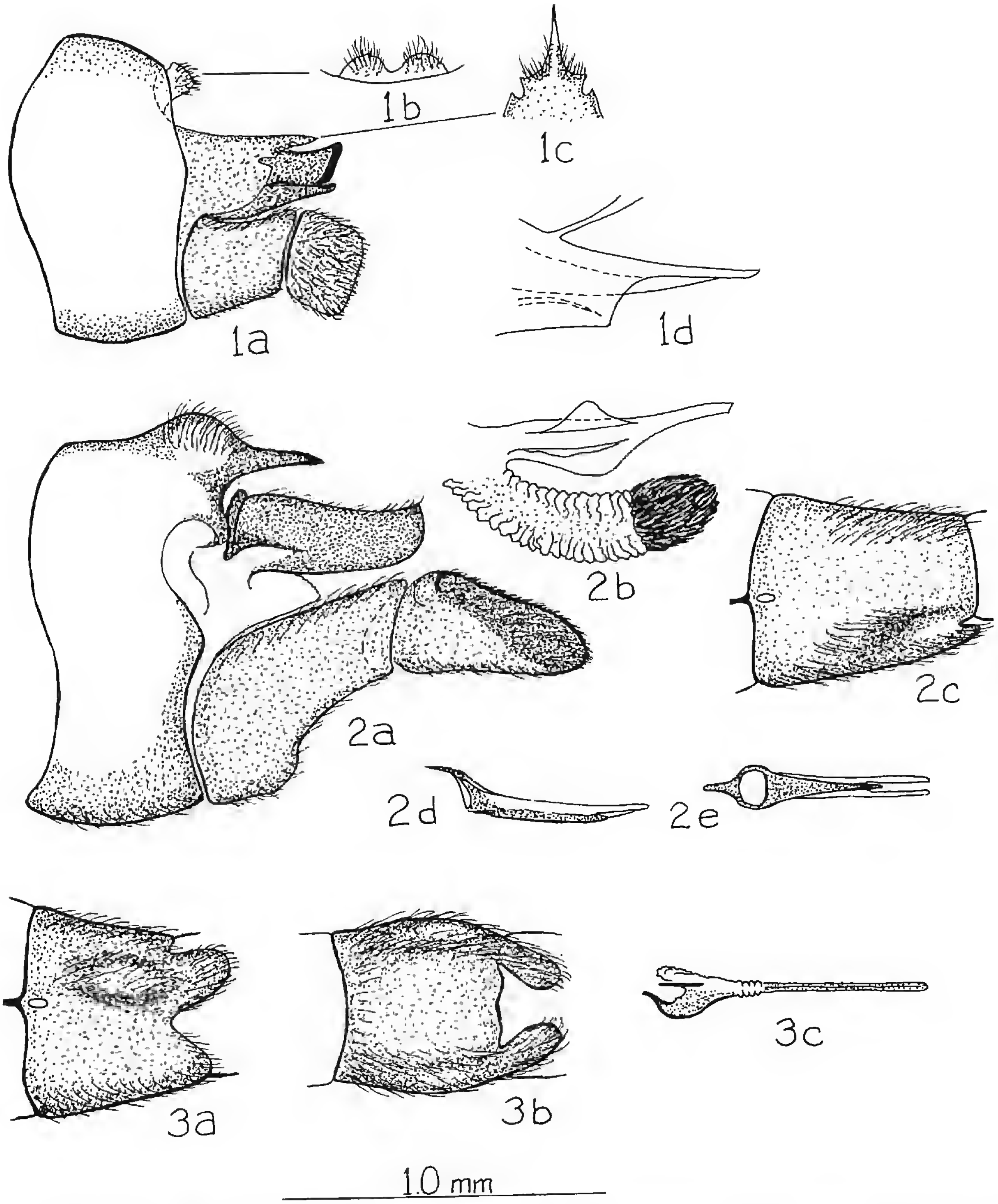
The species is tentatively placed in the *ecosa* group although there is a resemblance to *R. lineata* Denning in the *viquaea* group. Until the female and additional specimens are collected this placement will remain tentative. Diagnostic differences from described species are the emarginated margin of the ninth tergite, the subquadrate second clasper segment, and the peculiar phallus complex.

Male.—Length to apex of folded wings 10.3 mm. General color fuscous but darker dorsally, especially on head. Sternum 7 with minute mesal process. Genitalia as illustrated (Fig. 1). Segment 9, lateral aspect, widest medially, anterior margin arcuate; from dorsal aspect distally emarginate (Fig. 1b). Preanal plates large, posterolateral margin emarginated (Fig. 1a); dorsal margin acuminate from lateral or dorsal aspect (Fig. 1c). Tergum 10 partially obscured by preanal plates; heavily sclerotized, from lateral aspect apical margin obliquely truncate, black pigmented. Anal sclerite, lateral aspect (Fig. 1a) heavily sclerotized and elongate, apex black pigmented dorsally. Clasper basal segment short, rhomboid, the semi-quadrate distal segment densely covered mesally with short pubescence. Phallus structure (Fig. 1d): basal capsule elongated into lateral arms which lie alongisde the lightly sclerotized phalicata; ventral to this structure are two small ventrad curved spines.

Female.—Unknown.

Holotype male.—Shirttail Creek near western edge Tahoe National Forest, 3500′, Placer County, California, 9 June 1974, W. C. Fields, Jr.

It is with pleasure that I name this new species in honor of my former teacher at California State University, Sacramento, Professor R. E. Darby.



Figs. 1–3. Fig. 1. *Rhyacophila darbyi* Fields, male genitalia, 1a, lateral aspect; 1b, 9th tergite, dorsal aspect; 1c, preanal plates, dorsal aspect; 1d, phallus complex, lateral aspect. Fig. 2. *Rhyacophila acuminata* Fields, male and female genitalia; 2a, male genitalia, lateral aspect; 2b, phallus complex, lateral aspect; 2c, female 8th segment, lateral aspect; 2d, bursa copulatrix, lateral aspect; 2e, bursa copulatrix, ventral aspect. Fig. 3. *Rhyacophila spinata* Denning, female genitalia; 3a, 8th segment, lateral aspect; 3b, 8th segment, dorsal aspect; 3c, bursa copulatrix, lateral aspect.

Rhyacophila acuminata, new species
(Figs. 2a–e)

This species is a member of the *acropedes* group and is probably closest to *R. inculta* Ross and Spencer. Diagnostic characters are the prominent bulbous projection of the dorsum of segment 9 and the peculiar dorsal process of the phallus complex.

Male.—Length 13 mm to tip of folded wings. General color brownish. Wings faintly irrorate. Sternum 7 with minute mesal process; segment 5 with subpleural tubercle. Genitalia as in Fig. 2. Lateral margin segment 9 sinuate; tergum projecting dorsocaudad, bulbous, setose, distally acuminate, directed caudad approximately one-third length of segment 10 (Fig. 2a). Segment 10 similar to other members of the group; from lateral aspect caudal margin curved dorsad, structure projected beyond basal clasper segment. Phallus complex generally similar to other members of the *acropedes* group; extensile semimembranous parameres with apical pads of dark brown closely appressed setae; base of dorsal process bears dorsolateral flanges, ventrolateral ridges, and a short ventral keel (Fig. 2b). Clasper basal segment directed dorsocaudad, compressed laterally; apical segment gradually narrowed caudally to obtuse apex with dense short black pubescence dorsomedially.

Female.—Length 13 mm. Similar to male in general color and size. Sternum 6 with minute mesal process. Genitalia as in Fig. 2c, d, e. Base of segment 8 heavily sclerotized, pubescent, with median posteroventral keel, distally obtuse and slightly separated from remainder of segment (Fig. 2c). Bursa copulatrix a lightly sclerotized ring projecting anteriorly into dorsal point, caudally into parallel arms and with a ventral keel, Fig. 2d, e.

Holotype male.—Shirttail Creek, near western edge Tahoe National Forest, 3500′, Placer Co., Calif., 25 August 1974, W. C. Fields, Jr. Allotype female, same data as for holotype. Paratypes, 5 males, 2 females, same data as holotype. Additional specimens not in type series: 2 males, Lady's Canyon, 2300′, tributary to Middle Fork American River southeast of Foresthill, Placer Co., May 1978; 4 males, 1 female, Lady's Canyon, 5 May 1978, W. C. Fields, Jr. Larvae of the *acropedes* group have been collected from Shirttail Creek, 25 August 1974, but until these can be reared I can only postulate that they are the larvae of *R. acuminata* n. sp.

Rhyacophila spinata Denning

The unusual male of this species is described and figured by Denning (1965). The female is described here for the first time.

Female.—Length 14 mm to tip of folded wings. General color dark brown, darker than associated males; abdomen purplish brown dorsally. Wings brown, irrorate. Sternum 6 with minute mesal process. Genitalia as in Fig.

3. From dorsal aspect, anterior margin of segment 8 heavily sclerotized with pronounced emargination (Fig. 3b); from lateral aspect, deep triangular incision (Fig. 3a); segment expanded laterally. Segments 9, 10, and 11 may be withdrawn entirely into segment 8. Bursa copulatrix elongate, lightly sclerotized, scoop-shaped proximally, surmounted by a membranous lobe, and distally attenuated (Fig. 3c).

Female.—Lady's Canyon, 2300′, southeast of Foresthill, Placer Co., Calif., 13 March 1976, W. C. Fields, Jr., 5 males, 2 females, same data.

I am indebted to Donald G. Denning for his inspection of my specimens and suggestions regarding this paper.

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SCIENTIFIC NOTE

FIRST CALIFORNIA RECORD FOR *DENDROSOTER PROTUBERANS* (NEES) (HYMENOPTERA: BRACONIDAE)

In June 1978, *Dendrosoter protuberans* (Nees) was reared from bolts of Siberian elm wood (*Ulmus pumila* L.) collected in Los Angeles and San Bernardino Counties, California. This external braconid parasite was also reared from English elm wood (*Ulmus procera* Salisb.) collected in Sacramento County in June 1979. All of the wood from both locations was infested with *Scolytus multistriatus* (Marsham), the smaller European elm bark beetle. *D. protuberans* is a parasite of *S. multistriatus* but had not previously been reported from California.

Dendrosoter protuberans, a native of Russia, Europe and Asia Minor, parasitizes several species of Cerambycidae and many species of Scolytidae in its endemic area (Stary, 1957, Acta Soc. Entomol. Csl., 54:277–292). Among its hosts is *Scolytus multistriatus,* a native European bark beetle. This bark beetle was accidentally introduced into the United States in Massachusetts in 1909 (Chapman, 1910, Psyche, 17:63–68). It spread westward and became established in California in 1951 (Armitage, 1951, Calif. State Dept. Agric. Bull., 40:111–118).

S. multistriatus is of scientific and public interest as it is one of the principal vectors of Dutch elm disease. Since *S. multistriatus* was introduced into the United States, one of the strategies undertaken to control this beetle has been classical biological control. Only a few native North American natural enemies have been reported attacking *S. multistriatus.* Among the many European hymenoptera parasitizing *S. multistriatus, D. protuberans* was found to be a dominant parasite in eastern Austria (Schroeder, 1974, Z. Angew. Entomol., 76:150–159). In 1964, this braconid was introduced to the United States from Avignon, France and released in many states in the East and Midwest (Kennedy, 1980, personal communication; Riedl, 1979, personal communication). Studies of this species demonstrated that it could easily be reared in the laboratory, could overwinter in the Midwest and could reproduce under field conditions (Kennedy, 1970, Ann. Entomol. Soc. Am., 63:351–358). Successful Successful establishment has occurred in many of the release sites investigated, although the numbers of this parasite are limited by the bark thickness of the wood through which it must oviposit (Truchan, 1970, Ph.D. Thesis, Mich. St. Univ., 97 pp.). *D. protuberans* has been reared from two alternate species of bark beetles in Colorado, *Scolytus rugulosus* (Ratzeburg) and *Leperisinus californicus* Essig (Merlino, 1980, personal communication).

The farthest west that *D. protuberans* has been intentionally released is

Colorado. It is not known how long this parasite has been in California, nor how it arrived, but it appears to have become readily established. This species was reared from only three of the eight counties sampled in 1978 and 1979. A program to distribute this parasite throughout California could hasten the spread of the parasite and possibly provide increased control of local populations of *S. multistriatus*.

The authors thank Dr. Leland Brown, University of California, Riverside, for providing the infested bolts from southern California. We also thank Dr. Bruce Kennedy, USFS, Northeastern Forest Experiment Station, Delaware, Ohio, Mr. Roger Fuester, USDA, Newark, Delaware and Dr. Helmut Riedl, University of California, Berkeley, California for their encouragement and information on parasite releases in the United States. Dr. P. M. Marsh, USDA Systematic Entomology Laboratory, Beltsville, Maryland provided species identification.

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PACIFIC COAST ENTOMOLOGICAL SOCIETY

Marius Wasbauer *President*	David Kavanaugh *President-elect*	R. E. Somerby *Secretary*	Paul Arnaud, Jr. *Treasurer*

PROCEEDINGS

FOUR HUNDRED AND SECOND MEETING

The 402nd meeting was held on Friday, 17 October 1980, at 8:00 p.m., in the Goethe Room, California Academy of Sciences, Golden Gate Park, San Francisco, with President Wasbauer presiding. A total of about 80 persons were present.

Minutes of the meeting, held 18 April 1980, were summarized. One scientific note was given.

Dr. Wasbauer introduced Dr. Edward Laidlow Smith of the California Academy of Sciences and San Francisco State University who presented a talk entitled "Decade of Discovery: The New Morphology and Phylogeny of Insects and Other Arthropods." The topic revealed a concerted effort to revolutionize and simplify our concepts of the evolution of arthropods.

Refreshments were served in the Goethe Room following the meeting.—R. E. Somerby, Secretary.

FOUR HUNDRED AND THIRD MEETING

The 403rd meeting was held on Friday, 21 November 1980, at 8:00 p.m., in the Goethe Room, California Academy of Sciences, Golden Gate Park, San Francisco, with President Wasbauer presiding. A total of about 90 persons were present, of which 36 members and 17 guests signed the register.

Minutes of the meeting held 17 October 1980 were summarized. The following individuals were nominated to membership: Regular members, L. D. Corkum, H. Brailovsky, N. M. Downie, S. Elliott, W. C. Fields, C. A. Toft, J. W. Johnson, and J. F. Peters; Student members, T. N. O'Brien and B. K. Orr; Student-family membership, Mr. R. L. and Gretchen Pederson. No scientific notes were given.

Dr. Wasbauer introduced Dr. Alan M. Barnes of the Plague Branch, Vector Borne Disease Division, Communicable Disease Center Laboratory, Fort Collins, Colorado, who presented a talk entitled "Bubonic Plague—New Information on the Epidemiology and Ecology of an Ancient Disease." The well presented talk stirred considerable interest and discussion. Much new information was presented.

Refreshments were served in the Goethe Room following the meeting.—R. E. Somerby, Secretary.

FOUR HUNDRED AND FOURTH MEETING

The 404th meeting was held on Friday, 12 December 1980, at 8:00 p.m. in the Goethe Room, California Academy of Sciences, Golden Gate Park, San Francisco, with President Wasbauer presiding. A total of about 53 persons were present of which 34 members and 14 guests signed the register. Ms. Celuta H. Paganelli of the Museu de Zoologia, São Paulo was introduced as a guest.

Minutes of the meeting, held on Friday, 21 November 1980, were summarized. The following individuals were nominated to membership: Regular member, H. W. Oswald; Student members, E. A. Sugden and R. Bradberry. Next, the chairpersons of the standing committees were asked to give reports.

Dr. Arnaud reported the Auditing Committee under the Chairmanship of Mr. H. Vannoy Davis had reviewed the financial records of the Society and had prepared a statement of income, expenditures and changes in fund balances that will be published in the forthcoming Proceedings of Meetings.

Dr. Arnaud also reported the Treasurer's office is indebted to Mrs. Vashti F. Getten (as volunteer) and Mrs. L. Gail Freihofer (Entomology secretary) for their handling of the Society's accounts, billings, and mailing of publications, and to our member, Mr. H. Vannoy Davis, for his annual audit and the completion of the Society's tax forms.

Three notes were presented. Edward Smith gave the first note on fossil insects with wing folding ability. They were predatory mid-Carboniferous insects. Next, J. Gordon Edward gave us an overview of the gypsy moth problem. He summarized the defoliated eastern U.S. acreage as 5.9 million acres. More damage is expected this year. In other studies it was found that Eucalyptus and Manzanita are excellent hosts. The last note was given by Larry Bezark. He reported on the presence of *Dryops arizonensis* near the Colorado River in California, a new state record.

Dr. Wasbauer introduced the incoming president, Dr. David Kavanaugh, Curator of Coleoptera for the California Academy of Sciences, whose entomological interest includes Silphidae, Amphizoidae and Carabidae.

Dr. Kavanaugh in turn introduced Dr. Wasbauer of the California State Department of Food and Agriculture who presented a talk entitled, "Ethological Patterns in the Pompilidae, the Spider Wasps." He reviewed the biology and ecology of the spider wasps noting that only 8% of the genera are known ethologically. The simplest behaviors were discussed first followed by more complex patterns.

Refreshments were served in the Goethe Room following the meeting.—R. E. Somerby, Secretary.

FOUR HUNDRED AND FIFTH MEETING

The 405th meeting was held on Friday, 16 January 1981, at 8:00 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President David Kavanaugh presiding. A total of about fifty persons were present.

Minutes of the meeting, held on Friday, 12 December 1980, were summarized. The following individuals were nominated to membership: Regular member, A. R. Olsen; and Student member, L. Kirkendall. The President gave a note on a new species of *Nebria* from the Trinity Alps, Siskiyou County.

Dr. David Kavanaugh introduced Dr. Paul M. Tuskes, from Berkeley, who presented a talk entitled "The Biology of California Aquatic Moths, with Discussion of Interspecific Competition." The talk was well illustrated and well received, with a number of questions being answered.

Refreshments were served in the entomology laboratory following the meeting.—R. E. Somerby, Secretary.

FOUR HUNDRED AND SIXTH MEETING

The 406th meeting was held on Friday, 20 February 1981, at 8:00 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President David Kavanaugh presiding. A total of about forty-one persons were present, of which 18 signed as regular members, and 21 as guests.

Minutes of the meeting held on Friday, 16 January 1981, were summarized. The following individuals were nominated to membership: Regular members, H. P. Brown, J. Schmidt, and D. O. Hathaway; Student members, Fu K. Wong and J. B. Whitfield.

Dr. Rust gave a note on the Nevada dunes in Churchill County. He mentioned 10 new species which were taken from the dunes. Dr. Williams gave a second note in collaboration with Dr. Philip concerning work involved with tabanid flies. Some rather primitive horse flies were taken at a blacklight. The significance of this phenomenon among habitually day-flying tabanids is not understood.

Dr. Kavanaugh introduced Mr. Larry Orsak, from the Department of Entomology at Berkeley who presented a talk entitled "Why is the Bright Blue Copper So Rare?" He gave an in-depth analysis of distribution, host preference and its quality to establish the ecological parameters favorable to the Blue Copper. The talk was well illustrated and well received.

Refreshments were served in the entomology laboratory following the meeting.—R. E. Somerby, Secretary.

FOUR HUNDRED AND SEVENTH MEETING

The 407th meeting was held on Friday, 24 April 1981, at 8:00 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President David Kavanaugh presiding. A total of about fifth persons were present, of which 28 signed as regular members, and 13 as guests.

Minutes of the meeting held on Friday, 20 February 1981, were summarized. The following individuals were nominated to membership: Regular member, H. Arnett; Student members, R. S. Anderson, V. P. Jones and D. B. Herbst.

Dr. Paul Arnaud announced the death of P. H. Timberlake of Riverside. Paul suggested sending a letter of condolence to his daughter.

Dr. Kavanaugh introduced Dr. Harvey I. Scutter from California State College at Hayward who presented "Upper Miocene Fossil Insects from Steward Valley, Nevada." The talk was well illustrated and well received.

Refreshments were served in the entomology conference room following the meeting.—R. E. Somerby, Secretary.

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